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Ethnobotanical study of medicinal plants used by Baka people in the treatment of erectile dysfunction

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Erectile dysfunction is a disease that is increasingly affecting men. The study examined the traditional use of medicinal plants in the treatment of erectile dysfunction among the Baka people in the eastern region of Cameroon. The study took place over interspersed periods from January 2018 to January 2021 in 9 villages. Forty-four people were interviewed via a questionnaire. One hundred and fifty-nine citations and 71 treatments were recorded, involving 44 plant species distributed in 38 genera, and 25 families. The User Agreement Value (UAV) index and the Spatial Use Convergence index (SUC) lead to the same results highlighting the importance of some plant species used by Baka people for treating erectile dysfunction problems. The results obtained thus show the effectiveness of the methods used to detect plants confirmed for traditional use. This work would serve as a basis for more elaborate pharmacological and toxicological studies to confirm the biological activity of other species widely used by the Baka as medicines, and which have not yet been indicated elsewhere and studied; thus justifying their use in traditional medicine.

Key words: Ethnobotanical study, medicinal plants, Baka people, treatment of erectile dysfunction.

INTRODUCTION

Erectile dysfunction (ED) was defined at the second international consultation on sexual dysfunction in 2004 as: "the persistent or recurrent inability of a man to achieve or maintain an erection of the penis sufficient to

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permit sexual activity" (McCabe et al., 2016). ED has been also considered as a manifestation of a functional and/or structural abnormality affecting penile circulation as part of a more generalized vascular disorder (Yaman et al., 2008). Sexual dysfunction is a serious medical and social symptom that occurs in 10 to 52% of men and 25 to 63% of women (Singh et al., 2018). Erectile dysfunction affects almost 50% of men in the 40 to 70 year age range, which corresponds to approximately 150 million worldwide (Yaman et al., 2008). The prevalence of this condition may be increased in certain populations such as diabetics, hypertensives and renal insufficiency (Oueslati et al., 2017). Sexual dysfunction is associated with smoking and excessive alcohol consumption (Becher and Glina, 2002), anxiety and depression; so affecting quality of life through effects on self-esteem (Finkelstein et al., 2007) and the life of a couple. According to Ajit et al. (2007), there are several types of ED of which lack of orgasm, premature ejaculation, frigidity, and impotence are the most common.

Herbal aphrodisiacs are widely used to combat the effects of age on sexual performance, stress-related impotence and frigidity, premature ejaculation, erectile difficulties, lack of sexual vigor, as well as to obtain a more intense libido or orgasm. People prefer to use herbal drugs due to their perceived low toxicity (Dibong et al., 2011), and low cost (Dansi et al., 2008) compared to conventional drugs. This reinforces the search for solutions to primary health problems through herbal medicine in developing countries.

The important prevalence of erectile dysfunction, whose causes are diverse, has led to the search for new solutions for its management. Indeed, some erectile disorders are already treated with conventional drugs. It is noted that most of the drugs are made from plant extracts from forests. It is the case of “Tadenan” formulated from extracts of bark of *Prunus africana* for treatment of benign prostatic hyperplasia (Soukaina, 2018). Several males in Uganda have been already consulting on the treatment of ED using herbal remedies, either by themselves or through friends (Kamatenesi, 2004). However, most of the traditional remedies used are not well documented and researched. It is the same line with Tugume et al. (2016) in Uganda. Also, one of the fundamental problems that undermine the promotion of traditional medicine or the development of ITM (Improved traditional medicine) based on traditional knowledge, is the lack of veracity of the information provided by respondents. More often than not, much of this information is incorrect. Indeed, informants are often reserved and there is a lot of reluctance, especially about medicinal plants (Betti, 2002). The solution therefore lies in the search for analytical methods that can highlight from the large amount of information collected that can be considered confirmed for use in traditional medicine.

This study aims to document the knowledge on the traditional use of medicinal plants by the Baka populations living in the Eastern region of Cameroon in the treatment of ED problems as a basis to be used as the alternative for management of sexual dysfunction. Through the identification of plants used in the treatment of ED problems, characterization of their traditional uses; and finally highlighting the relative importance of used plant species. The study of the popular pharmacopoeia of the Baka, and related tribes, contributes to the cultural vulgarization of these peoples who are often stifled. Surveys of Baka communities would firstly contribute to enhancing their cultures, and to raising the standard of living of the Baka by transforming their skills into products that are accessible, less toxic and available to the wider Cameroonian population.

MATERIALS AND METHODS

Study area

The study was carried out in nine villages distributed in three subdivisions, including Dimako (2 villages), Lomié (4), and Yokadouma (3) in the Eastern Region of Cameroon (Table 1). The villages are located in the semi-caducified dense rainforest domain, a semi-caducified forest sector sensus stricto, dominated by Sterculiaceae and Ulmaceae species (Sonké, 1998).

Data collection

Data collection started with an information and sensitization meeting with Baka communities to obtain their consent. Before starting the survey in each village, meetings were held to inform villagers of the objectives of the study and also to set appointments. The study used the “method for the popular pharmacopeia”, which consists of gathering data on the traditional usage of medicinal plants among villagers, traditional healer or not (Betti, 2001a). Information was collected from any anyone (healer or not) who voluntarily agreed to receive us, and who had a history of treating ED. A total of 44 respondents were interviewed. Each person was asked to provide information about the erectile dysfunction-related illnesses they usually treat. Information related to medico-magical effects was not requested, so as to generate information strictly related to herbal remedies.

During our interview with the consenting populations, we thought it best to start from the diseases to the plants, rather than going the other way around, as per Betti (2001a). By showing our interlocutor a sample of a plant and asking about its uses, we risked encouraging him/her to invent recipes. An aphrodisiac component is defined as any food or drug that arouses the sexual instinct, induces veneral desire and increases pleasure and performance (Yakubu et al., 2007). In this paper, the plants used for treating ED refer to those which enter to cleansing dirty kidneys, in the treatment of sexual weakness, impotence, lack of vigor and performance, low libido and frigidity.

Data concerning the details of the recipes were collected according to a standardized framework proposed in the database of Traditional Medicine and Pharmacopoeia in acronym Pharmel (Adjanohoun et al., 1994). This framework is composed of five parts, namely: The identification of the informant, the therapeutic indications, the characteristics of the plant material used, the methods of preparation and administration of the remedy and the comments related to recipes. The main themes of the questionnaire used are detailed in Table 2.

Expeditions to each area were undertaken to collect voucher specimens, which were subsequently deposited in the National

Table 1. Characteristics of the study sites.

Administrative division	Sub-division	Villages	Forest type	Climate type	Rainfall (mm)	Mean temperature (°C)	Habitat
East region							
Boumba et Ngoko	Yokadouma	Zoulabot ancien, Ngatto ancien, Elanjo	Dense moist semi-deciduous forest	Hot and humid equatorial Guinean	1500 - 1800	23	Semi-deciduous sensus stricto
Haut Nyong	Lomié	Payo, Norzôh, Sissoh, Ngoulmekong	Dense moist evergreen forest	Equatorial Guinean	1600 - 1700	23	
	Dimako	Lossou, Mayos	Dense moist semi-deciduous forest	Equatorial Guinean	1500	24	

Source: Authors 2022

Table 2. Survey questionnaire form.

Parameter	Responses
Date:	
1. Identification of the informant	
Name (s)	
Age	
Sex	
Village	
2. Ailment	
Disease or symptoms	
Physiological effects	
3. Characterization of the plant material	
Vernacular name of the plants	
Plant parts	
Development stage	
Harvesting mode	
Harvesting site	
4. Mode of preparation and administration	
Mode of preparation	
Pharmaceutical form	
Associations of other plants	
Mode of administration	
5. Remarks:	

Source: Authors 2022

Herbarium of Cameroon in Yaoundé (YA). Samples were identified using the Flora of Cameroon, Gabon, Belgian Congo and Rwanda-Urundi and also other works of a purely ethnobotanical nature (Letouzey, 1976 for example) found in the YA. The plant identifications were completed and finalized by the plant databases available on the internet (https: //uses.plantnet project.org/fr/; https://www.ville-ge.ch/ musinfo / bd / cjb / africa / research.php? language = fr).

Data analyses

Data process

Each recipe is represented by one code composed of three groups of elements, including: the scientific name of the plant cited, which is composed of the two first letters of the genera and the species, the plant part comprising the two first letters, and the pharmaceutical form, which is also composed of the two first letters.

The different ages are grouped into classes of amplitude 10 corresponding to 10 years in an increasing manner. The classes were: [20-30], [30-40], [40-50], [50-60] and ≤60. For example, respondents aged of 20, 21, 22 or 25 years old were considered as belonging to the [20-30] range.

Convergences of spatial uses

Two indices were used to highlight the most significant uses or plants; the spatial use convergence index or SUC (Betti, 2001a) and the Use Agreement Value Index or UAVs (Philips and Gentry, 1993a,b). Pearson's correlation test from R software version 4.0.5 was used to assess if there was a correlation between the two indices; meaning if the VAU and SUC indexes lead to the same result.

Index of spatial use convergence (SUC): The index of the spatial use convergence (SUC) proposed by Betti (2001a) allows for the determination of similarities of use of plant species for the same health problem (that is, ED). The SUC is determined by an arbitrary scale ranging from 0 to 1 as follow: SUC = 0 when the plant species is cited by only one person, the importance of that plant is weak; SUC = 0.5 when the plant is cited by at least two people in the same site, the importance is average; SUC = 0.75 when the plant is cited in two different sites, the importance is high; and SUC=1 when the plant is mentioned in three sites, the importance of that plant species is very high.

Table 3. The socio-demographic characteristics of respondents.

Variable	Category	Number of informants	Percentage
Administrative subdivision	Dimako	15	34.1
	Lomié	9	20.45
	Yokadouma	20	45.45
Sex	Male	38	86.36
	Female	6	13.64
Age (years)	20 - 30	44	27.67
	30 - 40	54	33.96
	40 - 50	52	32.70
	50 - 60	6	3.77
	> 60	3	1.89
Number of citations	Dimako	55	34.6
	Lomié	36	22.64
	Yokadouma	68	42.77

Source: Authors 2022

The use agreement value index (VAUs): VAUs allows for an improved interpretation of the medicinal cultural value of plants (Ilumbe, 2010). It combines the use value index (VU) (Philips and Gentry, 1993a, b) and the confirmation index (ICs), which allows assessing or expressing the agreement of informants on the plants used (Ilumbe et al., 2014). The formula is:

UAV = UV x CIs with $\mathrm{CIs} = \frac{\mathrm{na}}{\mathrm{nt}}$ and $\mathrm{Uv} = \sum_{i=1}^{n} \frac{\mathrm{Uis}}{\mathrm{ns}}$

U is indicates the number of uses of the species mentioned by the informant i and ns corresponds to the number of people who mentioned this species. The CIs range from 0 to 1, a value close to 0 indicates that informants disagree on the plants used, while a value close to 1 indicates a strong consensus around the use of the indicated plant. Na is the number of people who mentioned the species "a", and Nt the total number of people surveyed.

RESULTS

Socio-demographic characteristics

Men represent 86.36% of the interviewees. The majority of respondents were of the [30 - 40] years (33.96%) and [40 - 50] years (32.7%) age groups. A total of 159 citations were obtained, with the highest number recorded in Yokadouma (42.77%) and Dimako (34.6%). The number of respondents in the same areas was 45.45 and 34.1%, respectively (Table 3).

Characterization of recipes

A total of 159 citations comprising 71 recipes (treatments) was recorded. Among the recipes cited (Table 4), the use of the stem bark of *Corynanthe johimbe* in decoction (Cojo-Sb-De) is the most represented in terms of informants and citations (12 informants; 16 citations). It is followed by the use of the decoction of the seeds of corn or *Zea mays* or Zema-Se-De (11; 14); and the use of the raw material of *C. johimbe* or Cojo-Sb-Np (10; 10) or that of *Milicia excelsa* or Miex-Sb-Np (7; 7). Several plant organs are used in recipes for the treatment of ED. The stem bark is most used (57.23% of respondents), followed by the root (15.09%) (Figure 1). A set of 6 pharmaceutical forms were identified, namely: Decocted, expressed, macerated, oil, ash and raw material. Decoction with decocted as pharmaceutical form is most used with a citation rate of 50% (Figure 2). The recipes using the stem bark of *C. johimbe* and *M. excelsa* in decoction (10.06 and 3.80%), or without any preparation (6.29 and 4.40%), or the decoction of the corn (*Zea mays*) (8.80%) in oral route are most used.

Diversity of flora

Forty-four plant species distributed in 38 genera and 25 families were recorded. The most mentioned families are: Rubiaceae (28 citations; 17.61% of all citations), Cannabaceae (17; 10.70%) and the Poaceae (15; 9.43%) (Figure 3). The most diverse families are Cannabaceae (4 species; 9.1%), Leguminosae-Cesaelpinioideae, Irvingiaceae and Leguminosae-Detarioideae (6.82% of citation each). Regarding species, the most cited are *C. johimbe* (16.35%), *Z. mays* (9.43%), *M. excelsa* (8.18%), *Diospyros crassiflora*, *Oldfieldia africana* and *Strychnos campicola* (5.66% each) (Figure 4). Mayos, located in the Dimako subdivision, is the most diversified village in terms of botanical families, plant species and medicinal

Table 4. Characteristics of recipes.

Recipes	Code of Informants	Number of informants	Number of citations
Afbi-fr-Np	LN1	1	1
Alfl-Sb-Np	DM2	1	1
Anma-Sb-Ma	LN4	1	1
Bato-Sb-De	LP1	1	1
Caal-Ro-Np	DM11, 1, 11	3	3
Cead-Sb-De	DM5	1	2
Cead-Sb-Np	DM1, 4, 7, LP1, YN3	5	5
Cemi-Sb-De	DM4, 5	2	4
Cemi-Sb-Np	DM4	1	1
Cepe-Ro-Np	YZ2	1	1
Cepe-Sb-Np	YN4	1	1
Ceph-Sb-De	DM3, 6, 11, YE3	4	4
Cojo-Sb-De	LNo2, 3, YE4, 5, 6, 7, 8, YN1, 4, 5, YZ2, 3	12	16
Cojo-Sb-Np	DM1, LN1, 2, LS1, YE5, 6, 7, 9, 11, YN1	10	10
Copa-Sb-Ma	DM2, 7	2	2
Cyga-Sb-De	DL3	1	1
Cyga-Sb-Ma	Lp1	1	1
Dead-Le-Ma	LN3	1	1
Degl-Sb-Oi	YE9	1	1
Dicr-Fr-Np	YE7	1	1
Dicr-Sb-De	DM9, YE4, 7	3	6
Dicr-Sb-Np	DM4	1	1
Dicr-Se-Np	Lp1	1	1
Elgu-Fr-Oi	YE9, 11	2	2
Ersu-Wo-De	YE1, 9	2	2
Gako-Fr-Np	LN1, 2	2	2
Grsu-Ro-Np	YZ2	1	1
Hada-Le-De	YE6	1	1
Hogr-Sb-De	DM9	1	1
Klga-Sb-De	DM1, LN2	2	2
Klga-Sb-Np	DM1	1	1
Klma-Sb-De	DL1	1	1
Laco-Ro-Np	LN3	1	1
Laow-Se-Np	DM10	1	1
Leth-Sb-De	YN2	1	1
Lotr-Sb-Ep	DM8	1	1
Maem-So-De	DM2	1	1
Miex-Sb-De	DL4, DM6, 10, LN1, YE7	5	5
Miex-Sb-Np	DM4, LN1, 2, LP1, LS1, YE1, 11	7	7
Miex-Wo-De	YN3	1	1
Mipu-Ro-Np	LNo1, LS1, YE5, 8, YZ2	5	5
Mipu-Sb-Np	LN2	1	1
Olaf-Ro-Np	LNo1	1	1
Olaf-Sb-De	YE8	1	1
Olaf-Sb-Np	LNo1	1	1
Olaf-Se-Np	Lp1	1	1
Olaf-Wo-De	YE2, 5, YZ2, 3, YE10	5	5
Peel-Sb-Ep	YE7	1	1
Pema-Ro-Np	LNo1	1	1
Pema-Sb-Np	LNo1	1	1
Pema-Wo-De	YE11	1	1

Table 4. Contd.

Piaf-Ro-Np	LNo2, 3, YN2	3	3
Piaf-Sb-De	DL1, YE10	2	2
Piaf-Sb-Np	LNo2, 3	2	2
Ptaq-St-Ma	DM2, 4	2	2
Stac-St-De	DL2	1	1
Stca-Ro -Np	DM5	1	1
Stca-Ro-Np	YE5,10, YZ1, 2	4	4
Stca-Ro-Oi	YE11	1	1
Stca-Ro-Wa	YZ4	1	1
Stca-Sb-Np	DM1	1	1
Stca-St-Wa	YZ4	1	1
Stus-St-Np	YE4	1	1
Teaf-Sb-De	DM6	1	1
Tete-Sb-De	DM11	1	2
Uagu-Ro-Np	DL1	1	1
Urtr-Le-Np	YE8	1	1
Xama-Fr-De	DM4	1	1
Xama-Tu-De	DM5	1	2
Zema-Se-De	DL1, DM4, 5, 6, 9, 11, YE2, 6, 7, 11, YN1	11	14
Zema-Se-Ex	DM8	1	1

Plant part: Le: leaf, Ro: root, Sb: stem bark, St: stem, Tu: Tuber, Fr:Fruit, Se:Seed, Wo: Wood Pharmaceutical form/mode of preparation: De: decocted/decoction, Ma: macerated/maceration, In: infused/infusion, Ash: ash/calcination, Np: not prepared or raw material/ not preparation.
Source: Authors 2022

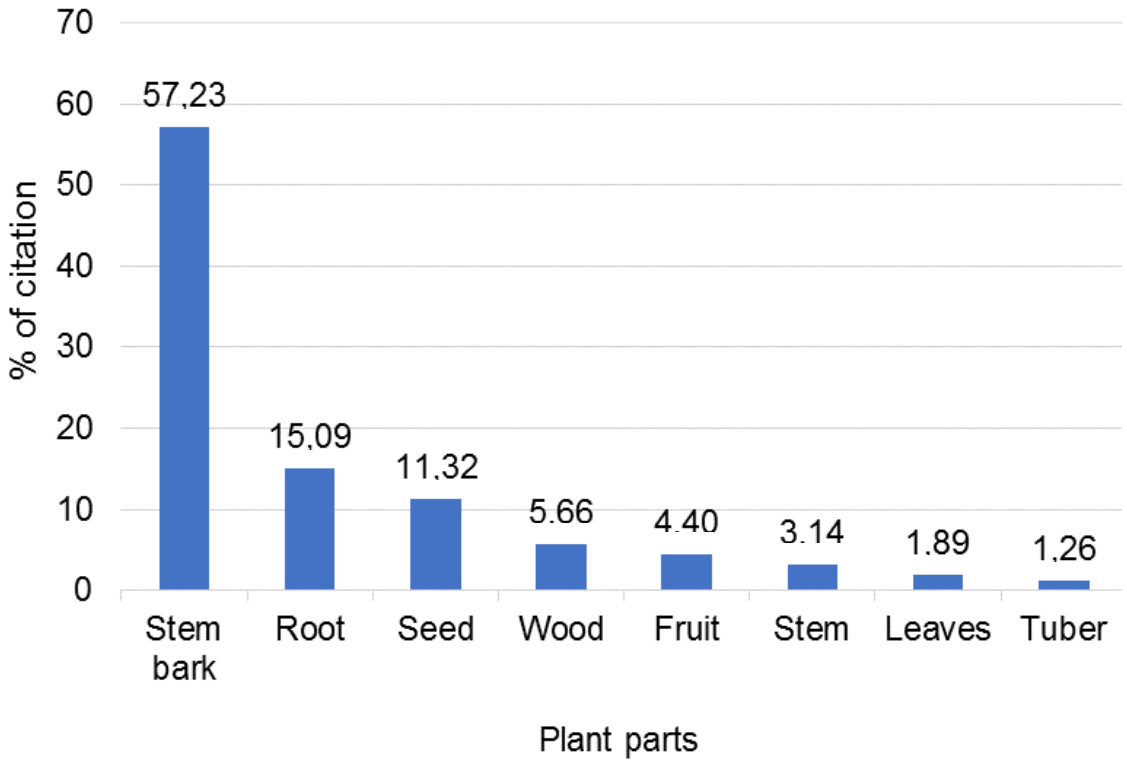

Figure 1. Plant parts solicited in the recipes.
Source: Authors 2022

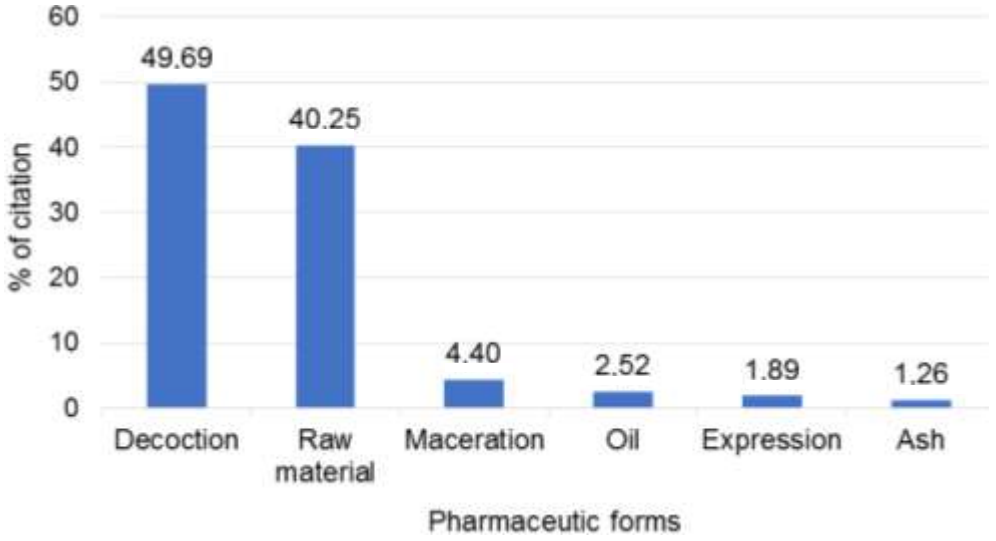

Figure 2. Pharmaceutical form used for the treatment of dysfunction erectile.
Source: Authors 2022

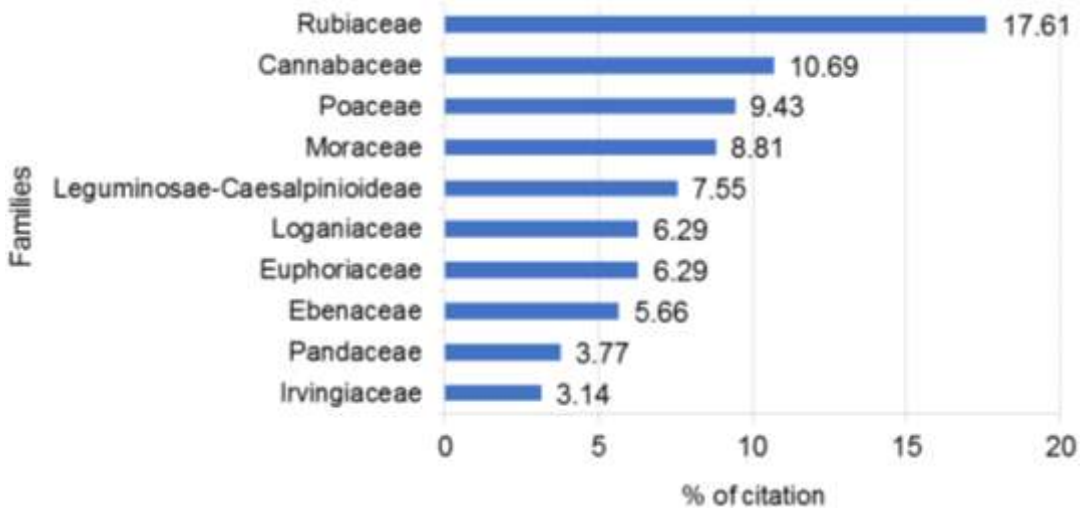

Figure 3. Relative importance of the 10 most cited plant families by Baka for the treatment of the erectile dysfunction problems.
Source: Authors 2022

recipes (16; 20 and 28%). It is followed by Elanjo village in Yokadouma subdivision (15, 18 and 23%); and Ngoulmekong village in Lomié subdivision (10, 10 and 11%) (Table 5).

Relative importance of plants

Convergence and significant usages of plants against erectile dysfunction problems

Among the 44 species mentioned, some are subject to convergence of uses. According to the use agreement indices, plant species with the highest values are: *C. johimbe* (VAU = 0.59), *Z. mays* (0.34), *M. excelsa* (0.30), *D. crassiflora* (0.20), *O. africana* (0.20) and *S. campicola* (0.20).

As per spatial use convergence, 14 species are subject to convergence or similarity of use. Six are mentioned in the three subdivisions, height in two subdivisions (Table 6). Five selected plant species have the SUC value of 1 showing their large citation in the three subdivisions including *Carpolobia alba*, *Celtis adolfi-friderici, C. johimbe*, *D. crassiflora* and *M. excelsa*. Four species are

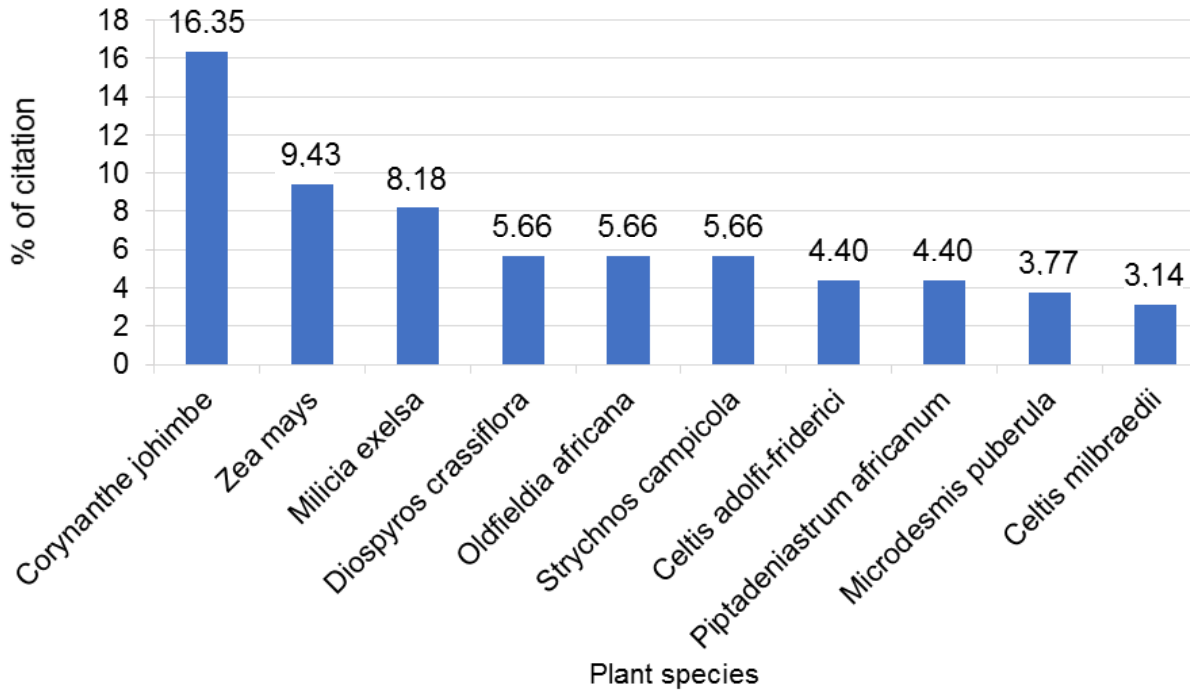

Figure 4. Ten most cited species in the management of ED.
Source: Authors 2022

Table 5. Distribution of respondents and the diversity of medicinal plants between the sites.

Site	Number of interviewees	Number of quotations	Families	Plants species	Recipes
Dimako	**15**	**55**	**17**	**25**	**33**
Lossou	4	7	7	7	7
Mayos	11	48	16	20	28
Lomié	**9**	**36**	**14**	**17**	**24**
Ngoulmekong	4	14	10	10	11
Norzôh	3	13	4	5	8
Payo	1	6	6	6	6
Sissôh	1	3	3	3	3
Yokadouma	**20**	**68**	**19**	**22**	**32**
Elanjo	11	46	15	18	23
Ngatto ancien	5	10	7	7	8
Zoulabot ancien	4	12	6	6	8
Total	**44**	**159**	**25**	**44**	**71**

Source: Authors 2022

cited in two subdivisions (SUC = 0.67), including: *Microdesmis puberula*, *O. africana*, *S. campicola* and *Z. mays*. *C. johimbe*, *M. exelsa*, *D. crassiflora*, *C. adolfi-friderici*, *P. africanum*, *Z. mays*, *O. africana* and *S. campicola* recorded the highest values of different spatial convergence indexes (ICs, VU, VAU and SUC) (Table 7).

Synthesis of significant uses

The result of the comparison using the Pearsons correlation test corresponds to a value of 0.72 (t = 6.7466, df = 42, p-value = 0.00000003352); reflecting a strong and positive correlation between VAU and SUC.

DISCUSSION

Characteristics of respondents

The characterization of the respondents shows a predominantly male workforce (86.36%) with a predominance of the age groups [30 - 40] years (33.96%) and [40 - 50] years (32.7%). The small number of women could be justified by the fact that conversations about sex are culturally considered taboo and shameful for the female gender. Sexual dysfunctions is more easily discussed topic in men than in women (Bashige et al., 2020), and hence the smaller representation of women in the study sample. Similar results were obtained in Togo where the practice of traditional medicine is the preserve of middle-aged men (Gbekley et al., 2015). These dominant age groups reflect the maturity of the people interviewed, and hence, as expected, had inclination to answer questions on ED, which might be a function of more of knowledge on ED treatment than the younger age grouping of 20 - 30. Older people generally provide more reliable information, since they are the holders of ancestral knowledge. In the department of Lom and Djérem, in the Eastern Region of Cameroon, Etame et al. (2018) found that the use of medicinal plants was very important for the age groups [31 - 40] years (28.33%). The low interest in traditional medicine among those under 20 (3.33%) can, according to Mpondo et al. (2017) lead in the long term to a loss of the therapeutic uses of medicinal plants. Consequently, this will lead in the long term to the disappearance of the ancestral traditional knowledge and skills of the Baka culture.

Characterization of recipes

The Baka make use of several plant organs to treat ED problems (Ezebilo and Mattsson, 2010). The barks (57.23%) and roots (15.1) are the plant organs that the Bakas use most in the treatment of ED. These organs are most solicited because of the high content of active compounds in these particular areas. Barks, fruits, roots and leaves are the site of biosynthesis (Bitsindou, 1996), and sometimes of the stockage of secondary metabolites responsible for the healing properties of plants (Mpondo et al., 2017). However, for the same amount of bark, leaves, and fruits, the concentration of metabolites would be higher in bark than in leaves or fruits (Mpondo et al., 2017). But harvesting of barks and roots lead more to the endangerment of the plants compared to the harvesting of leaves and fruits (Betti, 2001b).

Decoction is most used with a citation rate of 49.68. This can be explained by the fact that the decoction method collects the most active ingredients and attenuates or cancels the toxic effect of certain recipes (Salhi et al., 2010). Medicines were most prepared by boiling (61.9%) in the Limpopo Province of South Africa (Semenya and Potgieter, 2013), as well as in other regions of South Africa (De Wet et al., 2011) and other parts of Africa (Yirga, 2010; Tabuti et al., 2010). On the contrary, maceration is most cited in Congo (Ipona et al., 2018). According Semenya and Potgieter (2013), most (95.2%) herbal preparations were prescribed orally in Limpopo Province. In addition, they noted that medication in a liquid dosage form is readily absorbed; hence its preference.

Diversity of taxa used

The 44 people interviewed during this study cited 44 plant species distributed in 38 genera and 25 families; which testifies to the richness in medicinal plants and the high level of knowledge of plants by respondents. Forests of the East Region of Cameroon are known for their richness in medicinal plants as shown by Mpondo et al. (2017) in the Haut Nyong division (90 species, 83 genera and 47 families), and Etame et al. (2018) in the Lom and Djerem division (115 species, 59 families and 105 genera). The families most represented in terms of citations/quotations are: Rubiaceae (22%), Cannabaceae (10.70%) and Poaceae (10%). Rubiaceae is one of the six most common botanical families found in angiosperms (Karou et al., 2011). In Democratic Republic of the Congo, Ipona et al. (2018) has also found Rubiaceae (12.5%) as the most represented family. According to Martins and Nunez (2015), this family is characterized by the production of bioactive metabolites with great pharmacological potential. In addition, Rubiaceae is the major medicinal families due to its richness in alkaloids (Takayama et al., 1994). These alkaloids also found in *Carpolobia lutea*, are responsible to restoring sexual function, aphrodisiac effects and effects on male hormones (Yakubu and Jimoh, 2014). Also, the aphrodisiac activity of Yohimbine, an alkaloid extracted from the bark of *C. johimbe* (Lee, 2005; Gundidza et al., 2009), is due to a central α2-adrenergic antagonist effect, which increases catecholamines and improves mood. It also has an action on the penile arteries and erectile bodies (Khaled, 2006). The alpha-2 adrenergic receptor antagonist enhances the release of norepinephrine from penile nerves by acting on catecholamines in the synapse in the treatment of erectile dysfunction for over 70 years. Dhaou et al. (2010) indicate that the Poaceae are being used more and more in African herbal medicine. For example, *Z. mays* cause arousal and performance of sexual behavior. It contains kaempferol, quercetin, morine, naringenin and hesperitin, protocatechuic acid, vanillic acid, syringic acid, 2,4,6-trihydroxybenzoic acid responsible to aphrodisiac activity (Lao et al., 2017). Miguel et al. (2017) also states that the aqueous crude extract of corn has an aphrodisiac activity.

Relative importance of plants used

The Pearson's correlation test reveals that UAV and SUC

Table 6. Citation of plants in different subdivisions.

Species plant	Code of the plant	Family	Dimako	Lomié	Yokadouma	Total general
Afzelia bipidensis Harms	Afbi	Leguminosae-detarioideae		1		1
Allanblackia floribunda Oliv.	Alfl	Clusiaceae	1			1
Anonidium mannii (Oliv.) Engl. & Diels Anma	Anma	Annonaceae		1		1
Baillonella toxisperma Pierre	Bato	Sapotaceae		1		1
Carpolobia alba G. Don	Caal	Polygalaceae	1	1	1	3
Ceiba pentandra (L.) Gaertn	Cepe	Bombacaceae			2	2
Celtis adolfi-friderici Engl.	Cead	Cannabaceae	5	1	1	7
Celtis milbraedii Engl.	Cemi	Cannabaceae	5			5
Celtis philippensis Blanco	Ceph	Cannabaceae	3		1	4
Corynanthe johimbe K. Schum.	Cojo	Rubiaceae	1	7	18	26
Corynanthe pachyceras K. Schum.	Copa	Rubiaceae	2			2
Cylicodiscus gabunensis Harms	Cyga	Leguminosae-detarioideae	1	1		2
Desbordesia glaucescens (Engl.) Tiegh.	Degl	Irvingiaceae			1	1
Desmodium adscendeus (Sw.) DC.	Dead	Leguminosae-papilionioideae		1		1
Diospyros crassiflora Hiern	Dicr	Ebenaceae	3	1	5	9
Elaies guineensis Jacq.	Elgu	Arecaceae			2	2
Erythrophleum suavolens (Guill. & Perr.) Brenan	Ersu	Leguminosae-detariodeae			2	2
Garcinia kola Heckel	Gako	Clusiaceae		2		2
Greenwayodendron suaveolens (Engl. & Diels) Verdc.	Grsu	Annonaceae			1	1
Haumania danckelmania (J. Braun & K. Schum) Milne-Redh.	Hada	Marantaceae			1	1
Holoptelea grandis (Hutch.) Mildbr.	Hogr	Cannabaceae	1			1
Klainedoxa gabonensis Pierre ex Engl.	Klga	Irvingiaceae	2	1		3
Klainedoxa macrophylla Pierre ex. Tiegh	Klma	Irvingiaceae	1			1
Landolphia congolensis (Stapf) Pichon	Laco	Apocynaceae		1		1
Landolphia owariensis P. Beauv.	Laow	Apocynaceae	1			1
Leplaea thompsonii (Sprague & Hutch.) EJM Koenen & JJ de Wilde	Leth	Meliaceae			1	1
Lovoa trichilioides Harms	Lotr	Meliaceae	1			1
Maesopsis eminii Engl.	Maem	Rhamnaceae	1			1
Microdesmis puberula Hook. f. ex. Planch.	Mipu	Pandaceae		3	3	6
Milicia exelsa (Welw.) C.C. Berg	Miex	Moraceae	4	5	4	13
Oldfieldia africana Benth. & Hook. f.	Olaf	Picrodendraceae		3	6	9
Pentaclethra macrophylla Benth.	Pema	Leguminosae-caesalpinioideae		2	1	3
Pericopsis elata (Harms) Meeuwen	Peel	Leguminosae-papilioniodeae			1	1
Piptadeniastrum africanum (Hook. f.) Brenan	Piaf	Leguminosae-caesalpinioideae	1	4	2	7
Pteridium aquilinum (L.) Kuhn	Ptaq	Dennstaedtiaceae	2			2
Streblus usembarensis (Engl.) CC Berg	Stus	Moraceae			1	1
Strychnos aculeata Soler.	Stac	Loganiaceae	1			1
Strychnos campicola Gilg ex Leeuwenb.	Stca	Loganiaceae	2		7	9
Tessmannia africana Harms	Teaf	Leguminosae-detariodeae	1			1
Tetrapleura tetraptera (Schumach. & Thonn.) Taub.	Tete	Leguminosae-caesalpinioideae	2			2
Uapaca guineensis Müll. Arg.	Uagu	Euphorbiaceae	1			1
Urera trinervis (Hochst.) Friis & Immelman	Urtr	Urticaceae			1	1
Xanthosoma mafaffa Schott	Xama	Araceae	3			3
Zea mays L.	Zema	Poaceae	9		6	15
Total			**55**	**36**	**68**	**159**

Source: Authors 2022

Table 7. Convergence of spatial use between the different districts.

Species plant	Dimako	Lomié	Yokadouma	Total number of citations	Number of Informants	UVs	VAU	SUC
Afzelia bipidensis Harms		1		1	1	1	0.02	0.33
Allanblackia floribunda Oliv.	1			1	1	1	0.02	0.33
Anonidium mannii (Oliv.) Engl. & Diels		1		1	1	1	0.02	0.33
Baillonella toxisperma Pierre		1		1	1	1	0.02	0.33
Carpolobia alba G. Don	1	1	1	3	3	1	0.07	1
Ceiba pentandra (L.) Gaertn			2	2	2	1	0.05	0.33
Celtis adolfi-friderici Engl.	5	1	1	7	6	1.17	0.16	1
Celtis milbraedii Engl.	5			5	2	2.5	0.11	0.33
Celtis philippensis Blanco	3		1	4	4	1	0.09	0.67
Corynanthe johimbe K. Schum.	1	7	18	26	18	1.44	0.59	1
Corynanthe pachyceras K. Schum.	2			2	2	1	0.05	0.33
Cylicodiscus gabunensis Harms	1	1		2	2	1	0.05	0.67
Desbordesia glaucescens (Engl.) Tiegh.			1	1	1	1	0,02	0.33
Desmodium adscendeus (Sw.) DC.		1		1	1	1	0.02	0.33
Diospyros crassiflora Hiern	3	1	5	9	5	1.8	0.20	1
Elaies guineensis Jacq.			2	2	2	1	0.05	0.33
Erythrophleum suavolens (Guill. & Perr.) Brenan			2	2	2	1	0.05	0.33
Garcinia kola Heckel		2		2	2	1	0.05	0.33
Greenwayodendron suaveolens (Engl. & Diels) Verdc.			1	1	1	1	0.02	0.33
Haumania danckelmania (J. Braun & K. Schum) Milne-Redh.			1	1	1	1	0.02	0.33
Holoptelea grandis (Hutch.) Mildbr.	1			1	1	1	0.02	0.33
Klainedoxa gabonensis Pierre ex Engl.	2	1		3	2	1.5	0.07	0.67
Klainedoxa macrophylla Pierre ex. Tiegh	1			1	1	1	0.02	0.33
Landolphia congolensis (Stapf) Pichon		1		1	1	1	0,02	0.33
Landolphia owariensis P. Beauv.	1			1	1	1	0.02	0.33
Leplaea thompsonii (Sprague & Hutch.) EJM Koenen & JJ de Wilde			1	1	1	1	0.02	0.33
Lovoa trichilioides Harms	1			1	1	1	0.02	0.33
Maesopsis eminii Engl.	1			1	1	1	0.02	0.33
Microdesmis puberula Hook. f. ex. Planch.		3	3	6	6	1	0.14	0.67
Milicia exelsa (Welw.) C.C. Berg	4	5	4	13	12	1.08	0.30	1
Oldfieldia africana Benth. & Hook. f.		3	6	9	7	1.13	0.20	0.67
Pentaclethra macrophylla Benth.		2	1	3	2	1.5	0.07	0.67
Pericopsis elata (Harms) Meeuwen			1	1	1	1	0.02	0.33
Piptadeniastrum africanum (Hook. f.) Brenan	1	4	2	7	4	1.4	0.16	1
Pteridium aquilinum (L.) Kuhn	2			2	2	1	0.05	0.33
Streblus usembarensis (Engl.) CC Berg			1	1	1	1	0.02	0.33
Strychnos aculeata Soler.	1			1	1	1	0.02	0.33
Strychnos campicola Gilg ex Leeuwenb.	2		7	9	8	1.13	0.20	0.67
Tessmannia africana Harms	1			1	1	1	0.02	0.33
Tetrapleura tetraptera (Schumach. & Thonn.) Taub.	2			2	1	2	0.05	0.33
Uapaca guineensis Müll. Arg.	1			1	1	1	0.02	0.33
Urera trinervis (Hochst.) Friis & Immelman			1	1	1	1	0.02	0.33
Xanthosoma mafaffa Schott	3			3	2	1.5	0.07	0.33
Zea mays L.	9		6	15	12	1.25	0.34	0.67
Total	**55**	**36**	**68**	**159**	**44**			

Source: Authors 2022

indexes are comparable. In other words, the VAU index is in accordance with that of CUS in determining the plants confirmed for their uses in traditional medicine for the treatment of erectile dysfunction. Thereby, the two indices highlighting the importance of *C. alba*, *C. johimbe*, *D. crassiflora*, *M. excelsa*, *C. adolfi-friderici, M. puberula*, *Oldfieldia africana*, *S. campicola* and *Z. mays* are among plant species used by Baka people to treat erectile dysfunction problems.

Conclusion

Spatial use convergence indexes allowed the selection of *C. alba*, *C. adolfi-friderici*, *C. johimbe*, *D. crassiflora*, *M. puberula, M. excelsa*, *Oldfieldia africana*, *S. campicola* and *Zea mays* for their importance in the treatment of erectile dysfunction. The information gathered can be used to consolidate the existing scientific database and to serve as an avenue to explore for further work on the little known or unexplored plant species mentioned, with a view to confirming the effective presence of the molecules of interest responsible for their biological activity. It would also be interesting to follow and describe the harvesting practices of plant organs used in the natural environment surrounding the Baka villages in order to assess the impact of harvesting techniques on the availability of the resource.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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