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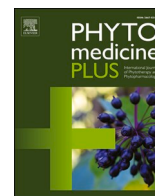


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Ethnobotany, floristic and phytochemical studies of medicinal plants used to treat uterine fibroids in Mbarara City, Uganda

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ABSTRACT

Uterine fibroids (UF) are the most common non-cancerous benign gynaecologic tumours in premenopausal females. In Uganda, the prevalence of UF is estimated at 20%, and several risk factors have been identified as contributing to this prevalence. This study aimed to document the ethnobotanical knowledge of traditional medicine practitioners (TMPs) in Mbarara City, Southwestern Uganda on the use of medicinal plants for UF management. The TMPs play a vital role in the healthcare within this region, often incorporating conventional diagnostic methods such as ultrasound scans before providing herbal treatments. To achieve the study aim, data was collected from April 2024 to May 2024 using structured questionnaires administered. Twenty-six (26) respondents were selected using purposive and snowball sampling techniques. Data were gathered on socio-demographic characteristics, treatment-seeking behaviour, and use of herbal formularies for treatment of UF. Statistical analysis involved descriptive statistics, and computation of the frequency of citation, relative frequency of citation and fidelity level. Our results indicated that most TMPs knew about UF and valued conventional means of diagnosis before initiating herbal treatment. Forty-seven (47) plant species belonging to 32 families and 45 genera were identified. Fabaceae (10.6%), Asteraceae, Lamiaceae (8.5% each), Asparagaceae and Cucurbitaceae (6.4% each) were the most ordinary families. At the same time, *Oxygonum sinuatum*, *Hoslundia opposita*, *Opuntia ficus-indica*, *Sesamum angustifolium*, *Phyllanthus niruri*, *Ricinus communis*, *Erythrina abyssinica* and *Leonotis nepetifolia* were the most frequently cited species. Leaves (47.6%), stems (17.5%) and flowers (9.5%) of herbs (61.7%), trees (23.4%) and shrubs (14.9%) were the primarily utilized plant parts for preparing decoctions that are administered orally (94%). Classical phytochemical screening of plant organs from the eight most cited species indicated flavonoids, phytosterols, terpenoids, saponins and alkaloids. With initial evidence of the bioactive secondary metabolites, this study underscores the need for further bioassay-guided studies to isolate and characterize bioactive molecules associated with the anti-fibroid efficacy of the species.

1. Introduction

Uterine fibroids (UF), also less commonly known as uterine leiomyomas or uterine myomas, are the most common benign female gynaecologic tumours and a significant cause of morbidity in premenopausal females (Lou et al., 2023; Yang et al., 2022). It is established to affect more than 70% of women, but its prevalence in symptomatic patients is no more than 30% (Moroni et al., 2014). Nevertheless, striking variations in the incidences as well as prevalences of UF by

ancestry (race) and ethnicity have been witnessed in previous research efforts (Baird et al., 2003; Wise et al., 2005). For example, clinical reports have indicated that the cumulative incidences of UF in women who are 50 years or older are significantly higher for black women (>80%) when compared to their white counterparts (approximately 70%) (Sefah et al., 2023). Age, environmental factors, family history of UF and vitamin D deficiencies are some of the known risk factors for the development of UF in women (Sefah et al., 2023).

UF is typified by the presence of disordered bundles of smooth

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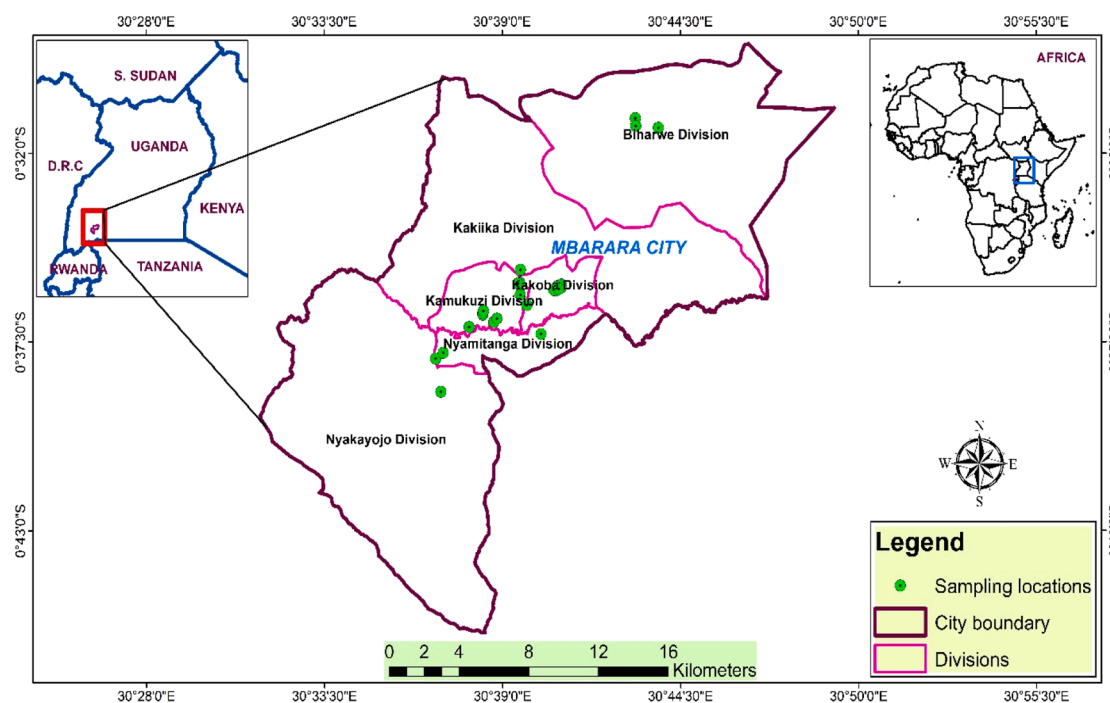


Fig. 1. Map of Mbarara City showing the location of studied divisions and the floristic distribution of the documented plants. Inset is the location of Mbarara City in South Western Uganda.

muscle cells, vascular smooth muscle cells, fibroblasts, leiomyoma-associated fibroblasts and an excess of acellular extracellular matrix (Morhason-Bello & Adebamowo, 2022). Despite its high prevalence, it is established that UF rarely develops into cancer (i.e. leiomyosarcoma), but this may occur in <0.1% of the cases. In symptomatic patients, UF is characterized by pelvic pain, menorrhagia, the presence of pelvic mass and, in some cases, infertility (Adawe et al., 2022).

Uterine fibroids (benign tumours of the uterus) are managed through various medical and surgical interventions tailored to symptom severity, fibroid characteristics, and patient preferences (Giuliani et al., 2020). Medical treatments include hormonal therapies such as gonadotropin-releasing hormone (GnRH) agonists, which reduce fibroid size and alleviate symptoms by inducing a temporary menopausal state (Angioni et al., 2021). However, prolonged use is limited due to side effects like bone density loss. Selective progesterone receptor modulators (SPRMs) offer an alternative by controlling bleeding and reducing fibroid volume, although concerns about endometrial changes necessitate careful monitoring (Horne & Bliethe, 2007).

In various cultural contexts, traditional medicine plays a significant role in managing UF, especially where access to conventional medical treatments is limited or where cultural preferences favour natural remedies (Haththotuwa et al., 2011). For instance, Traditional Chinese Medicine utilizes herbal formulations like Gui Zhi Fu Ling Wan, aimed at promoting blood circulation and reducing fibroid sizes (Dowd, 2017; Zeng et al., 2017). In African traditional medicine, certain herbs are employed based on ethnobotanical knowledge to manage fibroid-related symptoms. For example, species like *Securidaca longipedunculata* and *Cassia sieberiana* (Couliadiaty et al., 2021). While these remedies are integral to cultural practices and may offer relief, they often lack rigorous clinical evaluation, raising concerns about efficacy and safety (Moreira et al., 2014).

In Uganda (Eastern Africa), the prevalence of UF is estimated at 20%, and risk factors such as age, separation from spouses, overweight and obesity have been implicated in this prevalence rate (Adawe et al., 2022). In the Mbarara Hospital gynaecology clinic of South Western Uganda, the prevalence of UF was 28.2% (Adawe et al., 2022). Some studies have cited using herbal extracts to manage UF in Uganda

(Asimwe et al., 2021; Tabuti et al., 2003). Still, no specific research has been undertaken to establish an inventory of the medicinal plants used. The current study sought to unravel the awareness and knowledge of traditional medicine practitioners (TMPs), and their ethnobotanical knowledge of plants utilized to manage UF in Mbarara City of South-western Uganda. Phytochemical screening of the most used plants was performed to establish a basis for future research.

2. Materials and methods

2.1. Study area

The present study was conducted in Mbarara City (0° 36' 20.43"S, 30° 38' 54.78"E), the largest city and central business hub of South-western Uganda (Mackay et al., 2022). The city is located 270 km (by road) southwest of the capital of Uganda (Kampala) and covers an area of 1,778.4 square kilometres (Fig. 1). It comprises six city boroughs: Kakoba, Kamukuzi, Nyamitanga, Biharwe, Kakiiika, and Nyakayojo.

Due to the rural economy of Uganda and abundant rainfall, several parts of Mbarara city (including suburban areas) have evident agricultural activities (Kyembabazi & Ssemakula, 2020). Some of the major crops grown include vegetables, coffee, bananas, sugarcane and tea, among others (Atwongyeire et al., 2018; Nseka et al., 2022). The inhabitants of Mbarara District are well known for their distinguished use of medicinal plants (Barigye, 2019; Katuura et al., 2018; Katuura et al., 2007), and this, in part, instigated the current study.

2.2. Sample size determination

The sample size (S) was computed to be 144 respondents after applying the formula suggested by Krejcie and Morgan (Krejcie & Morgan, 1970):

$$S = \frac{X^2 NP (1 - P)}{d^2 (N - 1) + X^2 P (1 - P)}$$

From which X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841), N = the population size

of Mbarara City; P = the population proportion (assumed to be 0.50 since this would provide the maximum sample size), and d = the degree of accuracy expressed as a proportion (0.05).

Due to the use of the purposive nature of the study, only 26 consenting respondents with top-notch knowledge of using herbs for UF treatment were interviewed.

2.3. Sampling design

A cross-sectional survey was done in Mbarara City from April 2024 to May 2024. With the help of local authorities, TMPs of Mbarara City, South Western Uganda, aged 18 years and above were engaged. The study targeted TMPs with knowledge of using medicinal plants for treating UF, with experience of 3 years or more. Thus, the study employed snowball and purposive sampling techniques to obtain the required number of TMPs, and this was done until saturation was attained in every division (Asiimwe et al., 2021; Tabuti et al., 2023). The ethnobotanical survey was conducted in the local dialect (Runyankore) and Luganda, another Bantu language commonly spoken in the city. The questions covered socio-demographic characteristics, awareness and knowledge of the TMPs about UF, methods through which the ethnomedicinal knowledge was acquired, the medicinal plants utilized in the treatment or management of UF and their habitat, the method of preparation as well as administration of the herbal formularies.

2.4. Data collection procedures

The survey was conducted in all the boroughs of Mbarara City using pre-tested semi-structured questionnaires. The data collectors acquired appropriate informed consent from the TMPs and promised to share the results after the study. For ethnobotanical data, plants mentioned by the TMPs were collected during guided field walks, and voucher specimens for each species were prepared. A botanist authenticated the collections and deposited them at the Department of Biology, Mbarara University of Science and Technology, Mbarara, Uganda. The botanical names of the cited species followed the nomenclature in the International Plant Name Index and the World Flora Online.

2.5. Data analysis

All data were stored in Microsoft Excel (Microsoft Corporation, USA). Descriptive statistical analysis was used to process qualitative data, subsequently presented as percentages and frequencies. On the other hand, quantitative ethnobotanical data were used to calculate the frequency of citation (FC), relative frequency of citation (RFC) and fidelity level (FL). The RFC and FL were calculated using equations 1 and 2 (Trotter & Logan, 1986).

$$RFC = \frac{FC}{N} \quad (1)$$

$$FL = \frac{I_p}{I_u} \times 100 \quad (2)$$

Where N = number of participants in the survey, I_p = number of respondents that mentioned a particular plant species used to treat UF, and I_u = total number of respondents in the survey.

2.6. Phytochemical screening of the most highly cited medicinal plants

Eight plants with the highest FC were selected for classical phytochemical screening. The organs used to treat UF were briefly shade-dried for two weeks, and infusions were prepared. These included *Oxygonum sinuatum* and *Phyllanthus niruri* whole plants and leaves of *Hoslundia opposita*, *Sesamum angustifolium* and *Leonotis nepetifolia*. Hot boiling water was added to the crushed plant material in a 10 mL per gram ratio, covered and sonicated at 125 revolutions per minute for 15 minutes at

Table 1
Sociodemographic characteristics of TMPs recruited in the study (n = 26).

Characteristic	Categories	Frequency	Percentage
Gender	Female	20	76.9
	Male	06	23.1
Age (years)	18-25	01	3.8
	26-30	03	11.5
	31-40	05	19.2
	41-50	04	15.4
	51-60	05	19.2
	61-70	08	30.8
Level of education	Illiterate	01	3.85
	Primary	11	42.31
	Secondary	09	34.62
	Tertiary	05	19.23
Source of ethnobotanical knowledge	Family	16	61.5
	Training	6	23.0
	Community	1	3.9
	Family and Community	2	7.7
	Family and training	1	3.9

30°C. The mixtures were then filtered, and the filtrates were collected. On the other hand, decoctions were prepared from *Ricinus communis* seeds, *Erythrina abyssinica* bark and *Opuntia ficus-indica* stem. The shade-dried plant organs were crushed, weighed and boiled in water at a 10 mL per gram ratio for 60 minutes; the resultant solution was filtered.

All the filtrates were concentrated by rotary evaporation and reconstituted in distilled water in a ratio of 1:10 (w/v) before phytochemical screening. The extracts were tested for the presence of alkaloids (Dragendorff's test), saponins (foam test), phenols/tannins (ferric chloride test), glycosides (Borntrager's test), terpenoids (Salkowski test), flavonoids (sodium hydroxide test) and phytosterols following standard methods described by Evans (2009).

2.7. Ethical considerations

Approval to undertake this study was sought from the Department of Pharmacy, Mbarara University of Science and Technology (Approval no. 2020/PHA/073/PS). All participants were asked for their consent and signed informed consent forms.

3. Results

3.1. Sociodemographic profile of the TMPs

There was reluctance to share ethnobotanical knowledge, and only 26 TMPs participated in the study. Of these, the majority were females (76.9%) in the age bracket of 61-70 years (30.8%) with only a basic primary level of education (42.3%) (Table 1). Those interviewed (61.5%) stated that their knowledge of medicinal plants was acquired from family members, followed by training (30.8%), family and community (19.2%), family and training (7.7%) and acquisition from the community (3.9%).

3.2. Knowledge of uterine fibroids and their treatment using herbal medicine

Most TMPs attested that UF was common among their patients, and they defined it as swellings that invade the uterus. Lower abdominal pain, massive uterine bleeding and lower back pain were its recognizable signs and symptoms. Other characteristic symptoms were changes in menstrual cycle and feeling of abdominal fullness. The use of family planning medications, taking too long without giving birth, infections (such as those sexually transmitted and of the urinary tract), poor diet, hormonal imbalance, and stress (during a woman's reproductive ages) were the most commonly reported causes of UF. Heredity, lifestyle, cancer, obesity, having sex, and the last water remaining in the uterus

Table 2

Medicinal plants used in the treatment of uterine fibroids in Mbarara City, Southwestern Uganda.

S/ N	Botanical name (voucher no.)	Family	Local name	Preparation method	Administration mode	Dosage	Growth form	Plant part	Plant source	Other additives	FC	RFC	FL
1	<i>Oxygonum sinuatum</i> (Hochst.& Steud.ex Meisn.) Dammer (CN 001)	Polygonaceae	Kacumita mbogo (Run), kafumita bagenda (Lug)	Squeeze in a cup of water or make powder	Oral	A cup or half a cup of extract	Herb	WP, L	Bush		9	0.35	34.6
2	<i>Hoslundia opposita</i> Vahl (CN 002)	Lamiaceae	Esitemwe (Run) Kamunye (Lug)	Leaves boiled for trans night and extracted after cooling. Pound, squeeze out, and filter	Oral	Half a glass thrice daily	Shrub	F, L	Bush		5	0.19	19.2
3	<i>Opuntia ficus-indica</i> (L.) Mill (CN 003)	Cactaceae	Ngabo ya kabaka (Lug)	Remove thorns, cut into pieces add hot water, and leave for 10 minutes	Oral	1 cupful 3 times a day for a month	Shrub	S	Garden	Okra	5	0.19	19.2
4	<i>Sesamum angustifolium</i> (Oliv.) Engl. (CN 004)	Pedaliaceae	Olutungotungo (Lug)	Compression, make powder added to water and drink. Boil the leaves, filter out the extract	Oral	½ a cup 3 times a day	Herb	L	Bush		4	0.15	15.4
5	<i>Phyllanthus niruri</i> L. (CN 005)	Phyllanthaceae	Musimba nyiriri katabizimba (Lug)	Boil and filter out the extract Dry to powder used as tea	Oral	1¼ teaspoonful 3 times for 2 months	Herb	WP	Garden, Bush	Charcoal	4	0.15	15.4
6	<i>Ricinus communis</i> L. (CN 006)	Euphorbiaceae	Eshogashoga Ensogasoga (Lug)	Pressing the seeds to get oil	Topical	Smear on the abdomen twice a day for a month	Shrub	Sd	Garden	Rosemary, sage or thyme oil	3	0.12	11.5
7	<i>Erythrina abyssinica</i> Lam. (CN 007)	Fabaceae	Ekiko (Run) Jirikiti (Lug)	Boil and use the extract	Oral	A cup in the evening, half glass thrice day	Tree	B	Bush		3	0.12	11.5
8	<i>Leonotis nepetifolia</i> (L.) R.Br. (CN 008)	Lamiaceae	Ekifumufumu (Lug), Ekicumucumu (Run)	Boil the plant and filter out the extract	Oral, Topical	Half a cup thrice a day. Insert into the vaginal cavity	Herb	L, S	Bush		3	0.12	11.5
9	<i>Prunus africana</i> (Hook.f) Kalman (CN 009)	Rosaceae	Omugote (Run) Entasesa (Lug)	Dry bark, make powder give with honey	Oral	Tablespoon with honey	Tree	B	Bush	Honey	2	0.08	7.7
10	<i>Macrotyloma axillare</i> (E. Mey.) Verdc (CN 010)	Fabaceae	Ekaihabukuru (Run)	Boil in water and make a filtrate	Oral	½ a glass 3 times a day	Herb	L, S	Bush	Omujaja	2	0.08	7.7
11	<i>Plectranthus cyaneus</i> Gurke (CN 011)	Lamiaceae	Maarwa (Run) Kibwankulata (Lug)	pound and squeeze out the filtrate	Oral	½ a cup twice a day	Herb	L	Bush		2	0.08	7.7
12	<i>Pseudarthria hookeri</i> Wight & Arn. (CN 012)	Fabaceae	Omukongorani (Run) Omukakala (Lug)	Pound leaves, add water, boil and filter	Oral	A cup 3 times a day	Herb	L	Bush		2	0.08	7.7
13	<i>Cucurbita pepo</i> L. (CN 013)	Cucurbitaceae	Ekishusha (Run) Enssujju (Lug)	Boil in water Squeeze out extract	Oral	1 cup daily	Herb	L	Garden		2	0.08	7.7
14	<i>Dracaena steudneri</i> Schweinf. ex Engl. (CN 014)	Asparagaceae	Kajjo Iyenjovu (lug) Ekigologolo (Run)	Boil and extract	Oral	½ a cup 3 times a day	Tree	B	Bush	Omujaja	2	0.08	7.7
15	<i>Psidium guajava</i> L. (CN 015)	Myrtaceae	Epeera (Lug) Omupeera (Run)	Boil 1 kg of leaves in 6 cups to obtain 2 cups of extract	Oral	Three spoons thrice a day	Tree	L	Bush		1	0.04	3.8
16	<i>Ipomoea cairica</i> L. (CN 016)	Convolvulaceae	Kalandalugo (Lug)	Boil in water Dry to powder	Oral	A cup or ½ a cup	Herb	L	Bush		1	0.04	3.8
17	<i>Argemone mexicana</i> L. (CN 017)	Papaveraceae	Akatojo (Run) Katovu (Lug)	Boil the whole plant	Oral	1 cup in the evening	Herb	WP	Bush, Garden		1	0.04	3.8
18	<i>Plantago palmata</i> Hook. f. (CN 018)	Plantaginaceae	Embatabata (Lug)	Boil in water and filter out the extract	Oral	1 cup in the evening	Herb	L	Bush		1	0.04	3.8
19	<i>Zanthoxylum gilletti</i> (De Wild.) (CN 019)	Rutaceae	Omutatembwa (Lug)	Boil in water and filter out the extract	Oral	A cupful 2 times a day	Tree	S	Bush		1	0.04	3.8

(continued on next page)

Table 2 (continued)

S/ N	Botanical name (voucher no.)	Family	Local name	Preparation method	Administration mode	Dosage	Growth form	Plant part	Plant source	Other additives	FC	RFC	FL
20	<i>Warbugia ugandensis</i> Sprague (CN 020)	Canellaceae	Muwiya (Run) Mukuzanume (Lug)	Dry bark, make powder. Boil in water, and filter out extract	Oral	60g in 1L	Tree	B	Garden, Forest		1	0.04	3.8
21	<i>Trimeria grandifolia</i> (Hochst.) Warb (CN 021)	Flacourtiaceae	Omwatanshare (Run)	Boil in water and filter out the extract	Oral	A cupful	Shrub	L	Bush		1	0.04	3.8
22	<i>Persea americana</i> Mill. (CN 022)	Lauraceae	Ovakedo (Lug)	Dry and crush add powder to a cup of hot water	Oral	1 spoonful in 1 cup of water for a month	Tree	Sd	Garden		1	0.04	3.8
23	<i>Urtica massaica</i> Mildbr. (CN 023)	Urticaceae	Ekichuregyenyi (Run)	Dry to powder, drink in water	Oral	1 spoonful in 1 cup of water for 2 weeks	Shrub	L	Garden		1	0.04	3.8
24	<i>Abrus precatorius</i> L. (CN 024)	Fabaceae	Akarunga (Run), Olusiiti (Lug)	Boil in water for 4 hours	Oral	A cupful	Herb	L	Bush	Charcoal	1	0.04	3.8
25	<i>Moringa oleifera</i> Lam. (CN 025)	Moringaceae	Muringa (Lug)	Boil in water for 4 hours	Oral	A cupful	Tree	L, S, R	Bush	Charcoal	1	0.04	3.8
26	<i>Coffea arabica</i> Benth. (CN 026)	Rubiaceae	Emwanyi (Lug)	Boil the leaves in water and filter out the extract	Oral	1L divided into 3 doses per day	Tree	L	Garden		1	0.04	3.8
27	<i>Bidens pilosa</i> L. (CN 027)	Asteraceae	Enyabarasana (Run), Sere (Lug)	Boil in water and filter out the extract	Oral	1L divided into 3 doses	Herb	WP	Bush		1	0.04	3.8
28	<i>Alangium chinense</i> (Lour.) Harms (CN 028)	Cornaceae	Omusiisa (Lug)	Boil in water and filter out the extract	Oral	1L divided into 3 doses	Herb	B	Bush		1	0.04	3.8
29	<i>Dracaena fragans</i> (L.) Ker Gawl. (CN 029)	Asparagaceae	Omulamura (Run) Oluwanyi (Lug)	Boil in water and filter out the extract	Oral	½ a glass 3times a day	Shrub	L	Garden		1	0.04	3.8
30	<i>Mosla scabra</i> (Thunb.) C.Y. Wu & H.W.L (CN 030)	Lamiaceae	Omweya (Run)	Boil in water a filter the extract	Oral	½ a glass 3times a day	Tree	L	Bush		1	0.04	3.8
31	<i>Crassocephalum</i> <i>picridifolium</i> (DC.) S. Moore (CN 031)	Asteraceae	Kitonto (Lug)	Pound leaves, add water, and filter	Oral	A cup 2 times a day	Herb	L	Bush		1	0.04	3.8
32	<i>Crassocephalum</i> <i>vitellinum</i> (Benth.) S. Moore (CN 032)	Asteraceae	Entalahonda (Run) Omusununu (Lug)	Boil in water and filter out the extract	Oral	A cup three times a day	Herb	L	Bush	Omujaja	1	0.04	3.8
33	<i>Momordica foetida</i> Schumach. (CN 033)	Cucurbitaceae	Orwihura (Run) Ebombo (Lug)	Boil it in water Eat it raw	Oral	A cup twice a day	Herb	WP	Bush		1	0.04	3.8
34	<i>Cyathula uncinulata</i> (Schrad) Schinz (CN 034)	Amaranthaceae	Ekikwasi (Run)	Boil in water and filter out the extract	Oral	A cup three times a day	Herb	L	Bush	Omujaja	1	0.04	3.8
35	<i>Bothriocline tomentosa</i> (Oliv. & Hiern) Wild & G.V.Pope (CN 035)	Asteraceae	Ekyoga nyanja (Run), Entwata (Lug)	Boil in water and filter out the extract	Oral	A cup 3 times a day	Shrub	L	Bush	Omujaja	1	0.04	3.8
36	<i>Cassia alata</i> L. (CN 036)	Fabaceae	Omukyora (Run) Omugabagaba (Lug)	Boil the leaves and get the extract	Oral	½ a cup 2 times a day	Herb	R, L	Bush		1	0.04	3.8
37	<i>Portulaca quadrifida</i> L. (CN 037)	Portulacaceae	Bwanda (Lug)	Boil in 2 L of water until it dries to ½ the volume	Oral	½ a cup 2 times a day	Herb	L, S	Bush	Mukazi murofa	1	0.04	3.8
38	<i>Cucumis sativus</i> L. (CN 038)	Cucurbitaceae	Chukamba (Lug)	Boil in water and filter out the extract Eat raw fruit	Oral	½ a cup 2 times a day	Herb	F	Garden		1	0.04	3.8

(continued on next page)

Table 2 (continued)

S/N	Botanical name (voucher no.)	Family	Local name	Preparation method	Administration mode	Dosage	Growth form	Plant part	Plant source	Other additives	FC	RFC	FL
39	<i>Brassica oleracea</i> convar. <i>costata</i> (DC) (CN 039)	Brassicaceae	Broccoli (English)	Boil in water and take the soup	Oral	A cup twice daily	Herb	L, F	Garden		1	0.04	3.8
40	<i>Solanum lycopersicum</i> L. (CN 040)	Solanaceae	Enyanya (Lug)	Boil in water and take the soup	Oral	A cup twice daily	Herb	F	Garden		1	0.04	3.8
41	<i>Curcuma longa</i> L. (CN 041)	Zingiberaceae	Ekinzaali (Lug)	Boil in water and take the soup	Oral	A cup twice daily	Herb	Rhizome	Garden		1	0.04	3.8
42	<i>Piper nigrum</i> L. (CN 042)	Piperaceae	Kaamulali (Lug)	Boil in water and take the soup	Oral	A cup twice daily	Herb	F	Garden		1	0.04	3.8
43	<i>Allium cepa</i> L. (CN 043)	Amaryllidaceae	Obutungulu (Lug)	Boil in water and take the soup	Oral	A cup twice daily	Herb	S	Garden		1	0.04	3.8
44	<i>Allium sativum</i> L. (CN 044)	Amaryllidaceae	Katungulu Cumu (Lug)	Boil in water and take the soup	Oral	A cup twice daily	Herb	S	Garden		1	0.04	3.8
45	<i>Ipomoea batatas</i> (L.) Lam (CN 045)	Convolvulaceae	Ebitakuri (Run) Lumonde (Lug)	Boil in water	Oral	A cup twice a day	Herb	Tuber	Garden		1	0.04	3.8
46	<i>Basella alba</i> L. (CN 046)	Basellaceae	Nderema (Run)	Boil and filter out the extract	Oral	½ a cup 2 times a day	Herb	L, S	Bush		1	0.04	3.8
47	<i>Maesa lanceolata</i> Forssk. (CN 047)	Primulaceae	Omuhunga (Run)	Boil the leaves in water and prepare a steam bath	Topical	Sit in a steam bath for 15 minutes	Tree	L	Bush		1	0.04	3.8

Note: Languages: Ru = Runyankole, Lug = Luganda; Plant parts: L = leaves, S = stem, B = Bark, R = roots, WP = whole plant, F = fruits; Other additives: omujaja is the Luganda name for *Ocimum gratissimum* L.; FC = frequency of citation, RFC = relative frequency of citation and FL = fidelity level.

were other supposed causes of UF. All the TMPs reiterated that for diagnosis of UF, a scan is used before administering phytomedicines. The TMPs believed that herbal elixirs shrink UF until they diminish or burst and are passed out in the urine. The potions may also boost immunity and fight the pathogens that promote the progression of UF. Altogether, TMPs disclosed that no risks are expected to be associated with the use of herbal potions for treating UF but the development of rashes, vomiting, dizziness, and fatigue is likely if herbs were taken at night or the wrong posology was administered.

3.3. Medicinal plants inventoried for UF treatment

In aggregate, 47 distinct plant species classified into 32 families and 45 genera were identified (Table 2). Fabaceae (10.6%), Lamiaceae (8.5%) and Asteraceae (8.5%) were the dominant botanical families (Fig. 2). *Allium* and *Crassocephalum* were the two prominent genera represented by two species each. The most highly cited species were *Oxygonum sinuatum* (FC = 9, RFC = 0.35 and FL = 34.6), *Hoslundia opposita*, *Opuntia ficus-indica* (FC = 5, RFC = 0.19 and FL = 19.2), *Sesamum angustifolium*, *Phyllathus niruri* (FC = 4, RFC = 0.15 and FL = 15.4), *Erythrina abyssinica*, *Leonotis nepetifolia* and *Ricinus communis* (FC = 3, RFC = 0.12 and FL = 11.5).

3.4. Growth habit, conservation status and plant organs used

Herbs (61.7%), trees (23.4%) and shrubs (14.9%) harvested from the bush (62%), gardens (36%) and forests (2%) were the life forms of the plants identified. The plant organs for preparing herbal treatments included leaves, whole plants, stems, roots, seeds, rhizomes, flowers, bark and tubers. Largely, leaves (47.6%), stems (17.5%), and flowers (9.5%) were the preferred plant parts (Fig. 3). Most preparations used water as the solvent.

Some plant parts were prepared in combination with others. Leaves of *omujaja* (*Ocimum gratissimum* L.), for instance, proved to be a cherished flavor in preparations from *Macrotyloma axillare* (leaves and stem), *Dracaena steudneri* (bark) and leaves of *Bothriocline tomentosa*, *Crassocephalum vitellinum* and *Cyathula uncinulata*. In formularies of *Abrus precatorius* (leaves), *Moringa oleifera* (leaves, stem and bark) and *Phyllathus niruri* (whole plant), charcoal is added, supposedly as a blood cleanser. Honey was the only adjuvant included in a preparation from *Prunus africana* bark.

3.5. Preparation, posology and administration of herbal medicaments

Decoction (up to 70%) was the predominant preparation method used by the TMP (Table 2). Other methods entailed infusing plant organs or drying them before pulverization to obtain fine powders that may be mixed with either water or honey. In specific cases such as seeds of *Ricinus communis*, it is pressed to obtain oil.

The most significant percentage (up to 93.8%) of the remedies were delivered orally. Although less frequently, topical and rectal remedies were applied as smears on the lower abdomen, vaginal inserts or steam baths of the herbal preparation (6.2%). Oral posology was prescribed for cups or glasses (full, half, quarter or one-and-quarter). There were, however, variations in the duration for the treatments, with some remedies from *Opuntia ficus-indica*, *Persea americana* and *Ricinus communis* taken up to 1 month while those from *Phyllathus niruri* were to be taken up to 2 months (Table 2).

3.6. Classical phytochemical screening results

Flavonoids were present in all eight plant extracts, whereas other metabolite classes varied between plants. Phenols were identified in all the aqueous extracts except in *Erythrina abyssinica*. Similarly, phytosterols and terpenoids were identified in all the extracts except those of *Opuntia ficus-indica* and *Leonotis nepetifolia*, *Sesamum angustifolium* and

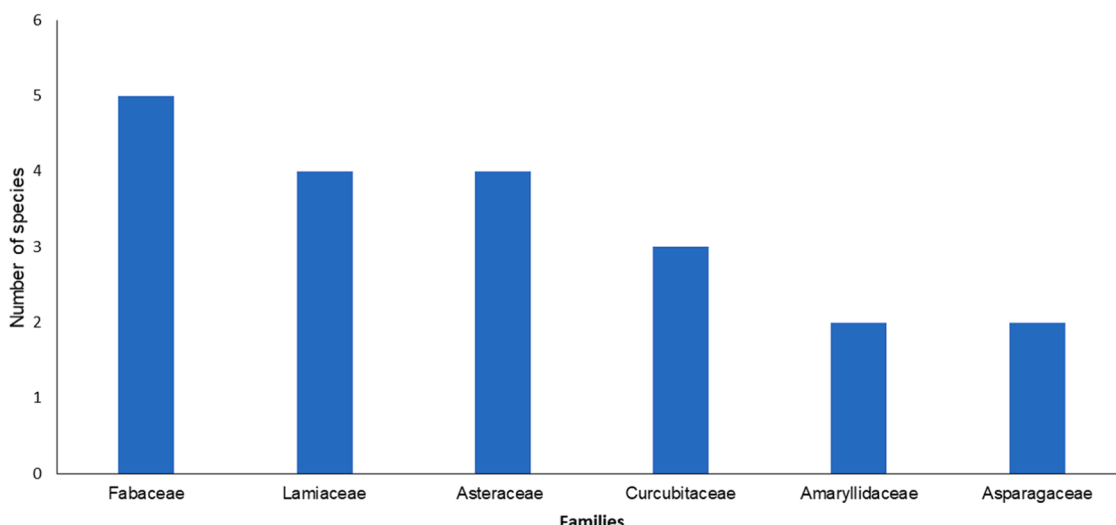


Fig. 2. Major botanical families from which herbal remedies for treatment of uterine fibroids are prepared in Mbarara City, South Western Uganda.

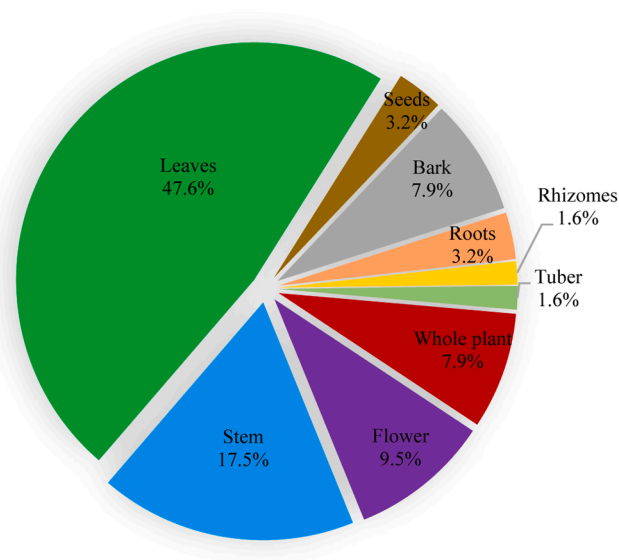


Fig. 3. Plant parts constituting ingredients of herbal medicaments for uterine fibroids in Mbarara City, South Western Uganda.

Leonotis nepetifolia, respectively. Based on the foam test results, saponins were absent in *Phyllathus niruri* and *Sesamum angustifolium* extracts. Alkaloids were not detected in *Hoslundia opposita*, *Sesamum angustifolium* and *Leonotis nepetifolia*. Glycosides were present in all the extracts except those of *Phyllathus niruri* and *Leonotis nepetifolia* (Table 3).

Table 3
Secondary metabolites identified in highly cited plants used for treating uterine fibroids in Mbarara City, Uganda.

Plants	Saponins	Alkaloids	Terpenoids	Phytosterols	Phenols	Glycosides	Flavonoids
<i>O. sinuatum</i>	+	+	+	+	+	+	+
<i>H. opposita</i>	+	-	+	+	+	+	+
<i>O. ficus-indica</i>	+	+	+	-	+	+	+
<i>S. angustifolium</i>	-	-	-	+	+	+	+
<i>P. niruri</i>	-	+	+	+	+	-	+
<i>R. communis</i>	+	+	+	+	+	+	+
<i>E. abyssinica</i>	+	+	+	+	-	+	+
<i>L. nepetifolia</i>	+	-	-	-	+	-	+

Note: + means present, - means absent.

4. Discussion

Medicinal plants continue to furnish important lead compounds that facilitate the development of therapeutic molecules pivotal for the success of orthodox medicine. Herein, an ethnobotanical survey was conducted in Mbarara City to gather ethnomedicinal uses of plants for the management of UF. The survey had a higher proportion of female TMPs (Table 1), plausibly explained by the notion that women are more attached to traditional practices than men, continuously get involved in heritage practices, interpretation, and transmission and are known to exchange information among themselves much more easily (Adia et al., 2014; Gumisiriza et al., 2023; Mathilde, 2021). This observation is also concordant with previous ethnobotanical reports in South Western Uganda, where females of at least 40 years old formed the most significant proportion of the respondents (Asiimwe et al., 2021; Gumisiriza et al., 2023; Maling et al., 2024). It could be expected that females are more likely to participate in such surveys due to their possession of rich knowledge of herbal medicines (Asiimwe et al., 2014; Nalumansi et al., 2014). It would also be expected that more females would participate as UF is a distinct health challenge for this gender (Lou et al., 2023; Yang et al., 2022).

The TMPs hinted that their cognizance of herbal medicine was fundamentally inherited from family members and training. To our knowledge, traditional medicine erudition in indigenous societies is more or less hereditary (Bagwana, 2015), and family members highly prioritize information relay. Such indigenous knowledge is acquired and preserved through repeated use and is only passed orally from the elders to the young through generations (Ouma, 2022).

Responses from the TMPs indicated that UF has a high prevalence in Mbarara City, corroborating a previous retrospective study report in the same area (Adawe et al., 2022). Consequently, TMPs provided

well-known clinical descriptions, features, and possible causes of UF. It was interesting to note that a diagnosis of UF using a scan was sought before administering herbal remedies. This suggests that herbalists are integrating conventional approaches in diagnosing and treating UF. Such integration and/or concurrent utilization of herbal and traditional medicine in treating diseases among Indigenous communities has been documented in Uganda before (Apolot et al., 2023; Logiel et al., 2021; Tabuti et al., 2023), and appears to be the treatment-seeking behaviour among patients in most developing countries where there are weak medical infrastructures (Beiersmann et al., 2007; Diallo et al., 2006; Orellana-Paucar et al., 2021).

About the medicinal plants utilized for UF treatment, 47 species were identified. The prevalence of members from family Fabaceae, Asteraceae, Lamiaceae and Cucurbitaceae is consistent with previous ethnobotanical studies, which indicate that members of these families dominate ethnobotanical surveys owing to their global distribution (Ajao et al., 2019). Asteraceae and Fabaceae were specifically cited to have species used in treating UF elsewhere (Fasola, 2015; Kaingu et al., 2013). Species from these families are established to possess therapeutic phytochemicals, including alkaloids, polyphenolics and saponins (Tanase et al., 2019; Tungmunthum et al., 2018). Considering the individual species, an earlier study in New York City reported using 67 plant species for treating UF by Latino TMPs (Balick et al., 2000). In Kenya, TMPs exclusively used six plants (*Acacia robusta*, *Adenia gum-mifera*, *Capparis sepiaria*, *Lawsonia inermis*, *Markhamia zanzibarica*, and *Thespesia danis*) for the treatment of UF (Kaingu et al., 2013). In West Africa (Nigeria), leaves of *Euphorbia lateriflora*, stems of *Euphorbia camerunika*, fruits of *Lagenaria brevifolia* and unripe fruits of *Carica papaya* are ingredients of herbal potions for the treatment of UF (Fasola, 2015). In Burkina Faso, the stem bark and roots of *Trichilia emetica*, *Securidaca longependunculata*, *Cassia sieberiana* and *Leannea acida* were decocted by patients and used as drinks, vaginal or sitz baths for medicating UF (Coulidiaty et al., 2021). However, none of the species in the preceding studies was registered in the current study. A floristic survey in South Western Nigeria (Adebisi, 2019) identified 102 plants for treating UF, including *Abrus precatorius*, *Allium cepa*, *Allium sativum*, *Bidens pilosa* and *Ricinus communis*, which TMPs also mentioned in the current study.

The primary source of the herbal remedies in Mbarara City was from plant organs of wild-collected herbs, trees and shrubs, which resonates well with earlier research findings in Eastern Africa (Kibonde, 2020; Tabuti et al., 2023). It could also translate to the fact that these species are not threatened or the TMPs have an interest in the conservation and sustainable use of the medicinal plants since some are collected from gardens (Kibonde, 2020; Sökand et al., 2024). The dominant use of leaves for preparing herbal medicines may be related to their accessibility and abundance throughout the year but also their principal photosynthetic role and the storage of therapeutic phytochemicals (Machado et al., 2018; Mwamatope et al., 2021; Ssenku et al., 2022).

Some plant parts were prepared in combination with others, a tendency often associated with Indigenous approaches to mask toxicity outcomes from poisonous plants or exploit the additive therapeutic potential of such herbal materials (Stangeland et al., 2011; Tugume et al., 2016). As noted with the transfer of knowledge of acquiring herbal medicine recipes, TMPs have also been cited for using complex plant organ combinations as strategies for concealing their herbal medicine recipes (Kuria et al., 2001; Omara, 2020).

The dominant use of decoction in Mbarara City could be because it is the most straightforward approach for extracting phytochemicals from herbal materials (Zhang et al., 2018). The TMPs endorsed the oral route of treating UF patients because oral dosage forms are easily prepared and administered (Murphy et al., 2001; Omara, 2020). Since UF is an internal condition, it was captivating to note treatment options comprised of steam baths and topical applications. Rectal routes are, for example, not invasive, allow for controlled medicine use and considerably lowers the chances of hepatic first-pass metabolism, systemic side

effects and possible herbal medicine-allopathic drug interactions (Sanz et al., 2015). Expectedly, the posology prescribed was not uniform, which may pose challenges during treatment. A long duration of treatment was suggested for some herbal preparations. This indicates that matrix interferences provoke the need for large quantities of herbal preparations, which may contain little active phytochemicals required to achieve the desired therapeutic effects.

It is held that qualitative phytochemical screening of herbal extracts should be performed to inform both the need and choice for their elaborate phytochemical analysis and/or pharmacological evaluation. This study identified several secondary metabolites such as flavonoids, phenols, phytosterols, terpenoids, saponins and alkaloids. Metabolites are the molecules responsible for the therapeutic effect of herbal extracts. The core target pathways for fibroid inhibition have been established to entail cell cycle arrest, apoptosis (through upregulation of reactive oxygen species production in tumor cells) as well as reduction of tumor cell growth factors (Koyejo et al., 2021). These results provide insight into the need to investigate individual plants for their anti-uterine fibroid activity in future studies.

5. Conclusions

The study documents a comprehensive ethnobotanical survey of medicinal plants used for treating UF in Mbarara, Uganda. In total, 47 medicinal plant species were identified and this inventory provides an invaluable resource for researchers exploring bioactive compounds with anti-fibroid efficacy. Phytochemical analysis confirmed the presence of key secondary metabolites, including flavonoids and alkaloids, which are known for their therapeutic properties. This correlation underscores the scientific validity of traditional practices and provides a foundation for further bioassay-guided studies to evaluate the anti-fibroid efficacy of isolated pure compounds. The study bridges the gap between traditional knowledge and scientific inquiry, advocating for integrative approaches in developing anti-fibrotic therapies. The findings serve as a crucial reference point for advancing ethnopharmacological research and promoting sustainable use and conservation of medicinal plants. Future studies should focus on isolating and characterizing the bioactive compounds in the medicinal plants to assess their efficacy and safety in treating UF.

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CRediT authorship contribution statement

Calton Nantinda: Writing – review & editing, Writing – original draft, Software, Investigation, Conceptualization. **Esther Lynnet Kisakye:** Visualization, Validation, Investigation, Formal analysis. **David Musana:** Visualization, Validation, Investigation, Formal analysis, Data curation. **Isaac Ssessanga:** Visualization, Validation, Methodology, Investigation, Formal analysis. **Ukashar Ssenabulya:** Validation, Methodology, Investigation, Formal analysis, Data curation. **Timothy Omara:** Writing – review & editing, Writing – original draft, Visualization, Validation, Formal analysis, Data curation. **Ivan Kahwa:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Florence Nalimu:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Conceptualization.

Declaration of competing interest

The authors declare no conflict of interest.

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