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Ethnomedical knowledge of plants used in alternative medicine to treat hemorrhoidal diseases in Lubumbashi, Haut-Katanga province, Southern Democratic Republic of Congo

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Abstract

Background A variety of medicinal plants are used in traditional medicine in Lubumbashi for the management of hemorrhoidal diseases. However, no investigation has been conducted to gather the knowledge required for this type of management in the region. The present study was conducted to inventory the plants used in Lubumbashi to treat hemorrhoidal diseases and to relate their ethnomedical characteristics.

Methods This study was conducted between March 2022 and February 2023 by interviews using semi-structured questionnaire with households ($n=1520$), herbalists ($n=25$), and traditional healers: THs ($n=59$).

Results The 1,604 respondents (sex ratio M/F = 0.9; mean age: 56 ± 3 years; experience: 12 ± 3 years) provided information on 100 taxa, 84 of which are used against internal hemorrhoids, *Phyllanthus amarus* being the most cited (Citation Index, CI: 0.76). Most of them are trees (38%) or shrubs (32%), belonging to 90 genera and 45 families dominated by the Fabaceae (10%) and Asteraceae (9%). They are indicated in 76 other pathologies, dominated by gastrointestinal disorders (GID), wounds and sexually transmitted infections (CI > 0.57). From these 100 taxa, 117 anti-hemorrhoidal formulations were derived, 11 of which combined more than one plant. In all these recipes, the leaf is the most commonly used part (> 60%) and the liniment (> 45%) is the most popular form of application. For the first time, this study reports 14 taxa as plants used in the treatment of hemorrhoids. Among these taxa, *Ficus stuhlmannii*, *Ficus laurifolia,* and *Ocimum centraliafricanum* are listed as medicinal plants for the first time. *Khaya nyasica,* and *Syzygium cordatum*, each with 11 uses, have the highest traditional medicinal value.

Conclusion The findings of this study indicate that a significant number of medicinal plants are used in traditional medicine in Lubumbashi for the treatment of hemorrhoidal diseases. Some of these plants are endemic to the biodiversity area, while others are shared with other cultures and regions. A series of pharmacological studies is currently underway with the objective of validating the anti-hemorrhoidal properties of these plants and in order to identify phytochemical compounds responsible of this activity.

Keywords *Ficus stuhlmannii*, *Khaya nyasica*, *Phyllanthus amarus*, Lubumbashi, Traditional healers, Hemorrhoids

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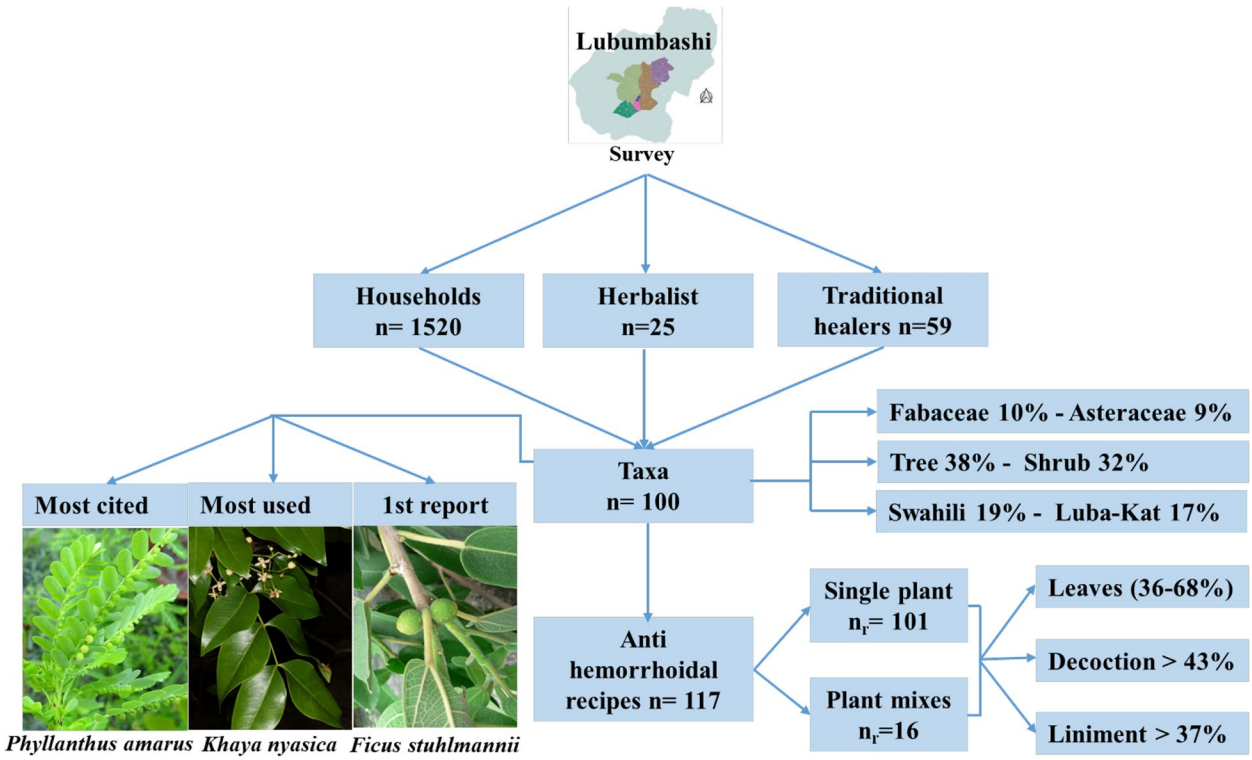
Graphical Abstract



Background

Hemorrhoids are a network of arterial and venous vessels that are present in the normal state at the level of the anal canal. They contribute to the maintenance of continence [1]. Hemorrhoids may be located either under the skin of the anal orifice (external hemorrhoids) or higher up under the mucosa of the anal canal (internal hemorrhoids) [2]. Normally, hemorrhoids may exhibit a slight degree of swelling during the act of defecation. However, when they remain permanently dilated, they constitute pathological hemorrhoids or Hemorrhoidal diseases [3, 4].

Hemorrhoidal diseases are defined by the presence of symptoms such as irritation, extreme pain, and itching around the anus, a painful or itchy lump or swelling near the anus, fecal leakage, painful stools, and the presence of blood on the tissue after defecation [5–7]. A number of studies have identified a number of risk factors for the development of hemorrhoidal diseases, including chronic constipation [8, 9], diarrhea, insufficient dietary fiber, exertion and prolonged sitting, particularly during defecation [10], abdominal obesity, depression, pregnancy [11], hypertension, smoking [12], as well as advanced age and a sedentary lifestyle [13]. The severity of hemorrhoidal disease is typically evaluated according to the Goligher classification system, which is based on the degree of prolapse through the anus. The Goligher classification system defines four grades of hemorrhoidal disease. Grade 1 is defined as a hemorrhoid that bleeds but does not prolapse. Grade 2 is defined by the capacity of the hemorrhoid to prolapse upon exertion, which may or may not be accompanied by spontaneous reduction or return to the anal canal. Grade 3 is defined by the ability of the hemorrhoid to prolapse on exertion, which can be manually pushed back into the anal canal. Grade 4 is defined by the permanent prolapse of the hemorrhoid, which cannot be manually reduced [13–15].

Hemorrhoidal disease is one of the most frequently encountered anorectal conditions in general practice [16]. However, its true prevalence in the general population is not well known, in part because many patients do not seek treatment in hospital facilities [17]. A multicenter study conducted in Europe and Brazil reported a prevalence of 11% [16]. Partial prevalences have been reported in various countries around the world, but these studies are not truly representative of their countries. In

the literature, we find that 16.6% of cases occur in Korea [12]; 48.1% in Eastern India [18]; 16% in Saudi Arabia [19]; and 38.9% in Australia [20]. In Africa, the reported incidence ranges from 7% to 13.1% in Ethiopia [9, 21], 56.2% in Bamako [22], 2.3% in Brazzaville [23], 14.6% in Ouagadougou [24], and 54% in Nigeria [25]. To date, no studies have been conducted on the prevalence of hemorrhoids in the Democratic Republic of the Congo, particularly in Lubumbashi.

The treatment of hemorrhoids is aimed at correcting the underlying cause, which may be a variety of factors. In cases where the condition is relatively straightforward, it is advisable to adopt a diet high in fiber, drink plenty of water, and apply local anesthetic creams to relieve itching and pain. In symptomatic cases, treatments containing analgesics, non-steroidal anti-inflammatories, or anesthetics are employed to address hemorrhoidal attacks. Another potential treatment option is the application of a ligature to the hemorrhoidal artery. In the event of disease progression, surgical intervention is the definitive treatment for severe and thrombosed external hemorrhoids [26–28].

In Lubumbashi, as in most developing countries, the use of traditional medicine is a primary approach to addressing health concerns such as hemorrhoidal diseases [29, 30]. A recent study indicated that 79.4% of the Lubumbashi population sought traditional medicine for various pathologies and social issues. This form of medicine is largely based on the use of medicinal plants. The study additionally revealed that hemorrhoidal diseases represent the primary reason for consulting traditional medicine in Lubumbashi [31]. However, neither national nor local studies have been conducted on the plants used to treat hemorrhoidal diseases.

Several ethnomedicinal studies have been conducted in Africa on the use of medicinal plants to treat hemorrhoidal diseases. For illustrative purposes, ethnobotanical studies have been conducted in Nigeria [32, 33], Cameroon [34], Tanzania [35], and Kenya [36].

In Lubumbashi, the majority of ethnobotanical studies have focused on the targeted pathologies. Some of these studies, although oriented towards other pathologies, have yielded insights into the treatment of hemorrhoidal diseases by medicinal plants that have been inventoried on this occasion. This is exemplified by *Vernonia shirensis* [synonym of *Baccharoides adoensis var. mossambiquensis* (Steetz) Isawumi, El-Ghazaly & B Nord, Asteraceae], whose macerated leaves are used locally against hemorrhoids [37]. Another example is the macerated leaves or stem bark of *Aframomum angustifolium* (Sonn.) K.Schum (Zingiberaceae)[38]. Furthermore, the decoction of the roots of *Bridelia atroviridis* Müll Arg, Phyllanthaceae [39]; the leaves of *Asparagus africanus* Lam, Asparagaceae [40]; the leaves of *Pericopsis angolensis* (Baker) Meeuwen, Fabaceae [41], and the roots of *Piliostigma thonningii* Schumach Milne-Redh, Fabaceae [42] are employed as an anti-hemorrhoidal agent in local non-conventional medicine. Nevertheless, no study has yet focused on the plants utilized in traditional medicine in Lubumbashi to treat hemorrhoidal diseases. In light of the above, the objective of this study was to conduct an ethnobotanical survey with the aim of documenting plants used in traditional medicine in Lubumbashi to treat hemorrhoidal diseases. The list was to be compiled from both the general population and among traditional medicine professionals in the region. The objective was to identify the most commonly utilized plants in the region for the management of hemorrhoidal diseases and to highlight the region's characteristic taxa.

Material and methods

Experimental framework

The study was conducted in the seven communes of the city of Lubumbashi: Annexe, Kampemba, Katuba, Kamalondo, Kenya, Lubumbashi, and Rwashi, in the province of Haut-Katanga in the Democratic Republic of Congo (Fig. 1).

Lubumbashi is situated between 11°26' and 11°55' north latitude and 27°15' and 27°40' east longitude at an altitude of 1,230 m. The climate is tropical, with an average annual temperature of 22.4 °C and an average annual rainfall of 512.7 mm.^{3}. The study area experiences two distinct seasons, with a relatively shorter rainy season spanning from November to April. The Miombo clear forest is the most prevalent vegetation type [42]

Ethnomedical data collection

This is a descriptive, cross-sectional study. The research was conducted by interviews using semi-structured questionnaire (supplementary data S1). Ethnomedical data were collected from a variety of sources, including households, herbalists, and traditional healers (THs), in Lubumbashi between March 2022 and February 2023. The interviews were conducted in Swahili. The sample size of household respondents was determined using two-stage sampling, comprising a stratified sample and a cluster sample. For each commune, considered as a stratum, the corresponding commune office provided the population size (Table 1). The size of the representative sample at this level was determined by the following formula according to [43, 44]:

$$n = \frac{\mathrm{p\ x\ (1-p)\ x\ N\ x\ t_p^2}}{\mathrm{t_p^2\ x\ p\ (1-p) + (N-1) x\ y^2}} \quad (1)$$

Where, n = sample size, N = actual population size, p = expected proportion of respondents (estimated p at 0.5), tp = sampling confidence interval (tp = 1.96 given that we set a 95% confidence interval) and y = margin of

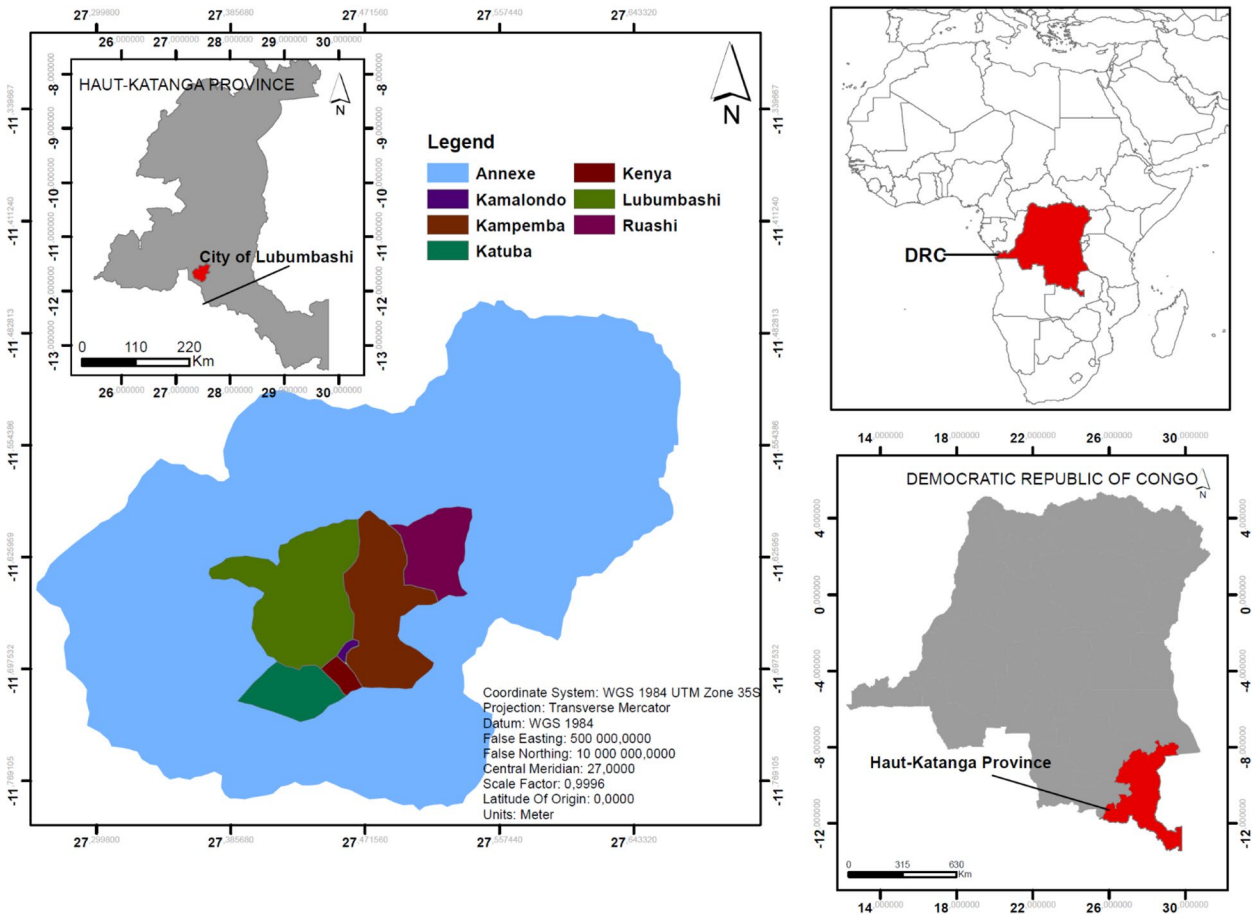


Fig.1 Lubumbashi's city in Haut-Katanga province, Democratic Republic of Congo

Table 1 Household sample size

Commune	N	n_r	n_e	D (%)
Annexe	749,142	384.0	390	0.2
Kamalondo	27,911	379.0	379	0.0
Kampemba	526 926	383.9	385	0.1
Katuba	469,228	383.8	384	0.0
Kenya	480,974	383.9	384	0.0
Lubumbashi	481,563	383.9	384	0.0
Ruashi	410 034	383.8	384	0.0
Total	**3, 145 778**	**2, 683**	**2, 690**	**0.3**

N (Target population), n_r(Calculated representative sample), n_e(Population surveyed in the field), D: Difference

sampling error: we set this at 0.05. This yields a household population of 2,690 (Table 1).

Of the 2,690 people contacted during the household surveys, 264 did not agree to participate in the study, 407 said they had never suffered from hemorrhoidal diseases, and 499 said they had never used traditional medicine to treat hemorrhoidal diseases. Therefore, the results of this study, based on data collected from households, concern only 1,520 households.

The study population was divided into clusters, with each cluster representing a specific avenue. This was achieved by counting every three households. In each household, we included any adult (≥18 years old) who had ever used plants to treat hemorrhoids, provided they were sufficiently unfamiliar with the interviewers.

Due to the lack of reliable data on the size of the herbalist population in Lubumbashi, the objective was to interview as many herbalists as possible, accessible through markets and other public spaces. This stage enabled us to meet 25 herbalists, all of whom consented to participate in the study.

The respondents in the Traditional Healer (TH) category were identified from a list of 50 Traditional Practitioners compiled during a recent survey conducted in the study area [42]. This step facilitated contact with 35 HTs, all of whom consented to participate in the study. Subsequently, we proceeded with a snowball sampling

approach to augment the sample size, which enabled us to engage with an additional 30 HTs, 24 of whom consented to participate in the study. Among these 24, four THs who were on the initial list of 50 THs and had not yet interacted with us through this list were also included. The survey of the THs was thus conducted on 59 respondents.

The study encompassed a total of 1,604 individuals, representing 1,520 households, 25 herbalist practitioners, and 59 Traditional Herbalists (THs).

Data processing and analysis

The names of the inventoried plant species were collected in the local languages during the surveys in the company of interviewers. At the same time, the voucher specimen were prepared and deposited in the Kipopo Herbarium, where the scientific names were assigned by the herbarium's botanical experts. The plant names were updated by comparison with the online botanical platforms: Plants of the World Online (https://powo.science.kew.org/) (The World Flora Online (http://www.worldfloraonline) or the African Plant Database https://africanplantdatabase.ch/).

In light of the current controversy surrounding ethnobotanical indexes [45], and in order to provide quantitative support for this study, we have employed only headcounts and three ratios.: citation index (CI), medicinal use index (MUI) and medicinal capability index (MCI). The plant citation index (CI) was calculated using the formula:

$$\mathrm{CI} = \frac{\textit{Number of informants citing the plant}}{\textit{Total number of informants who participated in the study}} \quad (2)$$

The medicinal use index (MUI) was calculated by the formula:

$$\mathrm{MUI} = \frac{\textit{Number of uses reported for a taxon}}{\textit{Total number of uses reported for the entire study}} \quad (3)$$

The medicinal capability index (MCI) was calculated by the formula:

$$\mathrm{MCI} = \frac{\textit{NNumber of taxa cited to manage a given pathology}}{\textit{Total number of taxa inventoried during the survey}} \quad (4)$$

In this study, the CI allows us to determine the number of times a plant has been cited in the management of hemorrhoids in the region, and consequently to identify the level of consensus within the population on the curative use of a given species in the management of hemorrhoids. The MUI highlights the level of medicinal use of a plant among the population studied. Finally, the MCI enables us to measure the potential of a given community to manage a well-defined pathology.

Ethics approval and consent to participate

The project proposal and ethical rules were reviewed and approved by the Department of Pharmacology, Faculty of Pharmaceutical Sciences, University of Lubumbashi, Democratic Republic of Congo (FSPUNILU-DP-BD-022022). Prior to data collection, voluntary verbal consent was obtained from all 59 traditional healers, 25 herbalists, and 1,520 households in accordance with the ethical standards of the University of Lubumbashi. All participants agreed to participate in the study and were informed that the data collected would be used for academic purposes only. Participants were assured of confidentiality and informed that the aim of the study was scientific and not commercial..

Results

General knowledge of hemorrhoidal diseases among the interviewees

The informants interviewed for this study (herbalists: $n=25$, traditional practitioners: $n=59$, and households: $n=2690$) demonstrated a clear distinction between internal and external hemorrhoidal diseases. However, only 1,520 individuals, representing 56.5% of the initial population, were responsible for the ethnobotanical knowledge of this category of the survey population.

In fact, of the 2690 individuals interviewed, 264 had not provided informed consent, 407 had never suffered from hemorrhoidal diseases, and 499 had never utilized plants during a hemorrhoidal crisis. Consequently, the proportion of the population who had ever suffered from hemorrhoids was 2019 out of 2426, or 83.2%, and the proportion who had ever used plants during a hemorrhoidal crisis was 1520, or 62.6%.

The survey population diagnosed hemorrhoidal diseases, locally known as "*Kilonda ntumbu*," based on nine symptoms: itching, pain in the anal region, fever, irritation, bleeding during or after bowel movements, internal burning sensations, and protuberances protruding from the anus. These symptoms were reported by over 50% of the subjects consulted, regardless of their category (Table 2).

The 12 factors identified as responsible for hemorrhoidal diseases include frequent constipation, pregnancy, habitual spicy food, carrying heavy loads on a daily basis, and long and frequent sitting positions. These factors were reported by over 60% of interviewees in all categories (Table 2).

These informants are aware that hemorrhoidal diseases can have a number of consequences, including pain and discomfort, as well as the frequent desire to have a bowel movement with no result. These consequences were reported by over 80% of them. The

Table 2 Healers' knowledge of hemorrhoidal disease

Sub-parameter	Herbalists ($n=25$)		Traditional healers ($n=59$)		Households ($n=1520$)	
	Nc	CI	Nc	CI	Nc	CI
Consequences of hemorrhoidal diseases						
Anemia	16	0.64	39	0.66	1102	0.73
Pain and discomfort	25	1.00	59	1.00	1520	1.00
Sexual dysfunction	15	0.60	38	0.64	1101	0.72
Frequent unsuccessful bowel movements	20	0.80	52	0.88	1508	0.99
Anal fissures	19	0.76	51	0.86	1506	0.99
Discomfort	17	0.68	49	0.83	1501	0.99
Type of hemorrhoids found						
Internal	20	0.80	59	1.00	1401	0.92
External	21	0.84	54	0.92	1447	0.95
Number of people treated for hemorrhoids one month prior to the study (year)						
20–30	5	NA	60	NA	NA	NA
30–40	25	NA	205	NA	NA	NA
40–50	2	NA	105	NA	NA	NA
50–60	7	NA	10	NA	NA	NA
≥60	0	NA	61	NA	NA	NA
Symptoms						
Itching	20	0.80	52	0.88	1508	0.99
Pain in the anal region	12	0.48	31	0.53	997	0.66
Discharge of mucus from the anus	9	0.36	20	0.34	340	0.22
Fever	16	0.64	39	0.66	1102	0.73
Irritation	19	0.76	51	0.86	1506	0.99
Bleeding during or after bowel movements	17	0.68	49	0.83	1501	0.99
Sensation of internal burning	15	0.60	38	0.64	1101	0.72
Sensation of inflammation in the rectum	10	0.40	21	0.36	965	0.63
Sensitive protuberances emerge from the anus	25	1.00	59	1.00	1520	1.00
Causes of hemorrhoidal disease						
Natural childbirth	5	0.20	17	0.29	164	0.11
Foods low in fresh vegetables and fruit	1	0.04	10	0.17	51	0.03
Frequent constipation	21	0.80	50	0.85	1410	0.93
Pregnancy	18	0.72	34	0.58	1189	0.78
Habitual spicy dishes	22	0.88	53	0.90	1418	0.93
Carrying heavy loads on a daily basis	23	0.92	57	1.0	1508	0.99
Frequent sitting for long periods	24	1.00	58	1.0	1510	0.99
Frequent sodomy	4	0.16	15	0.25	10	0.01
Frequent cycling	7	0.28	7	0.12	30	0.02
Genetic predisposition	0	0.00	3	0.05	10	0.01
Sedentary lifestyle	7	0.28	8	0.14	35	0.02
Overweight	5	0.20	4	0.7	37	0.02

NA Not applicable, *N* Number citations (of people surveyed), *CI* citation index, The number of patients treated for hemorrhoidal diseases is only recorded for herbalists and THs, whose average number of patients is 30 and 45 per month, respectively

experience of the traditional medical practitioners consulted (herbalists and traditional practitioners) indicates that the majority of individuals who consult them for hemorrhoids are between 30 and 50 years of age (Table 2).

General Characteristics of Inventoried Plants

Ethnobotanical surveys have revealed that 100 plant species belonging to 90 genera and 45 botanical families are used to treat hemorrhoidal diseases in Lubumbashi (Table 3). The majority of these medicinal taxa are trees

(38%), followed by shrubs (32%) (Fig. 2). These taxa are native to seven geographical regions, with the TA (Tropical Africa) and TA-SA (South Africa) regions accounting for over 60% of the taxa inventoried (Fig. 3). The taxa are named in 16 local ethnic languages, with Swahili, Luba-Kat, and Bemba accounting for over 50% of the names of the taxa collected (Fig. 4).

Medicinal plants used to treat hemorrhoidal diseases

A total of 100 taxa are utilized in 117 anti-hemorrhoidal recipes within the study area. Of these, 101 employ a single plant, while 17 utilize mixtures of two or three plants. Three of the single-plant recipes are employed for mixed hemorrhoidal diseases, 14 for external hemorrhoids, and the remaining 84 for internal hemorrhoids. In contrast, all the mixed-plant recipes are utilized for mixed hemorrhoids. The leaves of the plant are the most commonly used part in the preparation of herbal remedies, representing 69% of the cases, followed by root barks, which represent 36% of the cases (Fig. 6).

The respondents indicated that they utilize a variety of utensils, including teaspoons, tablespoons, cups, and bottles, to adjust the doses according to the patient's age (child or adult) and/or physiological state (e.g., pregnancy). In order to contextualize the results of this ethnobotanical survey, we sought to estimate the quantities of solutions (volumes) and solids (mass or powdered plant parts) as reported by respondents. This was done in reference to a previous study [137], which had attempted to do the same. The informants indicated that the treatment of hemorrhoidal diseases typically lasts between two and five days.

The information provided by the resource persons interviewed indicates that liniments are prepared by mixing three parts of palm oil with one part of solution (exudates, expression, decoction, macerated, or infused) or vegetable matter reduced to paste or powder, as the case may be. Ointments are prepared by mixing two parts of beeswax that have been melted in a water bath with one part of hot palm oil. Subsequently, plant extracts (30–40%) or dry matter are added to the aforementioned mixture.

With regard to the 16 recipes resulting from mixtures of two (12 recipes) or three taxa (3 recipes), these involve 27 taxa. It is notable that *Euphorbia hirta* (4 recipes) plays a significant role in several recipes, accounting for 25% of the total. The next most prevalent taxa are *Ageratum conyzoides*, *Albizia adianthifolia*, *Bridelia micrantha*, *Khaya nyasica*, *Monodora myristica,* and *Parinari curatellifolia*, which are each involved in two recipes. The remaining nine taxa are reported in only one polyherbal recipe. The most frequently cited polyherbal recipes are those based on the mixture of *P. angolensis* (leaves) and *P. thonningii* (root bark) (121 citations) and the mixture of *A. cordifolia* (root bark) and *A. hybridus* (roots) (107 citations) (Table 4).

Medicinal uses of plants surveyed

The taxa reported in this study are known and utilized by householders, herbalists, and traditional healers for the treatment of hemorrhoids (Fig. 9). The taxa are employed to treat internal hemorrhoids (83 taxa), external hemorrhoids (14 taxa), or both types concomitantly (3 taxa). Nevertheless, these taxa are also involved in the management of 75 other pathologies, signs, or symptoms, where gastrointestinal disorders are particularly prevalent. The most frequently cited indications were gastrointestinal disorders (CI: 0.622) and wounds (CI: 0.68) (Table 4).

According to the informants consulted, the taxa with the greatest number of medicinal uses in the study area are *Khaya nyasica* Stapf ex Baker f.b (Meliaceae), with 11 uses; *Syzygium cordatum* Subsp.a (Myrtaceae), with 11 uses; and *Ficus sur* Forssk f (Moraceae), with 9 uses. The next most frequently cited taxa are *Albizia adianthifolia* (Schum.) W. Wight (Fabaceae) (8 uses) and *Crossopteryx febrifuga* (Afzel. ex G. Don) Benth. (Rubiaceae) (8 uses). Collectively, they are implicated in over 60% of the pathologies mentioned in this study (Table 2).

Socio-demographic profile of persons consulted

The individuals consulted in this study were either household contacts (94.8%), herbalists (1.6%), or practitioners of traditional medicine (3.8%), with the majority being women (57.9%). The age range of the individuals consulted was 50 to 60 years old, with the youngest being 21 and the oldest 73 years old. The most respondents had received no formal education (37.6%) or had completed only primary school (36.7%). The informants were distributed across the 44 districts that comprise the seven communes of the city of Lubumbashi in similar proportions, ranging from 12.9% to 22.4%. However, in the Kamalondo and Kampemba communes, the proportion was slightly lower, at 7.9% and 9.9%, respectively. The respondents were engaged in six occupational categories, with housework (40.8%) and liberal (21.2%) representing the most prevalent types. In the majority of cases, the informants have accumulated over 11 years of experience in the use of medicinal plants (Table 6).

Discussion

Plants used to treat hemorrhoidal diseases.

Until now, traditional medicine has been the primary means of treating hemorrhoidal diseases in Katanga, and various plants are used for this purpose. This study reports for the first time 24 taxa of the 100 plants reported in our surveys as plants used in the management

Table 3 General characteristics on plants inventoried during the survey

Species[source] (Family)	NH	Local name (ethnicity)[GT]	CI ($n=1604$)	UP[MT]	Preparation[THD]	Medicinal uses	MUI ($n=76$)	Previous anti-hemorrhoidal uses	Previous anti-inflammatory activity
Acmella caulirhiza Delile[c] (Asteraceae)	KIP000111011	Mchapia tumbili[v] (Swahili)	0.027	WP^{y3}	Pilage[l]	Hemorrhoid	0.013	NR	NR
Adansonia digitata L.[c](Malvaceae)	KIP000111012	Mutshi munene[o] (Luba-kas)	0.003	Sb^{w}	Decoction[l]	Hemorrhoid, Clogged trumpet	0.026	Niger [46]	In vivo -Rat: $ED_{50}=145.3\pm7.6$ mg/Kg [47]
Aframomum daniellii (Hook.f.) K. Schum.[c] (Zingiberaceae)	KIP000111013	Matundu[u] (Luba-kas)	0.004	Sd^{y3}	Decoction[l]	Hemorrhoid	0.013	Cameroon [48]	NR
Aframomum melegueta K Schum (Zingiberaceae)	KIP000001341	Masusu[u] (Bemba)	0.007	R^{y3}	Decoction[E]	Hemorrhoid, wound, stomachache, diarrhea	0.052	Cameroon [34]	In vivo -Rat: $ED_{50}=1000$ mg/Kg [49]
Ageratum conyzoïdes L.[c] (Asteraceae)	KIP000111014	Riyani[m] (Swahili)	0.011	WP^{y1}	Pilage[l]	Hemorrhoid, Diarrhea, Hepatitis, Epilepsy and gonorrhea	0.079	Ivory Coast [50]	In vivo -Rat: $ED_{50}=200$ mg/Kg- Lv [51]
Aidia micrantha (K.Schum.) Bullock ex F.White[c] (Rubiaceae)	KIP000111015	Mutshi wa buanga[u] (Luba-kas)	0.013	Sb^{w}	Decoction[l]	Hemorrhoid, Sexual weaknesses	0.039	NR	NR
Albizia adianthifolia (Schum) W Wight[a] (Fabaceae)	KIP000001031	Kapetanzovu[u] (Luba-kat)	0.064	Rb^{w}	Decoction[E]	Asthenias, Tooth decay, Sexual dysfunction, Hemorrhoids, High blood pressure, Stomachache, Sinusitis, Coughs	0.105	Nigeria and South Africa [52]	In vitro -Cox1: $IC_{60—80}$: 100 µg/mL – Rb [52]
Albizia lebbeck (L.) Benth.[a] (Fabaceae)	KIP000111016	Kitutumie [o](Luba-Kat)	0.095	R^{w}	Maceration[E]	Hemorrhoid	0.011	DRC: [53]	In vivo -Rat: $ED_{50}=400$ mg/Kg—Sb [54]
Alchornea cordifolia (Schumach. & Thonn.) Müll. Arg.[c] (Euphorbiaceae)	KIP000111017	Tshibeji[u] (Luba-kas)	0.032	Lv^{x}	Pilage[l]	Hemorrhoid, Diarrhea, Wounds, Diabetes, Anemia, Dysentery	0.078	DRC [55]	In vivo -Rat: $DE_{50}=1000$ mg/Kg- Sb [56]
Aloe vera (L.) Burn.f.[a] (Asphodelaceae)	KIP452120002	Aloé[q] (Swahili)	0.634	Lv^{x}	Maceration[l]	Hemorrhoid, Acne, tooth decay, constipation, burns, gastric ulcer	0.078	Cameroon [57]	In vivo -Rat: $DE_{50}=100$ mg/Kg-Lv [58]
Alstonia boonei De Wild.[a] (Apocynaceae)	KIP000111018	Mutshi wa bukula[u] (Luba-kas)	0.009	Sb^{w}	Maceration[l]	Hemorrhoid, diarrhea and typhoid	0.039	Cameroon [48]	In vivo -Rat: $ED_{70\text{-}90}=50$–200 mg/Kg- Sb [59]
Amaranthus hypochondriacus L.[a] (Amaranthaceae)	KIP000111019	Tshitekuteku[r] (Luba-kas)	0.006	R^{y1}	Pilage[l]	Hemorrhoid	0.013	NR	NR

Table 3 (continued)

Species[source] (Family)	NH	Local name (ethnicity)[GT]	CI ($n=1604$)	UP[MT]	Preparation[THD]	Medicinal uses	MUI ($n=76$)	Previous anti-hemorrhoidal uses	Previous anti-inflammatory activity
Amaranthus spinosus L.[a] (Amaranthaceae)	KIP000111020	Tshiteku[v] (Luba-kas)	0.686	Lv[y1]	Exudation[l]	Hemorrhoid	0.013	DRC [55]	In vivo -Rat: $ED_{70\text{-}90}=50–250$ mg/Kg- Lv [60]
Anacardium occidentale L.[c] (Anarcardiaceae)	KIP000111021	Kabanga banga[v] (Luba-kas)	0.004	Rb[x]	Decoction[l]	Hemorrhoid, leprosy, diarrhea	0.039	Burkina Faso: [61]	In vivo -Rat: $ED_{50}=100$ mg/Kg-Sb [62]
Anchomanes difformis (Blume) Engl.[c] (Araceae)	KIP000111022	Sikili[u] (Swahili)	0.003	Rz[w]	Pilage[l]	Hemorrhoid	0.013	Cameroon [48]	In vivo -Rat: $ED_{50}=800$ mg/Kg: Lv [63]
Annona senegalensis Pers.[c] (Annonaceae)	KIP452120003	Elolo[o] (Luba-kat)	0.003	Rb[x]	Infusion[l]	Hemorrhoid, abdominal pain, STI, Gastritis	0.052	DRC [64] Niger [46]	In vivo -Rat: $ED_{50}=100$ mg/Kg: Lv [65]
Anonidium mannii (Oliv). Engl. & Diels[c] (Annonaceae)	KIP000111023	Nkundo[u] (Lingala)	0.004	Rb[w]	Decoction[l]	Hemorrhoid	0.013	NR	NR
Antidesma venosum auct.[b] (Phyllanthaceae)	KIP293612638	Kifubia[v] (Luba-kat)	0.011	Sb[x]	Decoction[l]	Hemorrhoid, STI, bilharzia	0.039	NR	In vitro -Cox: $ED_{50\text{-}100}=250$ µg/mL—Lv [66]
Antirrhinum majus L.[a] (Plantaginaceae)	KIP000111024	Lueni[p] (Swahili)	0.011	R[x]	Maceration[l]	Hemorrhoid	0.013	NR	In vitro -Cox2: $ED_{100}=100$ µg/mL: Lv [67]
Antrocaryon klaineanum Pierre[b] (Anacardiaceae)	KIP000111025	Mbota ya nyama[u] (Luba-kas)	0.071	Rb[w]	Decoction[l]	Hemorrhoid, STI, stomach pain, painful menstruation	0.052	Cameroon [48]	In vivo -Rat: $ED_{90}=600$ mg/Kg—Sb [68]
Asparagus africanus Lam.[b] (Asparagaceae)	KIP000111026	Mukoma[v] (Luba-kat)	0.014	Lv[x]	Decoction[l]	hemorrhoid, STI, cough, diarrhea, rheumatism, sore throat	0.079	DRC [69]	In vivo -Rat: $ED_{25}=250$ mg/Kg -Rb [66]
Aspilia kotschyi (Sch. Bip. ex Hochst.) Oliv.[c] (Asteraceae)	KIP000111027	Tshipukapuka[u] (Luba-kas)	0.012	WP[y1]	Decoction[l]	Hemorrhoid, Haemorrhagia, wound	0.039	DRC [70]	NR
Baccharoides adoensis (Sch.Bip. ex Walp.) H.Rob[c] (Asteraceae)	KIP000111028	Alete[v] (Hunde)	0.007	Rb[w]	Decoction[l]	Hemorrhoid, fever, diabetes, flu	0.052	NR	NR
vBaillonella toxisperma Pierre[c] (Sapotaceae)	KIP000111029	Muabi[u] (Luba-kas)	0.009	Rb[w]	Decoction[l]	Hemorrhoid, backache, kidney failure, inflammation	0.052	Cameroon [48]	NR
Balanites aegyptiaca (L) Delile (Zygophyllaceae)	KIP000111030	Mubambangoma[r] (Bemba)	0.002	Rb[w]	Decoction[E]	Hemorrhoid, fever, diabetes, jaundice	0.052	India [71]	In vivo -Rat: $ED_{80}=600$ mg/Kg- Rb [72]

Table 3 (continued)

Species[source] (Family)	NH	Local name (ethnicity)[GT]	CI ($n=1604$)	UP[MT]	Preparation[THD]	Medicinal uses	MUI ($n=76$)	Previous anti-hemorrhoidal uses	Previous anti-inflammatory activity
Bridelia ferruginea Benth (Phyllanthaceae)	KIP000001040	Inkuka-i-nsii[u] (Yanzi)	0.009	Rb[w]	Decoction[&]Maceration[E]	Hemorrhoid, wound, TBC, Gonorrhea, Sickle cell disease, hypertension, dental caries	0.078	Nigeria [73]	In vitro -Cox2: $ED_{80}=200$ µg/mL-Rb [74]
Bridelia micrantha (Hochst.) Baill.[c] (Euphorbiaceae)	KIP000001041	Muteja[v] (Swahili)	0.011	Rb[w]	Decoction[l]	Hemorrhoid	0.013	DRC [39]	In vivo -Rat: $ED_{50}=200$ mg/Kg-Lv [75]
Canarium schweinfurthii Engl.[d] (Burseraceae)	KIP000111031	Elemi[u] (Luba-kat)	0.039	Rb[w]	Decoction[l]	Hemorrhoid, renal failure	0.026	DRC [40]	In vitro -Lox: $IC_{50}=62,6$ µg/L—Resin [76]
Capsicum frutescens L.[c] (Solanaceae)	KIP000001044	Ushinda[r] (Luba-kat)	0.024	Lv[x]	Expression[l]	Hemorrhoid, rheumatism, muscle and joint pain	0.052	DRC [77]	NR
Carica papaya L.[a] (Caricaceae)	KIP041463406	Kipapayi[u] (Luba-kat)	0.015	Sd[x]	Maceration[l]	Hemorrhoid	0.013	DRC [70]	In vitro -Lox: $IC_{50}=48.0$ µg/mL- Seed [78]
Chromolaena odorata (L.) R.M. King & H. Rob.[c,a] (Asteraceae)	KIP000001049	Mokili-mobimba[v] (Lingala)	0.013	Lv[x]	Decoction[l]	Hemorrhoid	0.013	NR	In vivo -Rat: $ED_{50}=400$ mg/Kg- Lv [79]
C itrus limon (L.) Burm.f.[f] (Rutaceae)	KIP000111032	Limau[o] (Swahili)	0.627	Fr[w]	Fermentation[l]	Hemorrhoid, Tired, stomachache	0.039	DRC [80, 81]	In vivo -Rat: $ED_{40}=400$ mg/Kg—Fr [82]
Clerodendrum bungei Steud.[c] (Lamiaceae)	KIP000111033	Sinawolo[u] (Kimbala)	0.017	Lv[w]	Decoction[l]	Hemorrhoid	0.013	DRC [81]	In vitro—lipopolysaccharide (LPS): Clerodenone B $IC_{50}=6.3$. µM—Lv [83]
Cola chlamydantha K. Schum.[c] (Malvaceae)	KIP000111034	Karoj[u] (Rund)	0.007	Rb[w]	Decoction[l]	Hemorrhoid, anemia	0.026	Cameroon [48]	NR
Coleus kilimandschari Gürke[b] (Lamiaceae)	KIP000111035	Mulavumba[v] (Swahili)	0.009	Lv[x]	Infusion[l]	Hemorrhoid, asthma, thrombosis, weight loss	0.052	DRC [69]	NR
Costus afer Ker Gawl.[c] (Costaceae)	KIP000111036	Tangawisi sapiral[u] (Swahili)	0.029	S[y3]	Decoction[l]	Hemorrhoid, constipation, diarrhea, rheumatism, malaria	0.056	Cameroon [48]	In vivo -Rat: $ED_{40}=400$ mg/Kg—Lv [84]
Crossopteryx febrifuga (Afzel. ex G.Don) Benth[c] (Rubiaceae)	KIP000001056	Okane[u] (Kimbala)	0.007	Rb[w]	Maceration[l]	Hemorrhoid, diabetes, chickenpox, measles, GID, malaria, constipation, rheumatism	0.089	DR[64]	NR

Table 3 (continued)

Species[source] (Family)	NH	Local name (ethnicity)[GT]	CI ($n=1604$)	UP[MT]	Preparation[THD]	Medicinal uses	MUI ($n=76$)	Previous anti-hemorrhoidal uses	Previous anti-inflammatory activity
Croton oligandrus Pierre ex Hutch.[c] (Euphorbiaceae)	KIP000111037	Tuki[u] (Swahili)	0.011	Rb[w]	Decoction[l]	Hemorrhoid, Cystitis	0.026	Cameroon [48]	NR
Cyathula prostrata (L.) Blume[c] (Amaranthaceae)	KIP000111038	Tshilawulawu[n] (Luba-kas)	0.016	Lv[y1]	Decoction[l]	Hemorrhoid, asthma, diarrhea, colic, abdominal pain	0.056	Cameroon [48]	In vivo -Rat: $DE_{60}=50$ mg/Kg: Lv [85]
Cylicodiscus gabunensis Harms[c] (Mimosaceae)	KIP000111039	Okane[u] (Kimbala)	0.030	Rb[w]	Decoction[l]	Hemorrhoid, itching, swollen foot	0,039	NR	In vivo -Rat: $DE_{50}=200$ mg/Kg—Lv [86]
Cymbopogon citratus[c] (DC.) Stapf (Poaceae)	KIP000111040	Tshipuka[l] (Luba-kas)	0.029	Lv[y3]	Decoction[l]	hemorrhoid, swollen foot	0.026	Cameroon [48]	In vivo -Rat: $DE_{80}=68.24$ mg/Kg: Lv [87]
Cyperus articulatus L.[a] (Cyperaceae)	KIP000111041	Sokasoka[m] (Luba-Kat)	0.014	R[x]	Maceration[l]	hemorrhoid, tired, dizziness	0.039	DRC [81]	In vitro -Cox2: $DE_{15—35}$: 10 µM—Rb [88]
Cyphostemma adenocaule (Steud. Ex A. Rich.) Desc. ex Wild & R.B. Drumm.[c] (Vitaceae)	KIP000111042	Muteja ya pori[u] (Swahili)	0.011	R[y3]	Infusion[l]	hemorrhoid	0.013	DRC [81]	NR
Dalbergia lactea Vatke[c] (Fabaceae)	KIP000111043	Obwat[u] (Kimbala)	0.012	Lv[x]	Decoction[l]	hemorrhoid, pneumonia, diarrhea, dental caries, diabetes	0.056	DRC [81]	NR
Diplorhyncus condylocarpon (Mull. Arg.)[c] (Apocynaceae)	KIP361753009	Mwembe[u] (Bemba)	0.013	Lv[x]	Decoction[E]	hemorrhoid, wound, GID, fever, snakebite	0.056	NR	NR
Droogmansia munamensis De Wild [c] (Fabaceae)	KIP000001350	Mununganunga[h] (Bemba)	0.009	Lv[x]	Decoction[E]	hemorrhoid, diabetes, dysentery, wounds	0.056	NR	NR
Entada abyssinica Steud. Ex A. Rich.[g] (Fabaceae)	KIP000001353	Tshitefu[n] (Luba-Kas)	0.618	R[x]	Decoction[l]	hemorrhoid, malaria, diabetes, low back pain, headaches	0.056	DRC: [38]	In vivo -Rat: $DE_{50}=200$ mg/Kg—Lv [89]
Erigeron bonariensis L.[a] (Asteraceae)	KIP000111044	Riyani moya[r] (Swahili)	0.623	Lv[y1]	Exudation[l]	hemorrhoids, rheumatism, stretch marks	0.039	NR	NR
Erigeron sumatrensis Retz.[f] (Asteraceae)	KIP000111045	Kitukituki[m] (Luba-kat)	0.644	R[y1]	Maceration[l]	hemorrhoids, rheumatism, stretch marks	0.039	DRC [81]	NR
Euphorbia hirta L.[e] (Euphorbiaceae)	KIP000001354	Kisanga[m] (Kikongo)	0.642	Sb[y1]	Decoction[l]	hemorrhoid, diarrhea, gonorrhea, dysentery	0.056	Cameroon [48]	In vivo -Rat: $DE_{75}=100$ mg/Kg—Lv [90]

Table 3 (continued)

Species[source] (Family)	NH	Local name (ethnicity)[GT]	CI ($n=1604$)	UP[MT]	Preparation[THD]	Medicinal uses	MUI ($n=76$)	Previous anti-hemorrhoidal uses	Previous anti-inflammatory activity
Ficus laurifolia Lam (Moraceae) [f] (Moraceae)	KIP501400542	Kikuyu[v] (Luba-kat)	0.635	Rb[w]	Pilage [I,E]	hemorrhoid, wound, peptic ulcer, diabetes, STI, tuberculosis	0.078	NR	NR
Ficus stuhlmannii Warb [f](Moraceae)	KIP000111046	Chilemba[s] (Bemba)	0.635	Rb[w]	Pilage[I,E]	hemorrhoids, Anemia, Abdominal pain, Gonorrhea (STI), Diarrhea, Syphilis, Coughs	0.078	NR	NR
Ficus sur Forssk[f] (Moraceae)	KIP539378804	Mupulamako[u] (Bemba)	0.013	Rb[w]	Pilage[I]	hemorrhoids, anemia, female sterility, cough, syphilis, jaundice, amoebiasis, dysentery and helminthiasis	0.100	NR	In vitro -Cox2: DE_{50}: 80 µg/mL—Lv [91]
Garcinia punctata Oliv.[c] (Clusiaceae)	KIP000111047	Nkodo[u] (Lingala)	0.006	Lv[w]	Decoction[I]	hemorrhoid, sexual weakness, infections	0.039	NR	NR
Gardenia ternifolia subsp. jovis-tonantis (Welw) VeDRC[c] (Rubiaceae)	KIP000001366	Mankeba[u] (Bemba)	0.007	Rb[x]	Pilage[E]	hemorrhoid, malaria, diarrhea, hypertension, dental caries, schistosomiasis	0.067	DRC [92]	In vitro -Cox1: IC_{90}: 100 µg/mL—Lv [93]
Gymnanthemum amygdalinum (Delile) Sch.Bip[c] (Asteraceae)	KIP312286606	Mubilishi[v] (Kirega)	0.006	R[x]	Decoction[I]	hemorrhoid, gonorrhea, malaria, diabetes	0.056	DRC [94]	In vivo -Rat: $ED_{95}=200$ mg/Kg—Lv [95]
Hibiscus cannabinus L.[c] (Malvaceae)	KIP000111048	Ngayi[v] (Kirega)	0.011	Lv[y1]	Maceration[I]	hemorrhoid, obesity, indigestion	0.039	DRC [81]	In vivo -Rat: $DE_{65}=400$ mg/Kg—[96]
Hymenocardia acida Tul.[b] (Phyllanthaceae)	KIP464414491	Ambalanga[u] (Hemba)	0.012	R[x]	Decoction[I]	hemorrhoid	0.011	DRC [40]	In vivo -Rat: $DE_{70}=200$ mg/Kg—Lv [97]
Indigofera capitata Kotschy[b] (Fabaceae)	KIP000111049	Onkaï[u] (Teke)	0.009	F[y1]	Maceration[I]	hemorrhoid, sexual dysfunction, bronchitis, cough, dyspnea	0.066	NR	NR
Khaya nyasica Stapf ex Baker f.[b] (Meliaceae)	KIP000001372	Bamba[j] (Luba-kat)	0.012	F[w]	Pilage[I,E]	hemorrhoid, anemia, diarrhea and dysentery, amebiasis, ascariasis, cholera, ovarian cyst, malaria, wound, dermatosis	0.145	Nigeria [73]	NR
Landolphia owariensis P.Beauv[b] (Apocynaceae)	KIP000111050	Mazangu[u] (Kikongo)	0.066	Lv[z]	Pilage[E]	hemorrhoid, spasms	0.026	DRC [81]	In vivo -Rat: $DE_{55}=400$ mg/Kg—Lv [98]
Luffa cylindrica (L.) M.Roem.[c] (Cucurbitaceae)	KIP000111051	Tseke[n] (Kiyombe)	0.011	Sb[z]	Maceration[I]	hemorrhoid, bronchitis, sinusitis, rhinitis	0.056	Nigeria [99]	In vivo -Rat: $DE_{30}=50$ mg/Kg—Lv [100]

Table 3 (continued)

Species[source] (Family)	NH	Local name (ethnicity)[GT]	CI ($n=1604$)	UP[MT]	Preparation[THD]	Medicinal uses	MUI ($n=76$)	Previous anti-hemorrhoidal uses	Previous anti-inflammatory activity
Mangifera indica L.[e] (Anacardiaceae)	KIP000111052	Mwembe[v] (Shi)	0.009	Sb[w]	Decoction[I]	hemorrhoid, diarrhea, diabetes, colic, dysentery	0.066	DRC [64] Cameroon [34]	In vitro -Human Red Blood Cell (HRBC) Membrane Stabilization Method: IC_{50}: 100 µg/mL—Lv [101]
Markhamia tomentosa (Benth.) K.Schum. ex Engl.[c] (Bignoniaceae)	KIP000111053	Esate ou onz[u] (Kimbala)	0.007	Lv[x]	Decoction[I]	hemorrhoid, skin infection, wound, rheumatism	0.066	DRC [81]	In vivo -Rat: DE_{66} = 200 mg/Kg -Lv [102]
Memecylon flavovirens Baker[c] (Melastomaceae)	KIP000001376	Musunda[u] (Bemba)	0.006	Lv[y1]	Pilage[E]	hemorrhoid, cough, helminthiasis, nasal congestion	0.056	NR	NR
Mesosphaerum suaveolens (L.) Kuntze[f] (Lamiaceae)	KIP000111054	Mifisha[u] (Bemba)	0,704	Lv[y1]	Pilage[E]	hemorrhoid, malaria, fever, hernias, wounds	0.066	NR	In vitro -TNF-α: IC_{90}: 100 µg/mL—Lv [103]
Monodora myristica (Gaertn.) Dunal[c] (Annonaceae)	KIP000111055	Mpeya[u] (Kikongo)	0.080	Lv[w]	Decoction[I]	hemorrhoid, stomachache, headache, diarrhea, hypertension	0.066	DRC [69]	In vivo -Rat: DE_{60} = 200 mg/Kg: Seed [104]
Moringa oleifera Lam.[c] (Moringaceae)	KIP000111056	Konse-konse[l] (Bemba)	0.064	Sb[w]	Maceration[I]	hemorrhoid, diarrhea, abdominal pain, sexual impotence	0.066	Niger [46]	In vivo -Rat: DE_{60} = 250 mg/Kg-Lv [105]
Musa x paradisiaca L.[f] (Musaceae)	KIP000111057	Mugomba[u] (Swahili)	0.013	Lv[w]	Maceration[E]	hemorrhoids, wounds, dysentery, bronchitis, diarrhea	0.066	Nigeria [73]	In vitro -Human Red Blood Cell Membrane Stabilization Method: IC_{43} = 1000 µg/mL – Sb [106]
Myrianthus arboreus P.Beauv.[a] (Urticaceae)	KIP000111058	Mbubu[u] (Luba-Kat)	0.032	R[w]	Decoction[I]	hemorrhoid, diarrhea, constipation, abdominal pain	0.056	Cameroon [48]	In vivo -Rat: DE_{59} = 250 mg/Kg—Lv [107]
Newbouldia laevis (P.Beauv.) Seem. ex Bureau[c] (Bignoniaceae)	KIP000111059	Mpese[u] (Kikongo)	0.026	Lv[w]	Pilage[I]	hemorrhoid, epilepsy, convulsion	0.039	Ghana Cameroon Nigeria [108]	In vivo -Rat: DE_{90} = 400 mg/Kg: Rb [109]
Ocimum centraliafricanum R.E.Fr.[a] (Lamiaceae)	KIP000111060	Gish[u] (Rund)	0.006	Lv[y3]	Decoction[I]	hemorrhoid	00.13	NR	NR
Ocimum gratissimum L.[a] (Lamiaceae)	KIP000001383	Ditsususu[o] (Kiyombe)	0.004	Lv[y3]	Maceration[I]	hemorrhoid, cough, cold, dysentery	0.056	DRC [38]	In vitro -Cox-Lox: IC_{50}: 125–144 µg/mL Lv [110]
Parinari curatellifolia subsp[c] (Chrysobalanaceae)	KIP000001385	Mpundu[n] (Bemba)	0.009	Rb[w]	Pilage[E]	Hemorrhoid, malaria, diarrhea, hypertension	0.056	DRC [41]	In vivo -Rat: DE_{25} = 400 mg/Kg—Lv [111]

Table 3 (continued)

Species[source] (Family)	NH	Local name (ethnicity)[GT]	CI ($n=1604$)	UP[MT]	Preparation[THD]	Medicinal uses	MUI ($n=76$)	Previous anti-hemorrhoidal uses	Previous anti-inflammatory activity
Passiflora foetida L.[c] (Passifloraceae)	KIP000111061	Maua[v] (Swahili)	0.012	Sb[y2]	Decoction[l]	hemorrhoid, asthma, nervousness, digestive disorder, muscle spasm	0.066	NR	In vitro -NO: IC_{50}: 30–50 µg/mL—Lv, Fr [112]
Pentaclethra macrophylla Benth.[c] (Fabaceae)	KIP000111062	Ngunga[u] (Swahili)	0.017	R[w]	Infusion[l]	hemorrhoid, inflammation, parasites	0,039	DRC [69]	In vivo -Rat: $DE_{20}=150$ mg/Kg: Sb [113]
Pentadiplandra brazzeana Baill.[c] (Pentadiplandraceae)	KIP000111063	Mutitatita[u] (Kirega)	0.031	Sb[x]	Maceration[l]	hemorrhoid, pneumonia, edema	0.039	Cameroon [34]	In vitro -Albumin denaturation method: IC_{52}: 50 µg/mL-Rb [114, 115]
Pericopsis angolensis (Baker)[c] (Fabaceae)	KIP000111064	Mubanga[h] (Bemba)	0.032	Rb[w]	Decoction[l]	hemorrhoids, fever, diarrhea	0.039	NR	In vitro -NO assay: No activity -Sb [116]
Phyllanthus amarus Schumach. & Thonn.[f] (Phyllanthaceae)	KIP000111065	Kivumbwa[n] (Hemba)	0.756	R[y1]	Decoction[l]	hemorrhoid, diabetes, flu, inflammation, liver cirrhosis	0.066	DRC [117]	In vitro -pro-inflammatory cytokines assay: $IC_{50}=60$ µg/mL -WP [118]
Phyllanthus muelleri-anus (Kuntze) Exell [c] (Phyllanthaceae)	KIP277202454	Mupetwa lupe[u] (Bemba)	0.002	Lv[x]	Pilage[l]	hemorrhoid, constipation, wound, hepatitis	0.056	DRC [69]	In vivo -Rat: $DE_{47}=300$ mg/Kg—Lv [119]
Phytolacca dodecandra L'Hér.[c] (Phytolaccaceae)	KIP000111066	Loko[o] (Kirega)	0.002	R[x]	Pilage[l]	hemorrhoids	0.013	DRC [53]	In vivo -Rat: $DE_{74}=600$ mg/Kg—Lv [120]
Plumbago zeylanica L.[c] (Plumbaginaceae)	KIP000111067	Beji ya risasi (Swahili)	0.003	Sb[x]	Decoction[l]	hemorrhoid, vomiting, rheumatism	0.039	DRC [81]	In vivo -Rat: $DE_{45}=100$ mg/Kg: Rb [121]
Psidium guajava L.[a] (Myrtaceae)	KIP000301861	Mapele[r] (Swahili)	0.019	Lv[x]	Maceration[l]	hemorrhoids, hemorrhage, diarrhea	0.039	DRC [64]	In vivo -Rat: $DE_{55}=250$ mg/Kg—Lv [122]
Psorospermum febrifugum Spach[a] (Hypericaceae)	KIP510193316	Kafifi[u] (Bemba)	0.021	Rb[x]	Decoction[E]	hemorrhoid, diarrhea, amoebae, malaria	0.056	DRC [37]	In vivo -Rat- xylene-induced ear oedema assay: $DE_{55}=400$ mg/Kg: Sb [122]
Pterocarpus angolensis DC.[e] (Fabaceae)	KIP000001393	Mulambwa[v] (Luba-kat)	0.646	Sb[w]	Pilage[l]	hemorrhoid, epilepsy, abdominal pain, ascariasis	0.056	DRC [40]	In vitro -Cox assay:$IC_{90}=250$ µg/mL -Sb [123]
Radlkofera calodendron Gilg[c] (Sapindaceae)	KIP000111068	Luet[u] (Kikongo)	0.007	Lv[w]	Decoction[l]	hemorrhoid	0.013	DRC [81]	NR

Table 3 (continued)

Species[source] (Family)	NH	Local name (ethnicity)[GT]	CI ($n=1604$)	UP[MT]	Preparation[THD]	Medicinal uses	MUI ($n=76$)	Previous anti-hemorrhoidal uses	Previous anti-inflammatory activity
Senna alata (L.) Roxb.[c] (Fabaceae)	KIP000111069	Tunda[n] (Swahili)	0.009	Lv[x]	Decoction[l]	hemorrhoids, fever, diarrhea, dysentery, sexual weakness	0.056	Thailand [124]	In vitro -HRBC membrane stabilizing method:$IC_{50}=9.93$ µg/mL -Lv [125]
Sida rhombifolia L.[c] (Malvaceae)	KIP000111070	Lumvumvu[v] (Kikongo)	0.013	Lv[x]	Decoction[l]	hemorrhoid, depression, bronchitis, inflammation, fever	0.066	DRC [81]	In vitro -NO assay:$IC_{50}=9.93$ µg/mL -Lv [126]
Solanum lycopersicum L.[a] (Solanaceae)	KIP000111071	Tomate[m] (Luba-kat)	0.016	Lv[y3]	Exudation[l]	Hemorrhoids	0.011	DRC [53]	In vivo -Rat: $DE_{50}=50$ mg/Kg: Fr [127]
Strychnos spinosa Lam (Malvaceae)	KIP000111072	Lumvumvu[v] (Kikongo)	0.127	Lv[x]	Pilage[l]	hemorrhoids, depression, bronchitis, inflammation, fever	0.066	DRC [81]	In vitro -NO assay:$IC_{50}=88.43$ µg/mL -Lv [128]
Symphytum officinale L.[c] (Boraginaceae)	KIP000111073	Duyemba[t] (Tshisala)	0.009	Sb[y3]	Decoction[l]	hemorrhoid, inflammation, dry cough	0.039	NR	In vivo -Rat: $DE_{58}=500$ mg/Kg—R [129]
Syzygium cordatum Subsp.[a] (Myrtaceae)	KIP000111074	Ciyambaganyi[i] (Shi)	0.006	Lv[x]	Exudation[l]	hemorrhoid, malaria, diabetes, convulsion, pains, Abdominal, epilepsy, meningitis, Typhoid fever, Gonorrhea, tooth decay	0.145	DRC [53]	In vitro -Cox assay: $IC_{75}=250$ µg/mL -Lv [130]
Terminalia mollis M.A.Lawson[f] (Combretaceae)	KIP452120033	Kibobo[u] (Luba-kat)	0.728	Lv[w]	Pilage[l]	Hemorrhoid, constipation, diarrhea, abdominal pain	0.056	DRC [31]	In vitro -NO assay: $IC_{50}=40$ µg/mL -Lv [131]
Tetradenia riparia (Hochst.) Codd [c] (Lamiaceae)	KIP370001297	Mutuzo[v] (Shi)	0.011	WP[w]	Pilage[l]	Hemorrhoid, cough, diarrhea, constipation	0.056	DRC [80]	In vitro -NO assay: $IC_{50}=2.05\pm1.18$ µg/mL -Lv [132]
Thonningia sanguinea Vahl [c] (Balanophoraceae)	KIP000111075	Bisusu[u] (Luba-kat)	0.015	Sb[y3]	Decoction[l]	Hemorrhoid, Osteomyelitis	0.026	DRC [81]	In vivo -Rat-Albumin induced paw oedema: Non active—Lv [133]
Uapaca guineensis Müll.Arg.[c] (Phyllanthaceae)	KIP000111076	Ngwaka[u] (Kirega)	0.032	Lv[w]	Infusion[l]	hemorrhoids, muscular weakness, sexual weakness	0.039	NR	In vivo -Rat: $DE_{90}=124$ mg/Kg: R [134]
Vernonia shirensis Oliv. & Hiern[b] (Asteraceae)	KIP000111076	Kilulunkunja[v] (Swahili)	0.009	Lv[y3]	Decoction[l]	hemorrhoid, headache, diarrhea, diabetes, fever	0.066	DRC [40]	NR
Zanha africana (Radlk.) Exell[b] (Sapindaceae)	KIP000001397	Kalayi[h] (Bemba)	0.012	Rb[w]	Pilage[l]	hemorrhoid, malaria, diabetes, convulsion	0.056	NR	In vivo -Rat: $IC_{50}=0.47$ mM-Lv: Zanhasaponin A [135]

Table 3 (continued)

Species[source] (Family)	NH	Local name (ethnicity)[GT]	CI ($n=1604$)	UP[MT]	Preparation[THD]	Medicinal uses	MUI ($n=76$)	Previous anti-hemorrhoidal uses	Previous anti-inflammatory activity
Zanthoxylum chalybeum Engl.[c] (Rutaceae)	KIP000001016	Pupwe kyulu[u] (Lubakat)	0.019	R[x]	Decoction[l]	hemorrhoid	0.013	NR	In vitro -Cox assay: $IC_{95}=500$ µg/mL -Rb [66]
Zingiber officinale Roscoe[a] (Zingiberaceae)	KIP000111077	Tangawisi[k] (Swahili)	0.548	Rz[y3]	Decoction[l]	hemorrhoid, constipation, diarrhea, hepatitis	0,056	DRC [64]	In vivo -Rat: $DE_{80}=100$ mg/Kg—Rz [136]

Abbreviations: *NH,* voucher number; *CI* citation index, *GT* geographical type, *UP* used part, *MT* morphological type, *FU* form of use, *MUI* medicinal use index, *THD* type of hemorrhoid diseases, *NR* Not Reported
Data sources: Traditional practitioners & herbalists (d), Traditional practitioners (c), Households (a), Herbalists (b), Traditional practitioners & herbalists & Households (e), Traditional practitioners & Households (f). ***Morphological types***: Tree (w), Shrub (x), Annual herb (y1), Biennial herb (y2), Perennial herb (y3) and Liana (z).***Hemorrhoidal types***, I (internal hemorrhoid), E (external hemorrhoid). ***Geographical types***: CA: (h) CA-SA (i) EA (j) MA (k); MA-NA-TA (l); MA-NA-TA-SA (m); MA-TA (n); MA-TA-SA (o); NA (p); NA-TA (q); NA-TA-SA (r) W (s); NN (t); TA (u); TA-SA (v); CA (Central Africa); SA (Southern Africa); MA(Madagascar); EA (East Africa); NA (North Africa); WE (West Africa). ***Used part***: Whole plant, WP; Root bark, Rb; Stem Bark, Sb; Leaves, Lv; Seed, Sd; Fr, Fruit; Rz: Rhizome. Morphological and geographic types were determined from the above databases (see Methodology section): POWO, The World Flora Online and African Plant Database

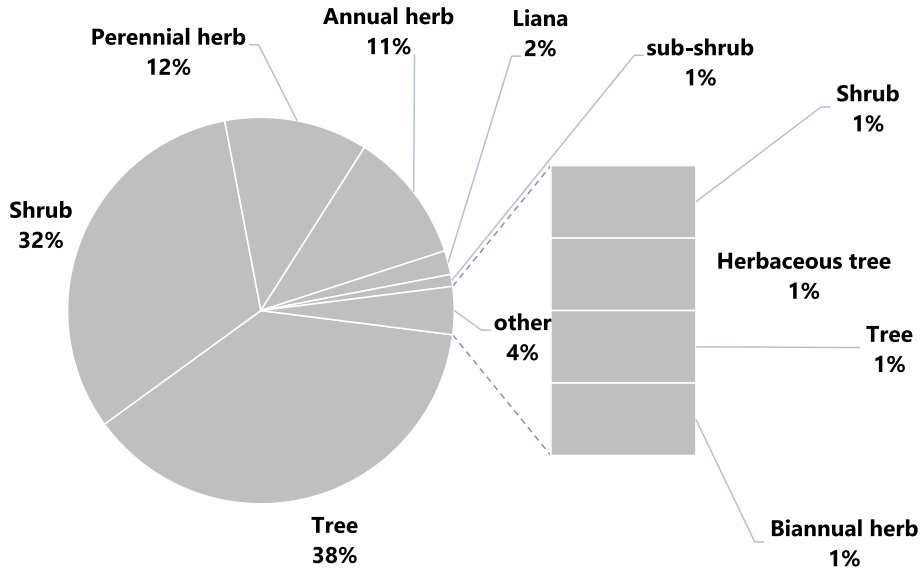


Fig. 2 Morphological types ($n = 100$)

of hemorrhoidal diseases, in view of the available literature (Table 3). These are *Acmella caulirihza* Delile (Asteraceae), *Aidia micrantha* (K.Schum.) Bullock ex F.White (Rubiaceae), *Amaranthus hybridus* L. (Amaranthaceae), *Anonidium mannii* (Oliv). Engl. & Diels (Annonaceae), *Antirrhinum majus* L. (Plantaginaceae), *Baccharoides adoensis* (Sch.Bip. ex Walp.) H.Robc (Asteraceae), *Chromolaena odorata* (L.) R.M. King & H. Rob. (Asteraceae), *Crossopteryx febrifuga* (Afzel. ex G.Don) Benthc (Rubiaceae), *Diplorhyncus condylocarpon* (Mull. Arg.) (Apocynaceae), *Droogmansia munamensis* De Wild (Fabaceae), *Erigeron bonariensis* L. (Asteraceae), *Ficus laurifolia* Lam.f (Moraceae), *Ficus stuhlmannii* Warb (Moraceae), *Ficus sur* Forssk (Moraceae), *Garcinia punctata* Oliv. (Clusiaceae), *Indigofera capitata* Kotschyb (Fabaceae), *Mesosphaerum suaveolens* (L.) Kuntze (Lamiaceae), *Ocimum centraliafricanum* R.E.Fr. (Lamiaceae), *Passiflora foetida* L. (Passifloraceae), *Pericopsis angolensis* (Baker) (Fabaceae), *Symphytum officinale* L. (Boraginaceae), *Uapaca guineensis* Müll.Arg.c (Phyllanthaceae), *Zanha africana* (Radlk.) Exellb (Sapindaceae) and *Zanthoxylum chalybeum* Engl. (Rutaceae) (Table 2). The most cited by more than 60% of interviewees are: *Mesosphaerum suaveolens* (CI: 0.704), *Ficus laurifolia* (CI: 0.635), *Ficus stuhlmannii* (CI: 0.635) and *Erigeron bonariensis* (CI: 0.623).

Of the 24 taxa, 14 have not previously been studied for their anti- inflammatory activity. In order of importance of citation, the taxa are as follows: *Crossopteryx febrifuga*, *Ficus stuhlmannii*, *Ficus laurifolia*, *Indigofera capitata*, *Diplorhynchus condylocarpon*, *Droogmansia munamensis*, *Baccharoides adoensis*. *Aidia micrantha*, *Erigeron bonariensis*, *Garcinia punctata*, *Acmella caulirhiza*, *Amaranthus hypochondriacus*, *Anonidium mannii*, and *Ocimum centralafricanum*. According to Plants of the World Online (https://powo.science.kew.org), all of these taxa are native to the DRC, with the exception of *Erigeron bonariensis* and *Amaranthus hypochondriacus*, which are introduced taxa.

Of the 14 taxa initially reported by this study as plants with anti-hemorrhoidal uses in Katanga, a literature search revealed that only eight taxa, namely *Acmella caulirhiza* [138], *Aidia micrantha* [81], *Amaranthus hypochondriacus* [139], *Anonidium mannii* [140], *Crossopteryx febrifuga* [40, 41], *Diplorhynchus condylocarpon* [37, 42, 141], *Droogmansia munamensis* [40], *Garcinia punctata* [142, 143] have previously been documented as medicinal plants in Congolese traditions.

Although not reported as medicinal plants in the Democratic Republic of the Congo (DRC), three of the fourteen taxa; *Indigofera capitata*, *Baccharoides adoensis*, and *Erigeron bonariensis*, are reported as medicinal plants in other African regions. In Nigeria [144] and, in Uganda [145], powder *from Indigofera capitata* is employed as a remedy for snakebites, while in the Republic of Congo, the dried infrutescences of this plant are utilized for their hallucinogenic properties [146]. In Zimbabwe, *Baccharoides adoensis* is traditionally employed for the treatment of fever, upper respiratory tract infections, and currently for tuberculosis [147]. In Kenya, the root decoction is utilized for the treatment of sexually transmitted diseases, heart and kidney problems, while the leaves are employed in the treatment of malaria and tuberculosis [148]. In South Africa, the decoction of *Erigeron bonariensis* [synonym: *Conyza bonariensis* (L.)] is a folk remedy

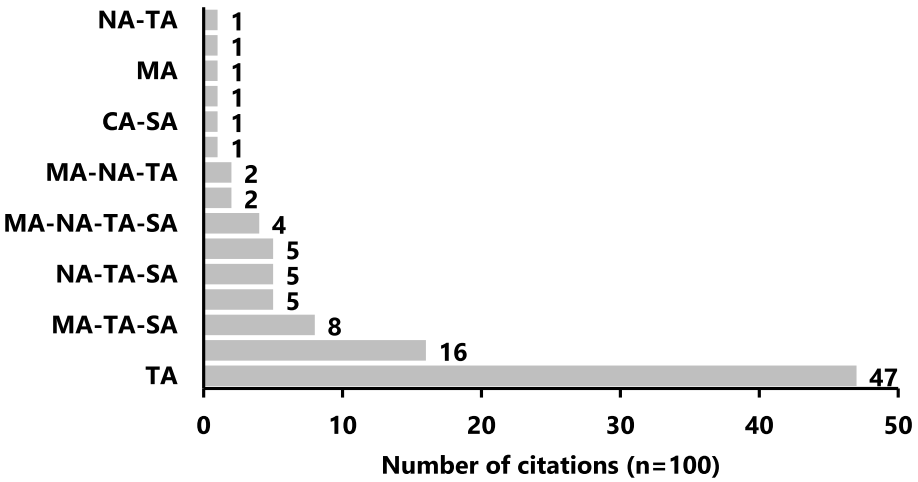


Fig. 3 Geographical type. ***Legend***: TA(Tropical Africa); NEA(North-East Africa); CA (Central Africa); SA(Southern Africa); MA(Madagascar); EA(East Africa); NA(North Africa); WE(West Africa)

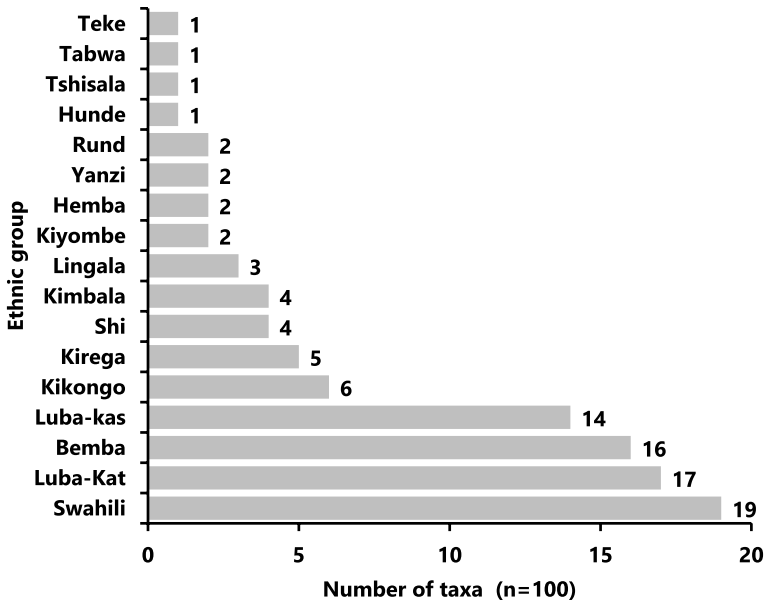


Fig. 4 Plant naming languages. Seventeen families have more than two taxa each. The Fabaceae (10 species), Asteraceae (9 plant species), Lamiaceae (7 species), Phyllanthaceae (6 species), Anacardiaceae (5 species), Euphorbiaceae (4 species), Malvaceae (4 species) and Sapindaceae (4 species) families are the eight most important, collectively accounting for 49% of all plants cited (Fig. 5)

that is widely used for the treatment of tuberculosis. The leaves of this plant are employed as folk medicine for the treatment of a number of ailments, including rheumatism, gout, cystitis, nephritis, dysmenorrhea, toothache, and headaches [149].

To the best of our knowledge, although *Ficus stuhlmannii*, *Ficus laurifolia*, and *Ocimum centraliafricanum* are considered native plants to the country, according to POWO, no medicinal use has yet been reported for any of them. This study, therefore, presents the first account of their related ethnomedicinal knowledge. The fact that *Ocimum centraliafricanum* was reported only by the household population indicates that ethnomedicinal knowledge in our study area is not the exclusive domain of traditional healers. This is further corroborated by the fact that ethnomedicinal knowledge in our area is a family legacy, as evidenced by the findings of previous studies [37, 40, 42, 150]. Although these plants are not reported as having anti-hemorrhoidal uses, some taxa of the same genus are used in traditional medicine to

treat hemorrhoidal ailments. This is exemplified by *Ocimum gratissimum*, whose leaves are utilized in Benin as a decoction against typhoid fever [151]. The same is true of the species *Ocimum basilicum* L described in the Persian pharmacopoeia, which has been demonstrated to possess anti-inflammatory and myorelaxant properties in vivo, thus confirming its indication in the management of hemorrhoids [152]. In the *Ficus* genus, several taxa have been reported to be used in traditional medicine to treat hemorrhoids, including *Ficus vallischoudae* delile [153], *Ficus exasperata* Vahl [154], *Ficus carica* L [152], *Ficus umbellata* (Vahl) [155], *Ficus benghalensis* [156], *Ficus sycomorus* L, *Ficus palmata* Forssk, and *Ficus vasta* Forssk [30]. The two taxa of the Ficus genus reported in our study contribute to the growing list of numerous species of this genus used in various cultures for the management of hemorrhoidal diseases.

The majority of the medicinal plants mentioned by the respondents belong to the Fabaceae family, with 10 taxa identified (Fig. 3a). The prevalence of Fabaceae in this study can be attributed to the fact that it is the most dominant family of medicinal plants in the region. Ethnobotanical studies conducted in the Miombo region (Democratic Republic of the Congo, Tanzania, Angola, Zambia, Malawi, Zimbabwe, and Mozambique) have demonstrated that Fabaceae is the most prevalent family of medicinal plants. A case in point is the study carried out in the Sikonge district of Tanzania [35], in the province of Bié in Angola [157], in the provinces of Western, Copperbelt, Central and Northern Zambia [158], in Zomba, Malawi [159] and in Gokwe, Zimbabwe [160], where Fabaceae were the most cited. A bibliographical review of medicinal plants in Mozambique also highlighted the preponderance of Fabaceae, with 95 out of 731 taxa [161]. In the Democratic Republic of the Congo (DRC), the Miombo forest covers the provinces of Lualaba, Tanganyika, and Haut-Katanga. In Haut-Katanga province, where the city of Lubumbashi is located, no study has inventoried and characterized all the medicinal plants in the region. However, several ethnomedicinal studies targeting a specific pathology have been carried out, and in most cases, Fabaceae have taken the lead. These include the study of plants used to treat gastrointestinal disorders in Kamina and Kanyama ($n=10$ taxa, Fabaceae = 2 taxa) [162], the study of anti-cariogenic plants in Lubumbashi ($n=14$ taxa, Fabaceae = 3 taxa) [163], and the study of anti-malarial plants in the Lubumbashi area and its surroundings ($n=19$, Fabaceae: 11 taxa [164], $n=96$, Fabaceae = 22 taxa [41]). The study on anti-diabetic plants from Lubumbashi and its surroundings yielded 45 taxa, with Fabaceae accounting for 11 taxa [40]. The study on plants used against urogenital schistosomiasis yielded 61 taxa, with Fabaceae accounting for 17 taxa [37]. The study on plants used in the management of sexual dysfunctions in the Kampemba commune (Lubumbashi) yielded 21 taxa, with Fabaceae accounting for 7 taxa [165] is followed by the study on plants used in Lubumbashi and surrounding areas to treat gastritis ($n=14$, Fabaceae = 3 taxa [166]. Finally, the study on plants used in Lubumbashi to treat typhoid fever ($n=54$, Fabaceae = 20 taxa) [42] is presented.

Each of the plants reported in this study is named in one of the DRC's local languages, with Swahili, Luba, and Bemba being the most prevalent (Fig. 3b). This result is consistent with previous ethnobotanical studies conducted in the region [37, 40, 165, 167], which have reported the predominance of Bemba and Luba in the practice of traditional medicine in Katanga. It is noteworthy that the names of ethnic groups not endemic to Katanga, such as Lingala and Kikongo, which are languages spoken in the west of the country, also appear in the list. This may be indicative of a certain degree of cultural cross-fertilization that traditional Katangese medicine has undergone [42].

A citation index: CI of 0.7 or greater was observed in three taxa, which were the most frequently cited in the overall study. The most frequently cited taxa were *Phyllanthus amarus* Schumach & Thonn f. (Phyllanthaceae), *Terminalia mollis* MA Lawson f. (Combretaceae) and *Mesosphaerum suaveolens* (L) Kuntze (Lamiaceae). These taxa were reported by both traditional healers and the general population. According to Plants of the World Online (https://powo.science.kew.org/), only *Terminalia mollis* is native to the DRC, while the two other taxa are introduced plants. To the best of our knowledge, only the first two taxa are reported as medicinal plants in the DRC.

In southern Katanga, the infusion of *Phyllanthus amarus* leaves is employed to treat asthma, diabetes, typhoid fever, hepatitis, bronchial infections, and peptic ulcer [42], while decoction of the whole plant is utilized to treat dysentery [39]. In Central-Kongo, infusion of the plant's leaves is employed to promote diuresis, while maceration of the roots is utilized to treat amoebiasis and snail fever [140]. Its potential use in the treatment of haemorrhoidal pathologies may be based not only on its anti-inflammatory properties, as demonstrated in vitro [118], but also on the numerous flavonoids reported in its leaves [168], which have been associated with strengthening blood vessel walls, increasing venous tone and lymphatic drainage, and normalizing capillary permeability at the anal level [169, 170].

The root bark of *Terminalia mollis* is employed in Katanga as a decoction for a variety of ailments, including dysentery, intestinal worms, cancer, lice, diarrhea,

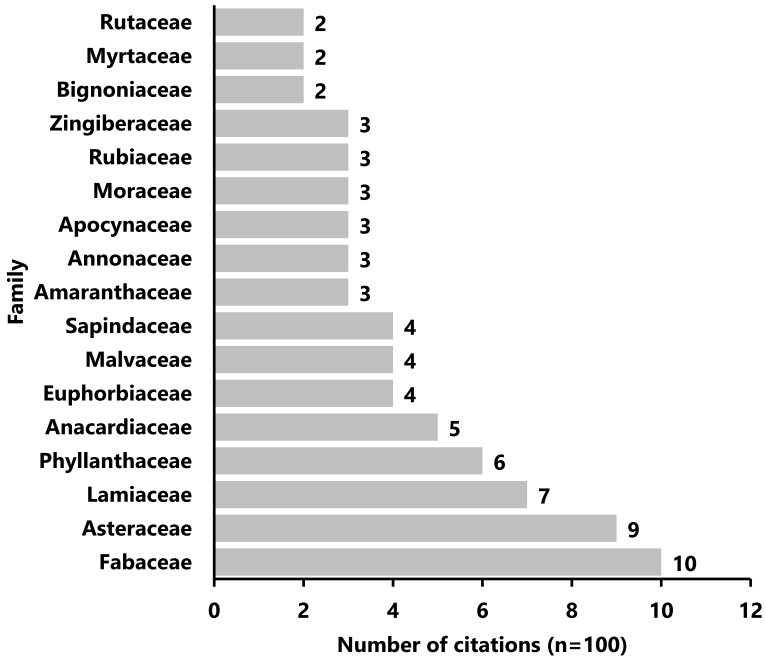


Fig. 5 Family with taxa n ≥ 2. The most frequently cited taxa are *Phyllanthus amarus* Schumach. & Thonn. (Phyllanthaceae), *Terminalia mollis* MA Lawson (Combretaceae), and *Mesosphaerum suaveolens* (L.) Kuntze (Lamiaceae). These taxa were claimed by over 1123 resource persons (CI ≥ 0.728) in total, with each species being cited individually (Table 2)

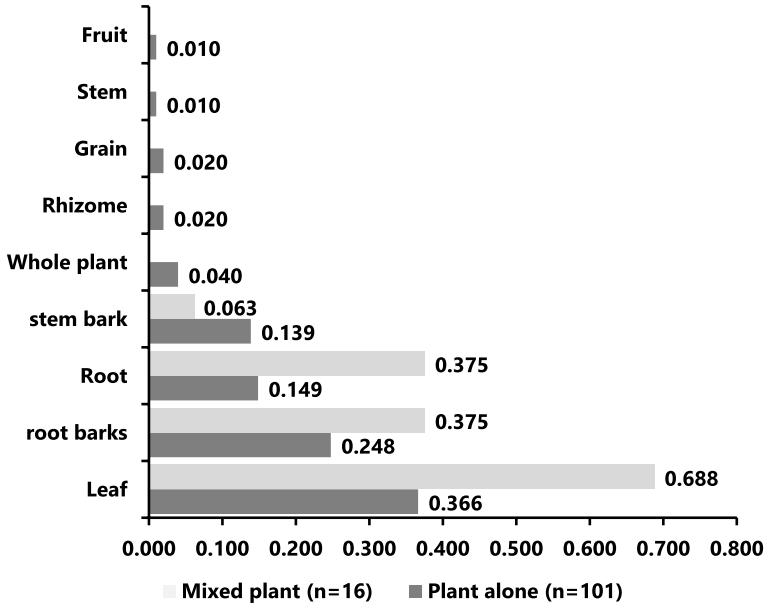


Fig. 6 Parts of plants used to treat hemorrhoids**.** The most prevalent method of preparing herbal remedies is decoction (51%) in mono-herbal recipes and pounding (44%) in polyherbal recipes (Fig. 7). Topical administration of herbal remedies is employed in five forms, with liniment (CI: 0.49–0.38) and sitz bath (CI: 0.30–0.25) representing over 50% of anti-hemorrhoidal recipes (Fig. 8)

abdominal pain [141, 171], typhoid fever [42], sexual dysfunction [165], diabetes, and syphilis [40]. In powder form, they are employed as a treatment for jaundice. The anti-inflammatory activity observed in vitro and the presence of tannins in its root barks may be the basis for its use against hemorrhoids.

To the best of our knowledge, *Mesosphaerum suaveolens* has never been reported as a medicinal plant in the

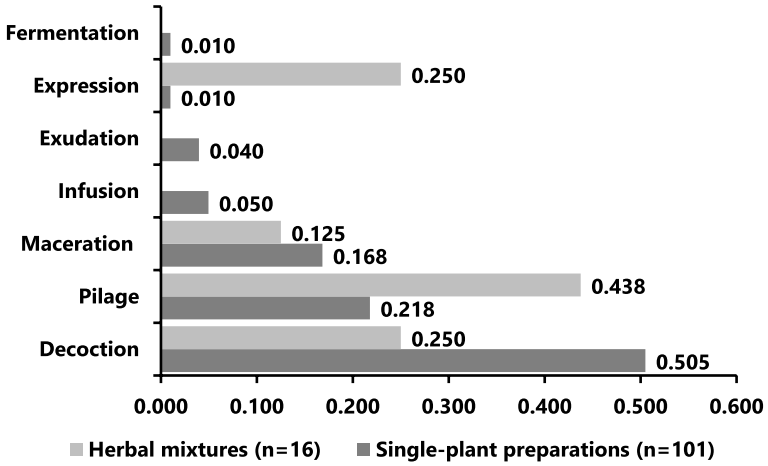


Fig. 7 Mode of anti-hemorrhoidal recipe's preparation

Democratic Republic of the Congo (DRC). However, the plant is a species that has been traditionally used for the treatment of a wide range of ailments, including stomach pain, cough, verminosis, ulcer, liver disease, fever, influenza, nasal congestion, and inflammation in various countries, such as Brazil, Benin, India, Nigeria, and Togo [172]. The use of the plant against hemorrhoids is linked to the presence of numerous phenolic compounds isolated from its leaves and to its anti-inflammatory activity in vitro [103].

The majority of the taxa identified in this study are either trees or shrubs (Fig. 5), which is consistent with previous ethnobotanical studies conducted in the region [39, 42, 164, 173]. Previous ethnomedicinal studies targeting anti-hemorrhoidal plants have yielded varying results regarding the predominant morphology of the taxa used, depending on the study. In a study conducted in southwestern Nigeria, the majority of taxa inventoried were trees [73]. This is also the case for the study carried out in southeast Cameroon [34] or in Tabora, Tanzania [35]. The results were similar to those reported in our study. In contrast, in studies conducted in Madurai district in India [174] or in north-central Nigeria [32], grass was in the majority. The morphological aspect of taxa is therefore not a specific characteristic of plants with a reputation for anti-hemorrhoidal action. However, the preferential use of tree or shrub morphological types offers the advantage of year-round availability of plant material, providing the possibility of uninterrupted pathology management throughout the year. However, this practice increases the risk of extinction of a species in great demand, especially in the current context of global warming [175–177]. It would be beneficial for traditional healers to receive training in plant species conservation techniques, particularly in situ and ex vivo methods and biotechnological approaches. Additionally, it is crucial for the country to regulate harvesting practices and the use of plant resources for the intensive management and conservation of medicinal plants, with the objective of perpetuating the practice of traditional medicine while eradicating the risk of extinction of interesting taxa.

Anti-hemorrhoidal Recipes

Of the 117 anti-hemorrhoidal recipes, over 60% are based on leaves, which have been prepared in 7 different ways, with decoction being the most common method (Fig. 8). The preponderance of leaves and decoction as the part used and mode of extraction of the active ingredient are reported in various ethnobotanical studies carried out in Katanga [37, 41, 163, 164]. However, it should be noted that these modes of extraction are not universally consistent. In other ethnobotanical studies conducted in the same region, the root was found to be the main organ used [40, 178]. This diversity in the organ preferentially used is also observed in ethnobotanical studies focusing on plants with anti-hemorrhoidal uses. In some cases, the leaf is the most commonly used organ [30, 32, 179], while in others, the root [35, 180–182], stem bark [34], or aerial parts [183] are the preferred choice. The lack of consensus on the most important organ for the use of plants in the management of hemorrhoidal diseases can be justified by the diversity of compounds likely to contribute to the management of hemorrhoidal disorders. The utilization of leaves as a source of raw material offers a number of advantages. (i) Leaves are generally more accessible and abundant than other plant parts such as roots or bark, which may require damaging the plant to harvest [184]; (ii) they can contain a high concentration of bioactive compounds because they are the site of photosynthesis and other metabolic processes, which can

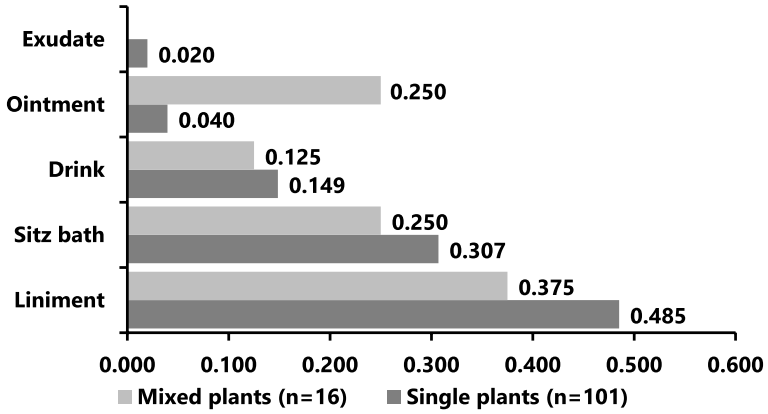


Fig. 8 Form of uses of recipe

Table 4 Characteristics of herbal healing recipes used in blends

N°	species 1	species 2	species 3	UP (Ratio)	Form	CI (*n* = 2774)	Preparation
1	*A melegueta*	*E hirta*	NA	Lv-Lv (1 ÷ 2)	Ointment	0.009	Expression
2	*A conyzoïdes*	*A adianthifolia*	NA	R-R (1 ÷ 1)	Sitz bath	0.013	Decoction
3	*A cordifolia*	*A hybridus*	NA	R-Rb (1 ÷ 2)	Drink	0.039	Maceration
4	*A senegalensis*	*B aegyptiaca*	NA	Lv-R (2 ÷ 1)	Liniment	0.027	Spraying
5	*E hirta*	*A conyzoides*	NA	Lv-Lv (2 ÷ 1)	Ointment	0.028	Expression
6	*B micrantha*	*C kilimandschari*	NA	Rb-Rb (2 ÷ 1)	Sitz bath	0.032	Decoction
7	*C febrifuga*	*D condylocarpon*	NA	Lv-R (1 ÷ 1)	Drink	0.032	Decoction
8	*F sur*	*K nyasica*	NA	R-Sb (1 ÷ 1)	Liniment	0.011	Pulverization
9	*L owariensis*	*M indica*	NA	Lv-Lv (2 ÷ 1)	Ointment	0.014	Pulverization
10	*M tomentosa*	*M myristica*	NA	Lv-Rb (1 ÷ 1)	Liniment	0.016	Pulverization
11	*O fimbriatum*	*P curatellifoli*	NA	Rb-R (2 ÷ 1)	Liniment	0.026	Spray
12	*P angolensis*	*P thonningii*	NA	Lv-Rb (2 ÷ 1)	Liniment	0.044	Spray
13	*P angolensis*	*S cordatum*	*M myristica*	Lv-Rb-Rb (1 ÷ 2 ÷ 1)	Liniment	0.013	Pulverization
14	*T riparia*	*G amygdalinum*	*E hirta*	Lv-Lv-Lv (1 ÷ 2 ÷ 1)	Ointment	0.032	Expression
15	*P curatellifolia*	*A adianthifolia*	*P guajava*	Lv-Lv-Lv (1 ÷ 2 ÷ 2)	Sitz bath	0.033	Maceration
16	*B micrantha*	*K nyasica*	*E hirta*	Lv-Lv-Lv (1 ÷ 2 ÷ 2)	Sitz bath	0.035	Decoction

Legend *L* Leave, *R* Root, *Rb* Root bark, *Sb* Stem bark. The unit of raw material (plant organ) intake is the handshake. *NA* Not applicable, *UP* used part

lead to the accumulation of beneficial phytochemicals [185]. (iii) They are more readily dried and ground than other plant parts, which renders them more convenient for preparing extracts and medicines [185]. (iv) They are more sustainable as they can be harvested without killing the plant, allowing for continuous use and conservation of plant species [184].

In traditional medicine, the preparation of a medicinal recipe through the use of a decoction offers several advantages. Firstly, it is an optimal method for extracting active compounds that are stable at high temperatures. Secondly, the process does not necessitate the use of complex or expensive equipment, thereby facilitating its widespread applicability. Thirdly, the process is relatively straightforward and does not necessitate the involvement of a trained operator, which is advantageous in traditional settings. Fourthly, it is a cost-effective method that can be readily implemented in a domestic setting. Nevertheless, decoctions are unsuitable for the extraction of heat-sensitive constituents, as the boiling process may result in their degradation [186, 187]. Nevertheless, it is necessary to await the results of biological experiments before a proper assessment of the choice of organ and method of preparation used for each recipe can be made.

In contrast to previous ethnobotanical studies conducted in the region, which predominantly reported oral administration [40–42], our study primarily focused on topical applications. This is consistent with previous

Table 5 Other pathologies treated by plants inventoried during surveys

Indications	Nt ($n=76$)	MCI ($n=100$)	Nc	CI ($n=1604$)	species
Acne	1	0.01	48	0.030	*Aloe vera*
Amoebiasis	4	0.04	12	0.007	*Ficus sur, Khaya nyasica, Pentaclethra macrophylla, Psorospermum febrifugum*
Anemia	4	0.04	1	0.001	*Alchornea cordifolia, Ficus stuhlmannii, Ficus sur, Khaya nyasica*
Asthma	3	0.03	6	0.004	*Coleus kilimandschari, Cyathula prostrata, Passiflora foetida*
Bleeding	2	0.02	18	0.011	*Aspilia kotschyi, Psidium guajava*
Bronchitis	5	0.05	2	0.001	*Indigofera capitata, Luffa cylindrica, Musa paradisiaca, Sida rhombifolia, Strychnos spinosa*
Burns	1	0.01	48	0.030	*Aloe vera*
Chicken pox	1	0,01		0,000	*Crossopteryx febrifuga*
Cholera	1	0.01	1	0.001	*Khaya nyasica*
Cirrhosis of the liver	1	0,01	1	0,001	*Phyllanthus amarus*
Clogged tubes	1	0.01	1	0.001	*Adansonia digitata*
Colic	9	0.09	439	0.274	*Annona senegalensis, Cyathula prostrata, Ficus stuhlmannii, Mangifera indica, Moringa oleifera, Myrianthus arboreus, Pterocarpus angolensis, Syzygium cordatum, Terminalia mollis*
Constipation	9	0.09	247	0.154	*Aloe vera, Costus afer, Myrianthus arboreus, Phyllanthus muellerianus, Crossopteryx febrifuga, Psidium guajava, Terminalia mollis, Tetradenia riparia, Zingiber officinale*
Convulsion	3	0.03	1	0.001	*Newbouldia laevis, Syzygium cordatum, Zanha africana*
Cough	9	0.09	126	0.079	*Albizia adianthifolia,Asparagus africanus, Ficus stuhlmannii, Ficus sur, Indigofera capitata, Memecylon flavovirens, Ocimum gratissimum, Symphytum officinale, Tetradenia riparia*
Cyst	2	0.02	7	0.004	*Croton oligandrus, Khaya nyasica*
Depression	2	0.02	1	0.001	*Sida rhombifolia, Strychnos spinosa*
Diabetes	15	0.15	721	0.450	*Alchornea cordifolia, Baccharoides adoensis, Balanites aegyptiaca, Crossopteryx febrifuga, Dalbergia lactea, Droogmansia munamensis, Entada abyssinica, Ficus brachypoda, Gymnanthemum amygdalinum, Mangifera, indica, Phyllanthus amarus, Syzygium cordatum, Vernonia amygdalina, Vernonia shirensis, Zanha africana*
Dysentery	9	0.09	134	0.084	*Alchornea cordifolia, Euphorbia hirta, Droogmansia munamensis, Ficus sur Forssk, Khaya nyasica, Mangifera indica, Musa paradisiaca, Ocimum gratissimum, Senna alata*
Dyspnea	1	0.01	4	0.002	*Indigofera capitata*
Edema	1	0.01	1	0.001	*Pentadiplandra brazzeana*
Epilepsy	4	0.04	12	0.007	*Ageratum conyzoïdes, Newbouldia laevis, Syzygium cordatum, Pterocarpus angolensis*
Tiredness	3	0.03	124	0.077	*Citrus limon, Albizia adianthifolia, Cyperus articulatus*
Fever	9	0.09	494	0.308	*Baccharoides adoensis, Balanites aegyptiaca, Diplorhyncus condylocarpon, Mesosphaerum suaveolens, Pericopsis angolensis, Senna alata, Sida rhombifolia, Strychnos spinosa, Vernonia shirensis*
Flu	2	0.02	13	0.008	*Baccharoides adoensis, Phyllanthus amarus*
Gastric ulcer	2	0,02	48	0,030	*Aloe vera, Ficus brachypoda*
Gastritis	2	0.02	13	0.008	*Aframomum melegueta, Albizia adianthifolia, Annona senegalensis*
Gastrointestinal disorders (GID)	31	0.31	997	0.622	*Aframomum melegueta, Ageratum conyzoides, Alchornea cordifolia, Alstonia boonei, Anarcardium occidentale, Asparagus africanus, Costus afer, Crossopteryx febrifuga, Cyathula prostrata, Dalbergia lactea, Diplorhyncus condylocarpon, Euphorbia hirta, Ficus brachypoda, Ficus stuhlmannii, Gardenia ternifolia, Khaya nyasica, Mangifera indica, Monodora myristica, Moringa oleifera, Musa paradisiaca, Myrianthus arboreus, Parinari curatellifolia, Pericopsis angolensis, Plumbago zeylanica, Psidium guajava, Psorospermum febrifugum, Senna alata, Terminalia mollis, Tetradenia riparia, Vernonia shirensis, Zingiber officinale*
Headach	3	0.03	25	0.016	*Entada abyssinica, Monodora myristica, Vernonia shirensis*
Hepatitis	3	0.03	108	0.067	*Ageratum conyzoïdes, Phyllanthus muellerianus, Zingiber officinale*
Hernias	1	0.01	10	0.006	*Mesosphaerum suaveolens*

Table 5 (continued)

Indications	Nt ($n=76$)	MCI ($n=100$)	Nc	CI ($n=1604$)	species
Hypertension	5	0.05	159	0.099	*Albizia adianthifolia, Bridelia ferruginea, Gardenia ternifolia, Monodora myristica, Parinari curatellifolia*
Indigestion	1	0.01	5	0.003	*Hibiscus cannabinus*
Infections	1	0.01	10	0.006	*Garcinia punctata*
Inflammations	6	0.06	217	0.135	*Baillonella toxisperma, Pentaclethra macrophylla, Phyllanthus amarus, Sida rhombifolia, Strychnos spinosa, Symphytum officinale*
Intestinal worms	5	0,05	134	0,084	*Ficus sur, Pterocarpus angolensis, Khaya nyasica, Memecylon flavovirens, Pentaclethra macrophylla*
Itching	1	0.01	1	0.001	*Cylicodiscus gabunensis*
Jaundice	2	0.02	10	0.006	*Balanites aegyptiaca, Ficus sur*
Joint pain	1	0.01	1	0.001	*Capsicum frutescens*
Kidney failure	2	0.02	2	0.001	*Baillonella toxisperma, Canarium schweinfurthii*
Leprosy	1	0.01	3	0.002	*Anarcardium occidentale*
Lumbago	2	0.02	1	0.001	*Baillonella toxisperma, Entada abyssinica*
Malaria	13	0.13	258	0.161	*Costus afer, Crossopteryx febrifuga, Entada abyssinica, Gardenia ternifolia, Gymnanthemum amygdalinum, Khaya nyasica, Mesosphaerum suaveolens, Parinari curatellifolia, Pentaclethra macrophylla, Psorospermum febrifugum, Syzygium cordatum, Vernonia amygdalina, Zanha africana*
Measles	1	0.01	4	0.002	*Crossopteryx febrifuga*
Meningitis	3	0.03	3	0.002	*Antrocaryon klaineanum, Citrus lemon, Monodora myristica*
Meningitis	1	0.01	5	0.003	*Syzygium cordatum*
Muscle pain	1	0.01	1	0.001	*Capsicum frutescens*
Muscle spasm	2	0.02	1	0.001	*Landolphia owariensis, Passiflora foetida*
Muscular weakness	1	0.01	3	0.002	*Uapaca guineensis*
Nasal congestion	1	0.01	5	0.003	*Memecylon flavovirens*
Nervousness	1	0.01	1	0.001	*Passiflora foetida*
Obesity	1	0.01	2	0.001	*Hibiscus cannabinus*
Osteomyelitis	1	0.01	10	0.006	*Thonningia sanguinea*
Painful periods	1	0.01	1	0.001	*Antrocaryon klaineanum*
Parasites	1	0.01	1	0.001	*Pentaclethra macrophylla*
Pneumonia	2	0.02	2	0.001	*Dalbergia lactea, Pentadiplandra brazzeana*
Rheumatism	8	0.08	38	0.024	*Asparagus africanus, Capsicum frutescens, Crossopteryx febrifuga, Costus afer, Erigeron bonariensis, Erigeron sumatrensis, Markhamia tomentosa, Plumbago zeylanica*
Rhinitis	2	0.02	1	0.001	*Luffa cylindrica, Ocimum gratissimum*
Schistosomiasis	2	0.02	1	0.001	*Antidesma venosum, Gardenia ternifolia*
Sexual dysfunction	9	0.09	478	0.298	*Aidia micrantha, Albizia adianthifolia, Ficus sur, Garcinia punctata, Indigofera capitata, Indigofera capitata, Moringa oleifera, Senna alata, Uapaca guineensis*
Sexual Transmitted Infections	14	0.14	917	0.572	*Ageratum conyzoïdes,Annona senegalensis,Antidesma venosum, Antrocaryon klaineanum, Asparagus africanus, Bridelia ferruginea, Euphorbia hirta, Ficus brachypoda, Ficus stuhlmannii, Ficus sur, Garcinia punctata, Gymnanthemum amygdalinum, Syzygium cordatum, Vernonia amygdalina*
Sickle cell disease	1	0.01	1	0.001	*Bridelia ferruginea*
Sinusitis	2	0.02	1	0.001	*Albizia adianthifolia, Luffa cylindrica*
Skin infections	1	0.01	6	0.004	*Markhamia tomentosa*
Snake bite	1	0.01		0.001	*Diplorhyncus condylocarpon*
Sore throat	1	0.01	3	0.002	*Asparagus africanus*
stretch mark	2	0,02	31	0,019	*Erigeron bonariensis, Erigeron sumatrensis*
Swollen feet Edema	2	0.02	2	0.001	*Cylicodiscus gabunensis, Cymbopogon citratus*
Thrombosis	1	0.01	4	0.002	*Coleus kilimandschari*

Table 5 (continued)

Indications	Nt ($n=76$)	MCI ($n=100$)	Nc	CI ($n=1604$)	species
Tooth decay	6	0.06	49	0.031	*Albizia adianthifolia, Aloe vera, Bridelia ferruginea, Dalbergia lacteal, Gardenia ternifolia, Syzygium cordatum*
Tuberculosis	2	0.02	1	0.001	*Bridelia ferruginea, Ficus brachypoda*
Typhoid	2	0.02	1	0.001	*Alstonia boonei, Syzygium cordatum*
Vertigo	1	0.01	21	0.013	*Cyperus articulatus*
Weight loss	1	0.01	4	0.002	*Coleus kilimandschari*
Wounds	11	0.11	963	0.600	*Aframomum melegueta, Alchornea cordifolia, Aspilia kotschyi, Bridelia ferruginea, Diplorhyncus condylocarpon, Droogmansia munamensis, Ficus brachypoda, Markhamia tomentosa, Mesosphaerum suaveolens, Musa paradisiaca, Phyllanthus muellerianus*

Nt Number of taxa, *Nc* Number of citations. *MCI* Medical Capability Index. The Medical Capability Index (MCI) refers to a community's potential to manage a disease, *AHT* Arterial hypertension, *HIV* human immunodeficiency virus, *STI* Sexually transmitted infections

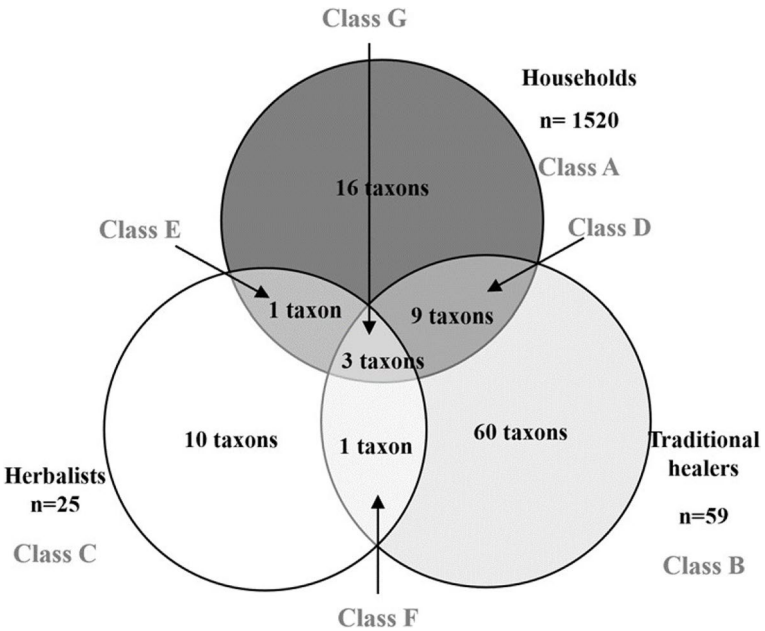


Fig. 9 Distribution of plants inventoried across the 3 categories of people surveyed. The five pathologies for which the resource persons in this study have the most taxa, in addition to hemorrhoids, are GID (31 taxa), diabetes (15 taxa), sexually transmitted infections (STI; 14 taxa), malaria (13 taxa), and wounds (11 taxa) (Table 5)

studies on plants purported to have anti-hemorrhoidal properties [30, 32, 34]. This is particularly evident when considering the localized nature of hemorrhoidal diseases.

The majority ($n=101$) of the recipes documented in this study utilize a single plant, a finding consistent with several ethnobotanical studies conducted in Katanga [37, 38, 40]. However, there are also recipes resulting from mixtures of two or three taxa ($n=16$), a pattern observed in other ethnobotanical studies conducted in the region [42, 165]. While the combination of plants may be based on the search for a certain synergy, there is a risk of increasing the risk of drug interactions and collateral effects. Nevertheless, it is of the utmost importance to remain vigilant during biological experiments in order to ensure that each recipe is duly evaluated.

Knowledge of Hemorrhoidal Diseases

In this survey, respondents referred to hemorrhoidal pathologies hemorrhoidal diseases in Swahili as "*Kilonda ntumbu*," which translates to "the wound of the belly." This term is linked to the perception among the local population that hemorrhoidal diseases originate from a specific type of diet, which is reflected in the allusion to the stomach.

Table 6 Socio-demographic characteristics of people consulted

Category	Household ($n=1520$)		Herbalists ($n=25$)		THs ($n=59$)		Total ($n=1604$)
	Nc	%	Nc	%	Nc	%	%
Age							
20–30	280	18.42	7	28.00	11	18.64	18.58
30–40	672	44.21	11	44.00	21	35.59	43.89
40–50	410	26.97	5	20.00	14	23.73	26.75
50–60	153	10.07	2	8.00	8	13.56	10.16
>60	5	0.33	0	0.00	5	8.47	0.62
Experience (Year range)							
0–5	149	9.8	6	24	10	16.9	10.3
6–10	105	6.9	7	28	9	15.3	7.5
11–15	1006	66.2	3	12	20	33.9	64.2
16–20	17	1,1	8	32	11	18.6	2.2
21–25	143	9.4	1	4	9	15.3	9.5
Profession							
Retailer	304	20,00	0	100.00	0	8.47	20.82
Civil servant	191	12.57	0	0.00	0	0.00	11.91
Liberal	320	21.05	0	0.00	0	67.80	22.44
Housekeeper	655	43.09	0	0.00	0	0.00	40.84
THs	00	000	0	0,00	59	100.00	3,67
Herbalist	0	0	25	100	0	0.00	1.56
Gender							
Female	907	59.67	17	68.00	4	6.78	57.86
Male	613	40.33	8	32.00	55	93.22	42.14
Residence							
Annex	210	13.82	5	20.00	15	25.42	14.34
Kamalondo	157	10.33	0	0.00	2	3.39	9.91
Kampemba	112	7.37	3	12.00	11	18.64	7.86
Katuba	243	15.99	3	12.00	7	11.86	1577
Kenya	198	13.03	4	16.00	5	8.47	12.91
Lubumbashi	347	22.83	4	16.00	9	15.25	22.4
Ruashi	253	16.64	6	24.00	10	16.95	16.77
Level of education							
None	587	38.62	8	32.00	8	13.56	37.59
Primary	542	35.66	12	48.00	35	59.32	36.72
Vocational	138	9.08	2	8.00	5	8.47	9.04
Secondary	239	15.72	3	12.00	11	18.64	15.77
University	18	1.18	0	0.00	0	0.00	1.12

THs traditional healers, *NC* Number of citation, % Percentage

The fact that more than 65% of subjects mentioned symptoms typically associated with hemorrhoidal diseases (Table 6) suggests that the people interviewed were familiar with the pathology for which they mentioned healing plants. This finding is consistent with previous studies that have demonstrated the prevalence of hemorrhoids in Lubumbashi [31].

Other pathologies treated by inventoried plants

In the Democratic Republic of the Congo (DRC), the 10 most deadly pathologies are in order of importance, as follows: malaria, tuberculosis, lower respiratory infections, neonatal disorders, diarrheal diseases, stroke, ischemic heart disease, road injuries, hypertensive heart disease, and cirrhosis and other chronic liver diseases

[176]. Among the most deadly pathologies, the plants inventoried in this study were cited in the treatment of diarrhea (31 taxa), malaria (10 taxa), lower respiratory infections (7 taxa), and tuberculosis (2 taxa) (Table 4). It can be reasonably concluded that the resource persons consulted during this study have plant resources capable of coping with at least four of the ten most deadly pathologies in the Democratic Republic of the Congo. This provides indirect evidence of the capacity of traditional medicine in Lubumbashi to address the major health challenges facing the DRC.

In addition to hemorrhoidal diseases, the resource persons have identified at least ten taxa for each of the following five pathologies: In descending order of importance, these are gastrointestinal disorders, diabetes, sexually transmitted infections, malaria, and wounds (Table 4). The availability of multiple taxa to treat a given pathology indicates the community's capacity to address the condition in question. Given that traditional medicine is culturally specific, this can provide insight into the particular management approaches of a given community in the context of specific pathologies.

The socio-demographic characteristics of the interviewees

In contrast to previous ethnobotanical studies conducted in Lubumbashi, this study interviewed a greater proportion of women than men [40–42, 165]. This discrepancy can be attributed to the fact that, unlike the present study, the aforementioned studies were conducted among practitioners of traditional medicine, predominantly men. In contrast, the present study's account was conducted with the general population, which, like the national population in the 40–60 age range, is predominantly female according to Index Mundi in 2023 (https://www.indexmundi.com). Furthermore, the fact that the majority of informants were met in households may also explain the preponderance of women. Indeed, in households, the probability of encountering women during surveys is higher than that of encountering men, particularly given that in our society, household tasks are typically performed by women. Almost two-thirds of those surveyed had experience with the use of medicinal plants to treat their ailments, which suggests that traditional medicine plays a role in the study area. These data are consistent with a study conducted in the region on the practice of traditional medicine, which found that 79.4% of respondents had utilized traditional medicine to address their health or social concerns [31]. Moreover, several of the plants referenced in this study have been identified as anti-hemorrhoidal agents in other regions, and some have been demonstrated to possess indirect anti-hemorrhoidal properties (Table 2). These findings should enhance the credibility of the information presented in the present study.

It is essential to consider the constraints of this study when interpreting its findings. Firstly, there is a paucity of data concerning the precise manner in which the plants in question were utilized for the treatment of a range of pathologies, with the exception of hemorrhoidal diseases. Secondly, there is a dearth of knowledge regarding the practices that could potentially safeguard biodiversity despite the use of the aforementioned plants. Finally, there is an absence of evidence concerning alternative natural resources utilized by the Lubumbashi population for the treatment of hemorrhoidal diseases.

Conclusion

The findings of this study indicate that the population of Lubumbashi (DRC) employs a diverse range of taxa to treat hemorrhoidal diseases, particularly internal hemorrhoids. However, these plants offer considerable potential for managing a wide range of other pathologies, including gastrointestinal disorders, wounds, sexually transmitted infections, and diabetes. Among the taxa employed, some are endemic to the study area and specific to the region. Currently, studies are being conducted to assess the efficacy of these plants in the management of hemorrhoidal diseases. Nevertheless, further ethnopharmacological studies are required to validate the other properties of these plants. Such studies could result in the development of improved traditional medicines or the identification of new drug candidate molecules. These findings provide compelling evidence to motivate self-sufficient communities to explore sustainable methods of conserving these plants for the collective benefit of biodiversity conservation in the Miombo.

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Abbreviations

TA	Tropical Africa
NEA	North-East Africa
CA	Central Africa
SA	Southern Africa
MA	Madagascar
EA	East Africa
NA	North Africa
WE	West Africa
MCI	Medical Capability Index
CI	Citation index
GT	Geographical type
UP	Used part
MT	Morphological type
FU	Form of use
MUI	Medicinal use index
TH	Type of hemorrhoid
WP	Whole plant
Rb	Root bark
Sb	Stem Bark
Lv	Leaves
Sd	Seed

Fr	Fruit
Rz	Rhizome
NH	Herbarium number
FU	Form of use
MUI	Medicinal use index
THD	Type of hemorrhoid diseases
Nc	Number of citations
Nt	Number of taxa

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

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Authors' contributions
BCV designed, coordinated this research and drafted the manuscript. MM, MBH and BCV carried out experiments and data analysis. BCV, BAS, ONP and LSJB conceived of the study, and participated in research coordination. The all authors read and approved the final manuscript.

Availability of data and materials
Some of the data supporting the results of this study are available in the Supplementary Material to this article, and the rest are incorporated directly into the study.

Data availability
The data that supports the findings of this study are available in the supplementary material of this article.

Declarations

Ethics approval and consent to participate
Ethical review was provided by the Department of Pharmacology – Faculty of Pharmaceutical Sciences – University of Lubumbashi (FSPUNILU-DP-BD-022022). All participants provided verbal informed consent to participate in the study.

Consent for publication
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Competing interests
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