Medicinal plants used in treatment of various diseases in the Rwenzori Region, Western Uganda

Casim Umba Tolo, Ivan Kahwa, Upton Nuwagira, Anke Weisheit and Hilda Ikiriza

Correspondence

Casim Umba Tolo[1,2]*, Ivan Kahwa[1,3] , Upton Nuwagira[2], Anke Weisheit[1] and Hilda Ikiriza[1,2]

[1]Pharm-Biotechnology and Traditional Medicine Centre, Mbarara University of Science & Technology, P.O. Box 1410, Mbarara Uganda.
[2]Department of Biology, Mbarara University of Science and Technology, P. O. Box 1410, Mbarara, Uganda.
[3]Department of Pharmacy, Mbarara University of Science and Technology, P. O. Box 1410, Mbarara, Uganda.

*Corresponding Author: tolocas@must.ac.ug

Ethnobotany Research and Applications 25:62 (2023) - http://dx.doi.org/10.32859/era.25.62.1-16
Manuscript received: 01/03/2023 – Revised manuscript received: 15/05/2023 - Published: 22/05/2023

Research

Abstract

Background: The Rwenzori region is endowed with a rich diversity of medicinal plants, which are utilized by communities to treat various diseases because they are easy to access, prepare and is part of a wealth of indigenous knowledge. Despite the utilization of these plants, there is a need to systematically document plants used in the Rwenzori region, which will help in preserving indigenous knowledge and aid the process of discovering new drugs that act as agents for health promotion and disease prevention.

Methods: A cross-sectional survey was conducted in the western districts of Kabarole, Kasese, Bundibugyo, and Bunyangabu with the help of semi-structured questionnaires for data collection and 24 key informants' interviews with native herbal medicine men/women in the region.

Results: Overall, seventy-seven medicinal plant species distributed in 40 families were found to be used by communities for treating over 67 diseases. The most commonly used medicinal plants included *Prunus africana* (Hook. f.). Kalkman (12), *Hoslundia opposita* Vahl (11), *Bidens pilosa* Linn. (11), *Conyza sumatrensis* (Retz.) E. Walker (9) and *Ageratum conyzoides* Linn. (9). The family of Asteraceae and Fabaceae made up most of the medicinal plant species used by the natives. The most used plant parts are the leaves, and boiling water is the main solvent used in the preparation of these herbal remedies, which are taken mainly orally.

Conclusion: The communities of the Rwenzori region depend a lot on herbal medicine to treat various diseases irrespective of the availability of modern health care.

Keywords: Ethnobotany; Asteraceae, Indigenous communities; Human diseases, Herbal medicine

Background

The use of medicinal plants is increasing globally by 50-95 % (Pan *et al.* 2019, Asiimwe *et al.* 2021). The situation in Africa is not different, as more than 80% of the population, especially in developing countries, directly depends on plants for their basic medical needs (Tugume & Nyakoojo, 2019). Plants make an important part of health care,

especially for the poor populations and it is on that ground that the Government of the Republic of Uganda has especially focused on the use of herbal medicine and is in the process of assimilating it into the main health care system (Kamatenesi *et al.* 2011). As a result, the government of the Republic of Uganda enacted into law 'The Indigenous and Complementary Medicine Bill 2015' which is accented to by the president on 14th September 2020 (Mwaka *et al.* 2019). In the Rwenzori region in particular, 21% of the households are in the low-income bracket of UGX 338,527 (UBOS 2008; World Population Prospects, 2022) and this hinders them from the use of modern health services, resorting to traditional medicine considering that there is high medicinal plant diversity in this region (Oryem-Origa *et al.*1995). Unfortunately, medicinal plants are unsustainably harvested from the wild and this kind of exploitation of this resource is endangering these medicinal plants (Nuwagira *et al* 2022) leading to innaccessibilty of most potent plants thus negatively affecting the health of many people who cannot afford the services of biomedicine (Ssegawa & Kasenene, 2007). This makes the documentation, sustainable use, and conservation of these medicinal plants essential (Balunas & Kinghorn,2005). Various studies have been conducted on numerous medicinal plants for the treatment of various diseases in the different communities available in different geographical locations in Uganda (Kahwa *et al.* 2023; Nuwagira *et al* 2022; Nuwagira *et al.* 2021; Wangalwa *et al.* 2021; Tenywa *et al.* 2021; Ikiriza *et al.* 2021; Tenywa *et al.* 2020; Ikiriza *et al.* 2019; Namuli et al.,2018; Tabuti *et al* . 2003). However, each community has its own way of using these medicinal plants, hence, our study focused on a few selected districts of the Rwenzori region. In addition, there are still many medicinal plants and their uses that have not been documented. Therefore, against this background, here we documented and report the utilization of medicinal plants in primary health care by communities in the Rwenzori region. was. This will ensure the wealth of traditional knowledge system about the use of these medicinal plants is conserved and will also facilitate the discovery of new sources of drugs leading to and promoting the sustainable use of medicinal plant resources in Uganda.

Materials and Methods

Study area

The study was conducted in the Rwenzori region, western Uganda in the districts of Kabarole, Kasese, Bundibugyo, and Bunyangabu. The area constitutes three ethnic groups of the region namely; Batooro, Bakonzo, and Bamba.The selected districts boarder Kibale National Game Park, Queen Elizabeth National Game Park, Semuliki National Park and Rwenzori Mountains National Park which give a great chance to the local community using the rich stock of medicinal plant materials preserved in protected areas. The study area lies between 0° 21.589'N, 30° 18.253'E (Figure 1). The Rwenzori Region is bordered to the north by Lake Albert, to the west by the Democratic Republic of Congo and the Rwenzori Mountains, to the south Queen Elizabeth National Park, to the east by Kibale National Park. 7,500 km2 or 3.1% of the nation's total area makes up the region. The area is distinguished by a variety of topographic features and landscapes. The most notable physical feature of the area, which is home to thousands of people, numerous local species, and some of the last equatorial glaciers in the world, is the Rwenzori Mountains, which rise to heights of more than 5,000 meters. A portion of the Albertine Rift lowland, home to the Great Lakes, Queen Elizabeth National Park's savannah, and Bundibugyo's central African tropical forests, is also included in the region. Additionally, the highlands of the Kabarole and Kasese districts offer a rich climate that supports a population that is primarily rural.

Ntoroko, Bundibugyo, Kabarole, and Kasese are the present districts that make up the Rwenzori Region, running from north to south. Later in 2010, when the county of Ntoroko separated from Bundibugyo District, Ntoroko District was created. To enable comparisons between data before and after the creation of the new district, all maps in this report display district boundaries as they did for the first three districts in 2010). Tropical weather prevails over most of Uganda, including the Rwenzori region, with temperatures being tempered by the area's high altitude (Montserrat et al.2013).

Ethnobotanical data collection

The survey was carried out between June and November 2021. The study parishes with corresponding respondents' numbers included; Bukangama (4), Gatyanga (3), Kihondo (1), Kichwamba (3), Ntandi ward (5), Rwimi (1), Katumba (1), Kyabarungira (2) Kyanyarowa (2), and Nsura (2). The number of respondents in each parish was selected on the basis of knowledgeable members of the community and the size of the parish. In total, 24 key informants were interviewed with the help of three field assistants who were conversant with Rutoro, Lubwisi and Rukonjo; the three dialects commonly used in the area. It involved using non- probabilistic sampling (n = 24), by applying the snowball method to select the local experts in the use of medicinal plants (herbs). Of the 24 key informants, 15 were female and 9 male. All study participants gave their voluntary oral and written prior informed consent before the commencement of the interview. We performed informal interviews by use of semi-structured questionnaires in

the local languages that led to the recognition of the first local traditional herbalist (birth attendant), who was acknowledged and respected by several people in the community. Therefore, rather than being regarded as a trend for the entire society, our results may be better understood as a tendency for local specialists. This method allowed for the inclusion of seniors (greater than 60 years). Every single respondent was a native of the research area (de Medeiros *et al.*, 2021).

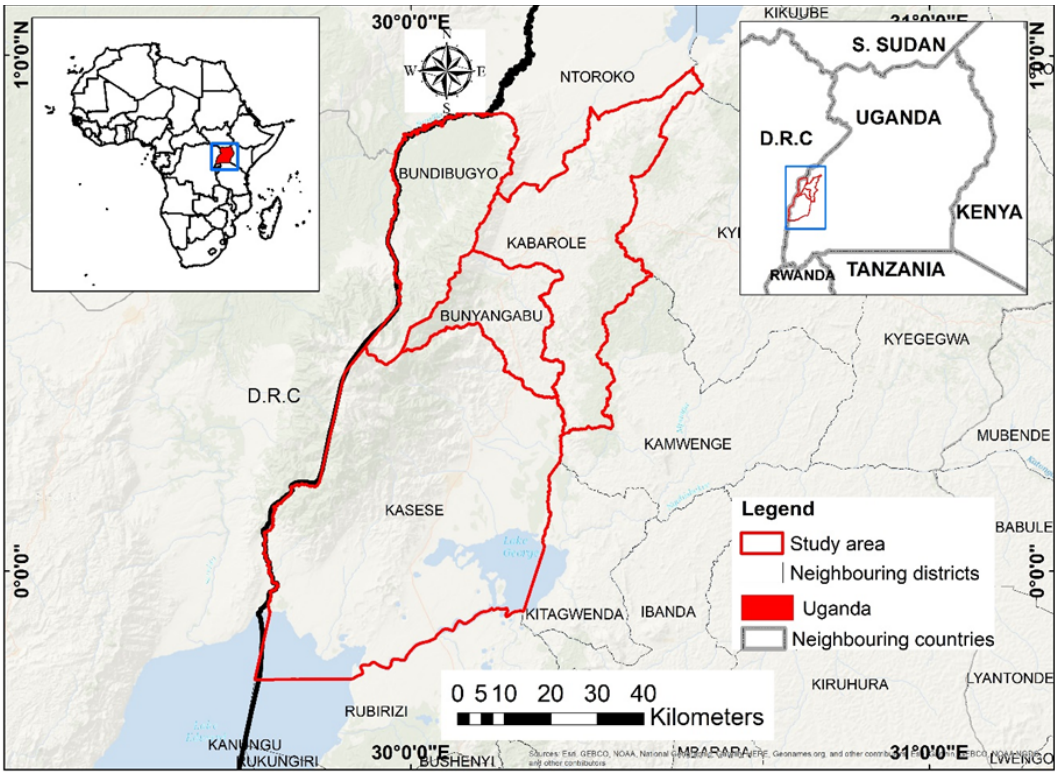

Figure 1. Map of the the study area, with seleceted districts' boundaries in red colour.

Collection and Identification of the Plant Species

Using key informants interview guide and semi-structured questionnaires, homesteads and individual herbalists were visited and asked to provide the following details for each of the medicinal plants they were using to treat diseases: local name, parts of the plant used, mode of preparation and administration and whether the plant is used alone or with other plants in combination. The collected plant species were identified by a botanist at the Department of Biology at Mbarara University of Science and Technology and compared with herbarium specimens at the National herbarium at Makerere University, Kampala, Uganda. Online databases were also used to verify plant scientific names, families, and authorities while in the field, including the International Plant Name Index (www.ipni.org), and the Royal Botanic Garden Kew (www.theplantlist.org). The study protocol was approved by the Research Ethics Committee for Mbarara University of Science and Technology (MUST- REC), under the number MUST-2021-195. Consent for participation in the study was obtained before each interview was conducted by proving to the participants all the information related to the nature of the study and its objective.

Data Analyses

Data were analyzed using descriptive and quantitative statistical methods. In this regard, the ethnomedicinal data were analyzed using the frequency of citation (Hosseini *et al.* 2021).

Results and Discussion

The demographics of the respondents were mainly female (62.5%) over 18 years of age. They had low education levels in which 11% had not achieved formal education, 45.8% had achieved at least primary education while the rest had attained secondary education level. The majority of participants were women because they are usually the caregivers, especially for children, and even so in the absence of modern health care, they have to ensure their children are kept away from diseases and thus their knowledge on the use of medicinal plants is inevitable (Torres-Avilez *et al.* 2016). Besides, the low levels of education of participants imply limited employment opportunities, and

hence limited income and so not easy to access modern medicine except the use of herbal medicine that is easily accessible to provide health care for themselves and their children (Kamel *et al.* 2022) as summarized in Table 1.

Table 1. Demographic characteristics and knowledge of medicinal plants used by the respondents in Rwenzori region.

Parameter	Participant group	Number (n=24)	%
Gender	Male	9	37.5
	Female	15	62.5
Age	18-35	3	12.5
	36-45	5	20.8
	46-60	11	45.8
	>60	5	20.8
Residence	Rural	14	58.3
	Urban	10	41.7
Education status	None	4	16.7
	Primary	11	45.8
	Secondary	9	37.5
Occupation	Farmer	10	41.7
	Trader	3	12.5
	Teacher	1	4.2
	TMP	9	37.5
	Others	1	4.2
Where they learnt from the knowledge of medicinal plants' use	Family member	13	54.2
	Community elder	6	25.0
	Herbalist	4	16.7
	Others	1	4.2

Ethnomedicinal use of plants

The study revealed a total of 77 different plant species from 40 families. The Asteraceae family (10 species) had the highest number of plant species, followed by Fabaceae (6 species) and Solanaceae (4 species). Other families represented only 1, 2, or 3 species (Table 2). The high use of species from the Asteraceae family could be associated with very significant economic importance in terms of food and medicine (Jansen & Palmer,1987). Elsewhere, the Asteraceae family has been proven to be of medicinal importance to indigenous communities (Cilia-López *et al.* 2021, Kachura & Harris, 2022; Komoreng *et al.* 2017) consisting of over 1600 genera and 2500 species distributed globally with proven pharmacological potential, due to its widely distributed range of phytochemical groups, such as phenolic compounds, flavonoids, and terpenoids (Rolnik & Olas, 2021).

Plant parts used in preparation of the medicines

Leaves (56.0%) are the plant parts frequently used, followed by stem bark (17.1%), roots (12.2%), whole plant (4.9%), seeds and fruits (3.7%), and least used are flowers (2.4%) as shown in Figure 2.

The leaves emerging as the most commonly used plant parts to treat diseases agrees with the findings of (Ssenku et al. 2022) where he noted that leaves were the commonest parts used in medicinal preparations. Research indicates that the leaf is the medicinal plant part that is most frequently used in ethnopharmacological applications (Tugume & Nyakoojo, 2019). The availability, quantity, effectiveness of use, and attention to the conservation points are the key drivers behind the available capital of the leaves by local healers, according to field discussions and other comparable data (Hosseini *et al.* 2021).

Habitat of the most used plants

On the other hand, the most commonly used plant forms were herbs (41.0%), shrubs (26.9%), trees (24.4%), climbers (5.1 %) and grasses (2.6 %),(Figure 3).

Table 2. List of the medicinal plants used by local communities in the Rwenzori region; the diseases treated, parts used, mode of preparation and administration, habitat and growth forms, and frequency of citation.

Scientific name	**Family**	**Voucher numbers**	**Local names** (Rutoro, Lubwisi and Rukonjo)	**Disease**	**Part(s) used**	**Preparation**	**Administration**	**Habitat & growth form**	**FC**
Acanthus pubescens. Thomson ex Oliv. Engl	Acanthaceae	IK002	Ekitojo	Erectile dysfunction	Roots	Boil	Oral	Wild, shrub	1
Justicia betonica L.	Acanthaceae	IK37	Quinine	Malaria, uterus problems	Leaves	Leaves are Crushed, squeezed, and drunk	Oral	Wild, shrub	4
Justicia gendarussa Burm f.	Acanthaceae	IK38	Ebele	Cough and flu, malnourished kids	Leaves	Leaves are pounded and drunk	Oral	Garden, herb	2
Aerva lanata (L.) Juss. ex Schult	Amaranthaceae	IK004	Olweza	Curses	Leaves	Boil leaves and bath	Topical	Wild, herb	1
Allium sativum L. Fam	Amaryllidaceae	IK008	Omubwana	Uterine diseases, sore throat, flu, kidney disease	Bulb	Boil	Oral	Garden, herb	4
Mangifera indica L.	Anacardiaceae	IK43	Omuyembe	Erectile dysfunction, chest pain, cough	Leaves, stembark	Leaves and stem bark are boiled and drunk	Oral	Garden, tree	4
Annona muricata L.	Annonaceae	IK10	Mustaferi	Headache, diabetes, chest pain	Leaves	Boil	Oral	Wild, tree	3
Centella asiatica (L.) Urb.	Apiaceae	IK16	Embutami entaito	Prolonged menstruation, false teeth	Leaves	Squeeze and drink	Oral	Wild, herb	2
Mondia whitei (Hook.f.) Skeels	Apocynaceae	IK48	Emirondwa	Erectile dysfunction	Roots	Chewed and the liquid swallowed	Oral	Wild, climber	1
Tabernaemontana stapfiana Britten	Apocynaceae	IK72	Eribotsyo	Breast milk stimulation	Fruit /sap	Fruit or sap is boiled with beans soup	Oral	Wild, tree	1
Colocasia esculenta (L.) Schott	Araceae	IK19	Mahole	Paronychia	Stembark	Pound to make a paste and tie on the toe	Topical	Garden, herb	1

Aloe barbadensis Mill.	Asphodelaceae	IK009	Ekitanga	Malaria, meat allergy, immune booster, cough, back pain, ulcers, candida, UTIs	Leaves	Boil with water and honey added	Oral	Garden, shrub	6
Acmella caulirhiza Delile	Asteraceae	IK003	Ensoimya	Prolonged menstruation,	Leaves	Boil	Oral	Wild, herb	1
Ageratum conyzoides L.	Asteraceae	IK005	Omutalyambene	Hernia, dysentery, fresh wounds, ulcers, syphilis, curses	Leaves	Leaves are squeezed	Oral, nasal	Wild, herb	9
Bidens pilosa L.	Asteraceae	IK13	Omusoni	Diarrhoea, wounds, headaches, ulcers, poisoning, curses, loss of appetite, not eating meat, dysentery	Leaves	The leaves are pounded and squeezed in the mouth	Oral	Wild, herb	11
Conyza sumatrensis (Retz.) E. Walker	Asteraceae	IK20	Amazi gendege-Lukonzo, Munyoka-Lubwisi	Syphilis, Eye infection, ulcers, diarrhoea, Internal wounds, allergy to meat	Leaves	The leaves are squeezed and drunk; then also some drops are put in the eyes.	Oral, ocular	Wild, herb	9
Erlangea tomentosa S. Moore	Asteraceae	IK27	Ekyoganyanza	Migraine	Leaves	Squeeze and drink	Oral	Wild, shrub	1
Senecio hadiensis Forssk	Asteraceae	IK61	Omuziranfu	Pains during pregnancy	Leaves	Pounded	Oral	Wild, herb/shrub	1
Solanecio mannii (Hook. f.) C. Jeffrey	Asteraceae	IK65	Omusununu	Stomach gas, ulcers	Leaves	Squeezed	Oral	Wild, shrub	3
Sonchus oleraceus L.	Asteraceae	IK69	Ekirimyamuliro	Malaria	Leaves	Pound leaves and bath	Topical	Wild, herb	1
Vernonia amygdalina Del.	Asteraceae	IK73	Mubirisi	Malaria	Leaves	Steamed	Nasal/ oral	Wild, shrub	3
Vernonia cinerea (L.) Less.	Asteraceae	IK74	Kayayana	Stomach complications in babies	Leaves	Boiled	Oral	Wild, herb	1

Basella alba L.	Basellaceae	IK12	Enderema	Ulcers, back pain, measles, immune booster	Leaves	Pound leaves and squeeze in the mouth to drink	Oral	Wild, climber	5
Kigelia africana (Lam.) Benth	Bignoniaceae	IK40	Omuboro	Erectile dysfunction, UTIs	Leaves, stem bark, roots	Boil leaves and drink	Oral	Wild, tree	2
Markhamia lutea K.Schum.	Bignoniaceae	IK45	Omusambya	Erectile dysfunction	Roots	Roots are pounded, boiled, and drunk	Oral	Garden, tree	2
Spathodea campanulata P. Beauv	Bignoniaceae	IK70	Omunyara	Syphilis, fibroids, UTIs, Vaginal dryness	Stembark	Decocted	Oral, vaginal douche	Wild, tree	5
Opuntia ficus-indica (L.) Mill.	Cactaceae	IK53	Cactus	Ulcers blocked fallopian tubes	Leaves	The outer peel of the leaf is diluted in water and then drunk	Oral	Wild, herb	3
Warburgia ugandensis Sprague	Canellaceae	IK75	Omubwananzini	Erectile dysfunction, malaria,hernia	Stem bark, leaves	Decocted	Oral	Wild, tree	3
Carica papaya Linn.	Caricaceae	IK15	Eipapali	Erectile dysfunction, toothache, pimples, blood tonic	Stem Bark	Pound, mixed with water and drink, then apply on the skin	Topical, oral	Garden, herb	4
Chenopodium opulifolium Schrad. ex W.D.J.Koch & Ziz.	Chenopodiaceae	IK17	Omwetango	Curses, asthmatic cough	Leaves	Boil leaves, bath, and then drink	Topical, oral	Wild, herb	2
Kalanchoe glaucescens Britten	Crassulaceae	IK39	Ekiyondo	Prolonged menstruation	Leaves	Boil leaves and drink	Oral	Wild, shrub	1
Momordica foetida Schumach.	Cucurbitaceae	IK47	Orwihura	Arthritis, migraine, ulcers	Whole plant	Boiled and drunk	Oral	Wild, climber	3
Zehneria scabra (L.f.) Sond.	Cucurbitaceae	IK76	Akabindiizi	Allergies	Whole plant	Boiled	Oral	Wild, herb	1
Dracaena fragrans (L.) Ker Gawl.	Dracaenaceae	IK24	Omuworoworo	Muscle pain, body pain, vein and artery blockage, stomach wounds in children	Stem bark	Boil and drink	Oral	Wild, shrub	4

Euphorbia hirta L.	Euphorbiaceae	IK30	Akamaramahano	Cataract, asthmatic cough,wounds	Sap	Sap is squeezed and put in the eye and also drunk	Ocular , oral	Wild, herb	3
Flueggea virosa (Roxb. ex Willd.) Royle	Euphorbiaceae	IK33	Omukalali	Erectile dysfunction, wounds	Roots	Root barks are peeled off, cleaned and decocted	Oral	Wild ,tree	2
Jatropha curcas L.	Euphorbiaceae	IK36	Ekisogasoga	Intestinal worms, love portion, fresh wounds	Stem bark, sap	The sap is dropped on fresh wounds. Stembark is boiled &taken as a douche	Oral Topical	Wild, shrub	3
Manihot esculenta Crantz	Euphorbiaceae	IK44	Muhogo	Sickle cell, uterine diseases	Leaves	Leaves are pounded, boiled, and drunk	Oral	Garden, shrub	2
Mimosa pudica L.	Fabacae	IK46	Enyangumbani	Uterine diseases	Leaves/roots	Leaves and or roots are pounded, boiled, and drunk	Oral	Wild, herb	1
Albizia gummifera (J. F. Gmel.) C. A. Sm.	Fabaceae	IK006	Mukundeshebere	Pneumonia cough	Stembark	Decoct dried stembark	Oral	Wild, tree	1
Canavalia ensiformis (L.) DC.	Fabaceae	IK14	Ekihimba	Snake bites	Seeds	The beans are put on the wound directly	Topical	Wild, shrub	2
Erythrina abyssinica Lam. ex DC	Fabaceae	IK28	Omuko	Erectile dysfunction, UTIs, vomiting associated with diarrhea, allergies, backache, hernia	Leaves, Stembark	Fresh leaves are pounded and drunk. Stem bark is boiled and also drunk	Oral	Wild, tree	6
Senna siamea (Lam.) H. S. Irwin & Barneby	Fabaceae	IK62	Omubiriti	Intestinal wounds	Flowers	Boiled	Oral	Wild, shrub	1
Sesbania sesban (L.) Merr.	Fabaceae	IK63	Omubimba	Madness	Leaves	Pounded and squeezed in nostrils	Nasal	Wild, tree	1
Hydnora abyssinica A. Braun	Hydnoraceae	IK35	Omutima gwensi	Arthritis, hypertension	Roots	Pound and boil the paste, then drink	Oral	Wild, herb	2

Hoslundia opposita Vahl	Lamiaceae	IK34	Omwenye	Blocked fallopian, cough, whopping cough, malaria, headache, wounds, hernia, uterine diseases, ulcers,	Leaves	Boil the leaves and drink	Oral	Wild, shrub	11
Leonotis nepetifolia (L.) R.Br.	Lamiaceae	IK41	Akacumucumu	Kidney diseases, ulcers, and diarrhea in children	Whole plant	Boil and drink	Oral	Wild, herb	4
Ocimum tenuiflorum L.	Lamiaceae	IK52	Omujaja	Stomach gas, stomachache in babies, cough, headache, loss of appetite, constipation, malaria fever, migraine	Leaves	Leaves are boiled and drunk	Oral	Wild, shrub	9
Persea americana Mill.	Lauraceae	IK57	Ovakado	Hypertension, headache, kidney disease, migraine, loss of appetite, hernia	Leaves	Boiled	Oral	Garden, tree	7
Abelmoschus esculentus L.Moench	Malvaceae	IK001	Bamya	Ulcers	Seeds	Pound and Boil	Oral	Garden, herb	2
Alcea rosea L.	Malvaceae	IK007	Omukirawangwe	Prolapsed rectum	Whole plant	Boil	Oral	Wild, herb	1
Sida tenuicarpa Vollesen	Malvaceae	IK64	Akabiryo	Swelling of legs, wounds	Leaves	Leaves are pounded, squeezed, and can also be Boiled	Oral	Wild, shrub	2
Artocarpus heterophyllus Lam	Moraceae	IK11	Ejaka	Ebola, uterine problems	Fruit	The young fruits are chopped and boiled	Oral	Garden, tree	2
Ficus natalensis Hochst.	Moraceae	IK31	Omutoma/kitumba	Bedwetting, back pain, unstable menstruation	Stembark	Decoct the bark and drink	Oral	Wild, tree	3
Ficus sycomorus L.	Moraceae	IK32	Omukimbakimba	Syphilis	Stem bark	Decoct the bark and drink	Oral	Wild, tree	1

Moriinga oleifera Lam	Moringaceae	IK49	Muringa	Ulcers, snake bites, immune booster	Leaves	Roots are pounded, boiled, and drunk	Oral	Garden, herb	3
Ensete ventricosum (Welw.) Cheesman	Musaceae	IK25	Ekitembe	Epilepsy	Fruit	Juice is prepared and drunk	Oral	Wild, herb	1
Musa× paradisiaca L.	Musaceae	IK50	Enkonompa	Uterine problems	Flower	Flowers are boiled and applied to the position of the uterus	Topical	Garden, herb	1
Maesa lanceolata Forssk	Myrsinaceae	IK42	Omuhangahanga	Arthritis, Backache, syphilis	Stembark	Stembark is decocted and drunk	Oral	Wild, tree	3
Eucalyptus grandis W. Hill ex Maiden	Myrtaceae	IK29	Kalitunsi	Hernia, kidney diseases, malaria, cough, flu, chest pain, eye pain, fibroids	Leaves, stem bark	Boil the mixture of the two plant parts and drink	Oral	Garden, tree	8
Psidium guajava L.	Myrtaceae	IK59	Eripera	Chest pain	Leaves, seeds	Both are pounded, then Boiled	Oral	Garden, tree	2
Oxalis corniculata L.	Oxalidaceae	IK54	Kanunambuli	Prolonged menstruation, wounds	Leaves	Pounded	Oral	Wild, herb	2
Oxalis latifolia Kunth	Oxalidaceae	IK55	Omuywambende	Skin sores in children	Leaves	Pounded and applied on the skin	Topical	Wild, herb	1
Passiflora edulis Sims	Passifloraceae	IK56	Matunda	Intestinal worms	Leaves	Pounded and squeezed	Oral	Garden, climber	1
Cymbopogon citratus (hort. ex DC.) Stapf	Poaceae	IK21	Ekalifuha	Erectile dysfunction, sore throat, flu, epigastric pain and stomachache, cough, headache	Leaves, roots	Boil and drink	Oral	Garden, grass	6
Digitaria abyssinica (Hochst. ex A.Rich.) Stapf	Poaceae	IK23	Orumbugu	Prolonged menstruation, diarrhoea, joint pain, dysentery, kidney infections	Leaves, roots	Boil and drink	Oral	Wild, grass	7

Eriobotrya japonica (Thunb.) Lindl.	Rosaceae	IK26	Ensari	Hypertension	Leaves	Boil and drink	Oral	Garden, shrub	1
Prunus africana (Hook.f.) Kalkman	Rosaceae	IK58	Engote	Erectile dysfunction, immune booster, diarrhea in adults, gonorrhea, intestinal wounds, joint pain, syphilis, intestinal fever, malaria, ulcers, backache, typhoid	Stembark	Stembark is Boiled and honey added	Oral	Wild, tree	12
Rubus pinnatus Willd.	Rosaceae	IK60	Amakere	Erectile dysfunction, sickle cell	Berries	Chewed	Oral	Wild, shrub	2
Coffea canephora Pierre ex A.Froehner	Rubiaceae	IK18	Kaawa	Dysentery, vomiting, headache, migraine, diarrhoea	Leaves	Boil	Oral	Garden, tree	5
Nicotiana tabacum L.	Solanaceae	IK51	Etaba	Snake bites	Leaves	Leaves are pounded and drunk	Oral	Garden, herb	1
Solanum incanum L.	Solanaceae	IK66	Engusuru	Snake bites	Roots	Chewed	Oral	Wild, shrub	1
Solanum anguivii Lam	Solanaceae	IK67	Akatula	Bleeding gums, hypertension, vomiting	Branches	Crushed, Boiled	Oral	Garden, shrub	3
Solanum lycopersicum L.	Solanaceae	IK68	Enyanya	Fresh wounds	Leaves	Squeezed	Topical	Garden, herb	1
Stachytarpheta jamaicensis (L.) Vahl	Verbenaceae	IK71	Nalongo	Cough and flu, inflammation	Leaves	Boiled and drink	Oral	Wild, shrub	2
Cyphostemma adenocaule (Steud.) Desc.	Vitaceae	IK22	Akabombo	Curses, allergies, intestinal worms, uterus problems	Leaves	Boil leaves and bathe, then drink and apply to the body	Topical, oral	Wild, herb	4
Zingiber officinale Roscoe	Zingiberaceae	IK77	Tangauzi	Headache,chest pain	Rhizome/roots	Boiled	Oral	Garden, herb	2

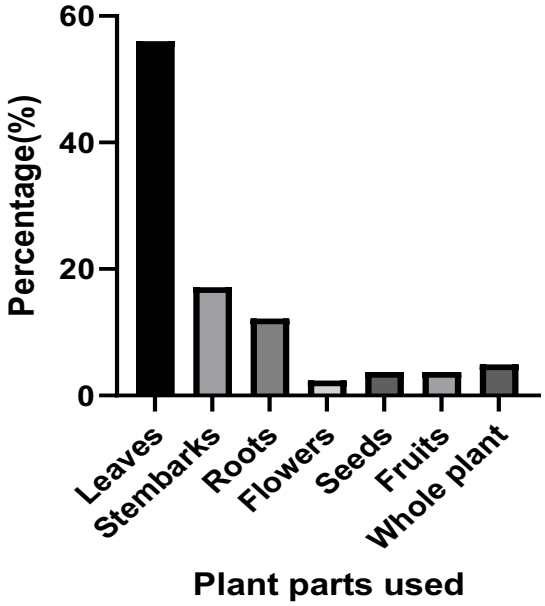

Figure 2. Plant parts used to prepare the medicines

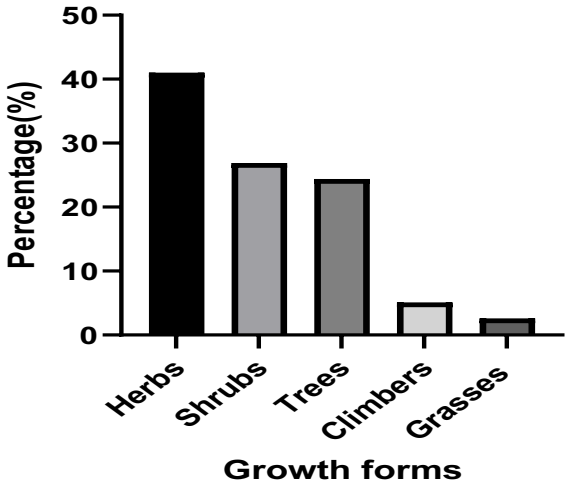

Figure 3. Growth forms of the medicinal plants used

This could be attributed to mainly their abundance throughout the year thus showing no threat to conservation and their valuable source for herbal therapies due to their highly pharmacologically active ingredients as compared to other growth forms (Tugume *et al*. 2016).

The most commonly used medicinal plants according to the frequency of citation included *Prunus africana* (12 times), *Hoslundia opposita* (11 times), *Bidens pilosa* (11 times), *Conyza sumatrensis* (9 times), and *Ageratum conyzoides* (9 times), as shown in Table 2. The high frequency of citation of *Prunus africana*, *Hoslundia opposita*, *Bidens pilosa*, *Conyza sumatrensis*, and *Ageratum conyzoides* is an indication that these plants could be effective and therefore of great cultural significance as well as potential drug leads for modern drug discovery. Our findings on *P. africana* being used most agrees with a recent study (Mwaura *et al*., 2020) in which *P. africana* was a highly traded medicinal plant. It is also noted by *P. africana* as very useful in afforestation, conservation, and rural development practices (Cunningham *et al*. 2016). The medicinal uses of *P. africana* could be due to the presence of several phytoconstituents such as β-sitosterol, pentacyclic triterpenoids, benzoic acid, and ferulic acid esters among others (Nyamai *et al*. 2015). In a related study, *H. opposita* has also been indicated among the most commonly used medicinal plants to treat 22 disease conditions (Asiimwe *et al*. 2021). In addition, the methanol extract of *H. opposita* showed significant antibacterial activity against all bacteria tested, including some resistant

strains of *Stapliyloccocus aureus*, with MIC ranging between 64-256 µg/mL (Jansen & Palmer,1987). Relatedly, *B. pilosa* was cited 11 times for use in the treatment of several diseases including diarrhea, wounds, headache, ulcers, poisoning, curse, loss of appetite, not eating meat, and dysentery but cited particularly 7 times for wound-healing. This plant has also been found to have antimicrobial and anti-inflammatory properties that help in the wound healing process (Rolnik & Olas, 2021).

Preparation of the plant remedies

Most of the plant species were prepared either singly or as a mixture of more than one species with non-plant components such as honey added mainly as a sweetener. Different methods were used for preparing the herbal mixtures; including decoction, boiling, squeezing, chewing, and pounding. The medicinal plant preparations were mostly administered orally (81.4%), and other methods of administration such as topical (12.8 %), nasal (3.5 %), and ocular (2.3 %) were also used concurrently (Figure 4).

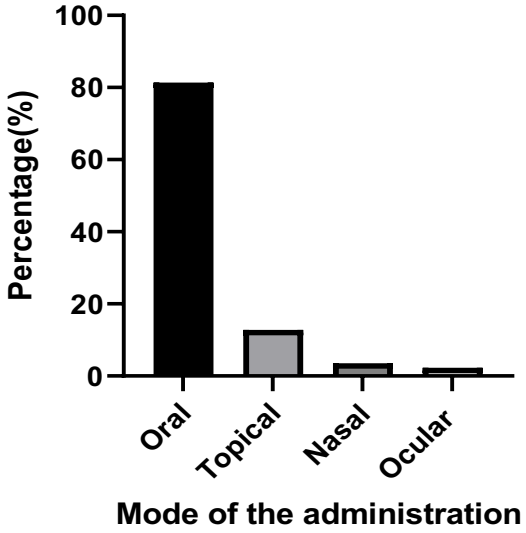

Figure 4. Mode of administration of medicinal plants in Rwenzori region.

Diseases treated by the communities

The plant species documented in this study have been found to treat 68 different diseases. Wounds were found to be treated by most of the plant species (20.9%) followed by ulcers (19.4%), erectile dysfunction (17.9 %), and cough (8.5%) as shown in Table 3.

Wounds are any disruptions of the skin or mucous membrane layer which cause injury to the skin as a result of physical damage or other underlying medical conditions (Hosseini *et al* .2021). It has been reported by Ericsson et al. (2001) that people living in mountainous areas oftentimes face dermatological infections such as persistent wounds, which could be a basis for its highly frequent disease.

Table 3. Summary of ten (10) common diseases treated by the different medicinal plants in Rwenzori region.

Disease	Frequency
Wounds	14
Ulcers	13
Erectile dysfunction	12
Cough	12
Malaria	9
Headache	8
Syphilis	7
Diarrhea	7
Hernia	6
Flu	6

Conclusions

Our study in the four districts of the Rwenzori region consisting of the Batooro, Bakonzo, and Bamba people revealed a vast traditional knowledge among the selected indigenous populations. To suit their pharmacological demands, they have utilized 77 different species of medicinal plants from 40 different families. The communities also used nasal and ocular administration methods in addition to the usual oral and topical use of ~~the~~ crude herbal medications. The local population frequently treated wounds and ulcers using herbal remedies. Few references to the use of medicinal plants like *Z. scabra*, *V. cinerea*, *T. stapfiana*, *S. lycopersicum*, and *S. oleraceus* may indicate that these plants are uncommon, not well-conserved, have been abandoned due to cultural adaptations, or are ineffective and thus not typical of the Rwenzori region. However, these plants might be significant in other regions of the nation where they are well-cited for treating specific illnesses. A few commonly used medicinal plants, such as *P. africana*, *H. opposita*, *B. pilosa*, *C. sumatrensis*, and *A. conyzoides*, are endangered and only found in a small portion of their natural habitats. As a result, immediate conservation measures are required.

Declarations

Ethics statement: Prior to the survey, we obtained oral informed consent from each study participant.

Consent for publications: Not applicable.

Funding: Authors received funding from the Pharm-Biotechnology and Traditional Medicine Centre (PHARMBIOTRAC), a World Bank supported Eastern and Southern Africa Higher Education Centers of Excellence (ACE II) Program hosted at Mbarara University of Science and Technology, Uganda.

Conflicts of Interest: The authors declare that there are no conflicts of interest in this article.

Data Availability statement: The figures and tables supporting the results of this study are included in the article, and the original data sets are available from the first author upon request.

Author contributions: Conceptualization: CUT, IK and HI; Data collection: CUT, IK and HI; Formal analysis: CUT, IK and HI; Helped with statistical analysis: UN; Investigation: CUT, IK and HI; Methodology: CUT, IK and HI; Writing – original draft and final copy: CUT, IK and HI.; Writing – review & editing: CUT, IK, HI, UN and AW. All authors read and agreed to the published version of the manuscript.

Acknowledgments: We are thankful to the people of the four districts (Kabarole, Kasese, Bundibugyo, and Bunyangabu) for sharing their knowledge on the use of medicinal plants for treating various diseases.

Literature cited

Asiimwe S, Namukobe J, Byamukama R, Imalingat B. 2021. Ethnobotanical survey of medicinal plant species used by communities around Mabira and Mpanga Central Forest Reserves, Uganda. Tropical Medicine and Health. 1:1-10.

Balunas MJ, Kinghorn AD. 2005. Drug discovery from medicinal plants. Life sciences. 5:431-441.

Cilia-López VG, Cariño-Cortés R, Zurita-Salinas LR. 2021. Ethnopharmacology of the Asteraceae family in Mexico. Botanical Sciences. 3:455-86.

Cunningham A, Anoncho VF, Sunderland T. 2016. Power, policy and the Prunus africana bark trade, 1972–2015. Journal of Ethnopharmacology.178:323-333.

de Medeiros PM, Figueiredo KF, Gonçalves PH, Caetano RD, Santos ÉM, Dos Santos GM, Barbosa DM, de Paula M, Mapeli AM. 2021. Wild plants and the food-medicine continuum—an ethnobotanical survey in Chapada Diamantina (Northeastern Brazil). Journal of Ethnobiology and Ethnomedicine. 1:1-10.

Ericsson CD, Steffen R, Basnyat B, Cumbo TA, Edelman R. 2001. Infections at high altitude. Clinical Infectious Diseases. 11:1887-1891.

Hosseini SH, Bibak H, Ghara AR, Sahebkar A, Shakeri A. 2021. Ethnobotany of the medicinal plants used by the ethnic communities of Kerman province, Southeast Iran. Journal of Ethnobiology and Ethnomedicine. 1:1-35.

Ikiriza H, Ogwang P E, Peter E L, Hedmon O, Tolo C U, Abubaker M, Abdalla A A M. 2019. Dioscorea bulbifera, a highly threatened African medicinal plant, a review. Cogent Biology. 1:1-6.

Ikiriza H, Ajayi CO, Okella H, Muwonge A, Abdalla MAA, Tolo, CU. 2021. Quantification of Diosgenin content in *Dioscorea bulbifera* Linn germplasm from Uganda. Academia Journal of Medicinal Plants 4:40-47.

Jansen RK, Palmer JD. 1987. A chloroplast DNA inversion marks an ancient evolutionary split in the sunflower family (Asteraceae). Proceedings of the National Academy of Sciences. 16:5818-522.

Kachura A, Harris CS. 2022. An ethnobotanical meta-analysis of North American medicinal Asteraceae. Botany. 2:207-217.

Kahwa I, Ajayi CO, Yadav R, Chauhan NS, Shah K, Abdelgadir AA, Shegena EA, Daniel S, Omara T, Asiimwe JB, Ikiriza H, Shabnoor I, Casim UT, Anke Patrick EO. 2023. Pharmacognostic and phytochemical studies as an invaluable approach for correct identification of medicinal plants: The case of *Artemisia vulgaris* L. substituted for *Artemisia annua* L. in Western Uganda. TMR Integrative Medicine. 1-13

Kamatenesi MM, Acipa A, Oryem-Origa H. 2011. Medicinal plants of Otwal and Ngai sub counties in Oyam district, Northern Uganda. Journal of Ethnobiology and Ethnomedicine. 7:1-4.

Kamel N, El Boullani R, Cherrah Y. 2022. Use of Medicinal Plants during Pregnancy, Childbirth and Postpartum in Southern Morocco. InHealthcare. 11: 1-27.

Komoreng L, Thekisoe O, Lehasa S, Tiwani T, Mzizi N, Mokoena N, Khambule N, Ndebele S, Mdletshe N. 2017. An ethnobotanical survey of traditional medicinal plants used against lymphatic filariasis in South Africa. South African Journal of Botany. 111: 12-16.

Montserrat LS, Cruz ET, Anderson A. 2013. Baseline report Rwenzori region case study Afromaison project. Fort Portal. 1-147.

Mwaka AD, Tusabe G, Garimoi CO, Vohra S, Ibingira C. 2019. Integration of traditional and complementary medicine into medical school curricula: a survey among medical students in Makerere University, Uganda. BMJ open, 9:1-10.

Mwaura A, Kamau J, Ombori O. 2020. An ethnobotanical study of medicinal plants commonly traded in Kajiado, Narok and Nairobi counties, Kenya: Medicinal Plant Species Traded in Kenya. East African Journal of Science, Technology and Innovation. 3:1-19.

Namuli A, Bazira J, Casim TU, Engeu PO. 2018. A review of various efforts to increase artemisinin and other antimalarial compounds in *Artemisia annua* L plant. Cogent Biology,1:1-8.

Nuwagira C, Peter EL, Ajayi CO, Adriko J, Kagoro GR, Olet EA, Ogwang PE, Tolo CU. 2021. Developmental stages influence in vivo antimalarial activity of aerial part extracts of *Schkuhria pinnata*. Journal of Ethnopharmacology,279: 1-7.

Nuwagira U, Yasin I, Ikiriza H. 2022. Review of Deforestation in Ugandan Tropical Rainforest Reserves: A Threat to Natural Medicine. *East African Journal of Environment and Natural Resources*.1: 204-217.

Nyamai DW, Mawia AM, Wambua FK, Njoroge A, Matheri F, Lagat R, Burugu M. 2015. Phytochemical profile of Prunus africana stem bark from Kenya. Journal of Pharmacognosy and Natural Products. 1:1-8.

Oryem-Origa HE, Kakudidi EK, Katande AB, Bukenya ZR.1995. Preliminary ethnobotanical studies of the Rwenzori Mountain Forest area in Bundibugyo district, Uganda. Bothalia. 1:111-119.

Pan X, Zhang A, Henderson G E, Rennie S, Liu C, Cai W , Tucker J D. 2019. Traditional, complementary, and alternative medical cures for HIV: rationale and implications for HIV cure research. *Global public health*.1:152-160.

Rolnik A, Olas B. 2021. The plants of the Asteraceae family as agents in the protection of human health. International journal of molecular sciences. 6: 1-10.

Ssegawa P, Kasenene JM. 2007. Medicinal plant diversity and uses in the Sango bay area, Southern Uganda. Journal of ethnopharmacology. 3:521-540.

Ssenku JE, Okurut SA, Namuli A, Kudamba A, Tugume P, Matovu P, Wasige G, Kafeero HM, Walusansa A. 2022. Medicinal plant use, conservation, and the associated traditional knowledge in rural communities in Eastern Uganda. Tropical Medicine and Health. 1:1-10.

Tabuti JR, Lye KA, Dhillion SS. 2003. Traditional herbal drugs of Bulamogi, Uganda: plants, use and administration. Journal of ethnopharmacology. 1:19-44.

Tenywa MG, Agaba A, Ogwang PE, Tolo CU, Ajayi CO, Katuura E. 2020. Medicinal plants used in gynecological procedures in Uganda. Journal of Medicinal Plants Research, 4: 185-194.

Tenywa MG, Katuura E, Tolo CU, Ajayi CO, Agaba, AG. 2021. Evaluation of the adverse effects of *Dracaena steudneri* Engl. stem bark aqueous extract in Wistar rats. African Journal of Pharmacy and Pharmacology, 12:197-205.

Torres-Avilez W, Medeiros PM, Albuquerque UP. 2016. Effect of gender on the knowledge of medicinal plants: systematic review and meta-analysis. Evidence-based complementary and alternative medicine.1-13.

Tugume P, Kakudidi EK, Buyinza M, Namaalwa J, Kamatenesi M, Mucunguzi P, Kalema J. 2016. Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda. Journal of ethnobiology and ethnomedicine. 12:1-28.

Tugume P, Nyakoojo C. 2019. Ethno-pharmacological survey of herbal remedies used in the treatment of paediatric diseases in Buhunga parish, Rukungiri District, Uganda. BMC Complementary and Alternative Medicine. 1:1-10.

Uganda Bureau of Statistics (UBOS) and International Livestock Research Institute (ILRI). 2008. *2005 Poverty GIS Database*. Kampala, Uganda: Government of Uganda, UBOS and ILRI. http://www.wri.org/publication/uganda-gis-data

Wangalwa R, Olet EA, Kagoro-Rugunda G, Tolo CU, Ogwang PE, Barasa B. 2021. Occurrence of Citropsis articulata in tropical forests in Uganda: implication for ex situ conservation. International Journal of Forestry Research, 2021: 1-19.

World Population Prospects: 2022 Revision https://data.worldbank.org/ Indicator/

SP.POP.TOTL?locations=UG-XM