



Determinants, Prevalence and Trend of Use of Medicinal Plants Among People Living with HIV: A Cross-Sectional Survey in Dschang, Cameroon

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Abstract

People living with HIV (PLHIV) in Cameroon often seek care from traditional health practitioners (THPs) and use medicinal plants (MP). Most MP, however, still lacks evidence for their efficacy and safety, and their use, often undisclosed to referring physicians, may interfere with standard therapies. Therefore, we conducted a survey of 247 PLHIV in Dschang to assess the determinants, prevalence and trend of MP use. Besides, we surveyed 16 THPs about the use of MP in PLHIV and HIV-related knowledge. 54.9% PLHIV declared using in total 70 plants, 91.3% users were satisfied with MP, and unwanted effects were reported in 2 cases. MP users were less educated than nonusers, had longer disease duration and were more often unemployed. Only 3 THPs used MP in PLHIV, and most of them had insufficient knowledge of HIV. Results may be useful for education on HIV and integration of traditional medicines with conventional therapeutics.

Keywords Medicinal plants · Ethnobotanical survey · Prevalence · HIV/AIDS · Dschang Cameroon

Introduction

HIV/AIDS is a major public health problem, affecting circa 36.7 million people worldwide [1]. Sub-Saharan Africa, which accounts for more than 2 in 3 people living with HIV (PLHIV), stands out as the epicentre of this epidemic [2]. Despite efforts to combat this disease, no definitive cure or

protective vaccine has yet been discovered [3]. The advent of combination antiretroviral therapy (cART) has made HIV/AIDS a chronic and treatable disease [4, 5]. However, there are still tremendous obstacles in accessing cART in some parts of the world, especially in resource-poor settings [6]. Common barriers to cART include stigma and discrimination, poverty, shortage of health personnel, drug resistance and the associated side effects of antiretroviral drugs [7, 8]. Overall, antiretroviral therapy still suffers from several largely unmet medical needs, which may induce PLHIV to seek care from complementary and/or alternative medicines [9, 10].

Medicinal plants (MP) represent the most common source of complementary and/or alternative medicines in different parts of the globe, and particularly in Sub-Saharan Africa [11]. Interest in MP lies mainly in their affordability, accessibility, cultural acceptability, perceived efficacy and safety [12]. However, there are concerns that most MP are still lacking supporting evidence for their efficacy, tolerability and safety [13, 14].

MP use is widespread in Cameroon, but still, the actual prevalence is unknown, especially among PLHIV [15]. Indeed, current data on the prevalence of MP use (33.7–97.3%) comes from previous research conducted

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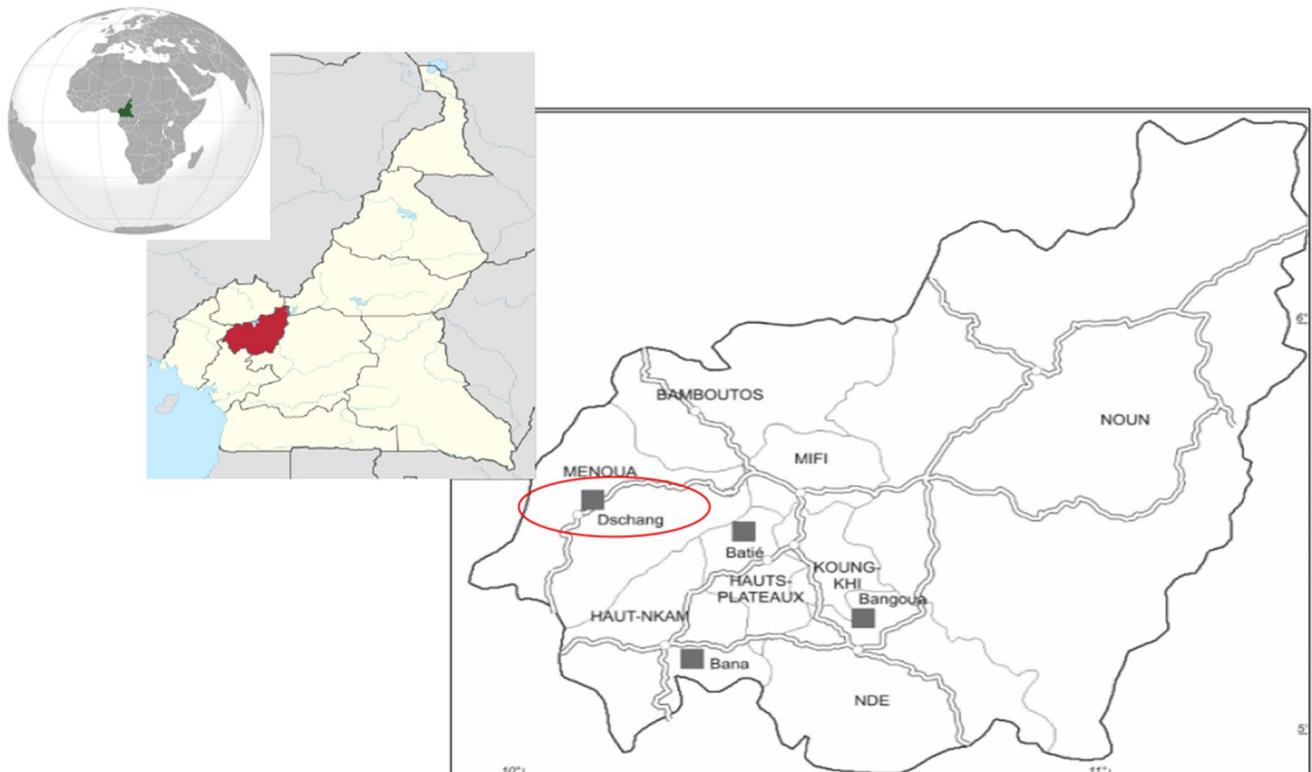


Fig. 1 Map of study area

outside Cameroon [16, 17]. Interestingly, in PLHIV under cART, MP are often used undisclosed to referring physicians, raising concerns about possible interference with standard therapies [13, 14]. Based on this background, we conducted a questionnaire-based survey to determine the prevalence, trend of use and factors associated with MP use among PLHIV in Dschang (West Region, Cameroon).

Traditional health practitioners (THPs) are custodians of knowledge about the traditional use of MP [18–20]. Almost 80% of the African population relies on THPs for most of their healthcare needs, 60% of whom have sexually transmitted infections including HIV/AIDS [21–23]. Given the lack of easily accessible conventional health facilities, the high costs of transportation to these facilities and the shortage of medical personnel, especially in rural and remote areas, THPs could fill gaps in the provision of primary health care to PLHIV. However, THPs are looked upon by many in the conventional medical system as unfit or poorly qualified to assist in the correct diagnosis of symptoms as well as prevention and treatment of HIV/AIDS [21]. This reluctance to integrate traditional medicine with conventional medicine is concerning given the growing burden of the HIV epidemic that is affecting health systems in Africa. In view of the above, we also examined the use of MP by THPs in PLHIV and their knowledge of HIV/AIDS with the aim to determine if THPs are an appropriate resource to assist in the

scaling up of HIV prevention and treatment delivery services in Cameroon.

Methods

Study Design and Administrative Procedure

This study was a cross-sectional questionnaire survey carried out between January and June 2017 in the city of Dschang. Permission to conduct this research was previously granted by the head of Dschang health district (No. 192/AR/MINSANTE/DRSPO/DSD) and the director of the Dschang District Hospital (No. 021/AR/MSP/DRO/DSD/HDD), respectively. Ethical approval for this study was obtained from the Cameroon National Ethics Committee under registration number CE No. 00172/CRERSHC/2017 (Supplementary data S1).

Study Area

Dschang is the capital city of the Ménoua division, in the West Region of Cameroon (Fig. 1). The city of Dschang was purposefully selected for this study because of its rich biodiversity and long tradition of MP use [24]. Second, it is home to about 221,031 inhabitants of different ethnic

and religious backgrounds. Third, the university that bears its name (University of Dschang), whose main campus is located in the municipality of Dschang, has largely contributed to the multi-cultural character of its population. Moreover, Dschang exhibits both the rural and urban landscapes of Cameroon, and traditional health beliefs are widespread in the countryside [25]. Lastly, the Dschang Health District is divided into 22 health areas, with a total of 66 health facilities including one district hospital.

With a capacity of 300 beds, ten care units and 95 medical and paramedical staff, the Dschang District Hospital is the reference health facility in Dschang. It has a care unit dedicated explicitly to PLHIV, although screening, prevention and care activities are integrated into the various care services throughout the hospital. All patients attending the national HIV treatment program are required to report each month to the pharmacy and at least once every 3 months to their referring physicians, for a refill of their prescriptions, and their medical follow-up, respectively. The psychosocial support of PLHIV is mainly provided by trained health care auxiliaries (psychosocial counsellors) and to some extent the members of local HIV/AIDS associations, community relay workers and social workers.

Participants

The survey was designed for PLHIV and THPs, and individual consent was obtained from each participant before the beginning of the interviews. PLHIV over 18 years old attending the national HIV treatment program were eligible to participate in the survey. They were then enrolled consecutively between January and June 2017—without financial incentive—during routine visits to the Dschang District Hospital (Unit care).

THPs, including healers and soothsayers, were enrolled in this study as well. They were identified by Maurice Kenzo, chairperson of Société Coopérative des Producteurs des Plantes Médicinales de l'Ouest—Cameroun (Cooperative Society of Producers of Medicinal Plants of West—Cameroon) based on their good reputation in traditional healing practice. Respondents were members of the aforementioned society, which has about forty members.

Interviews

Study participants were interviewed in a one-to-one fashion and in their preferred language (English or French). Interviews of PLHIV and THPs were conducted respectively by psychosocial counsellors and the chairperson of MP producers' society, using a semi-structured questionnaire. In all cases, the interview did not last more than 30 min.

The study questionnaire was designed with adaptations according to existing literature from similar studies [26]. Then, the surveyed questions were pretested among a sample of study participants, generating changes on the initial version of the questionnaire which was ultimately used to collect information in the current study. At that stage of the study, we noted reticence of PLHIV to discuss their condition freely, as well as the reluctance of THPs to talk with us because according to them, we were “uninitiated” to traditional beliefs. As a corrective measure, we, therefore, chose the psychosocial counsellors and the chairperson of MP producers' society to conduct the interviews.

The questionnaire addressed to PLHIV was a 15-item mixed questionnaire structured into three main sections (Supplementary data S2). The first section was dedicated to the socio-demographic characteristics of the respondents including gender, education level, home location, ethnicity and profession. The second part focused on the duration since HIV diagnosis, the current cART regimen and associated benefits/side effects. In the last section, study participants were asked about their MP use experience for HIV symptoms management or related conditions. Participants who acknowledged the use of MP (MP users) were subsequently invited to provide information about the names of plants they used, the reasons and modality of their use as well as ratings of desired and unwanted effects.

On the other hand, the questionnaire addressed to THPs also comprised three sections (Supplementary data S3). The first section explored their socio-demographics. The second section consisted of a psychometric scale to assess their knowledge of HIV transmission, prevention and symptoms. Further, THPs who reported to use MP in PLHIV were interviewed about their practice activity.

The questionnaires were anonymous to ensure confidentiality, to avoid possible reticence of PLHIV to unveil the use of MP to their healthcare givers, as well as to overcome any potential ethical or legal issues related to the use of illegal or endangered MP by PLHIV or by THPs.

Botanical Identification of MP

MP users were invited to provide photographs or specimens of plants. If needed, field trips were made, and plants were sampled and deposited at the University of Dschang (Laboratory of Phytochemistry, Department of Biochemistry). At the end of the survey, a complete set of plant specimens, together with the collection notes (plant parts, photographs, vernacular/local name, habitat, and traditional use) were sent to the National Herbarium of Cameroon for botanical identification (Identification Number 158/IRAD/DG/CRRA-NK/SSRB-HN/07/2017).

Table 1 Demographics of HIV-infected participants and association with MP use

Features	N (%)	MP nonusers (%)	MP users (%)	χ^2	OR (95% CI)	P value
Gender					0.8237 (0.4679–1.450)	0.5637
Female	176 (71.3)	73 (68.9)	94 (72.9)			
Male	71 (28.7)	33 (31.1)	35 (27.1)			
Level of education				4.685		0.0304
Primary	129 (52.2)	51 (48.1)	75 (58.1)			
Secondary	75 (30.4)	34 (32.1)	35 (27.1)			
University	19 (7.7)	12 (11.3)	6 (4.7)			
Unschooling	4 (1.6)	0 (0.0)	0 (0.0)			
Missing	20 (8.1)	9 (8.5)	13 (10.1)			
Duration of illness in years (years since HIV diagnosis)				5.456		0.0019
≤ 2 years	83 (33.6)	46 (43.4)	34 (26.4)			
3–5 years	60 (24.3)	24 (22.6)	35 (27.1)			
6–9 years	47 (19.0)	19 (17.9)	25 (19.4)			
> 9 years	49 (19.8)	16 (15.1)	29 (22.5)			
Missing	8 (3.2)	1 (0.9)	6 (4.7)			
Current cART regimen				3.952		0.1386
Tenofovir/Lamivudine + Efavirenz	219 (88.7)	97 (91.5)	112 (45.3)			
Tenofovir/Lamivudine + Nevirapine	6 (2.4)	0 (0.0)	4 (1.6)			
Zidovudine/Lamivudine/Nevirapine	19 (7.7)	7 (6.6)	12 (4.9)			
No treatment	1 (0.4)	0 (0.0)	1 (0.4)			
Missing	2 (0.8)	2 (1.887)	0 (0.0)			
Occupational status					2.636 (1.547–4.491)	0.0004
Yes	152 (61.5)	60 (56.6)	43 (33.3)			
No	93 (37.7)	45 (42.5)	85 (65.9)			
Missing	2 (0.8)	1 (0.9)	1 (0.8)			
Satisfaction with cART regimen					0.5792 (0.1693–1.981)	0.5537
No	14 (5.7)	4 (3.8)	8 (6.2)			
Yes	228 (92.3)	101 (95.3)	117 (90.7)			
Missing	5 (2.0)	1 (0.9)	4 (3.1)			

N sample size

Data Analysis

Data were processed in MS Excel and subsequently validated following the International Quality Standard ISO 28590:2017 guidelines. Outcome variables were presented as counts or percentage where appropriate. The distributions of sociodemographic and health variables among MP users and nonusers were assessed using χ^2 or Fischer's exact tests. The variables for which the *P* value was less than 5%, were considered as determinants of MP use in PLHIV.

The psychometric scale used to assess the knowledge of HIV/AIDS of THPs was adapted from a previously designed questionnaire [27]. For each question, THPs were invited to select one answer from a defined list of three choices including "true", "false" and "don't know". The correct answers were scored as "1" and the incorrect/"don't know" responses as "0". The percentage of correct answers was determined

for each HIV knowledge item as previously reported [28]. We considered that a mean frequency of correct answers below 50% suggests poor knowledge of HIV/AIDS. The Fischer's exact test was used for the analysis of differences in proportions of correct answers among THPs (MP users and nonusers). Value of *P* that was under 5% was used to define significant differences regarding knowledge of HIV/AIDS among the two groups.

Results

Demographics of Study Participants

A total of 247 PLHIV were enrolled in this survey, and their descriptive baseline characteristics are illustrated in Table 1. Participants were 71.3% females, 82.6% with

Table 2 Reasons for dissatisfaction with current cART regimen of study participants

Reported reasons for dissatisfaction with cART	n	MP users (n)	MP nonusers (n)
<i>Side effects</i>	5	2	3
“Decline in CD4 count”	2	2	0
“I stopped cART therapy a year ago because I did not perceive any improvement in my HIV serological status”	1	1	0
“My work does not allow me to take my pills”	1	1	0
“No change in serological status”	1	1	0

n number of citations

primary or secondary education level but only 7.7% with university degree, 1 out of three with disease duration ≤ 2 years and 1 out of five > 9 years, more than 60% with work (although usually precarious, data not shown), almost all on cART and 92.3% satisfied with it.

On the other hand, 16 THPs were surveyed, including 13 traditional healers and three diviners. Most of them were males ($n = 13$, 81.3%) and had at least 10 years of seniority in traditional health practice ($n = 10$, 62.5%).

Prevalence and Determinants of MP Use in PLHIV

235 HIV positive participants have answered the question about the use of MP (response rate = 95.1%). Respondents reporting the use of MP but not answering open-ended questions about MP and vice versa were considered MP users. Overall, 129 PLHIV (54.9% of the respondents) declared having used MP to manage HIV symptoms and related conditions. MP users were mainly females ($n = 94$, 72.9% of MP users) and came from the West region of Cameroon ($n = 123$, 95.3%). Most had 3–5 years of illness ($n = 35$, 27.1%) and primary school education level ($n = 75$, 58.1%). Nearly all MP users were currently receiving the first-line cART ($n = 128$, 99.2%) and most of them were satisfied with their therapy ($n = 117$, 90.7%). In comparison to nonusers, MP users were less educated ($\chi^2 = 4.685$; $P < 0.05$), had longer HIV diagnosis duration ($\chi^2 = 5.456$; $P < 0.01$) and were more often unemployed (Odds ratio [OR] 2.636; 95% confidence interval [CI] 1.547–4.491; $P < 0.001$) as presented in Table 1. However, there was no difference between MP users and nonusers regarding gender (OR 0.8237; 95% CI 0.4679–1.450; $P = 0.6$), current cART regimen ($\chi^2 = 3.952$; $P = 0.1$) and satisfaction with cART regimen (OR 0.5792; 95% CI 0.1693–1.981; $P = 0.6$). Dissatisfaction with cART was reported only by few subjects ($n = 8$, 6.2%, 5 MP users and 3 nonusers) and the most frequently reported reason was side effects induced by cART as listed in Table 2.

Reasons for MP Use

MP were used with conventional drugs to manage non-HIV-related diseases ($n = 94$, 72.9% of MP users), to recover from HIV-related conditions ($n = 83$, 64.3%), or to cure HIV/AIDS ($n = 12$, 9.3%). Commonly reported pathological conditions or symptoms treated with MP included malaria ($n = 27$, 18.4% of total citations), cough ($n = 20$, 13.6%) and abdominal pain ($n = 16$, 10.9%). The complete list of reported diseases/symptoms treated with MP is shown in Table 3.

The benefits of using MP reportedly ranged from moderate ($n = 60$, 57.7%) to complete ($n = 35$, 33.7%) relief, while only eight subjects (7.7% of MP users) reported no change in their terms. Anecdotally, two MP users claimed *Combretum micranthum* G. Don was able to clear HIV. Interestingly, of six individuals who answered the questions regarding the unwanted effects associated with MP use, only two subjects (33.3% of respondents) denounced fatigue and weight loss.

Table 3 Frequently reported diseases and conditions ($n > 5$) treated with MP

Diseases/conditions	Occurrence (n)	% of total reports
Malaria	27	18.4
Cough	20	13.6
Abdominal pain	16	10.9
Typhoid fever	13	8.8
Dysentery	11	7.5
Fever	10	6.8
Weakness/fatigue	10	6.8
Diarrhoea	9	6.1
Headache	9	6.1
Anaemia	7	4.8
Bile	5	3.4
Skin problems	5	3.4
Stomach hurts	5	3.4

Trend of Use of MP in PLHIV

A total of 70 MP, chiefly the herbs, were mentioned by 106 informants [82.2% of total MP users (mean \pm SEM) 2.2 ± 0.2 MP/subject, min 1, max 11], of which forty-nine have been botanically identified, and the most popular species (in at least four users) are listed in Table 4.

MP were usually used after PLHIV started the antiretroviral treatment ($n = 46$, 63.0% of respondents). The plant parts most commonly collected for the preparation of herbal remedies included the leaves ($n = 129$, frequency of citations: 68.3%), bark ($n = 17$, 9.0%) and fruits ($n = 16$, 8.5%). Other ingredients such as palm oil, palm wine, and palm kernel oil, were often added to plant-based preparations. Most frequently, MP were administered orally in the form of decoction and without any specific dosage or mode of conservation (data not shown). They were harvested and/or purchased in the fields ($n = 79$, frequency of citations: 66.4%), market ($n = 26$, 21.8%), traditional healers ($n = 13$, 10.9%) and others ($n = 1$, 0.8%). MP were used as self-medication ($n = 63$, frequency of citations: 55.8%) or upon the recommendation of THPs ($n = 42$, 37.2%), acquaintance and relatives ($n = 6$, 5.3%), nurse ($n = 1$, 0.9%) and media ($n = 1$, 0.9%).

Traditional Health Practitioners' Use of MP in PLHIV

Few THPs interviewed ($n = 3$, 18.8%) acknowledged the use of MP to manage diseases in PLHIV. Specifically, the leaves of *Aloe vera* ($n = 3$), *Moringa oleifera* ($n = 1$) and "Mbeuheu Ser"¹ ($n = 1$), were administered orally in the form of infusion or decoction with the purpose to treat symptomatic conditions such as diarrhoea ($n = 1$). Other desired goals include strengthening immune function ($n = 1$) and increasing CD4 + T cell count ($n = 1$). Beyond the bitter taste of MP extracts, HIV-infected clients claimed no unwanted effects.

Traditional Health Practitioners' Knowledge of HIV/AIDS

All THPs who agreed to participate in the survey were also evaluated for their knowledge of HIV transmission, prevention and diagnosis. Regarding HIV transmission, all respondents knew that a pregnant woman with HIV can give the virus to her unborn baby and a person can get HIV even if she or he has sex with another person only one time. Ten THPs were aware that it is possible to get HIV when a person gets a tattoo ($n = 10$), while a greater number believed that showering, or washing one's genitals/private parts after sex keeps a person from getting HIV ($n = 13$). Interestingly, some THPs believed that HIV can be spread by mosquitoes

($n = 4$) and that a person can get HIV from a toilet seat as well as through contact with saliva, tears, sweat, or urine ($n = 7$). The majority ignored that coughing and sneezing do not spread HIV ($n = 11$), while all believed that pulling out the penis before a man climaxes keeps a woman from getting HIV during sex.

Concerning HIV prevention, all THPs were aware that having sex with more than one partner can increase a person's chance of being infected with HIV. The majority knew that there is a female condom that can help decrease a woman's chance of getting HIV ($n = 14$). However, almost all THPs interviewed believed that there is a vaccine that can stop adults from getting HIV ($n = 15$).

Regarding HIV diagnosis, all THPs believed that HIV and AIDS are the same and there is a cure for AIDS. Only a few THPs knew that a person with HIV can look and feel healthy ($n = 7$) and that taking a test for HIV 1 week after having sex will tell a person if she or he has HIV ($n = 5$).

The HIV-related knowledge of THPs was assessed as the percentage of correct responses as presented in Table 5. Overall, the mean frequency of correct answers was relatively low (48.0% of correct answers). Interestingly, THPs who reported the use of MP in PLHIV provided a higher proportion of correct answers in comparison to nonusers, although the difference between the two proportions was not statistically significant (58.3% of correct answers vs 45.7% for the nonusers; OR 1.665; 95% CI 0.8820–3.144; $P = 0.149$).

Discussion

MP use is popular in Cameroon; however, the current use prevalence among various categories of patients remains undetermined. The present study sought to gain a cross-sectional picture of the overall use of MP in the HIV-infected population. We observed that 54.9% of PLHIV in Dschang used MP. This finding is not so surprising as it reflects the status of the use of MP, estimated to nearly 80% in the general population in Cameroon [15, 29]. However, our prevalence estimate is marginally higher than the 33.7% use prevalence in Uganda and lower than the 97.3% use prevalence among PLHIV in Trinidad [16, 17]. This discrepancy could stem from the diverse sociodemographic and sociocultural features of the informants as well as the difference in their access to conventional cares, and the heterogeneity in the design of the different surveys.

Typical MP users were less educated than nonusers, unlike previous research [9, 16, 30–33]. This can be explained by the fact that less educated PLHIV are more likely to be influenced in their decision to use MP compared to their more educated counterparts. This assumption is supported by our finding that the decision to use MP

¹ Name of the plant in a local language (Yemba, Dschang).

Table 4 Most popular (in at least 4 users) MP listed

Users (n)	Scientific names	Vernacular/common names	Part used	Reasons for use										Weakness	Other	
				Abdom-inal pain	Anaemia	Bile	Cold	Cough	Diarrhoea/dysentery	Fever	Stomach hurts	Headache	Malaria			Typhoid fever
20	<i>Cymbopogon citratus</i> (DC.) Stapf	Fipagrassi; Fhou Ngouoya/Citronelle	L		x	x	x	x	x	x	x	x	x	x	x ^a	
16	<i>Psidium guajava</i> L.	Goyavier	B; L; R	x		x	x	x	x	x	x	x	x	x	x ^b	
15	<i>Carica papaya</i> L.	Papayer	F; L; R	x		x	x	x	x	x	x	x	x	x	x ^c	
12	<i>Ageratum conyzoides</i> (L.) L.	Tchouamo'o/roi des herbes	L	x		x	x	x	x	x	x	x	x	x	x ^d	
12	<i>Mangifera indica</i> L.	Manguier	B; L; R	x		x	x	x	x	x	x	x	x	x		x
11	<i>Citrus limon</i> (L.) Osbeck	Citron	F	x		x	x	x	x	x	x	x	x	x	x ^e	
9	<i>Aloe barbadensis</i> Mill.	Aloe	L	x		x	x	x	x	x	x	x	x	x		
7	<i>Ananas comosus</i> (L.) Merr.	Ananas	F										x	x		
7	<i>Manihot esculenta</i> Crantz	Pkwem/Cassava	L													x ^f
6	<i>Eucalyptus globulus</i> Labill.	Eucalyptus	L					x								
6	<i>Ocimum gratissimum</i> L.	Massep; basilic sauvage; Kotmajo	L											x		x ^g
5	<i>Persea americana</i> Mill.	Pia'a/avocat	L											x		
4	<i>Eremomastax spectiosa</i> (Hochst.) Cufod.	Houeou; Wouomekwa; Panzem ze mo' / rouge un côté	L	x												x ^h

Table 4 (continued)

Users (n)	Scientific names	Vernacular/common names	Part used	Reasons for use														
				Abdominal pain	Anaemia	Bite	Cold	Cough	Diar-rhoea/dysentery	Fever	Stomach hurts	Headache	Malaria	Typhoid fever	Weakness	Other		
4	<i>Kalanchoe crenata</i> (Andrews) Haw.	Djoudjou; Ntonkenou'	L		x			x										x ⁱ
4	<i>Vernonia amygdalina</i> Delile	bitter leaf/Ndolè	L	x					x									x
4	Unidentified	Tseuseuneck/épingle noir																x

B bark, *F* fruits, *L* leaves, *R* roots

^aOedema, hypertension, itching, diabetes

^bIndigestion

^c“poison de nuit”: it refers to the afflictions suffered after a meal ingested during a dream

^dChest pain, nightmare

^eTuberculosis

^fFoot cramps

^gNausea, constipation

^hNappy rash

ⁱOtitis

Table 5 Frequency of correct answers for each HIV-related knowledge item

HIV knowledge item	N (%)	Users (%)	Nonusers (%)
A pregnant woman with HIV can give the virus to her unborn baby (T)	16 (100)	3 (100)	13 (100)
A person can get HIV even if she or he has sex with another person only one time (T)	16 (100)	3 (100)	13 (100)
Having sex with more than one partner can increase a person's chance of being infected with HIV (T)	16 (100)	3 (100)	13 (100)
There is a female condom that can help decrease a woman's chance of getting HIV (T)	14 (87.5)	3 (100)	11 (84.6)
HIV can be spread by mosquitoes (F)	12 (75.0)	3 (100)	9 (69.2)
It is possible to get HIV when a person gets a tattoo (T)	10 (62.5)	3 (100)	7 (53.8)
A person can get HIV from a toilet seat (F)	9 (56.3)	3 (100)	6 (46.2)
A person can get HIV through contact with saliva, tears, sweat, or urine (F)	9 (56.3)	2 (66.7)	7 (53.8)
A person with HIV can look and feel healthy (T)	7 (43.8)	2 (66.7)	5 (38.5)
Coughing and sneezing DO NOT spread HIV (T)	5 (31.3)	0 (0.0)	5 (38.5)
Taking a test for HIV 1 week after having sex will tell a person if she or he has HIV (T)	5 (31.3)	3 (100)	2 (15.4)
Showering, or washing one's genitals/private parts, after sex keeps a person from getting HIV (F)	3 (18.8)	0 (0.0)	3 (23.1)
There is a vaccine that can stop adults from getting HIV (F)	1 (6.3)	0 (0.0)	1 (7.7)
HIV and AIDS are the same thing (F)	0 (0.0)	0 (0.0)	0 (0.0)
There is a cure for AIDS (F)	0 (0.0)	0 (0.0)	0 (0.0)
Pulling out the penis before a man climaxes/cums keeps a woman from getting HIV during sex (F)	0 (0.0)	0 (0.0)	0 (0.0)
Total	123 (48.0)	28 (58.3)	95 (45.7)

Correct answers appear in parentheses (T true, F false)

was usually influenced by the recommendation of THPs, acquaintance and relatives, nurse or the mass media. In addition, less educated MP users are likely to be low-income earners. Consequently, their access to conventional health care is financially limited and, as such, they may likely look for inexpensive treatment options such as MP, to meet their health care needs. This speculation seems to be corroborated by our finding that MP users were more likely to be unemployed, although such observation, was not in keeping with previous research in which MP use was associated with more significant financial resources [31, 34]. In line with prior studies [9, 33, 35], we found that PLHIV with longer disease duration were more inclined to use MP than nonusers. One possible explanation could be that the long-term toxicity of cART, as well as its lack of effectiveness over time, may lead PLHIV to seek alternative or complementary medicines such as MP.

Use of MP is considered a proxy for some unmet needs of conventional therapies [26]. In the current study, however, almost all MP users were satisfied with their cART regimen. Notwithstanding, they used MP, not instead of standard therapies, but rather as an adjunct to manage diseases/conditions they face. This finding, somewhat surprising, should be perceived in a positive tone since MP use did not compromise adherence to antiretroviral therapy, which is a pressing concern among MP users [36, 37]. Our result can be explained by the fact that there are misconceptions that attribute the cause of HIV/AIDS to supernatural forces or witchcraft [38]. This may prone PLHIV under cART to seek help from traditional

medicine whose therapeutic approach is primarily based on MP. This speculation can be supported by our finding that THPs were the main advisors of the use of MP. Moreover, MP were more often self-prescribed, suggesting they are an integral part of the daily life of PLHIV who wish, through their use, to align with their cultural and spiritual behaviours and beliefs.

However, the concurrent use of MP and cART or other allopathic medicines is concerning given the possibility of herb-drug interferences which may jeopardise the efficacy and tolerability of conventional therapies [39, 40]. Also, the risk of adverse drug reactions increases with the fact that MP were mainly used without appropriate medical supervision. The lack of medical monitoring is attributable to the fact that physicians are not adequately educated on MP and are reluctant to MP use [41]. Additionally, MP use is not frequently asked during the consultation and, if otherwise, patients most often ignore the name of the used plants [42, 43]. Putting together, these findings strengthen the need for physicians to routinely enquire their HIV-infected patients about the potential use of MP during the consultation. This will create a platform to discuss the risk and benefits of MP use by their patients and provide appropriate educational intervention. Alternatively, the patients' descriptive characteristics such as the occupational status, educational level and disease duration, may be applied by the physician in detecting the most likely MP users and, therefore, in addressing relevant and personalised educational interventions. The effectiveness of such a discussion requires physicians to be knowledgeable about the commonly used MP in PLHIV.

MP were mainly used to improve the lifestyle of PLHIV; only a few of them used MP to clear the virus. Most informants claimed benefits from the use of MP. Importantly, anecdotal reports suggest that the leaves of *Kinkéliba*² (*Combretum micranthum* G. Don, Combretaceae) were able to eradicate HIV. The question of whether these claims on benefits retrieved from MP use correspond to a real clinical benefit still awaits further research. So far, however, among the cited MP, at least the leaves of *Aloe* species and *Persea americana* Mill. have supporting scientific evidence for their anti-HIV1 activity [44, 45]. Interestingly, unpleasant side effects related to MP were reportedly mild and denounced only in few cases. Some caution is however required in interpreting this finding since MP users are less likely to report side effects [46]. Indeed, in the current survey, we observed that only 6 out of 129 MP users answered the question about side effects associated with MP. The underlying explanation may lie in patients' perception of MP as "natural" and therefore effective or at least risk-free [42, 43, 47]. All in all, these findings suggest that PLHIV perceives MP as a safer and more effective adjunct to improving their health concerns.

MP were usually harvested in the wild and such an easy access modality to MP may also account for their high use prevalence in PLHIV. Leaves were the MP part most frequently used, which is less detrimental to the plant species. Only 1 out of 70 reported MP (*Garcinia kola* Heckel) is listed so far as endangered species in Cameroon [48]. The most commonly mentioned MP including *Aloe barbadensis* Mill., *Ageratum conyzoides* (L.) L., *Mangifera indica* L., *Cymbopogon citratus* (DC.) Stapf, *Eucalyptus globulus* Labill., *Ocimum gratissimum* L., *Carica papaya* L., *Vernonia amygdalina* Delile, *Persea americana* Mill., and *Psidium guajava* L., have also been reported in similar surveys conducted in Uganda [49, 50], Gabon [51], South Africa [52] and Nigeria [53], indicating convergent local ethnomedical traditions, possibly suggesting a sharing of ethnobotanical knowledge between these countries due to their geographical proximity and the migratory processes.

THPs were the main advisors of PLHIV on the use of MP, suggesting they hold in high esteem in the HIV-infected community. Thus, in the rest of our study, their knowledge and attitudes towards HIV/AIDS were surveyed aiming at understanding whether they may be an appropriate resource to assist in the scaling up of HIV prevention and treatment delivery services in Cameroon. We found that 3 out of the 16 THPs surveyed used MP in PLHIV, indicating that THPs are already involved in the local delivery of health services to PLHIV. Amongst the cited MP, *Moringa oleifera* Lam. and *Aloe vera* (L.) Burm.f. have also been reported elsewhere in similar studies [54–57]. Though PLHIV widely

values these plants, there is some evidence to suggest they may compromise the efficacy of antiretroviral drugs [44, 58, 59]. However, the concern raised by conventional healthcare providers about the THPs' inability to effectively assist them in HIV national program is understandable given that THPs surveyed globally had relatively low levels of HIV-related knowledge. Nevertheless, given the shortage of health staff and the burden of HIV/AIDS in this part of the globe, THPs need to be educated on HIV/AIDS, as part of a program aiming to integrate traditional medicine in a global response to HIV/AIDS epidemic.

Study Limitations and Strengths

PLHIV were enrolled from attendees of the national HIV treatment program, who generally receive cART and other conventional cares [60], missing, however, the experiences of patients who were not engaged in that program. The clinical profile and attitudes towards MP of those patients may be very different from the interviewed respondents. Therefore, the reported prevalence of MP use among PLHIV might be an underestimation of the real use prevalence as there is potential selection bias in study participation. On the other hand, our results did not represent the views of THPs non-members of MP producers' association, which may differ from those of people belonging to that organisation. Lastly, this study was conducted in Dschang, and as such, did not represent the views of the entire population of PLHIV and THPs in Cameroon. Follow-up studies conducted nationwide or in other localities are needed to assess the consistency of our findings. This study presents the first empirical evidence in Cameroon of the use of MP in PLHIV and evaluates the knowledge of THPs on HIV/AIDS. Therefore, it may lay the groundwork for designing proper data collection instruments for a more extensive scale survey.

This kind of research usually is exposed to recall bias. The face-to-face interview was purposefully used as previously recommended to improve informants' recall and assist them in their answers [61]. In this specific regard, as far as we are concerned, patients' interviews were conducted in a private room by a psychosocial counsellor to avoid their reticence to disclose the use of MP to their caring physicians and to discuss their condition freely. On the other hand, THPs' interviews were run by the chairperson of MP producers' association to avoid them being reluctant to discuss with people inexperienced in traditional beliefs.

In this study, we relied solely on self-reported MP use to categorise study participants into users and nonusers, and this approach can sometimes be inaccurate. In prospect, it would be worth considering the possibility to assess the plasma concentrations of the reported MP or their metabolites in all study participants, as well as to collect data from

² Common/local name of the plant species.

the hospital records of PLHIV, to assess their clinical conditions objectively. The lack of statistically significant differences between MP users and nonusers among THPs may be due to the small sample size. Therefore, future research is required in a larger sample.

Conclusions

PLHIV, though satisfied with their cART regimen, frequently use MP to improve their conditions. However, MP are used concomitantly with conventional medicines, raising the risk of severe side effects. Given the possibility that MP may also jeopardise the efficacy and tolerability of standard therapies, physicians need to be educated on the use of MP. Likewise, they should systematically assess the use of MP in their patients during routine visits to provide them with appropriate advice. Traditional knowledge of MP should be examined on purpose to make the most of the use of plants. THPs occupy an outstanding position in the HIV-infected community and can, therefore, assist conventional health care providers in the scaling up of HIV prevention and treatment delivery services in Cameroon. Importantly, some of THPs use MP in PLHIV, although their knowledge of the disease is relatively low. Therefore, they need to be educated on HIV/AIDS, as part of a program aiming to integrate traditional medicine in a global response to the HIV/AIDS epidemic.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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