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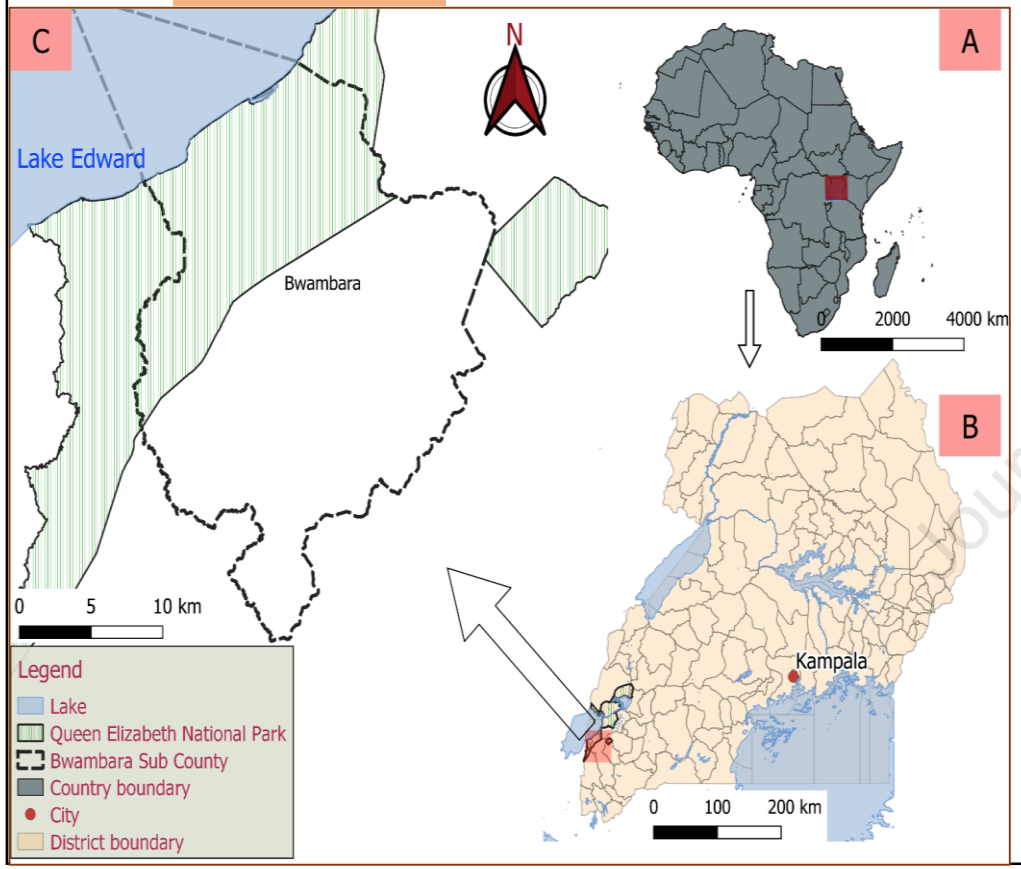
Study site



Data Collection

Results

- 39 ‘African’ diseases mentioned
- 67 medicinal plant species belonging to 28 families and 62 genera
- Leaves were the most used plant part
- High FIC for neurological disorders, hence high prevalence

Medicinal Plants Used to Treat 'African' Diseases by the Local Communities of Bwambara Sub-county in Rukungiri District, Western Uganda

Hannington Gumisiriza[a,*], Crispin Duncan Sesaazi[b], Eunice Apio Olet[c], Owen Kembabazi[d], Grace Birungi[a]

[a]*Department of Chemistry, Mbarara University of Science and Technology, P.O Box 1410, Mbarara, Uganda*

[b]*Department of Pharmaceutical Sciences, Mbarara University of Science and Technology, P.O Box 1410, Mbarara, Uganda*

[c]*Department of Biology, Mbarara University of Science and Technology, P.O Box 1410, Mbarara, Uganda*

[d]*Department of Marketing and International Business, Makerere University Business School, P.O Box 1337, Kampala, Uganda*

*Corresponding author; E-mail address: hgumisiriza@must.ac.ug Tel: +256-773-715 644

ABSTRACT

Ethnopharmacological relevance: In Africa, traditional medicine encompasses a diverse range of practices, including herbalism and spiritualism, where some diseases are believed to be "African" since they can only be traditionally treated. Indigenous knowledge on the management of "African" diseases using medicinal plants is still handed down orally from generation to generation by tribal societies of tropical Africa, and with the rapid westernization of these societies there is a pressing need to record local knowledge before it is lost forever.

Aim: This study documented medicinal plant species associated with the management of "African" diseases by the local communities of Bwambara sub-county in Rukungiri district, Western Uganda.

Methods: A cross-sectional study was conducted using semi-structured questionnaires and interviews. The data collected included names of plant species, plant parts used, diseases treated,

methods of preparation, and mode of administration of the herbal remedies. A total of 196 informants participated in the study. Data were analyzed and presented using descriptive statistics and the Informant consensus factor.

Results: We documented 67 medicinal plant species distributed over 27 families and 62 genera. The most commonly reported species belong to Asteraceae family. The most frequently used medicinal species were *Chenopodium opulifolium* (27), *Sesbania sesban* (26), *Thevetia peruviana* (25), *Leonotis nepetifolia* (23), *Momordica foetida* (23), *Euphorbia hirta* (21) and *Cassia mimosoides* (20). Leaves were the most commonly used plants parts and decoctions were the main method of preparation. Water was the main medium used for the preparation of the remedies which were administered orally while petroleum jelly was the main medium for those which were used as ointments. The medicinal plant species reported are used to treat 39 conditions which were clustered into 10 International Classification of Primary Care (ICPC) disease categories. There is a high degree of consensus among the informants on which medicinal plant species they use for different diseases especially disorders in the following categories: neurological (FIC = 0.90), general and unspecified (FIC = 0.87), digestive (FIC = 0.86) and female genital (FIC = 0.82).

Conclusion: Local communities of Bwambara sub-county in Rukungiri district, Western Uganda use a rich diversity of medicinal plant species in the management of various "African" diseases. Therefore, collaboration between users of medicinal plants and scientists is paramount, to help in the discovery of new drugs based on indigenous knowledge.

Keywords: African traditional medicine, Medicinal plants, "African" diseases, Bwambara, Western Uganda

1. Introduction

Traditional healing practices existed in Africa long before conventional medicine, and attempts by colonial governments and early religious missionaries to suppress it did not succeed (UNAIDS, 2002; Agbor & Naidoo, 2016), since more than 85% of the population in Africa still

relies on herbal medications for their healthcare needs (Jamshidi-Kia et al., 2018), and, at times, they are the only therapy that subsists (Mahomoodally, 2013). Although African traditional religion is not against the Western medical way of treatment or healing process, its followers believe that there are some diseases that Western medicine cannot treat (White, 2015). Such diseases are considered to be treated using African traditional medicine only and are referred to as "African" diseases (Green, 1992, UNAIDS, 2002). The term "African" diseases is directly translated as "*Endwara z'ekiraguju"* in Runyankole/Rukiga (the most used dialect in the study area), literally meaning "*diseases of the black people*". Unlike in Western medicine where diagnosis depends on empirical evidence, in Africa, good health is not a subjective affair (Omonzejele, 2008). Health is usually understood in terms of one's relationship with one's ancestors and adherence to the values and norms of society (Iroegbu, 2005). As an untapped reservoir of knowledge, philosophy and history, traditional medicine does not only offer the possibility of cures but it also provides a national heritage and a means of linking the land and its people (Agbor & Naidoo, 2016). According to findings by UNAIDS (2002) in Uganda, it has been realized that Western medicine offers a very narrow and incomplete approach and that "even with its limitations, traditional medicine is more complete in its response to the broad definition of health". Additionally, a previous study in Uganda reported that traditional medicine is as effective as Western treatment, if not more so, in treating herpes zoster (Homsy et al., 1999). Thus, to understand and appraise traditional and herbal medicines, both the social and natural sciences must be incorporated (Leonti & Casu, 2013).

The use of medicinal plants as a fundamental component of the African traditional healthcare system is possibly the most ancient and assorted of all therapeutic systems (WHO, 2004; WHO, 2007; Mahomoodally, 2013). The knowledge of medicinal plants and their uses in Uganda could be traced to early civilization (Kakooko & Kerwagi, 1996). Traditional healers have been working together with the government of Uganda (De Coninck, 2016), that saw the passing of the Traditional and Complimentary Medicines Bill, 2019 (Ministry of Health, 2019). This study focused on Bwambara sub-county in Rukungiri district, due to its location within the Western Rift Valley (RFDA, 2009). The flat savannah, described as an ecoregion or biodiversity hotspot, has been recognized by UNESCO as a world bio-sphere reserve (http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences /biosphere-reserves/africa/). The Western Rift Valley has a very strong cultural heritage and a rich

biodiversity, with many species endemic to the region (Katende et al., 1995; RFDA, 2009; Hartter et al., 2012). Additionally, previous ethnobotanical studies in Uganda have reported use of medicinal plants in the treatment of physical ailments (Ssegawa and Kasenene, 2007; Kamatenesi-Mugisha et al., 2008; Tabuti et al., 2010; Namukobe et al., 2011; Tabuti et al., 2012; Asiimwe et al., 2014; Nalumansi et al., 2014; Kakudidi et al., 2016; Tugume et al., 2016; Gumisiriza et al., 2019), but there is paucity of data on medicinal plants used to manage 'African' diseases.

Bwambara sub-county is inhabited by various ethnic groups, including Bakiga, who migrated from the overpopulated Kigezi by the 1950s and form the dominant ethnic group; Bahororo, Banyarwanda, Banyankole and Banyabutumbi. These ethnic groups practice subsistence farming and the area is still undeveloped. Bwambara is the most poverty-stricken area in Rukungiri district, with the highest poverty pockets (RFDA, 2009). Bwambara sub-county has poor service delivery, including limited access to primary healthcare services. It has only five health centers (both public and private) serving 79 villages (RDDP, 2015) with a total population of 28,875 people (UBOS, 2016), implying that people have to cover long distances to access these services (UBOS, 2017). These limitations, together with poor stocking of public health facilities, have put a big constraint on health service delivery in this area and in Uganda at large. In Uganda, the ratio of traditional healers and medical doctors to population is 1:200 and 1:33,000 respectively (De Coninck, 2016). Moreover, traditional healers provide client-centered, personalized healthcare that is tailored to meet the needs and expectations of their patients, which makes them strong communication agents for health and social issues (UNAIDS, 2002). They also have greater credibility than do health workers, especially with respect to social and spiritual matters (White, 2015). The extensive use of traditional medicine, especially medicinal plants, in rural Uganda is also attributed to limited access to medical facilities in far-flung locations; inadequate medicines and other medical supplies; shortage and low motivation of human resource at the available medical facilities; poverty, thus inability to afford Western medicine; socio-cultural barriers; and wide acceptance of traditional medicines (Kamatenesi et al., 2011; Nalumansi et al., 2014). This study aimed at answering three key questions; (i) Which "African" diseases are considered to be exclusively traditionally treated by the people of Bwambara sub-county? (ii) What are the medicinal plants used to treat these diseases? (iii) How are these medicinal plants used to treat these diseases?

2. Materials and methods

2.1. Study area

The study was carried out in Bwambara sub-county in Rukungiri district (Figure 1). Bwambara lies about 400 km west of the capital, Kampala and has a population of approximately 28,875 (UBOS, 2016), with more than 85% living in rural areas (RFDA, 2009).

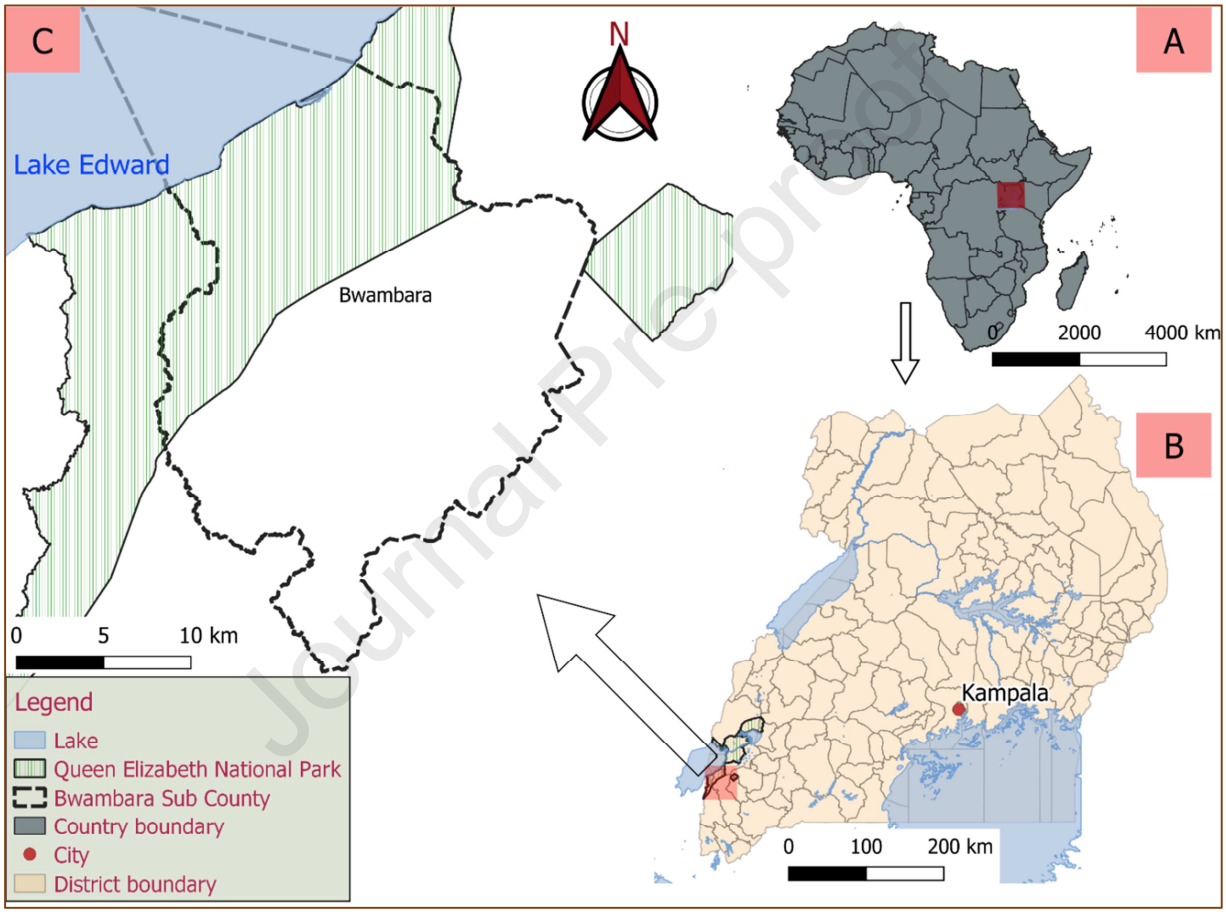


Figure 1: Map showing (A) Location of Uganda in Africa, (B) Location of Rukungiri in Uganda, (C) Location of Bwambara sub-county

The study area receives a bimodal pattern of annual rainfall, with a long rainy season between September and December, and a short rainy season from March to May (Lal et al., 2015). Land that is not under cultivation is covered by three main vegetation zones: forests, forest/savanna mosaic, and grass savanna (RFDA, 2009). Towards Queen Elizabeth National Park, savanna

grass is dominant. Bwambara sub-county is one of the few areas in the country that is endowed with a great variety of flora and fauna, found mainly in Queen Elizabeth National Park, Kigezi Wildlife Reserve and Maramagambo Central Forest Reserve (RFDA, 2009).

2.2. Ethical considerations

Ethical approval for this study was obtained from Mbarara University of Science and Technology Research Ethics Committee (MUST-REC number; 19/08-17) and the Uganda National Council for Science and Technology (UNCST number; NS34ES). Approval was also sought from the Resident District Commissioner (RDC) of Rukungiri District and the chairman Local Council I (LCI) of each village visited. The informants gave written informed consent before enrollment into the study as required by the International Society of Ethnobiology, (2006). The names and addresses of participants were excluded to maintain confidentiality.

2.3. Data collection

The study involved 196 adult respondents (≥ 18 years) who participated voluntarily, between January and July 2018. Herbalists and elderly people known to treat patients using herbal medicine were identified with the help of local council representatives. Using semi-structured questionnaires, homesteads and individual herbalists were visited and asked to provide information regarding the use of medicinal plants to treat diseases which are believed to be "African". Additional information was collected through semi-structured interviews following standard procedures as described by Martin, (1995). Runyankole/Rukiga was used during the survey since it is the most commonly used local language in the study area. Recorded interview data were later translated into English. A pilot study of the questionnaire involving participants from the same area was undertaken to determine the face validity of the tool and correct ambiguities. All the participants who took part in the pilot study were excluded from the final study.

Field visits with informants were conducted to collect voucher specimens of the medicinal plant species following standard procedures as described by Martin (1995) and Weckerle et al. (2018). The collected medicinal plant species were identified by a botanist at Mbarara University of Science and Technology and Makerere University Herbarium, where voucher specimens were deposited for future reference. The scientific plant names were given

according to the Plant List (www.theplantlist.org) and International Plant Name Index (www.ipni.org) databases. The family names of the plant species were cross-checked with the angiosperm phylogeny group (APG IV) (www.gbif.org).

2.4. Disease categories

The reported diseases were categorized using the International Classification of Primary Care, second edition (ICPC-2) (http://www.who.int/classifications/icd/adaptations/icpc2/en/). Being diseases which are considered traditionally treated, some conditions could not match the broad categorization. Therefore, some modifications were made in order to categorize all the mentioned diseases. The categorization resulted in a total of 10 disease categories: general and unspecified (A); blood, blood forming organs and immune mechanism (B); digestive (D); eye (F); musculoskeletal (L); neurological (N); respiratory (R); skin (S); urological (U) and female genital (X).

2.5. Data analysis

Descriptive statistics such as use reports, frequencies and percentages, and the Informant consensus factor (FIC) were used to analyze and present the ethnobotanical data. The FIC value, which is used as an indicator of the level of agreement on use of medicinal plant species on particular ailments, was calculated using the Trotter and Logan (1986) formula; FIC = $(N_{ur} - N_t)/(N_{ur} - 1)$. Where N_{ur} = the number of use reports from informants for a particular plant use category and N_t = number of taxa or species that use category for all informants. FIC values range from 0 to 1, where 1 indicates the highest level of informant consensus or shows that informants exchange indigenous knowledge on use of medicinal plants and/or use a well-defined selection criterion in the community (Heinrich, et al., 1998).

3. Results and discussion

3.1. Socio-demographic characteristics

One hundred and ninety six informants participated in the study which involved more females than males (Table 1). This finding is in agreement with Nalumansi et al. (2014) who found that 80% of the mothers were the most important healthcare providers, who used

traditional medicine to meet their own healthcare needs and those of their children. A related study also reported more women participants due to their role in conserving indigenous knowledge of nutri-medicinal plants as home caretakers, and managing diseases among children (Asiimwe et al., 2014).

Table 1: Socio-demographic characteristics of participants

Characteristic	**Frequency (n = 196)**	**Percentage (%)**
Mean age:		
	46.3 (±16.9)	
Sex:		
Female	114	58.2
Male	82	41.8
Age group (years):		
<35	52	26.5
≥35	141	71.9
Education:		
None	50	25.5
Primary	114	58.2
Above primary	28	14.3
Marital status:		
Married	152	77.6
Not married	40	20.4
Occupation:		
Peasant	170	86.7
Others	17	8.7
Ethnicity:		
Bakiga	168	85.7
Others	25	12.8

Ages of the informants ranged from 18 to 85 years, with mean age of 46.3 (±16.9) years, of which the majority 71.9 % were ≥35 years old as compared to 26.5 % aged < 34 years (the

youth). The presence of fewer youth in the study could be attributed to rural-urban migration in search for white collar jobs, as their engagement in agriculture which is the main activity in rural areas has declined (Kristensen & Birch-Thomsen, 2013; Food and Agriculture Organization of the United Nations (FAO), 2017). In addition, much as the youth constitute a majority of the Ugandan population with 77 % being below 30 years (Daumerie & Madsen, 2010), there is an inclination towards ownership of natural resources such as land by the older generation, causing the youth to have limited or no access to productive resources, which drives them to seek employment opportunities elsewhere (International Organization for Migration (IOM), 2015). The current study findings are, however, in contrast with a previous ethnobotanical study in Uganda which reported majority (88.5 %) of the participants to be less than 34 years (Nyeko et al., 2016). The difference could be due to the fact that the current study was conducted to document the use of medicinal plants among the general local communities while the former was purposively among mothers. The study revealed that 58.2 % of the informants had attained at least level one of primary education, 14.3 % had attained education above primary level, while 25.5 % did not attain any formal education. There are 27 primary schools and only two secondary schools in the study area, which partly justifies why the majority of informants had attained some level of primary education. The majority of the informants were peasants who practice subsistence farming. The current study is in agreement with the UBOS (2016) which reported that most of the households, about one in every seven, obtained their livelihood from subsistence farming with a majority in rural areas. More than 90 % of the population in Rukungiri district are engaged in farming (Uganda National Roads Authority (UNRA), 2013).

3.2. ‘African’ diseases traditionally treated using medicinal plants by the local communities of Bwambara sub-county, Western Uganda

Most of the informants 68.9 % (135/196) believed that there are diseases which can only be traditionally treated using medicinal plants, but never with Western medicine. This is in agreement with White (2015) who reported that the followers of African traditional religion believe that there are some diseases that Western medicine cannot treat. Table 2 shows such diseases as reported by informants. In the current study, informants asserted that such diseases are always fatal whenever Western medicine is used, and especially when injections are used.

They further stressed that since such diseases are “African”, they are not known to the Western world at all, and, therefore, they cannot be treated using Western medicine. More so, some diseases lack English/medical names since they are of African origin. Much as some of the mentioned diseases have a clear aetiology in conventional medicine, such as malaria, some of the names were simply given basing on descriptions of main characteristic symptoms experienced by the patients. In fact, some diseases have got their local names linked to some supernatural forces.

Table 2: “African” diseases treated using medicinal plants by local communities of Bwambara sub-county

Disease name	**Local name**	**Freq. (*n = 135)**	**Percentage (%)**	**No. MPs**
Febrile seizures	Ebiyaga/ebihungu	26	19.3	8
Helminthiasis	Enjoka z'omunda	17	12.6	9
Witchcraft	Oburogo	15	11.1	3
Strange traditional diseases	Amahano/amahaze	14	10.4	7
Allergy	Enfumbi	14	10.4	3
Cervical cancer	Mutigwanda	14	10.4	5
Colic pain	Ekintu	13	9.6	9
Stomach wounds linked to African traditions	Birondatumbo	11	8.1	6
Disease that affects central nervous system and can lead to a hump if untreated	Enkuriti	8	5.9	4
Pancreatic disease	Ekikuruma	6	4.4	2
Oath	Endahiro	6	4.4	5

Epilepsy	Enstimbo	6	4.4	2
Ulcers	Ekishansha	5	3.7	3
Breastbone disease	Akameeme	4	3.0	2
False teeth	Ebyiino	4	3.0	1
Burns/diseases caused by traditions of twins	Eibugane/obuhasha	4	3.0	6
Sharp pains in the abdomen	Emiti y'enda	1	0.7	1
Colic pains in children	Engundu	1	0.7	1
Migraine	Akasanga	2	1.5	1
Cellulitis	Entunika	4	3.0	2
Malaria	Omushwija	3	2.2	1
Tinea corporis	Ebisente	3	2.2	2
Chickenpox	Ebitojo	2	1.5	2
Pneumonia	Ekishonga	2	1.5	1
Dry cough due to worm infestation	Enkorora y'enjoka	2	1.5	2
Kidney disease	Ensigo	2	1.5	2
Sex dysfunction	Amaani g'ekitanda	1	0.7	3
Tinea capitis	Ebiguuna	1	0.7	3
Kwashiorkor	Eiyoshe	1	0.7	1
Enlarged spleen	Ekibaare	1	0.7	3
Liver disease	Ekitigu/ekine	1	0.7	1
Eye swelling	Entare y'eriisho	1	0.7	1

Chronic wound	Enzibe	1	0.7	1
Anal and nasal warts	Eshundo (omunyindo, omukibunu)	1	0.7	2
Rectal prolapse	Okureeta omwoyo	1	0.7	2
Snake bite	Okurumwa enjoka	1	0.7	3
Vomiting	Okutanaka	1	0.7	1
Urinary retention	Okuzibikira	1	0.7	1

*Number of informants who believe that there are certain diseases which can only be traditionally treated; Freq., Frequency; No. MPs, number of medicinal plants used

For instance, the local name for febrile seizures varies depending on ethnic groups, but all referring to the same force. Among the Bakiga, it is referred to as *Ebiyaga* literally meaning "winds", implying that it is caused by forces in the wind/space. Among the Banyankole, it is called *Ebihungu* literally meaning "eagles", implying it is a disease which moves in the sky like eagles. Among the Bahororo, it is called *Ebya seeri*, literary meaning "things from across", implying that it is a disease that crosses over from far places. Similarly, there is no specific English name that can be given to *Amahano/amahaze* referred to as "strange traditional diseases" in this study. Such diseases may resemble physical medical conditions, but because they are associated with supernatural forces, they are believed not to require hospitalization at all, which explains why some informants held that if one were treated for such conditions, for example, using an injection, it would be fatal. However, the danger is the inability to distinguish between the symptoms of the diseases that need hospitalization and those that do not, since symptoms may resemble. In Uganda, when a patient is hospitalized with such symptoms without improvement, reference is made to seek help from traditional healers or prayers in churches because, illness in the African society is perceived differently from the Western medicine point of view. Unlike in the West, disease in Africa is believed to be of natural, cultural, or social origin (Ozioma & Chinwe, 2019).

The results revealed that febrile seizures, helminthiasis, witchcraft, allergy, cervical cancer, colic pains, epilepsy and oath were the leading "African" diseases (Table 2). A previous study by Tabuti et al. (2003) reported that ailments such as epilepsy and madness could only be treated using traditional medicine. A study by Kakooza-Mwesige et al. (2017) also reported a considerable burden of febrile seizures and epilepsy, coupled with low awareness and a large treatment gap in Uganda. The use of medicinal plants only to treat certain diseases has been a common practice in Africa. For instance, 92 % of urban and all the rural mothers whose children suffered febrile seizures said they used traditional medicine (Ofovwe & Westers, 2002). The same study reported that 7.1 % of urban mothers employed prayers during febrile seizures, which confirms a linkage between disease and supernatural forces since prayers are meant to invoke the supernatural realm.

3.3. Medicinal plant species

In this study, local communities of Bwambara sub-county mentioned 67 medicinal plant species belonging to 62 genera and 28 families that are used to treat 39 "African" diseases (Table 3). The most commonly used medicinal plants are *Chenopodium opulifolium* Schrad. ex DC., *Sesbania sesban* (L.) Merr., *Thevetia peruviana* (Pers). K. Schum., *Leonotis nepetifolia* (L.) R.Br., *Momordica foetida* Schumach., *Euphorbia hirta* L. and *Cassia mimosoides* L., being cited 27, 26, 25, 23, 23, 21, and 20 times respectively (Table 3). *Chenopodium opulifolium* was also used to treat the highest number of ailments. The most commonly used medicinal plants were of the families Asteraceae and Lamiaceae, with 11 and six species cited respectively. Asteraceae, which was the dominant family in the current study, is the most reported family, with species used in herbal remedy preparation in Uganda (Hamill et al., 2000; Namukobe et al., 2011; Nalumansi et al., 2014; Gumisiriza et al., 2019; Tugume & Nyakoojo, 2019). The high number of species from Asteraceae can be attributed to the large number of its bioactive compounds (Thomas et al., 2009; Bessada et al., 2015). Additionally, Asteraceae is the second largest family of the flowering plants and has a cosmopolitan distribution (Bonifácio et al., 2018).

Table 3: List of the medicinal plants used by local communities of Bwambara sub-county; their parts used, diseases treated, mode of preparation and administration, and frequency of citation

Family; Species, Voucher number; Local name	Part(s) used	Disease(s) treated (use report)	Mode of preparation and Administration	Frequency of citation
Acanthaceae; *Acanthus pubescens* (Oliv.) Engl., GH18-097; Ekitojo	L	Chickenpox (2)	Decoction drunk	2
Acanthaceae; *Justicia wynaadensis* B. Hyene, GH17-0010; Nyarwehindura	L	Ulcers (1)	Decoction drunk	1
Amaranthaceae; *Amaranthus spinosus* L., GH18-164; Doodo yamahwa	L	Witchcraft (13)	Infusion drunk	13
Amaranthaceae; *Chenopodium opulifolium* Schrad. ex W.D.J.Koch & Ziz, GH18-076; Omwetango	L	Strange traditional diseases (14); Oath (6); Burns/diseases caused by traditions of twins (4); Sex dysfunction (1); Tinea capitis (1); Liver disease (1)	Infusion drunk OR Mix powder with petroleum jelly and smear	27
Amaranthaceae; *Dysphania ambrosioides* (L.) Mosyakin & Clemants, GH18-024; Runuka	Sh	Vomiting (1)	Decoction drunk	1
Anacardiaceae; *Mangifera indica* L., GH18-069; Omuyembe	Bk	Stomach wounds linked to African traditions (2); Kidney disease (1)	Decoction with rock salt, drunk	3
Apocynaceae;	L	Febrile seizures	Infusion drunk	25

Cascabela thevetia (L.) Lippold, GH18-091; Musenene		(23); Epilepsy (5)	OR steam and chew	
Asparagaceae; *Dracaena steudneri* Engl., GH18-172; Ekigorogoro	L	Helminthiasis (5); Disease that affects central nervous system and can lead to a hump if untreated (5); Pancreatic disease (4)	Infusion/decoction drunk	12
Asteraceae; *Adenostemma mauritianum* DC., GH18-171; Omuhuurambwa	L	Kwashiokor (1)	Infusion drunk	1
Asteraceae; *Ageratum conyzoides* (L.) L., GH18-047; Bukabuka	L	Breastbone disease (3)	Crash and rub	3
Asteraceae; *Bidens pilosa* L., GH18-160; Enyabarashana	L	Stomach wounds linked to African traditions (3); Ulcers (3); Sharp pains in the abdomen (1);	Decoction drunk	5
Asteraceae; *Bothriocline longipes* (Oliv. & Hiern) N.E.Br, GH18-043; Ekyoganyanja	L	Colic pain (12)	Decoction drunk	12
Asteraceae; *Crassocephalum crepidioides* (Benth.) S. Moore, GH18-094; Ekyinaami	L	Witchcraft (11)	Chewing	11
Asteraceae; *Dichrocephala*	L	Allergy (10); Oath	Infusion drunk	19

integrifolia (L.f.) Kuntze, GH18-119; Omubuza		(5); Burns/diseases caused by traditions of twins (4); Sex dysfunction (1); Tinea capitis (1)	OR crush and rub for Tinea capitis	
Asteraceae; *Melanthera scandens* (Schumach. & Thonn.) Roberty, GH18-017; Ekarwe	L	Anal and nasal warts (1)	Crash, squeeze juice on affected part	1
Asteraceae; *Sonchus oleraceus* (L.) L., GH18-070; Ekizimyamuriro	L	Cervical cancer (11)	Decoction drunk and soak in	11
Asteraceae; *Vernonia amygdalina* Delile, GH18-041; Omubirizi	L, R	Malaria (3); Febrile seizures (4); Helminthiasis (10)	Decoction or infusion drunk	15
Asteraceae; *Vernonia brachycalyx* O.Hoffm., GH18-098; Omuhe	L	Pancreatic disease (5); Colic pains in kids (1)	Chewing	6
Asteraceae; *Vernonia lasiopus* O. Hoffm., GH18-156; Omujuma	L	Colic pain (3); Helminthiasis (5)	Decoction drunk	6
Basellaceae; *Basella alba* L., GH18-036; Enderema	L	Cervical cancer (7); Ulcers (4); Sex dysfunction (1); Rectal prolapse (1)	Infusion drunk and soak in	11
Bromeliaceae; *Ananas comosus* (L.) Merr., GH18-162; Enanansi	Fr	Disease that affects central	Decoction drunk	2

		nervous system and can lead to a hump if untreated (2)		
Commelinaceae; *Commelina benghalensis* L., GH18-120; Entiija	Sh	Tinea corporis (2)	Crash and rub	2
Convolvulaceae; *Ipomoea cairica* (L.) Sweet., GH18-125; Akarandarugo	L	Cervical cancer (9)	Infusion drunk	9
Cucurbitaceae; *Lagenaria sphaerica* (Sond.) Naudin, GH18-050; Omutanga	L	Oath (3)	Decoction drunk	3
Cucurbitaceae; *Momordica foetida* Schumach., GH18-144; Omwihura	L	Helminthiasis (13); Colic pain (10); Pneumonia (2); Urinary retention (1)	Decoction drunk	23
Cucurbitaceae; *Peponium vogelii* (Hook.f.) Engl., GH18-180; Omugoshoora	L	Strange traditional diseases (7); Burns/diseases caused by traditions of twins (1)	Crash dry, smear in petroleum jelly	8
Ebenaceae; *Euclea divinorum* Hiern, GH18-102; Omusikizi	L	Cervical cancer (3)	Infusion drunk and soak in	3
Euphorbiaceae; *Croton macrostachys* Hochst. ex A.Rich., GH18-019; Omurangara	Bk	Cough due to worm infestation (1)	Chewing	1

Euphorbiaceae; *Euphorbia hirta* L., GH18-086; Kamaramahano	L	Strange traditional diseases (14); Oath (5); Burns/diseases caused by traditions of twins (4)	Infusion drunk	21
Euphorbiaceae; *Euphorbia tirucalli* L., GH18-048; Oruyenje	St	Cough due to worm infestation (2)	Scorch and chew	2
Euphorbiaceae; *Jatropha curcas* L., GH18-068; Ekitahutara	Sap	Chronic wound (1)	Apply sap	1
Euphorbiaceae; *Ricinus communis* L., GH18-133; Ekishogashoga	L	Stomach wounds linked to African traditions (4); Disease that affects central nervous system and can lead to a hump if untreated (2)	Infusion drunk	6
Fabaceae; *Chamaecrista mimosoides* (L.) Greene, GH18-184; Mukuruteitwebye	L	Febrile seizures (11); Strange traditional diseases (11)	Infusion drunk	20
Fabaceae; *Erythrina abyssinica* Lam., GH17-022; Ekiko	Fl	Rectal prolapse (1)	Steam and apply juice	1
Fabaceae; *Indigofera arrecta* A.	L	Breastbone disease	Crash and rub OR	3

Rich, GH18-129; Omusorooza		(2); Enlarged spleen (1)	infusion drunk for enlarged spleen	
Fabaceae; *Senna occidentalis* (L.) Link, GH18-064; Omwitanjoka	L	Helminthiasis (14);	Decoction drunk	14
Fabaceae; *Sesbania sesban* (L.) Merr., GH18-143; Omunyeganyegye	L, R	Febrile seizures (20); Colic pain (9)	Crash in water and bathe OR Infusion or decoction drunk or chewing	26
Lamiaceae; *Clerodendrum capitatum* (Wild.) Schumach. & Thonn., GH18-092; Ekishekashekye	L	Helminthiasis (9); Colic pain (9)	Decoction drunk	16
Lamiaceae; *Clerodendrum myricoides* R.Br., GH18-176; Omukuzanyana	R	Febrile seizures (18)	Chewing	18
Lamiaceae; *Leonotis nepetifolia* (L.) R.Br., GH18-044; Ekicumucumu	L	Febrile seizures (16); Colic pain (11)	Infusion/decoction drunk	23
Lamiaceae; *Leucas martinicensis* (Jacq.) R.Br., GH18-108; Akanyamafundo	L	Tinea corporis (2)	Crash and rub	2
Lamiaceae; *Ocimum gratissimum* L., GH18-118; Omujaaja	L	Colic pain (5)	Infusion or decoction drunk	5
Lamiaceae; *Plectranthus barbatus* Andrews, GH18-152; Ekicuncu	L	Colic pain (12)	Decoction drunk	12
Malvaceae; *Grewia similis*	L	Cervical cancer (1)	Infusion drunk	1

K.Schum., GH18-029; Orukoma			and soak in	
Malvaceae; *Malva parviflora* L., GH18-132; Ekituruguma	L	False teeth (4)	Incisions	4
Malvaceae; *Sida alba* L., GH18-113; Omucundeezi	L	Cellulitis (3), Migraine that may lead to madness (2)	Crash and tie on	5
Malvaceae; *Sida cordata* (Burm.f.) Borss.Waalk., GH18-012; Eihoza	L	Strange traditional diseases (9); Burns/diseases caused by traditions of twins (3)	Mix powder with petroleum jelly and smear	12
Primulaceae: *Maesa lanceolata* Forssk., GH18-026; Omuhanga	L	Febrile seizures (7)	Decoction drunk	7
Myrtaceae; *Psidium guajava* L., GH18-049; Amapera	L	Helminthiasis (11); Kidney disease (2)	Decoction drunk	12
Onagraceae; *Ludwigia abyssinica* A.Rich., GH18-188; Omuzigangore	L	Anal and nasal warts (1)	Crash, squeeze juice on affected part	1
Phyllanthaceae; *Flueggea virosa* (Roxb. ex Wild.) Royle, GH18-123; Omukarara	R	Helminthiasis (4)	Decoction drunk	4
Phyllanthaceae; *Phyllanthus capillaris* Schumach & Thonn., GH18-154; Omuturika	L	Chickenpox (1)	Crash with water and bathe	1

Phytolaccaceae; *Phytolacca dodecandra* L'Her., GH18-117; Omuhoko	L	Witchcraft (12)	Infusion drunk	12
Poaceae; *Cynodon sp.*, GH18-141; Omucwamba	Sh	Snake bite (1)	Crash and tie on	1
Poaceae; *Digitaria abyssinica* (A.Rich.) Stapf, GH18-056; Orumbugu	L	Helminthiasis (2); Snake bite (1)	Decoction drunk	3
Poaceae; *Imperata cylindrica* (L.) Raeusch., GH18-079; Omushojwa	L	Snake bite (1)	Tie above affected area	1
Poaceae; *Pennisetum purpureum* Schumach, GH18-074; Ekibingo	L	Disease that affects central nervous system and can lead to a hump if untreated (4); Oath (3)	Decoction drunk	6
Polygonaceae; *Oxygonum sinuatum* (Hochst. & Steud ex Meisen.) Dammer, GH18-015; Akacumitambogo	Sh	Cellulitis (2)	Crash and tie on	2
Polygonaceae; *Rumex abyssinicus* Jacq., GH18-170; Omufumbagasi	L	Allergy (8)	Chewing	8
Rhamnaceae; *Gouania longispicata* Engl., GH18-002; Omufurura	L	Allergy (13)	Infusion drunk	13
Rubiaceae; *Pavetta oliveriana*	L	Colic pain (3)	Infusion drunk	3

Hiern, GH18-030; Omuturaibare				
Rutaceae; *Toddalia asiatica* (L.) Lam., GH18-145; Kabakura	R	Epilepsy (4)	Chewing	4
Rutaceae; *Zanthoxylum gilletii* (De Wild.) P.G.Waterman, GH18-167; Omutatembwa	Fr	Strange traditional diseases (4)	Decoction drunk	4
Solanaceae; *Physalis peruviana* L., GH18-124; Ekituutu	L	Enlarged spleen (1)	Chewing	1
Theaceae; *Camellia sinensis* (L.) Kuntze,, GH18-186; Amajaani	L	Stomach wounds linked to African traditions (3)	Decoction drunk	3
Vitaceae; *Cyphostemma adenocaule* (Steud. ex A.Rich.) Desc. ex Wild & R.B.Drumm., GH18-191; Ekibombo	L	Eye swelling (1)	Crush and rub	1
Vitaceae; *Rhoicissus tridentata* (L.f.) Wild & R.B. Drumm., GH18-027; Omumara	L	Strange traditional diseases (6); Burns/diseases caused by traditions of twins (2)	Crash dry, smear in petroleum jelly	6
*All grass species plucked from where a helicopter takes off; Ebinyansi byahansi y'enyonyi	NA	Febrile seizures (17)	Decoction drunk	17
*Elephant dung; Amazi g'enjojo	NA	Stomach wounds linked to African traditions (9)	Decoction drunk	9

*Herbs without thorns; Ebiti ebiteine mahwa	NA	Stomach wounds linked to African traditions (1)	Decoction drunk	1

L, Leaf; R, Root bark; Fr, Fruit; Bk, Stem bark; Sh, Shoot; St, Stem; NA, not applicable (since it is a mixture of different plant parts); *, No specific plant species but a combination of various plants

Decoction; extraction by boiling herbal or plant material to dissolve the chemicals of the material

Infusion; extract prepared by soaking plant material or herbs in cold or hot water

The extensive use of medicinal plants to treat ailments shows that medicinal plants form the main source of medication for the local communities within the study area. The common use of medicinal plants is facilitated by the people's possession of an immense amount of indigenous knowledge of plants and their uses within the study area (Gumisiriza et al., 2019) as well as an easily accessible rich floral biodiversity (Katende et al., 1995). The wide usage could also be attributed to high poverty levels within the study area (RFDA, 2009), which makes it very difficult to access conventional medical care.

Leaves were the most used plant parts, decoction was the main method of preparation and oral route was the main mode of administration. These findings are in agreement with previous studies in Uganda (Namukobe et al., 2011; Nalumansi et al., 2014; Tugume et al., 2016; Gumisiriza et al., 2019).

Malaria which is the main cause of morbidity and mortality in Rukungiri district (RFDA, 2009) and particularly in Bwambara sub-county (Lal et al., 2015), was mentioned as one of the "African" diseases that are traditionally treated using medicinal plants only. *Vernonia amygdalina* Delile was mentioned as the traditional medicinal plant used to treat malaria. The current findings compare with the findings of Katuura et al. (2007) who found that malaria was the most common condition treated by traditional healers in Western Uganda. The study further showed that plants were the most single important source of natural products used for treatment of malaria.

3.4. Medicinal plants with dual names according to usage

Some medicinal plants were found to bear different local names (Table 4) which were believed to influence their effectiveness. They were reported to possess dual names depending on whether they were to be used in treatment of physical ailments or divination. One of the respondents recounted as follows "…*most plant species used by traditional healers for divination are the same as the ones used for common use, only that in this case, they are called by different names. If such plants are called by their common name during divination, they cannot be effective. The common local name is used when the herb is being used to treat physical ailments, whereas the other name is in most cases used during divination rituals such as casting out spells, chasing demons, and other related spiritual activities*." Such names are used with enchantments to connect with the supernatural world during treatment. In fact, long before the advent of Western medicine, Africans had developed their own effective way of dealing with diseases, whether they had spiritual or physical causes, with little or no side effect, and the treatments worked for them (Trinter, 2007; White, 2015). Proponents of Traditional African healing believe that it relates to God and religion/spirituality, and that its practitioners serve many roles which include but are not limited to custodians of the traditional African religion and customs, educators about culture, counselors, social workers, and psychologists (Mokgobi, 2014). In a traditional African setting, diseases mostly revolve around witchcraft/sorcery, gods or ancestors, nature, as well as inheritance, and, therefore, holistic treatment is required which cannot be offered by Western medicine. Similar to modern day Western treatment patterns, African traditional societies involve herbalism, surgery, dietary therapy, and psychotherapy, in addition to traditional exorcism, rituals, and sacrifice (Mokgobi, 2014). In this case, divination is important since it is associated with supernatural and magical powers, in which charms and symbols are used to cast out spells. Therefore, it is very important to use appropriate names for the medicinal plant in use for proper contact with the supernatural, such that the healing process is complete.

Table 4: Medicinal plant species with dual names for physical ailments and divination

Family name; Species name; Voucher number	**Common local name**	**Local name for divination [Direct translation]**
Amaranthaceae; *Celosia*	Omucuguzanyonyi	Bukokora [Elbow-like]

schweinfurthii Schinz.; GH18-010		
Apocynaceae; *Carissa edulis* Vahl; GH17-007	Amayonza	Akaitamizimu [Killer of demons]
Asteraceae; *Adenostemma mauritianum* DC; GH18-171	Omuhurambwa	Cureera [Calm down]
Asteraceae; *Ageratum conyzoides* L.; GH18-047	Bukabuka	Kibukaaza [Something that calms]
Asteraceae*; Bidens pilosa* L.; GH18-160	Enyabarashana	Kirashaniro [The shooter]
Asteraceae; *Bothriocline longipes* (Oliv. & Hiern) N.E.Br; GH18-043	Ekyoganyanja	Rugoogamu [Penetrator]
Asteraceae; *Solanecio angulatus* (Vahl.) C.Jeffrey; GH18-011	Omukunda	Omwanga [To hate]
Asteraceae; *Solanecio cydoniifolius* (O. Hoffm.) C. Jeffrey; GH18-022	Eirarira	Ekyeeza [Cleanser]
Asteraceae; *Vernonia brachycalyx* O.Hoffm; GH18-098	Omuhe	Orujugankando
Asteraceae; *Vernonia lasiopus* O. Hoffm; GH18-156	Omujuma	Bijumeero [Re-echoing]
Crassulaceae; *Bryophyllum pinnatum* (Lam). Kurz; GH18-077	Enkyenankyene/ereka	Omujuguta [Purifier]
Cucurbitaceae; *Zehneria scabra* Sond.; GH18-117	Akabindiizi	Akashambarugo [Fence kicker]
Euphorbiaceae; *Flueggea virosa* (Wild.) Viogt; GH18-123	Omukarara	Orubwera [Makes shy]
Fabaceae; *Aeschynomene abyssinica* (A. Rich) Vatke; GH18-020	Entambabyoona	Kamarirane [The finisher]
Lamiaceae; *Leucas martinicensis* (Jacq.) R.Br.; GH18-108	Akanyamafundo	Omutera [The beater]
Polygonaceae; *Oxygonum sinuatum* Dammer; GH18-015	Akacumitambogo	Akakokoromi

Disease category	Diseases		N_t	N_{ur}	FIC
Unidentified		Kabamugobe			Omuremampango [Cannot be cut by an axe]
Unidentified		Omuheire			Mbigyirenta [How can I handle these]

3.5. Informant consensus factor (FIC)

According to the FIC results for the 10 ICPC disease categories (Table 5), neurological disorders had the highest FIC values (0.90), signifying their prevalence. Only four conditions had FIC values lower than 0.50; that is, urological (0.33), eye (0.00) and blood, blood forming organs and immune mechanism disorders (0.00). The rest had higher FIC values ranging from 0.50 to 0.90. FIC values of ≥ 0.5 indicate informants' agreement about the use of medicinal plant species to treat particular ailments and/or cultural convergence (Kunwar et al., 2018). In the current study, the FIC values were generally high for most of the disease categories, indicating agreement on the medicinal plant species used, which confirms the cultural significance of the used medicinal plant species among the local communities and indicates that a large proportion of the local population uses relatively few plant species for a particular ailment category or that there is free information exchange between the informants (Heinrich et al., 1998). The results, therefore, reveal that, there is high free exchange of information concerning medicinal plant species used in the treatment of disorders in the following categories: neurological, general and unspecified, digestive and female genital, with FIC values of 0.90, 0.87, 0.86 and 0.82 respectively. The findings also confirm the cultural significance of the medicinal plant species used in the management of these diseases.

General and unspecified (A)	Witchcraft, strange traditional diseases, allergy, oath, malaria, chickenpox, pneumonia, kwashiorkor	20	145	0.87
Blood, blood forming organs and immune mechanism (B)	Enlarged spleen	2	2	0
Digestive (D)	Helminthiasis, Stomach wounds linked to African traditions, Pancreatic disease, colic pain, ulcers, false teeth, liver disease, sharp pains in the abdomen, rectal prolapse, colic pain in children, vomiting	26	186	0.86
Eye (F)	Eye swelling	1	1	0
Musculoskeletal (L)	Breastbone disease, cellulitis	4	10	0.67
Neurological (N)	Febrile seizures, epilepsy, disease that affects central nervous system and can lead to a hump if untreated, migraine	13	123	0.90
Respiratory (R)	Cough due to worm infestation	2	3	0.50
Skin (S)	Burns/diseases caused by traditions of twins, snake bite, tinea corporis, tinea capitis, chronic wounds, anal & nasal warts	14	30	0.55
Urological (U)	Kidney disease, urinary retention	3	4	0.33
Female genital (X)	Cervical cancer, sex dysfunction	7	34	0.82

Table 5: Informant consensus cactor (FIC) for the different categories of 'African' diseases N_t,number of taxa or species that use a category for all informants; N_{ur}, number of use reports from informants for a particular plant use category; FIC, Informant Consensus Factor

The highest number of medicinal plants (26 species) were used to treat digestive disorders such as helminthiasis (73 use reports), colic pain (74 use reports), and stomach wounds linked to African traditions (22 use reports). This finding is in agreement with a previous study in Uganda which reported that the highest number of medicinal plant species were used to treat gastrointestinal diseases (Anywar et al., 2020). General and unspecified disorders followed, with 145 use reports and 20 medicinal plant species used for treatment. The most common disorders in this category were witchcraft (36 use reports), strange traditional diseases (65 use reports), allergy (31 use reports) and oath (22 use reports), signifying their relative prevalence within the study area. The prevalence of such conditions except allergy, is linked to culture and tradition. According to African tradition, when ancestors are neglected or forgotten by their relatives, they are said to be angry with them. As such, the ancestors send misfortunes as punishment which may include physical or strange diseases (White, 2015). However, when the case or sickness is deemed to have physical causes, herbs are prescribed depending on the kind of disease. These prescriptions come with some strict instructions on how to prepare the herb and determine the dose, form of administration, and timeframe (Ayim-Aboagye 1993).

3.6. Ethnopharmacological potential of the most commonly used medicinal plants

Cross-validation with published data was done to ascertain the pharmacological relevance of some medicinal plant species cited by at least 20 informants (Table 6). Most of the recorded uses of medicinal plants in the present were not congruent with the previously reported pharmacological activities. This scenario could be attributed to the fact that the present study documents medicinal plants used in the treatment of “African” diseases, while the previous studies report about treatment of physical ailments. The difference in the findings signifies that there is a difference between the management of physical and “African” diseases by the local communities of Bwambara sub-county. For example, in the present study *Euphorbia hirta* was reported to treat strange traditional diseases, oath, and burns/diseases caused by traditions of twins which are diseases linked to supernatural powers. Much as their effects resemble those of physical ailments, wrong diagnosis maybe fatal. Previously, *Euphorbia hirta* was reported to exhibit antioxidant, antimalarial, and antibacterial activities (Vijayaa et al., 1995; Sudhakar et al., 2006; Liu et al., 2007; Kumar et al., 2010) and to contain reducing sugars, terpenoids, alkaloids,

steroids, tannins, flavonoids, and phenolic compounds (Basma et al., 2011). This variance agrees with the reported beliefs that African traditional medicine encompasses a diverse range of practices, including herbalism and spiritualism, and traditional healers represent a range of individuals who call themselves diviners, priests, faith healers or bone-setters, among others (UNAIDS, 2002; White, 2015). However, some of the current uses of some medicinal plants, such as *Chenopodium opulifolium*, were found to be coherent with the previously reported uses (Table 6). Much as ethnobotanical studies on the management of "African" diseases using medicinal plants has not been given much attention, these treatments should be recorded before the information is lost completely, given that these disease conditions will remain.

Table 6. Pharmacological relevance of the most cited medicinal plants

Medicinal plant	Previous studies				Present study		
	Part (s) used	Medicinal uses	Pharmacological properties	Reported compounds	Part(s) used	Medicinal uses	FC
Chenopodium opulifoliu m	L	Herpes zoster, liver disease, allergy, tinea capitis, worms (Gumisiriza et al., 2019)	Antioxidant, antinociceptive and anti-inflammatory effects (Ajayi et al., 2016)	Alkaloids, tannins, phlobatannins, flavonoids, and saponins (Ajayi et al., 2016)	L	Strange traditional diseases, oath, burns/diseases caused by traditions of twins, Sex dysfunction, tinea capitis, liver	27

						disease	
Sesbania sesban	L	Purgative, demulcent, maturant, anthelmintic and for all pains and inflammation (Gomase et al., 2012)	Antidiabetic (Pandhare et al., 2011).	triterpenoids, carbohydrates, vitamins, amino acids, proteins, tannins, saponin glycosides and steroids (Pandhare et al., 2011) & leanolic acid (Gomase et al., 2012)	L, R	Febrile seizures, colic pain	26
Thevetia peruviana	Sd,	Gastric decontamination (Bandara et al., 2010)	Antifungal (Gata-Goncalves et al., 2003)	Pulegone, linoleic acid and palmitic acid (Gata-Goncalves et al., 2003),	L	Febrile seizures, epilepsy	25

				thevetin C and acetylthevetin C (Kohls et al., 2012),			
Leonotis nepetifolia	L	Treatment of bronchial asthma, gynecological diseases, parasitic infections, coughs, stomachache, skin infections (Oliveira et al., 2015)	Antioxidant, antiproliferative (Veerabadran et al., 2013)	Terpene compounds, flavonoids, tannins, iridoids, sterols and fats (Sobolewska et al., 2012),	L	Febrile seizures, colic pain	23
Momordica feotida	L	Cough, stomachache, headache, intestinal disorder and earache (Odeleye & Oyedeji, 2008)	Antimicrobial (Odeleye & Oyedeji, 2008), antioxidant (Oloyede,& Aluko, 2012; Acquaviva et al., 2013)	Alkaloids, cardiac glycosides, flavonoids (Odeleye & Oyedeji, 2008)	L	Helminthiasis, colic pain, pneumonia, urinary retention	23

Euphorbia hirta	L	Intestinal parasites, diarrhoea, peptic ulcers, heartburn, vomiting, amoebic dysentery, asthma, bronchitis, hay fever, laryngeal spasms, emphysema, coughs, colds, kidney stones (Basma et al., 2011), female disorders, respiratory ailments (Kumar et al., 2010)	Antioxidant, antimalarial, antibacterial (Vijayaa et al., 1995; Sudhakar et al., 2006; Liu et al., 2007; Kumar et al., 2010)	Reducing sugars, terpenoids, alkaloids, steroids, tannins, flavonoids and phenolic compounds (Basma et al., 2011)	L	Strange traditional diseases, oath, burns/diseases caused by traditions of twins	21
Cassia mimosoide	WP	Cough,abnormalities	Lipase inhibitor, anti-	Daucosterol and	L	Febrile seizures,	20

s	(Gumisiriza et al., 2019)	obesity (Kim & Lee, 2010)	naphthalene glucoside (Park & Kwon1, 2009)	strange traditional diseases

Parts used: L, leaf; Sd, Seed; R, Root; WP, Whole plant; FC, Frequency of citation

4. Conclusion

There are a number of "African" diseases which are believed to be exclusively traditionally managed on which the local communities within Bwambara sub-county have vast knowledge of medicinal plant species used to treat them. Much as some of these diseases have similar symptoms to the diseases treated by Western medicine, distinguishing from them is difficult, which calls for sensitization of communities within the study area about the dangers associated with certain ailments, especially malaria which is the leading cause of morbidity and mortality in Uganda. For proper management of both "African" diseases and the other diseases, there is need to integrate traditional healers and other influential people in the communities into the processes aiming at addressing healthcare needs of the local population. Medicinal plants have contributed significantly to several disease therapies, including the treatment of supernatural conditions. Therefore, there is need for collaboration between users of medicinal plants and scientists to help in the discovery of new drugs based on indigenous knowledge. The findings should be used as a basis for scientists to enrich the utilization of herbal remedies in order to achieve the best benefits.

Authors' contribution

HG developed the concept and proposal. HG and OK collected, sorted, analyzed the data and wrote the manuscript. GB, EAO, and CDS supervised and followed the whole study process, wrote, and reviewed the final manuscript. All the authors have read and approved the final manuscript.

Conflict of interest

All the authors declare no conflict of interest.

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