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Ethnobotanical study of plants used as antimalarial in traditional medicine in Bagira in Eastern RD Congo

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Abstract
This transversal descriptive study was carried out to collect plants and recipes used in Bagira to treat malaria. Direct interview with field enquiries allowed collecting ethnobotanical data. Eighty-four Informants (age 46.9 ± 12.0 years, sex ratio: 2.0, experience 12.1 ± 5.1 years) reported 53 species belonging to 24 families dominated by Fabaceae (22.6%) and Asteraceae (20.7%). Antiplasmodial activity was previously reported for 34 plants and 16 species are first cited as antimalarial plants among which *Ekebergia benguelensis* (18,8%), *Dalbergia katangensis* (14,1%) and *Dialium angolense* (14,1%), are the most cited. From these plants come 83 anti-malarial recipes of which 67 use a single plant and the other combine two to four plants. Leaf (≥52%) and decoction (≥58%) respectively constitute organ and preparation methods most used. Several plants are used in traditional medicine in Bagira against malaria, some of which deserve to be studied more to isolate new antimalarial compounds.

Keywords: Bukavu, phytomedecine, malaria, ethno pharmacology

1. Introduction
Malaria is a major global health scourge [1] responsible for nearly 200 million cases each year. In 2018, 155 million cases, of which 93% in the Africa region, were recorded worldwide and an upsurge was noted with regret in the DRC, with cases ranging from 60.644 million in 2006 [2] to 97,2 million in 2018 [3]. In Bukavu, where the city of Bagira represents 23.9% of the city's workforce, 52,403 cases were recorded in 2017 [4]. In addition to this high prevalence, which is constantly increasing, there is unfortunately a low accessibility to the health care [5] and the emergence of resistance from both vector [6] and parasite [7]. In addition, the RTS, S® vaccine, which is in the process of being marketed, offers only very modest protection in the order of 30% [8]. There is therefore a need to find new drugs that are both effective and accessible.
Apart from the fact that the two current first-line antimalarial compounds, come from traditional medicine: Quinine, isolated from *Cinchona officinalis* L. [9] from traditional Peruvian medicine and artemisinin, isolated from the leaves *Artemisia annua* L. [10], formerly used in traditional Chinese medicine; previous work reports that traditional African medicine has provided improved traditional medicines such as Malarial 5® [11], Malaria® [12] currently use in DR Congo. In addition, traditional medicine offers strong compliance as long as more than 80% of the world population uses it as a first line [13]. It would therefore constitute a very credible alternative in malarial control. Several ethnobotanical studies have been reported in sub-Saharan Africa [14, 15], particularly in DR Congo [16] on anti-malarial plants. In Bukavu, the only works reported are those of Kasali *et al*. [17] and Manya *et al* [18] which, however, did not report all the knowledge of anti-malarial plants in Bukavu, particularly from the Bagira county. In addition to these works, in this study we report the various plants used in traditional medicine in Bagira in the management of malaria by situating them in the overall ethno medical knowledge of the region.

2. Material and Methods
2.1 Study area
With an area of 37.6 km^2 or 65.9% of the city of Bukavu, the city of Bagira is located between 2 ° (28-30) 'south latitude and 28 ° (48-50)' east longitude with an altitude ranging from 1488 to 2008 meters. It is bounded to the north by the Nyamuhinga River, to the south by the Tshula River, to the east by Lake Kivu and to the west by the Mbongwe mountain range.

With an average annual temperature of 20 ± 2 °C, it experiences a humid tropical climate with two dry and rainy seasons, the latter being the longest with 7 months. Its predominantly young population (5 to 49 years old), estimated at 123,214 inhabitants in 2014 and distributed in six sectors (Chikera, Ciriri, Kasha, Mulambula, Lumumba and Nyakavogo), has an ethno cultural mixture including Shi (71%) and rega (26%) constitute the majority ethnical groups [19].

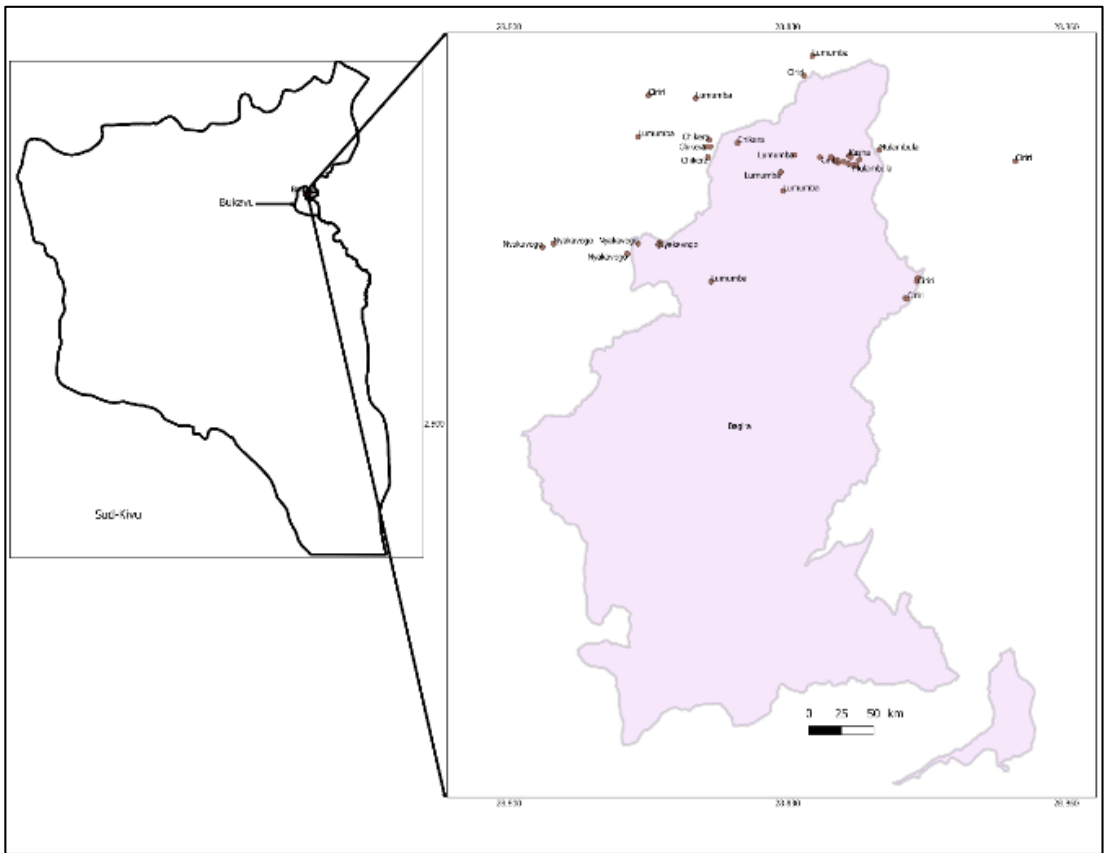


Fig 1: Map of Bagira commune in the city of Bukavu in RDC

2.2 Data collection
Ethnobotanical survey was carried out by direct interview using a guide questionnaire containing socio-demographic characteristics of the informant's practitioners of traditional medicine (IPTMs), their knowledge of malaria and of the plants informed, as well as the antimalarial recipes based on these plants. All the subjects informed as a plant-based caregiver in the city of Bagira were contacted (n = 111). Data collection was a consequence of the availability of subjects after informed consent (n=84). The harvesting and use of personal data have followed the principle of anonymization as stated in the Helsinki Declaration [20].

2.3 Harvest and identification of species
Plants were harvested in company of IPTMs and identified at the foot of the plant; GPS coordinates were taken, and a specimen was deposited at Kipopo herbarium in Lubumbashi where identification was made.

2.4 Data analysis
Graph Pad Prism version 6 was used where descriptive statistical methods were employed. The data obtained through the survey were analyzed and expressed as a percentage. Ring and sector graphics were used to express the following parameters: Morphological types, biological types, Phytogeographical distribution and harvest site. Fidelity level (FL), an index varying from 0 to 100, was obtained by dividing the number of informants who mentioned using the plants species (Ei) by the total number of informants participating in the survey: N and express in % [21].

3. Results and Discussion
3.1 Socio-demographic profiles of traditional healers and knowledge of malaria
Eighty-four IPTMs, mostly traditional healers (65.9%), age (46.9 ± 12.0; Extremes: 19-79 years) and sex ratio (Male ÷ Woman): 2.0, was interviewed. More than 69% of them have a low level of classical education. They had long experience (12.1 ± 5.1 years Extremes: 3-25) and the knowledge of most of them (63.5%), was transmitted by their ancestors; mashi (70.6%) and Swahili (94.1%) are the most widely spoken languages (table 1).

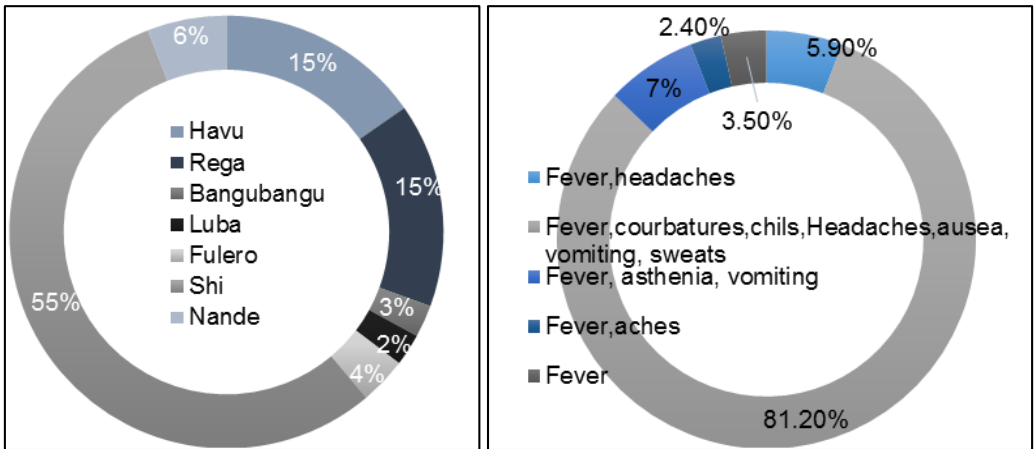
In most sub-Sahara African societies women are engaged in field work, thus leaving men the latitude to practice traditional medicine [22, 23] and may justify the sex ratio observed during this study (Table 1); the fact that mastering the practice of traditional medicine requires time and concentration, may justify the low level education observed with IPTMs and a long experience enjoyed by IPTMs, as reported in previous works [22, 23], may some extent justify the credibility of information from ethnobotanical surveys.

Table 1: Socio-demographic characteristics of IPTMs

	Class	E_i	F_i (%)
Age (ans)	[18-27]	4	4,7
	[27-37]	16	18,8
	[37-47]	11	12,9
	[47-57]	45	52,9
	>57	9	10,6
Experience (ans) as TPM	[1-5]	4	4,7
	[6-10]	16	18,8
	[11-15]	11	12,9
	[16-20]	45	52,9
	[21-25]	9	10,6
Gender:	F	28	32,9
	M	57	67,1
Studies	Graduate	10	11,8
	Postgraduate	12	14,1
	Primary	28	32,9
	No one	31	36,5
	Professional	4	4,7
Category	Witch	2	2,4
	Healer	27	31,8
	Traditional healer	56	65,9
Traditional Medicine learning pathway	Dream	12	14,1
	spirits	4	4,7
	Ancestors	54	63,5
	Another healer	6	7,1
	Self-Study	9	10,6
Spoken languages	French	40	47,1
	Bangubangu	2	2,4
	Fulero	6	7,1
	Havu	23	27,1
	Nande	7	8,2
	Rega	16	18,8
	Vira	9	10,6
	Lingala	20	23,5
	Shi	60	70,6
	Swahili	80	94,1
	Tshiluba	4	4,7

Mean age 46.9 ± 12.0 (range, 19-79 years); sex ratio: 2.0 in favor of men. Average experience 12.1 ± 5.1 (range: 3-25 years). Fi = citation frequency = n * 100 / N, n = simple; N = total workforce

Shi are the majority (more than 50%) ethic group and in most cases, IPTMs "diagnose" malaria using different signs and symptoms such as aches, fever and headaches (Figure 2). The preponderance of shi can be justified by the fact that they are majority and indigenous ethic group of the region [17, 18]. In addition, the observation of various signs evoked by the IPTMs to diagnose malaria, suggests that they treat simple malaria.



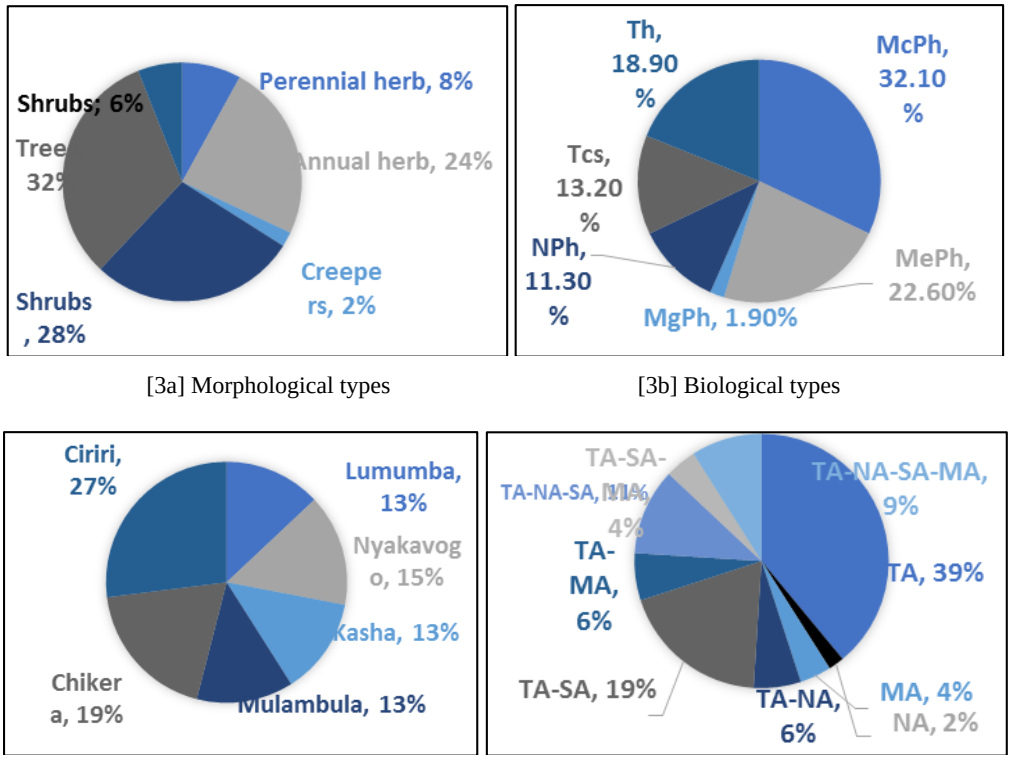
[2a.] Ethic group [2b.] Signs of malaria diagnoses by IPTMs

Fig 2: Signs of malaria diagnoses by IPTMs and ethical group of IPTMs

3.2 General characteristics of plants recorded

3.2.1 Morphological types, biological types, Phytogeographical distribution and harvest site

The plants listed in this survey are in most cases trees (32%), Microphanerophytes (32.1%) which are generally endemic to Tropical Africa TA (39%) as previously funding [17]. Few works of accessible literature evoke the question of the biological types of plants used in traditional medicine in the region. It would be difficult to have a definite point of view on the issue. About morphological type, the analysis of several ethnobotanical studies of the region [17, 24, 28] show, as in this study, that most of the plants used in traditional medicine in Bukavu are trees (figure 3).



[3a] Morphological types [3b] Biological types

[3c] Harvest site [3d] Phytogeographical distribution

Fig 3: Morphological types, biological types, Phytogeographical distribution and harvest site.

3.2.2 Identification of species and their Classification according to the literature data

In our ethnobotanical survey, 53 plants from 43 genera and 23 families were reported as anti-malarial plants used in Bagira. These plants have several vernacular names dominated by mashi (88.7%), Swahili (18.9%), Kinyarwanda (13.2%) and 66% of them are already studied from the point of view of antimalarial activity. It should also be noted that the consensus on use as an antimalarial is higher in *Cinchona ledgeriana* (Fl = 54.1%) for all plants and in *Ekebergia benguelensis* (Fl=18, 8%), *Dalbergia katangensis* and *Dialium angolense* with 14.1% of Fl, each among 18 plants not studied, (Table 2).

Table 2: Data information about 53 species according to nomenclature and literature

N°	Species [Synonym] (Family)	Vernacular name (ethnic group)	Reference of use as antimalarial	Evaluated antimalarial activity reference	Fl (N=84)	Herbarium code
1	*Acacia polyacantha* [*Senegalia polyacantha* (Willd.) Seigler & Ebinger (2013)] (Fabaceae)	Irangi (kihavu); Hibomo (hemba)	[18]	[29]	3,5	KIP0012
2	*Aframomum laurentii* [*Aframomum giganteum* (Oliv. & D. Hanb.) K. Schum.] (Zingiberaceae)	Amatimbiri (kinyarwanda), Ntiru (mashi)	[30]		12,9	KIP0013
3	*Ageratum conyzoïdes* [*Chromolaena corymbosa* (Aubl.) R.M. King & H. Rob.] (Asteraceae)	Kahyole, (mashi), Ruhera (kinyarwanda).	[18]	[31]	4,7	KIP0014
4	*Artemisia annua* [*Artemisia gmelinii* Weber ex Stechm.] (Asteraceae)	Artemizia (mashi), Atremisia (swahili).	[18]	[32]	29,4	KIP0015
5	*Azadirachta indica* [*Melia Azadirachta L.* (1753)] (Meliaceae)	Marumaru (mashi), Mwarubaini (swahili).	[18]	[33]	27,1	KIP0016
6	*Bidens pilosa* [*Kerneria pilosa* (L.) Lowe (1868)] (Asteraceae)	Kashisha (mashi), Nyasa (rega)	[18]	[34]	37,6	KIP0017
7	*Bobgunia madagascariensis* [*Swartzia madagascariensis* Desv] (Fabaceae)	Mpampi (tshiluba); Ndale (mashi)	[35]	[35]	14,1	KIP0018
8	*Cajanus cajan* [*Cytisus cajan* L. (1753)] (Fabaceae)	Cishimbo c'eluciga (mashi) Ngoliolio (tabwa).	[18]	[36]	4,7	KIP0019

9	*Carica papaya* L(Caricaceae)	Ipapayi (mashi), Papai (bembe).	[18]	[37]	31,8	KIP0020
10	*Cassia occidentalis* [*Senna occidentalis* (L.) Link (1829)] (Fabaceae)	Mushigemanjoka (mashi), Mujangajanga (fulero)	[18]	[38, 39]	14,1	KIP0021
11	*Catharanthus roseus* [*Vinca* rosea L. (1759)] (Apocynaceae)	*vinka* (swahili); Mwilu (mashi)	[40]	[41]	4,7	KIP0022
12	*Chenopodium abrosioides* [*Teloxys ambrosioides* (L.) W. A. Weber] (Chenopodiaceae)	Mugunduzimu (mashi), Kahusu (rega).	[42]	[43]	14,1	KIP0023
13	*Chenopodium opulifolium* [*Chenopodium erosum* Bastard] (Chenopodiaceae)	Gombegombe (mashi), Umugombe (kinyarwanda)			12,9	KIP0024
14	*Cinchona ledgeriana* [*Cinchona officinalis* L.] (Rubiaceae)	Kankina (shi); Kenkina (swahili).	[44]	[45]	54,1	KIP0025
15	*Clematis villosa* [*Clematopsis scabiosifolia* (DC.) Hutch.] (Ranunculaceae)	Kanyiza (mashi); Kituza (shi)			1,2	KIP0026
16	*Crassocephalum montuosum* [*Senecio montuosus* S. Moore (1902)] (Asteraceae)	Cifula (shi), Bupamba (bembe), Anatta (bembe)			2,4	KIP0027
17	*Crassocephalum picridifolium* [*Senecio acutidentatus* A. Rich.] (Asteraceae)	Mfubwidi (shi).			1,2	KIP0028
18	*Cymbopogon citratus* [*Andropogon citratus* DC.] (Poaceae)	Cahi (shi), Lunyasi (swahili)	[46]	[46]	32,9	KIP0029
19	*Dalbergia katangensis* Lechenaud (Fabaceae)	Mungobole; Nfuma (shi); Munyereza (fulero).			14,1	KIP0030
20	*Dialium angolense* [*Dialium evrardii* Steyaert (1960)] (WELW EX BETH) Harms (Fabaceae)	Kizimya (shi), Cituzo (havu); Mbindula (fulero).			14,1	KIP0031
21	*Dialopsis africana* RADCK (Sapindaceae)	Munyembe (shi); Mpungula (shi)			1,2	KIP0032
22	*Ekebergia benguellensis* WELW EX CDC (Meliaceae)	Mutuzya (shi); Ntuli (shi)			18,8	KIP0033
23	*Eleusine indica* [*Cynosurus* i*ndicus* L. (1753)] (L) GAERTN (Poaceae)	Mutuzya (shi).		[47]	1,2	KIP0034
24	*Entada abyssinica* [*Entadopsis abyssinica* (Steud. ex A. Rich.) G.C.C. Gilbert & Boutique] STEUD. ex A. RICH. (Fabaceae)	Cishangi (shi).	[48]	[48]	11,8	KIP0035
25	*Erythrina abyssinica* [*Chirocalyx abyssinicus* (Lam. ex DC.) Hochst. (1846)] LAM. Ex DC (Fabaceae)	Cigohwa (shi); Igiko (rega)	[49]	[49]	14,1	KIP0036
26	Euphorbia hirta [*Hamaesyce hirta* (L.) Millsp. (1909)] L. (Euphorbiaceae)	Eforbia (shi) et Dieza di nkandi (kikongo).	[50]	[51]	32,9	KIP0037
27	*Flueggea virosa* [*Phyllanthus virosus* Roxb. ex Willd. (1805)] (ROXB. Ex WILLD.) VOIGT (Phyllanthaceae)	Kashugishugi (shi), Mkwama (swahili)	[52]	[53]	11,8	KIP0038
28	*Hypoestes triflora* [*Justicia triflora* Forssk.] (FORSSK) ROEM, & SCHULT (Acanthaceae)	Mageru (shi); Pindula (swahili)			1,2	KIP0039
29	*Isoberlinia angolensis* [*Berlinia angolensis* Welw. ex Benth. (1866)] (WELW. Ex BENTH.) HOYLE & BRENAN (Fabaceae)	Mahunire (shi), Mboza (swahili)	[54]		1,2	KIP0040
30	*Isoberlinia tomentosa* [*Berlinia tomentosa* Harms (1901)] (HARMS) CRAIB & STAPF (Fabaceae)	Mbaru (shi)			1,2	KIP0041
31	*Jatropha curcas* [*Jatropha afrocurcas* Pax (1909)] L. (Euphorbiaceae)	Lubonobono (shi); Umukoni (fulero).	[55]	[56]	9,4	KIP0042
32	*Julbernardia paniculata* [*Berlinia paniculata* Benth. (1866)] (BENTH.) TROUPIN (Fabaceae)	Cigebu (shi) Ashindambuka (fulero).			14,1	KIP0043
33	*Lantana camara* [*Camara vulgaris* Benth.] L (Verbenaceae)	Kashukashuha (shi); makereshe (nande).	[18]	[57]	36,5	KIP0044
34	*Leucas martinicensis* [*Clinopodium martinicense* Jacq.] (JACQ.) R. BR. (Lamiaceae)	Kanyamafundwe (shi), Namafundo (fulero).	[58]	[58]	4,7	KIP0045
35	*Mangifera indica* [*Mangifera amba* Forssk.] L. (Anacardiaceae)	Mwembe (shi); Hembe (swahili).	[59]	[60]	18,8	KIP0046
36	*Moringa oleifera* [*Hyperanthera decandra* Willd.] LAM. (Moringaceae)	Muringa (shi).	[60]	[60]	10,6	KIP0047
37	*Ochna schweinfurthiana* [*Diporidium*	Musengosengo (shi),	[61]	[61]	18,8	KIP0048

	schweinfurthianum (F. Hoffm.) Tiegh. (1902).] F HOFFM (Ochnaceae)	Muvulalusengo (tabwa).				
38	*Ocimum gratissimum* [*Ocimum caillei* A. Chev. (1920)] L. (Lamiaceae)	Losobosolo (swahili); Ndundu (kinyarwanda).	[18]	[62]	15,3	KIP0049
39	*Phyllanthus muellerianus* [*Diasperus muellerianus* Kuntze] (KUNTZE) EXELL (Phyllanthaceae)	Mulembalemba (hemba).	[63]	[63]	10,6	KIP0050
40	*Phyllanthus niruri* [*Phyllanthus fraternus* G.L. Webster] L. (Phyllanthaceae)	Kalumbu (shi) Kahungahunga (tshiluba).	[41]	[41]	17,6	KIP0051
41	*Physalis angulata* [*Boberella angulata* (L.) E.H.L. Krause] L. (Solanaceae)	Imbuma (shi); Mbupuru (kinande)	[18]	[64]	10,6	KIP0052
42	*Piliostigma thonningii* [*Bauhinia thonningii* Schumach.] (SCHUM.) MILNE-REDH. (Fabaceae)	Tshifumbe (tshiluba) et Kifumbe (bembe)	[65]	[65]	10,6	KIP0053
43	*Psidium guajava* [*Guajava pumila (*Vahl) Kuntze] L. (Myrtaceae)	Ipera (shi et kinyarwanda), Mapera (swahili).	[66]	[66]	30,6	KIP0054
44	*Psorospermum corymbiferum* [*Psorospermum guineense* auct.] SPACH (Hypericaceae)	Munkubagwa (shi)			12,9	KIP0055
45	*Rothmannia engleriana* [*Randia engleriana* K. Schum. (1891)] (K. SHUM) KEAY (Rhubiaceae)	Mulwalwa (shi; tshiluba)			12,9	KIP0056
46	*Senecio cineraria* [*Jacobaea* maritima (L.) Pelser & Meijden (2005)] (DC) (Asteraceae)	*Kalira* (shi).			12,9	KIP0057
47	*Solanecio cydoniifolius* [*Senecio cydoniifolius* O. Hoffm. (1894)] (O HOFFM.) C. JEFFREY (Asteraceae)	Halire (shi).			3,5	KIP0058
48	*Spilanthes mauritiana* [*Acmella mauritiana* A. Rich. ex Pers. (1807)] (A. RICH. Ex PERS.) DC. (Asteraceae)	Chenda (shi) Ubushwima (kinyarwanda).	[67]	[67]	12,9	KIP0059
49	*Syzygium cordatum* [*Eugenia cordata* (Hochst. ex C. Krauss) Lawson (1871)] HOCHST. in C. KRAUSS (Myrtaceae)	Civambaganyi (shi) Omuvambanyi (kinyarwanda).	[68]	[68]	11,8	KIP0060
50	*Tagetes minuta* [*Tagetes glandulosa* Link (1822)] L. (Asteraceae)	Cikangambasi (shi).	[69]	[69]	8,2	KIP0061
51	*Tithonia diversifolia* [*Mirasolia diversifolia* Hemsl. (1881)] (HEMSL.) A. GRAY (Asteraceae)	Chilula (shi).	[18]	[70]	28,2	KIP0062
52	*Trema orientalis* [*Sponia orientalis (*L.) Planch. (1848)] (L.) BLUME(Ulmaceae)	Nyabwifomeke (mashi) Muhepfu (kinyarwanda).	[71]	[71]	8,2	KIP0063
53	*Vernonia amygdalina* [*Gymnanthemum amygdalinum* (Delile) Sch. Bip. ex Walp. (1843)] DELILLE (Asteraceae)	Mubirizi (shi); Mululuca (bembe)	[18]	[72]	22,4	KIP0064

Asteraceae and Fabaceae constitute respectively the second and the third family of flowering plants known worldwide [73] and Fabaceae only, the largest family of trees in tropical dry forests of Africa [74]. In addition, ethnobotanical studies carried out in the region [17, 18, 24, 25, 27, 75, 76] report the preponderance of Fabaceae and Asteraceae with very variable frequencies (5-23%); The results observed in this study (table 1) are therefore part of the general trend. Note also that this preponderance of Fabaceae accounts not only for the importance of this family in traditional Congolese medicine for the management of several pathologies such as diabetes [77], sickle cell anemia [78], schistosomiasis [79], dental caries [80] or diarrhea [81].

Regarding vernacular nomenclature (table 1), note that the frequency of Kinyarwanda (11%) sometimes higher than the designation in some languages originating in the province of South Kivu such as Bembe (7.5%) or rega (5.6%) suggests the influence of Rwanda, in the practice of traditional medicine in Bagira and suggests that many other people share the knowledge of the Bagira IPMTs. Names in vernacular languages also report that some names translate the action or the effect of the plant. This is the case of *kizimya*, designation of *Dialium angolense* in mashi, which means: "that which extinguishes" or the case of *nfuma*, designation of *Dalbergia katangensis* in mashi, which means: "*I am cured*"; On the other hand, other plants such as *Artemisia annua* or *Cinchona officinalis* do not have a real name in the vernacular of the region suggesting that they are imported plants. There are also plants that have vernacular names common to other plants. This is the case of *Dalbergia katangensis* which some informants called "*Mungobole*", the name given to *Dalbergia lactea* Vatke (Fabaceae), according to studies carried out in Kivu by the team of Chifundera [26]. This situation constitutes a probable source of confusion in the practice of traditional medicine and reveals that very often the vernacular names of plants in traditional medicine are based more on the genus than on the species thus raising in ethno pharmacological practice, l importance of identification at the base of the plant along with the IPMT during harvest.

According to literature data, these 53 species can be grouped in four class (A to D). Class A comprises 15 plants for which no ethnobotanical information has been available until now and for which no evaluation of anti-malarial activity has been reported. These plants are *Chenopodium opulifolium*,

Clematis villosa, *Crassocephalum montuosum*, *Crassocephalum picridifolium*, *Dalbergia katangensis*, *Dialium angolense*, *Dialopsis africana*, *Ekebergia benguellensis*, *Hypoestes triflora*, *Isoberlinia tomentosa*, *Julbernardia paniculata*, *Psorospermum corymbiferum*, *Rothmannia engleriana*, *Senecio cineraria* and *Solanecio cydoniifolius*, Class B includes 2 plants, *Aframomum laurentii and Isoberlinia angolensis*, previously used in traditional medicine as antimalarials but for which no activity has been evaluated to date; Class C comprises a plant, *Eleusine indica*, known for other ethnobotanical uses than antimalarials and for which no previous study to assess antiplasmodial activity has been reported and. Class D contains 35 plants for which previous studies have evaluated anti-malarial activity. This study therefore reports new ethnobotanical antimalarial knowledge of 16 plants (class A and C); it also suggests that there is a high probability of finding, among the 18 plants (class A, B and C) for which no pharmacological studies have been reported, compounds with beneficial antimalarial activity and suggests that studies of these 18 plants were evaluated for anti-malarial activity.

3.3 Ethnopharmacological data collected during the survey

The 53 plants listed in the survey are used to prepare 83 recipes, of which 67 use a single plant (R1-R67) and 16 combine two, three (R68-R83) or four plants (R72 and R75). Overall, one-plant recipes have higher quotient rates than multi-plant recipes. Among the recipes that use a single plant (R1-R67), nine plants have two recipes and are the most cited. Among them, *Artemisia annua* (R4 and R5) with 10 occurrences is the most cited. In recipes based on several plants, R72 based on the leaves of *Ageratum conyzoïdes*, *Bidens pilosa*, *Carica papaya* and *Senna occidentalis* is the most quoted with five occurrences. Several organs are solicited among which the leaf (≥ 52%) constitutes the most organ used, which is taken in the form of handle (65 ± 15 g). There are several ways of preparing the recipe including maceration, infusion, decoction, and decoction (≥ 50%) is the most used. The recipe is administered *per os* using *Kibuyu* (1.5 ± 0.2 L) as a dosage unit. These plants are involved in the management of 80 other pathologies including amoebiasis, diarrhea and intestinal worms, with 14 quotes each, constipation with 11 quotes and snakebite with nine quotes, are the most cited. *Biden's pilosa* and *Mangifera indica* with 14 indications each constitute the plants with the highest use values. (Table 3).

Table 3: Anti-malarial recipes and other indication belonging to 53 species used in Bagira

Species	Antimalarial Recipe	E_i	Other Indication (organ)
Acacia polyacantha	R1: Infusion of a tablespoon of the powder of the leaves in 1L of water. Drink 1 glass 3x / day for 7 days.	1	Irritation of the skin (F), Pneumonia (F), Diabetes, Toothache (ER), Amoebiasis (ER), Spasms, diarrhea (ER), Hypotension (Fr)
Aframomum laurentii	R2: Infusion of two handles of the aerial parts in 1L of water. Drink 1 glass 3x / day for 7 days.	1	Amoebiasis (F), syphilis (F), fungal (F).
Ageratum conyzoïdes	R3: Decoction of two fresh leaves in 1.5x2 L of water. Drink 1 glass 3x / day for 7 days.	1	Snake bite (PE), helminth & pneumonia (F)
Artemisia annua	R4: Decoction of two fresh leaves in 1L of water. Drink 1 glass 3x / day for 7 days.	10	Cold, pneumonia, Intestinal worms Hepatitis, gonorrhea (F), Intestinal worms (ER), Amoebiasis (ET), Syphilis (ET), Lice (Fl).
	R5: Infusion of a tablespoon of dried leaf powder into 1L of water. Drink 1 glass 3x / day for 7 days.	10	
Azadirachta indica	R6: Maceration of two handfuls of fresh leaves crushed in 1.5L of water. Drink 1 glass 3x / day for 7 days.	1	pneumonia, urinary tract infection (F), Amoebiasis, anemia (F), Typhoid fever (F), Poisoning (PE), Amoebiasis, wound, diarrhea (PE), Mycosis, dysentery (PE), Tuberculosis, myomas (PE), Syphilis (PE).
Bidens pilosa	R7: Infusion of two handfuls of fresh leaves in 1 / 2x2L. Drink 1 glass 2x / d for 4 days.	6	Convulsion, pains (ER), Abdominal, epilepsy, meningitis (ER), Typhoid fever (ER), Gonorrhea, tooth decay (ER),
Bobgunia madagascariensis	R8: Decoction of three pieces of crushed root peel in 1.5L of water. Drink 1/2 glass of filtrate 2x / day for 4 days.	2	Diarrhea, food poisoning (F), Kwashiorkor, measles (F), Stomach cancer, leukemia (F), Dysentery (ER).
Cajanus cajan	R9: Decoction of two handfuls of fresh leaves in 1.5L of water. Drink 2 glasses 3x / day for 3 days.	1	Bronchitis (Fl), wounds (S), verminosis (Gr), purulent wound (Fr), Dyspepsia, diphtheria (Fr), Snake bite (ET), Amoebiasis: R + F pour Persea americana + PE pour Euphorbia hirta, Jaundice and asthma (F)
Carica papaya	R10: Infusion of two handfuls of leaves in 1.5L of water. Drink a glass 3x / day for 7 days	12	Constipation, dysmenorrhea (R), Placental retention (R), Snake bite, fungal, intestinal worms (F), Amoebiasis (F), tuberculosis & pneumonia (Gr)
Cassia occidentalis	R11: Maceration of two handfuls of freshly crushed leaves in 1L of water. Drink 1 glass 3x / day for 7 days.	12	Diabetes (F), Amoebiasis, indigestion (PE), Diarrhea and gastritis (R).
Catharanthus roseus	R12: Infusion of a handful of fresh roots in 1.5L of water. Drink 0.5 glass 2 × / d for 4 days.	1	Intestinal worms, fever (F), Hemorrhaged, uterine pain (F), Epistaxis (T) and tuberculosis (F)
Chenopodium abrosioides	R13: Decoction of a handful of leaves in 1L of water. Drink 0.5 x 2x day for 4 days.	1	Food poisoning (R), Placental retention (R), Childbirth, hemorrhage (R), Snake bite and wounds (F)
Chenopodium opulifolium	R14: Decoction of fresh aerial parts in 1.5L of water. Drink 0.5 glass 2x / day for 4 days.	8	Splenomegaly, asthenia (F), Cold, constipation and anorexia (F),
Cinchona ledgeriana	R15: Decoction of 2 handles of the leaves in 0,5x2L of water. Drink: 1/2 glass 2x / day for 4 days.	5	Headache, cough (F), Cataract (Fl)
Clematis scabiosifolia	R16: Maceration of two handfuls of freshly crushed leaves in 1L of water. Drink 1 glass 3x / day for 7	1	Mental disorders, convulsion (R), Intestinal worms, wounds (F), Gonorrhea, diarrhea, sprain (F), Ulcer and

	days.		placental retention (F)
Crassocephalum montuosum	R17: Maceration of two handles of crushed roots in 0.5x2L of water. Drink 0.5 glass 2 x / day for 4 days.	1	Amoebiasis, renal failure (F), Wound, retention of placenta, cough (F).
Crassocephalum picridifolium	R18: Decoction of a handful of fresh leaves in 1L of water. Drink a glass3x / day for 7 days.	1	Stomach, flu, diabetes (F), Hemorrhoids (F), Gonorrhea, hepatitis, goiter (R), Cataract and purulent otitis (R).
Cymbopogon citratus	R19: Decoction of three handles of fresh leaves in 1L of water. Drink 2 glasses3x / d for 3 days.	1	Schistosomiasis, Amoebiasis (F), Intestinal worms, hyper gastralgia (F), Tuberculosis (F) Urethritis and Amoebiasis (F).
	R20: Maceration for 48 hours of two handfuls of fresh fruit in 1.5 L of water. Drink 1 glass 3x / day for 7 days.	3	
Dalbergia katangensis	R21: Infuse three handfuls of fresh root bark into 1.5 L of water (or immature banana wine: *ecibabe*). Drink 2 glass 3x / d for 3 days.	2	Vaginitis, bacillary dysentery (ER), Cholera, hyper gastralgia (ER), Round (ER), Furuncle, abscess (ET), Hemorrhoids and wounds (ET), Headache, fever, ulcer (ET), Tuberculosis (ET), conjunctivitis (F), Wounds and stomachaches (ER)
	R22: Infuse three handfuls of leaves in 1.5L of water Drink 2 glasses 3x / day for 3 days.	6	
Dialium angolense	R23: Decoction of a handful of fresh leaves in 1.5L of water. Drink 1 glass 3x / day for 7 days.	9	Headache, fever (R), Gastric ulcer, tuberculosis (R), Belly ache (R), Conjunctivitis and wounds (F)
Dialopsis africana	R24: Decoction of a handful of dry root bark in 1L of water. Drink 1 glass 3x / day for 7 days.	3	Constipation, madness (R), Malnutrition (G), Severe malnutrition (Gr), Angina, kwashiorkor with (F) from mukuzanya: *Clerodendrum myricoïdes* + Munyenenyenge: Sesbania sesban + Mucumucumu: *Leonotis nepataefolia*, Snake bite (F), Diarrhea and wounds (R).
Ekebergia benguellensis	R25: Decoction of a handful of fresh root bark in 1.5L of water. Drink 0.5 × 2 / day for 4 days.	16	Dental caries, sexual asthenia, hernia, low back pain 5R), Dysmenorrhea (ET), lily of the valley (F), Hepatitis, goiter (F), Cataracts and purulent otitis (Fl).
Eleusine indica	R26: Decoction of a handful of fresh roots in 1L of water. Drink 0.5x2x / d for 4 days.	10	Diarrhea, inflammation, inflammation, Shigellosis, dysentery, Gastrointestinal disorders (PE), Syphilis, cough (PE), Diarrhea, respiratory infections (PE), Intestinal worms and coughs (PE).
Entada abyssinica	R27: An infusion of 2 handles in 1L. Drink 1 glass 3 × / d for 7 days.	2	Schistosomiasis, hyper-gastralgia (R), Snake bite (R), Irregular rules and tuberculosis (F), Wounds, Abortion Threats and Weight Loss (PE).
	R28: Maceration for 48 hours of two handfuls of fresh fruit in 1.5L of water. Drink 1 glass 3x / day for 7 days.	3	
Erythrina abyssinica	R29: Decoction of two handles of the roots in 1.5L of water. Drinking 0.5 glass 2X / d for 4 days.	2	Splenomegaly, intestinal worms, and abdominal colic (ER)
Euphorbia hirta	R30: Decoction of three handfuls of fresh whole plant in 1L. Drink 1/2 glass 2x / day for 4 days.	14	Diarrhea, gout, and dysentery (ET)
Flueggea virosa	R31: Decoction of two handfuls of leaves in 1L of water. Drink 1 glass 3x / day for 7 days.	1	Dental caries, gastric ulcer €, Diarrhea, moth (F), Thumbtack and fever (F) Fever, dysentery (En), Gonorrhea (Fl) and cough (F).
	R32: Maceration of three handles of roots in 1.5L of water. Drink 1 glass 3X / day for 7 days.	1	
Hypoestes triflora	R33: Maceration of a handful of fresh roots in 1L of water. Drink 1/2 glass 2x / day for 4 days.	1	Rheumatism, Snake bite (F), Asthma, sinusitis, non-healing of wounds (F), fractures (T), Warm Intestinal (Gr).
Isoberlinia angolensis	R34: Decoction of two handles of crushed roots in 1.5L of water. Drink 1 glass 3x / day for 7 days.	1	Lumbar pain, palpitations, and postpartum pain (F), Intestinal warm (Nx), Amoebiasis (ET)
Isoberlinia tomentosa	R35: Decoction of three handles of fresh leaves in 1.5L. Drink 1/2 glass 2x / day for 4 days.	1	Syphilis, hemorrhoids, anemia (ET), Cough, angina, dehydration (F), Diabetes, diarrhea, fever, gastritis (F), Hypertension and poisoning (F)
Jatropha curcas	R36: Take 0.5L of the latex from the root and apply it at the neck 1/2 glass x2 / day for 4 days.	1	Gingivitis, indigestion (ER), Food poisoning (ER), Splenomegaly (ER), Wounds (ER), purulent urethritis (ET), Gastritis (F). Psoriasis, bacillary dysentery (F), Immunodeficiency (F).
	R37: Take 0.5L of the latex from the stem barks and apply it at the neck 1/2 glass x2 / day for 4 days.	1	
Julbernardia paniculata	R38: Infusion of three handfuls of fresh leaves in 1L of water for 20 minutes. Drink 1/2 glass 2 x / day for 4 days.	1	Headache, rheumatism (ET), Hemorrhoids, helminths (F).
Lantana camara	R39: Decoction of two handfuls of fresh flowers in 1.5L of water, drink 0.5 glass 2X / day for 4 days.	14	Dyspepsia, epilepsy and wound (ET).
Leucas martinensis	R40: Decoction of three handfuls of fresh whole plant in 1.5L. Drink 1/2 glass 2x / day for 4 days.	1	Diarrhea, hernia, fever, diabetes (ET), Hypertension and constipation (F).
Mangifera indica	R41: Decoction of a handful of fresh leaves in 1.5L of water. Drink 2 glasses 3x / day for 3 days.	1	Diabetes, Hepatitis, Colitis, Fever (F), Amoebiasis, headache, conjunctivitis (R)
M. oleifera	R42: Decoction of a handful of fresh leaves in 1L of water. Drink 2 glasses 3X / d for 3 days.	1	Gastritis, hemorrhoid, cough, abscess (ET), Constipation (ET).
Ochna schweinfurthiana	R43: Decoction of a handful of fresh stem bark in 1.5L of water. Drink 2 glasses 3x / day for 3 days.	8	Diarrhea (F), constipation (En), Vermifuge (ET) and Viral Infection (F).
Ocimum gratissimum	R44: Decoction of a tablespoon of the dried and	4	Madness, constipation, malnutrition (R), Fever,

	crushed leaves in 1.5L of water. Drink 2 glass 3x / d for 3 days.		Tuberculosis, Gonorrhea (R), Hemorrhoid (F)., Hemorrhoid (F). Mental disorders, Hypertension, and cough(R)
	R45: Maceration of a handful of fresh roots in 1L of water. Drink 1/2 glass 2x / day for 4 days.	4	
Phyllanthus muellerianus	R46: Decoction of a handful of fresh leaves in 1.5x2 L of water. Drink 2 glasses 3x / d for 3 days.	3	Gastritis, fever, cough, wounds (ER), Asthenia (ER)
Phyllanthus niruri	R47: Decoction of a handful of fresh leaves in 1 L of water. Drink 2 glasses 3x / day for 3 days.	12	Snake bite, constipation (PE), Intestinal worms (PE).
Physalis angulata	R48: Decoction of two handles of the leaves dry and looted in 1L of water. Drink 2 glasses 3x / day for 3 days.	1	Snake bite, Teeth ache (F), Foul, rheumatism, (F), Oral infections, colic (F), Insomnia (PE) Hepatic Diseases (R), Urethritis (F) and syphilis (Fr)
	R49: Maceration of the two handles of powder of the whole plant looted in 1.5L of water for 24h. Drink 1 glass of filtrate 3x / day for 7 days.	1	
Piliostigma thonningii	R50: Decoction of a handful of fresh leaves in 1.5L of water. Drink 1 glass 3x / day for 7 days.	5	Headaches, mycosis (ET), Dysmenorrhea (ET).
Psidium guajava	R51: Decoction of two handfuls of leaves in 1L of water. Drink 1/2 glass 2x / day for 4 days.	4	Psoriasis (F), back pain (with Igwarha: Cyathula uncinulata), intestinal worms, dermatitis (F), bacillary dysentery (F), Constipation and immunodeficiency (F1). Otitis, intoxication, vermifuge, (F), constipation, tumors, scabies and Anaplasmosis in cows (ET).
	R 52: Decoction of two handles of stem barks in 1.5x2 L of water. Drink 1/2 glass 2x / day for 4 days.	3	
	R53: Maceration for 48 hours of two handfuls of fresh fruit in 1.5L of water. Drink 1 glass 3x / day for 7 days.	3	
Psorospermum corymbiferum	R54: Macerate two handles of fresh root bark in 1L of water (or immature banana wine: ecibabe). Drink 1 glass 3x / day for 7 days.	1	Irritation of the skin (F), Pneumonia (F), Diabetes, Toothache (ER), Amoebiasis (ER), Spasms, diarrhea (ER), Hypotension (Fr)
Rothmannia englerianna	R55: Maceration of two handles of ground root bark in 1L of water. Drink 0.5 glass 2 x / day for 4 days.	4	Amoebiasis (F), syphilis (F), fungal (F), Snake bite (PE), helminth & pneumonia (F).
	R56: Decoction of a handful of fresh leaves in 1L of water. Drink 1 glass 3x / day for 7 days.	5	
Senecio cineraria	R57: Decoction of a handful of fresh whole plant in 1.5L of water. Drink 1 glass 3x / day for 7 days.	7	Cold, pneumonia, Intestinal worms (F).
Solanecio stuhlmannii	R58: Decoction of a handful of leaves in 1L. Drink 1 / 2verre 3x / d for 4 days.	1	Intestinal worms (ER), Amoebiasis (ET), Syphilis (ET), Hepatitis, gonorrhea (F), Lice (Fl)
Spilanthes mauritiana	R59: Maceration of two handfuls of the whole plant fresh and crushed in 1.5L of water. Drink 1/2 glass 2X / d for 4 days.	1	pneumonia, urinary tract infection (F), Amoebiasis, anemia (F), Typhoid fever (F), Poisoning (PE), Amoebiasis, wound, diarrhea (PE), Mycosis, dysentery (PE), Tuberculosis, myomas (PE), Syphilis (PE).
Syzygium cordatum	R60: Decoction of a handful of leaves in 1.5L of banana juice. Drink 1 glass 3x / day for 7 days.	9	Convulsion, pains (ER), Abdominal, epilepsy, meningitis (ER), Typhoid fever (ER), Gonorrhea, tooth decay (ER),
Tagetes minuta	R61: Maceration of two handfuls of fresh leaves crushed in 1.5L of water. Drink 1 glass 3X / day for 7 days.	5	Diarrhea, food poisoning (F), Kwashiorkor, measles (F), Stomach cancer, leukemia (F), Dysentery (ER). Bronchitis (Fl), wounds (S), verminosis (Gr), purulent wound (Fr), Dyspepsia, diphtheria (Fr), Snake bite (ET), Amoebiasis: R + F pour Persea americana + PE pour Euphorbia hirta, Jaundice and asthma (F).
	R62: Decoction of two handles of stem bark divided into 1.5L of water. Drink a glass 3x / d for 7 days.	4	
	R63: Maceration for 48 hours of three handfuls of fresh fruit in 1L of water. Drink 1 glass 3x / day for 7 days.	2	
Tithonia diversifolia	R64: Decoction of three leaves of freshly ground leaves in 1.5L of water. Drink ½ glass filtrate 2x / day for 4 days.	7	Diabetes (F), Amoebiasis, indigestion (PE), Diarrhea and gastritis (R).
Trema orientalis	R65: Decoction of a handful of crushed stem barks in 1.5x2 L of water. Drink 1 glass 3x / day for 7 days.	3	Intestinal worms, fever (F), Hemorrhage, uterine pain (F), Epistaxis (T) and tuberculosis (F)
	R66: Decoction of a handful of leaves in 0,5x2 L. Drink ½ glass 2x / day for 4 days	5	Food poisoning (R), Placental retention (R), Childbirth, hemorrhage (R), Snake bite and wounds (F)
Vernonia amygdalina	R67: Decoction of a teaspoon of the dried and crushed leaves in 1L of water. Drink 1 glass 3x / day for 7 days.	12	Splenomegaly, asthenia (F), Cold, constipation and anorexia (F).
Hypoestes triflora (PE) *Ekebergia benguellensis* (F) *Ageratum conyzoïdes* (F).	R68: Decant for 15 minutes in 1.5x3 L of water mixed handles and pounded in proportions 1 ÷ 1 ÷ 2. Filter and drink 1 glass 3x / d for 3 days.	1	
Mangifera indica (F) *Azadirachta indica* (F).	R69: Mix a handful of the leaves of each plant in proportions 1 ÷ 1, pound together and infuse for 25 minutes in 1.5x2 L of water. Drink 1 glass of filtrate 2x / day for 4 days.	2	
Catharanthus roseus (Fl), *Cinchona ledgeriana* (ER), *Senna occidentalis* (F).	R70: Mix a handful of the organ of each plant in proportions 1 ÷ 1 ÷ 2. Make a decoction in 1x2 liters of water for 30 minutes. Drink 1 glass 3x / day for 3 days.	3	
Tithonia diversifolia (F),	R71: Mix in proportions 1 ÷ 2 handles of the organ of	2	

Trema orientalis (ER).	each plant in 1L of water. Infuse the mixture of fresh powders for 10 minutes and drink 1 glass 3x / d for 7 days.		
Carica papaya (F), *Bidens pilosa* (F), *Bidens pilosa* (F), *Ageratum conyzoïdes* (F).	R72: Pile together the handles of the leaves of each plant in proportions 1 ÷ 1 ÷ 1 ÷ 1 and decocted for 15 minutes in 1.5x4 L and filter. Drink 1 glass 3x / day for 3 days.	5	
Bidens pilosa (F). *Chenopodium ambrosoïdes* (F) *Ageratum conyzoïdes* (F).	R73: Decant for 15 minutes in 1.5x3 L of water a handful of the leaves of each crushed plant in the proportions 1 ÷ 1 ÷ 1. Drink the filtrate 1 glass 3x / d for 3 days.	3	
Jatropha curcas (F) *Euphorbia hirta* (PE).	R74: Decant for 25 minutes in 1.5x2 L of water a handle according to the proportions 1 ÷ 1 of the organs of each crushed plant then filter. Drink 1 glass 2x / d for 4 days.	2	
Acacia polyacantha (F), *Bidens pilosa* (F), *Cymbopogon citratus* (F), *Senna occidentalis* (F).	R75: Macerate in 1x2 liters of water for 24 hours from the handles of the leaves of each plant in the proportions 1 ÷ 1 ÷ 2 ÷ 1. Drink 1 glass 3x / day for 3 days.	3	
Cajanus cajan (F), *Cymbopogon citratus* (F).	R76: Macerate for 24 h in 1x2 L of water, handfuls of mixed leaves in proportions 1 ÷ 2. Drink 1 glass 2x / d for 4 days.	1	
Bidens pilosa (F), *Cymbopogon citratus* (F), *Erythrina abyssinica* (ER).	R77: Decoction for 1 hour of the combination of a handful of each plant in a calabash or 1x2 liters of water. Drink 1 glass 3x / day for 3 days.	1	
Julbernardia paniculata (F)., *Psorospermum corymbiferum* (F), *Cinchona ledgeriana* (F).	R78: Maceration of a handful of the leaves of each plant for 72 h in 1.5x2 L of ecibabe. Drink 1 glass 2x / day for 4 days.	2	
Azadirachta indica (F), *Cajanus cajan* (F).	R79: Decant in 1x2 L of water for 15 minutes an association of the handles of the leaves in the proportions 3 ÷ 1. Drink 1 glass 3x / day for 3 days.	2	
Bidens pilosa (F) *Syzygium cordatum* (F).	R80: Decoction for 15 minutes of a combination of the handles of the crushed leaves in proportions 1 ÷ 2 in 1.5x3 L of *ecibabe* and filter. Drink 1 glass 3x / day for 3 days.	2	
Bidens pilosa (F). *Flueggea virosa* (F).	R81: Decant for 25 minutes in 1.5x2 L of water, handles of the leaves mixed and crushed in the proportions 4 ÷ 1. Drink the filtrate 1 glass 3x / d for 3 days.	3	
Cinchona calisaya (F), *Bidens pilosa* (F), *Chenopodium ambrosoïdes* (F)	R82: Macerate for 24 h in 1.5x2 L of water from the handles of the mixed leaves in proportions 1 ÷ 2 ÷ 3 and pounded together. Filter and drink, 1 glass 3x / d for 3 days.	4	
Rothmannia engleriana (F) *Psorospermum corymbiferum* (F)	R83: Decant for 35 minutes in 1,5x3 L of *écibabe* (2 calabashes) handles of the leaves mixed and crushed in the proportions 1 ÷ 3. Filter and drink 1verre 2 x / day for 4 days.	1	

F: leaves; AND: Stem barks; ER: root bark; R: roots; T: stem; Fl: Flowers; Fr: Fruits; G: pods; PE: Whole plant; PA: aerial parts; Gr: Seeds; S: sap, Nx: nucleus; j = day; v = glass, pdt : during, Ei= relative workforce, Glass = bamboo glass = 200 - 250 mL, Kabehe = 680 ± 60 mL (local intake unit), cup = 0.5 ± 0.1 L; a handful of leaves = 65 ± 15 g of fresh plant material, Kibuyu = 1.5 ± 0.5 L (local measurement unit), F e'cibabe= unripe banana wine.

These preponderances of leaf and decoction in herbal recipes are reported in several ethnobotanical surveys conducted on antimalarial plants [17, 18, 25, 35, 82]. According to the consulted IPTM, the recourse to the decoction would aim not only the extraction of the active principle but also its activation. It must be remembered, however, that this practice would be just as beneficial as it is harmful. Indeed, as much as it could facilitate the release of certain active principles often present in the plant in the glycoside form, as much it could not only release some toxic forms of secondary metabolites like cyanogenic glycosides [83] or deteriorate the active compounds. This practice therefore remains to be assessed on a case-by-case basis and only experimental work could determine its fair value as appropriate.

In addition, ethnobotanical studies carried out in DR Congo [77, 80, 82, 84], whatever the most often oriented towards a specific pathology, do not report plants used as an antidote to poisons, particularly against snake bites with a frequency comparable to that observed in the present study (17%); The population of Bagira would therefore have a particular knowledge of poisons. Note also that the results related to the pathologies treated by these plants are in the same line as that of work carried out in other regions of the country (24,35), which have established that most of the pathologies taken care of in traditional Congolese medicine are of infectious origin.

4. Conclusion

This study identified 53 plants used in traditional medicine in Bagira (DRC) for the treatment of malaria. These plants belong to 43 genera from 24 families dominated by Asteraceae and Fabaceae. They participate in 83 antimalarial recipes of which 67 use a single plant and the other associates two, three or four plants where the leaf is the most used organ in the form of a decoction. This study cites for the first time *Chenopodium opulifolium, Clematis villosa, Crassocephalum montuosum, Crassocephalum picridifolium, Dalbergia*

katangensis, Dialium angolense, Dialopsis africana, Ekebergia benguellensis, Hypoestes triflora, Isoberlinia tomentosa, Julbernardia paniculata, Psorospermum corymbiferum and Rothmannia engleriana as antimalarial plants and thus constitutes a database for further investigative investigations that may include the isolation of antimalarial compound or the production of improved traditional drugs.

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Competing Interests
Authors have declared that no competing interests exist.

Authors' Contributions
Bashige chiribagula valentin collected the first data by conducting ethnobotanical surveys; designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. 'Bakari Amuri Salvius and Okusa Ndjolo Philippe managed the analyzes of the study and the literature searches, Kahumba Byanga, Duez Pierre and Lumbu Simbi, supervised project and have corrected the manuscript. All authors read and approved the final manuscript.

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