State of knowledge and traditional uses of the organs of *Kigelia africana* (Lam.) Benth. in Benin, West Africa

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Research

Abstract

Background: Kigelia africana (Lam.) Benth. is a wild species whose organs have been used in multiple ways. Despite these multiple uses, there is very little scientific data relating to the use within the different socio-cultural groups of Benin. To fill this information gap which could hinder the sustainable conservation efforts of the species for the benefit of users, this ethnobotanical study was carried out in Benin.

Methods: Its objective is to assess ethnobotanical knowledge among major socio-cultural groups. The aim was to determine the levels of knowledge and use of the organs of *Kigelia africana* and to identify the different types of use of these organs in Benin. Focus groups and semi-structured individual interviews were conducted in 26 municipalities to collect information from 1,210 people.

Results: The results showed that the variables socio-cultural group, gender, level of education and age group have a significant influence globally ($p \leq 0.05$) on the levels of knowledge and use. Furthermore, the socio-cultural groups Bariba, Dendi, Yao-Lokpa, Peulh and Ditamari use the organs of *K. africana* extensively in medicine. The socio-cultural groups Adja, Yoruba and Fon have a higher knowledge than the other socio-cultural groups. Elderly and adult people have higher levels of organ use in medicine than younger people. According to the gender, it turns out that men know better and use said organs much more than women. As for the level of education, the results showed that the uneducated people followed by those of the primary level have the highest frequencies of use in medicine than the people of the primary level.

Conclusions: This study provides basic information for the valorization of *K. africana* organs in Benin in West Africa.

Keywords: Ethnobotany, traditional knowledge, uses, *Kigelia africana*, Benin, West Africa

Background

In Africa in general and in Benin in particular, wild plants represent one of the main food, medicinal and economic sources in rural areas (Fandohan et al. 2017, Wédjangnon et al. 2016, Yèvidé et al. 2022). Many studies have focused on these wild plants which over the last century have been threatened or have become almost rare (Djaha and Gnahoua 2014). *Kigelia africana*, which is a local species, is one of these endangered wild species in Benin (Lawin et al. 2016, Yaoitcha et al. 2016).

K. africana is a tree with twisted branches 7 to 12 or even 20 m high, flowers in large hanging panicles up to 90 cm long, cylindrical fruits up to 50 cm long and 10 cm in diameter. It is found in dense dry forests, gallery forests and savannahs (Husseini et al. 2020, Yaoitcha et al. 2016). K. africana is a food plant through its flowers, fruits and leaves for humans and animals (Alyegba et al. 2013, Ndwandwe 2019), medicinal through its bark, fruits and leaves (Dassou et al. 2014, Mbunde et al. 2016, Dossou-Yovo et al. 2020, Houmènou et al. 2018, Dossou-Yovo et al. 2022). According to Ancha et al. (2015), *Kigelia africana* is, thanks to its organs, the first anti-diabetes medicinal plant bringing more monthly economic value to traders in Nigeria (158.33 Naira). In southern Benin, more than 20 people buy *K. africana* organs every day on the Abomey-Calavi market (Adomou et al. 2012, Dossou-Yovo et al. 2020).

According to the red list of the International Union for Benin, *Kigelia africana* is vulnerable (Neuenschwander et al. 2011). Studies are increasingly being carried out to ensure sustainable management and conservation of forest resources in the face of their growing uses. This is the case of many scientific studies that have focused on the ethnobotanical assessment of local forest resources and have mainly focused on plants that are threatened or becoming almost rare. Among these ethnobotanical studies, we can cite studies related to *Pterocarpus erinaceus* Poir (Ouinsavi et al. 2021), *Khaya senegalensis* (Desr.) A. Juss. (Soha et al. 2019), *Cola millenii* K. Schum (Lawin et al. 2019), *Artocarpus communis* Forst & Forst (Dossa et al. 2018), *Haematostaphis barteri* Hook.f. (Sourou et al. 2016), *Diospyros mespiliformis* Hochst. Ex A.DC. (Samuel et al. 2021), *Prosopis africana* (Guill. & Perr.) Taub. (Houètchégnon et al. 2015), *Mansonia altissima* (A. Chev.) A.Chev. (Wédjangnon et al. 2016) and *Kigelia africana* (Lam.) Benth. (Dossou-Yovo et al. 2020). Of all these studies, the only one that specifically dealt with K. africana focused on a single large socio-cultural group in southern Benin. The major socio-cultural groups of Benin are the Fon and related (39.2%), the Adja and related (15.2%), the Yoruba and related (12.3%), Bariba and related (9.2%)), Fulani and related (7.0%), Dittamari and related (6.1%), Yoa Lokpa and related (4.0%) and Dendi and related (2.5%). Are the uses of the large sociocultural group in the South shown by Dossou-Yovo et al. (2020) identical to those of other groups in Benin? The management of forest resources can only be sustainable if it does not consider the social and cultural values that local communities associate with them. The dependence of socio-cultural groups on forest resources sometimes constitutes a threat to the balance of ecosystems (Ganka et al. 2022, Fandohan et al. 2017). Preventing the disappearance of these forest resources also requires taking into account the various social considerations linked to the resources. Not taking these social considerations into account could undermine sustainable conservation efforts for the benefit of resource users, particularly *Kigelia africana*.

This article aims to evaluate the diversity of traditional uses of Kigelia africana at the intra and inter sociocultural group level. To this end, we hypothesized that the usefulness of the species for different socio-cultural groups, age classes and sex, is a guarantee of its sustainable conservation in Benin.

Materials and Methods

Choice of survey locations and respondents

The choice of survey localities (communes) was made following an exploratory study carried out on the entire national territory of Benin. This exploration aimed, on the one hand, to study the distribution and relative abundance of *Kigelia africana* throughout Benin with the eight major socio-cultural groups (GSC) where they have an interest in this plant. In addition, according to INSAE (National Institute of Statistics and Economic Analysis) (2016), there are eight socio-cultural groups that have given rise to a number of socio-culturally homogeneous entities with a territorial base: Fon and related; Adja and related; Yoruba and related; Bariba and related; Fulani and related; Dendi and related; Otamari and related then Yao-Lokpa and related (Figure 1a.). Endogenous knowledge and the diet of populations being cultural and therefore variable from one socio-cultural group to another, the surveys were therefore carried out at the level of these major socio-cultural groups listed above.

Taking these socio-cultural groups into account, 25 communes (Figure 1b.) distributed throughout Benin were considered (Aplahoué, Klouékanmè, Dogbo and Lokossa for Adja and relatives; Abomey, Bohicon, Abomey-Calavi, Cotonou and Porto-Novo for the Fon and related; Parakou, Kandi and Kouandé for the Bariba and related; Parakou, Malanville and Djougou for Dendi and related; Bassila, Djougou and Ouaké for Yao-Lokpa and related; Bembérékè, Kalalé and Malanville for Peul and related; Boukoumbé, Tanguiéta and Natitingou for Otamari and related then Pobè, Kétou, Dassa-Zoumé and Porto-Novo for the Yoruba and related). In each sampled commune, preliminary surveys were first carried out among 100 people taken at random in order to identify, (i) people with knowledge of the organs of *Kigelia africana*, (ii) people using the organs of *Kigelia africana*. The size of the sample of respondents was determined according to the total population (Pt) within each socio-cultural group. The formula used is as follows :

$$n = \frac{Pt}{10000}$$

With n the sample size and Pt the total population.

Thus, on this basis, the sample by socio-cultural group and the total sample were determined. This method was used by Houéhounha (2009) for a similar study on Daniellia oliveri (Rolfe) Hutch. & Dalziel. The table 1 below shows the total sample size.

Table 1. Size of samples surveyed by socio-cultural group

Targets	Population in 2021 according to INSAE projection in 2016	Sample size surveyed
Benin	12 506 347	1210
Fon and related	4802437.2	481
Yoruba and related	1500761.6	151
Adja and related	1888458.4	181
Bariba and related	1200609.3	121
Peul and related	1075545.8	108
Dendi and related	362684.06	37
Ditamari and related	762887.17	77
Yao-Lokpa and related	537772.92	54

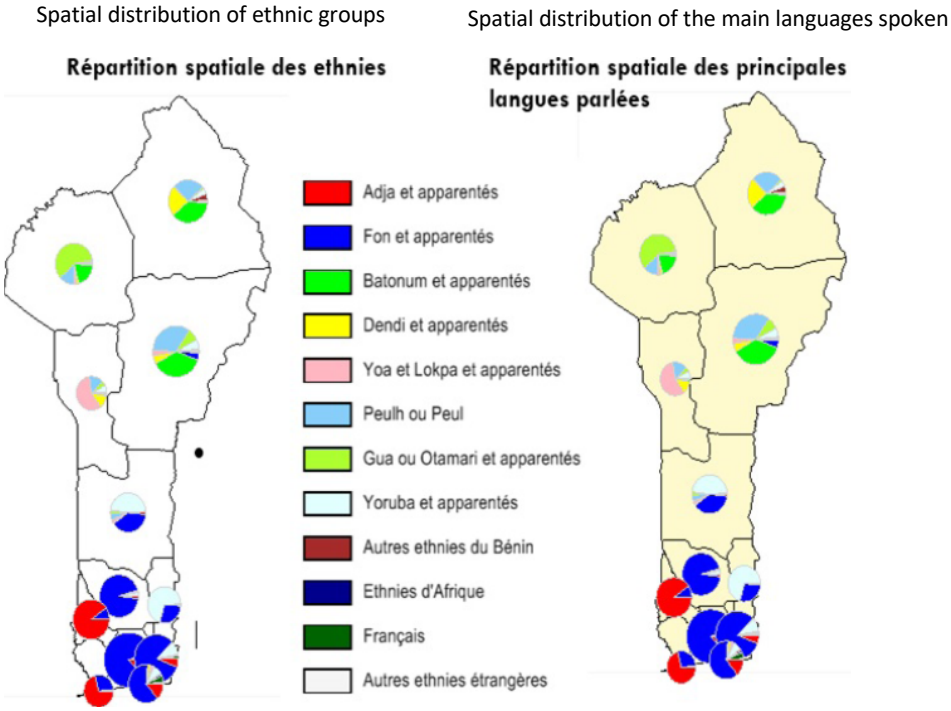

Figure 1a. Distribution of socio-cultural groups

Data collection

The data collected concerned the local uses of the organs of *Kigelia africana*, knowledge of the organs of *K. africana*, the places of research of the organs of *Kigelia africana* for use, the socio-cultural group to which the respondents belong, their sex, their level of education and their age.

Data processing and statistical analysis

To test the influence of GSC, gender, level of education and age group on the degree of use of *Kigelia africana* by category of use, the proportions of use of the species were calculated for each respondent. For each major category of use, Beta regressions were subsequently performed using the betareg function of the betareg package (Cribari-Neto and Zeileis 2010). In these models, the proportion of use was considered as the dependent variable and the GSC, gender, level of education

and age group were the predictors. We computed the relative frequency of citation for each organ within each ethnic group and built the matrix n x p (with n representing the number of ethnic groups as rows and p representing the number of organs as columns). We performed principal component analysis on this matrix to describe the association between organ usage and ethnic groups.

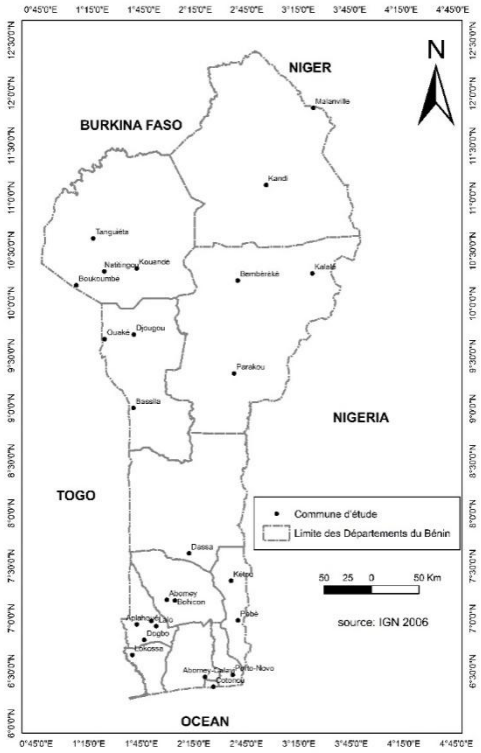

Fig. 1b. Communes of ethnobotanical studies of *K. africana*

The Information consensus index (IFC) makes it possible to assess the agreements of the informants on the medicinal use of the plant. It was also calculated for each medicinal use using the formula used by Sylla et al. (2018) which is as follows:

IFC = Na/Nt With Na = number of people having cited this medicinal use and Nt = total number of people interviewed. The IFC varies between 0 and 1. A low value, close to 0, indicates that the informants disagree on the corresponding medicinal use. A high value, close to 1, indicates a high or total consensus around the medicinal use of the plant.

Results

Sociodemographic characteristics of respondents

The profile of the surveys has a high relative frequency among the Fon, adults, men and illiterates respectively for socio-cultural groups, age group, gender and level of education. The lowest frequency is respectively for the socio-cultural groups, age group, gender and level of education Yao-Lokpa, young people, women and the higher level (Table 2).

Table 2. Description of the profile of respondents based on data on membership of the socio-cultural group (GSC), age group, gender and level of education

Variables/Modalities	Absolute Frequency	Relative Frequency (%)
Socio-cultural group (GSC)		
Adja	127	12.71
Bariba	121	12.11
Dendi	37	3.70
Fon	415	41.54
Otamari	77	7.71
Peulh	108	10.81
Yom-Lokpa	54	5.41
Yoruba	60	6.01
Age class		
Youth (Under 30)	152	15.22
Adults (Between 30 and 60 years old)	561	56.16
Old (over 60)	286	28.63
Gender		
Feminine	240	24,02
Male	759	75,98
Educational level		
Illiterate	459	45.95
Primary	362	36.24
Secondary	127	12.71
Superior	51	5.11

Knowledge of the organs of *Kigelia africana*

Socio-cultural group

Pearson's Chi-square test of independence indicated a strong association of organs used with socio-cultural groups (χ^2= 847.67, df = 42, P < 0.001). Thus, the results of the simple correspondence analyzes, indicated that the first three axes carried 98.78% of the initial information, proportions sufficient to guarantee precision in the interpretations.

On the first factorial axis, the socio-cultural groups: Adja, Bariba, Peulh and the organs: branch, fruit and trunk have a good contribution and correlation (Table 3); thus, their projection on this axis indicated that the Adja use more branches and trunks as opposed to the Bariba and Peulh who prefer fruits (Figure 2).

Table 3. Contribution and correlation matrix of sociolinguistic groups and organs with the first three factorial axes.

Variables	Contribution			Correlation		
	Dim 1	Dim 2	Dim 3	Dim 1	Dim 2	Dim 3
GSC						
Adja	66,06	19,66	0,27	0,83	0,17	0,00
Bariba	10,15	8,44	0,05	0,62	0,36	0,00
Dendi	3,28	3,19	0,30	0,56	0,38	0,01
Fon	1,08	42,31	19,06	0,03	0,88	0,08
Otamari	5,44	2,24	0,00	0,67	0,19	0,00
Peulh	11,39	13,21	1,58	0,54	0,44	0,01
Yom-lokpa	2,57	0,08	13,01	0,54	0,01	0,40
Yoruba	0,03	10,88	65,73	0,00	0,44	0,56
Organ						
Branch	51,64	19,22	4,57	0,78	0,21	0,01
Bark	0,01	29,02	45,89	0,00	0,75	0,25
Sheet	0,05	5,67	6,65	0,01	0,63	0,16
Flower	0,74	0,94	0,18	0,35	0,31	0,01
Fruit	25,16	25,73	0,60	0,58	0,42	0,00
Root	5,42	18,17	39,97	0,22	0,53	0,24
Trunk	16,98	1,24	2,14	0,93	0,05	0,02

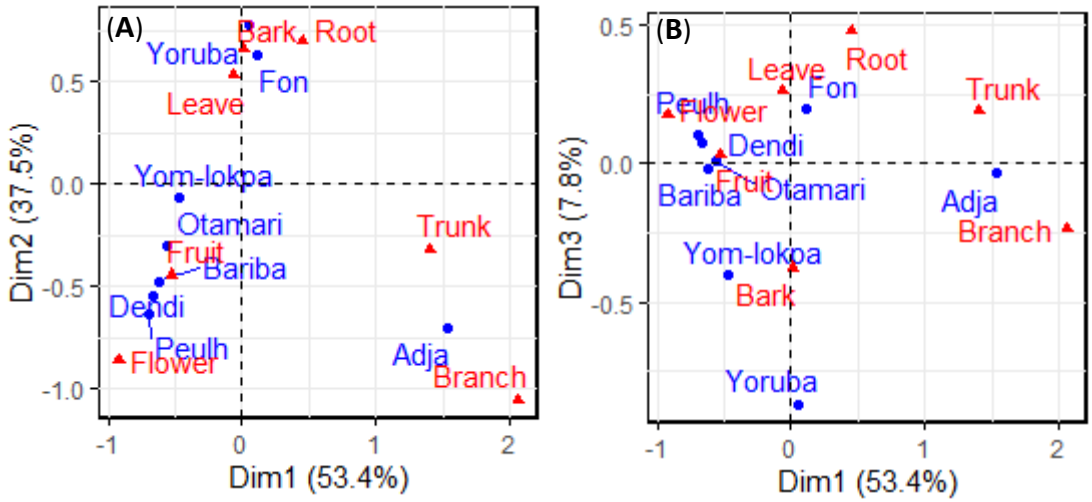

Figure 2. Projection of socio-cultural groups and organs on the three factorial axes (A: describes the relationship by considering the first two factorial axes and B the relationship by considering the first and the third factorial axis; The blue and red colors are respectively used to indicate sociolinguistic groups and organs).

On the second factorial axis, the socio-cultural groups Adja, Fon and the branch, bark, fruit and root organs have a good contribution and correlation (Table 3); thus, their projection on this axis indicated that the Fon and Yoruba preferentially use the bark and the root as opposed to the Adja who mostly use the fruits and branches.

Moreover, the third axis is strongly associated with the socio-cultural groups Yao-Lokpa, Fon, Yoruba and with the bark and root organs (Table 3); thus, their projection on this axis indicated that the Yao-Lokpa and Yoruba use more the bark as opposed to the Fon who prefer the roots (Figure 2)

Age, sex and level of education

Sankey diagram (Figure 3) showed organ use by age group (A), sex (B), and level of education (C). According to this diagram in part A, i.e. considering age, adults and old people make greater use of the fruits and bark of *K. africana*. According to gender (B), both men and women use the fruits and the bark. The same is true for education level.

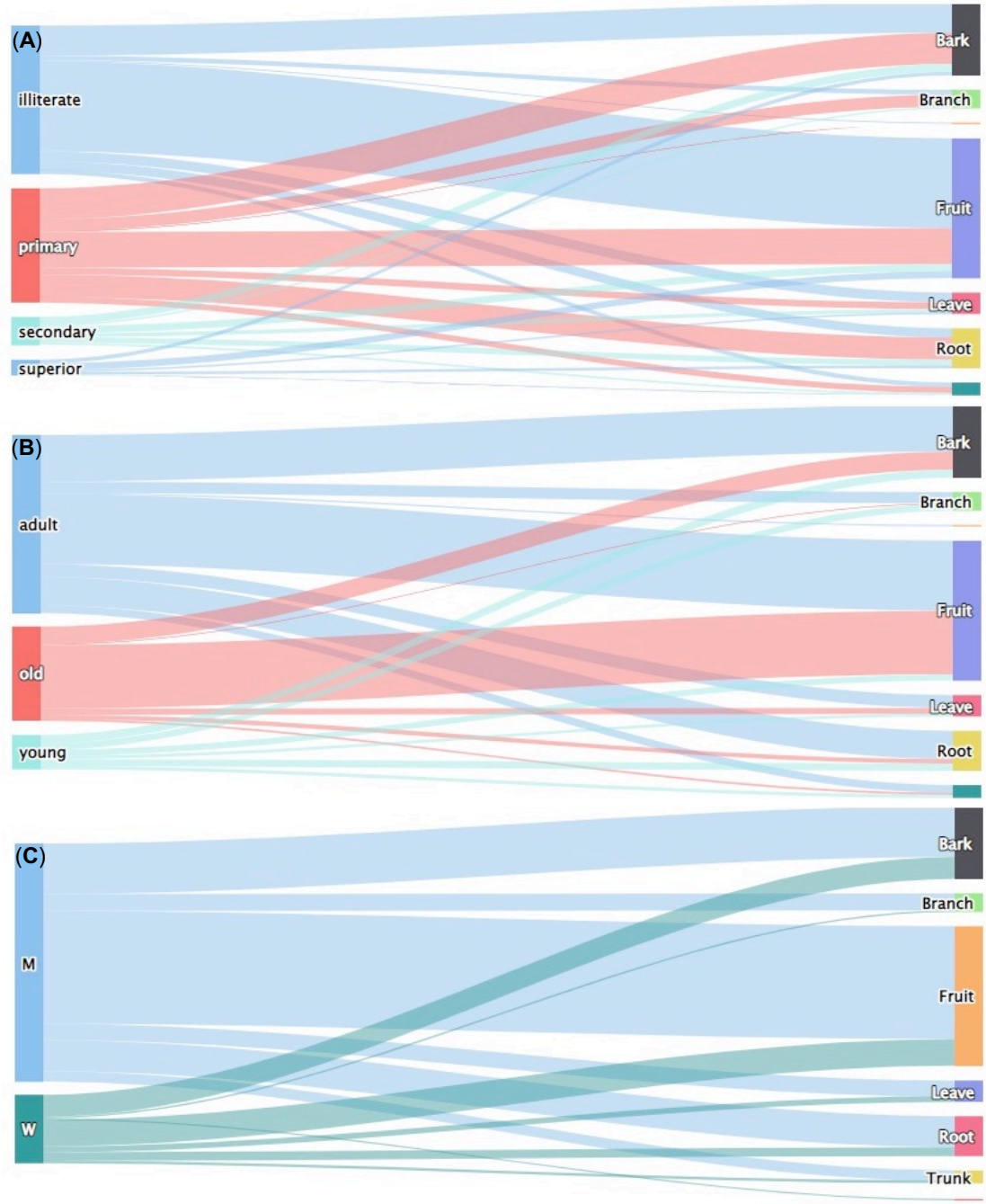

Figure 3. Sankey diagram showing the use of organs according to age group (A), sex (B), and level of education (C)

Use of *Kigelia africana*

The influence of GSC, gender, level of education and age group on the number of citations of the major use categories of *Kigelia africana* shows that the Bariba, Peulh and Yao-Lokpa have a significant influence of use of *Kigelia africana* ($p<0.001$). This is the same significant influence noted at the youth level (Table 4).

Table 4. Results of generalized linear regressions with the negative binomial distribution testing the influence of GSC, gender, level of education and age group on the number of citations of the major use categories of *Kigelia africana*.

Demographics	**Estimate**	**Std,Error**	**z value**	**Pr (>|z|)**
(**Intercept**)	0.01	0.12	0.12	0.902
EthnicityBariba	0.51	0.12	4.18	0.000
EthnicityDendi	0.24	0.17	1.41	0.158
EthnicityFon	-0.21	0.11	-1.94	0.052
EthnicityOtamari	0.28	0.14	1.97	0.049
EthnicityPeulh	0.57	0.12	4.55	0.000
EthnicityYom-lokpa	0.54	0.14	3.74	0.000
EthnicityYoruba	-0.07	0.16	-0.43	0.670
primary_education_level	0.04	0.07	0.54	0.587
secondary_education_level	-0.19	0.13	-1.52	0.129
superior_education_level	0.03	0.15	0.18	0.860
Age_classYoung	-0.28	0.11	-2.41	0.016
age_classOld	0.05	0.07	0.73	0.464
GenderM	0.08	0.07	1.12	0.261

The number of citations of the major categories according to demographic characteristics ranked the Bariba, Peulh and Yao-Lokpa first for the major categories unlike the other socio-cultural groups. According to the age classes, the old have more citations for the categories of use of *K. africana* (Table 5).

Table 5. Descriptive statistics (mean, median, rank) of the number of citations of major categories according to demographic characteristics

Demographics	Terms	Statistics		
		Mean	Median	Rank
GSC	Adja	1.00	1	2
	Bariba	1.87	2	1
	Dendi	1.43	1	2
	Fon	0.81	1	2
	Otamari	1.48	1	2
	Peulh	1.97	2	1
	Yom-lokpa	1.89	2	1
	Yoruba	1.03	1	2
Educational level	Illiterate	1.51	1	1
	Primary	1.10	1	1
	Secondary	0.72	1	1
	Superior	1.04	1	1
Age class	Adult	1.17	1	2
	Young	0.68	1	2
	Old	1.64	2	1
Gender	F	1.09	1	1
	M	1.28	1	1

Degree of use of *Kigelia africana* by category of use according to GSC, gender, level of education and age group

According to the degree of use, all the major socio-cultural groups have a significant degree of use ($p<0.001$) for food. Young people by age group also have a significant degree of use in food.

As for medicine, all major socio-cultural groups have a significant degree of use ($p<0.001$) (Table 6). The primary and secondary levels of education and then the young people at the level of the age group show a significant degree of use for medicine (Figure 4). Elderly people use *K. africana* more medicinally, followed by adults and young people (Figure 4). Figure 4 shows that knowledge in medicine is more observed among illiterates followed by people in primary, secondary and higher education.

As far as the broad category of magical use is concerned, a significant degree of use is noted at the level of the socio-cultural groups Bariba, Fon and Peulh ($p<0.001$). Young people for the level of education and primary for the level of education there is also a significant degree of use for the category of magic use.

Table 6. Influence of GSC, gender, level of education and age group on the degree of use of *Kigelia africana* by category of use.

Variables	Estimate	Std,Error	z value	Pr(>|z|)
Feed				
(Intercept)	-2.06	0.14	-14.67	<0.001
EthnicityBariba	-1.44	0.14	-9.94	<0.001
EthnicityDendi	-1.38	0.20	-6.84	<0.001
EthnicityFon	-1.52	0.11	-13.78	<0.001
EthnicityOtamari	-1.46	0.16	-8.96	<0.001
EthnicityPeulh	-1.39	0.15	-9.30	<0.001
EthnicityYom-lokpa	-1.39	0.18	-7.79	<0.001
EthnicityYoruba	-1.62	0.17	-9.74	<0.001
Age.classYoung	-0.24	0.10	-2.36	0.018
Age.classOld	-0.05	0.09	-0.60	0.547
Primary.education.level	0.05	0.08	0.58	0.565
Secondary.education.level	-0.01	0.12	-0.07	0.943
Superior_education_level	-0.03	0.16	-0.17	0.865
GenderM	0.02	0.08	0.21	0.833
Medicine				
(Intercept)	-1.11	0.13	-8.46	<0.001
EthnicityBariba	1.81	0.15	12.24	<0.001
EthnicityDendi	1.75	0.21	8.49	<0.001
EthnicityFon	0.59	0.11	5.36	<0.001
EthnicityOtamari	1.78	0.17	10.71	<0.001
EthnicityPeulh	1,83	0,15	12,03	<0,001
EthnicityYom-lokpa	1.87	0.18	10.21	<0.001
EthnicityYoruba	0.42	0.17	2.52	0.012
Age.classYoung	-1.69	0.11	-15.69	<0.001
Age.classOld	0.10	0.09	1.10	0.270
Primary.education.level	0.35	0.09	4.04	<0.001
Secondary.education.level	-0.54	0.12	-4.32	<0.001
Superior_education_level	-0.01	0.17	-0.05	0.956
GenderM	0.12	0.08	1.46	0.144
Magical				
(Intercept)	-1.83	0.11	-16.87	<0.001
EthnicityBariba	-0.34	0.14	-2.37	0.018
EthnicityDendi	0.19	0.21	0.87	0.382
EthnicityFon	0.87	0.12	7.33	<0.001

EthnicityOtamari	-0.16	0,16	-1,01	0,311
EthnicityPeulh	0.86	0.16	5.52	<0.001
EthnicityYom-lokpa	-0.12	0.18	-0.67	0.504
EthnicityYoruba	-0.44	0.17	-2.56	0.011
Age.classYoung	-0.30	0.11	-2.80	0.005
Age.classOld	-0.24	0.09	-2.77	0.006
Primary.education.level	0.31	0.08	3.71	<0.001
Secondary.education.level	0.03	0.12	0.21	0.831
Superior_education_level	0.46	0.18	2.56	0.011
GenderM	-0.06	0.09	-0.70	0.490

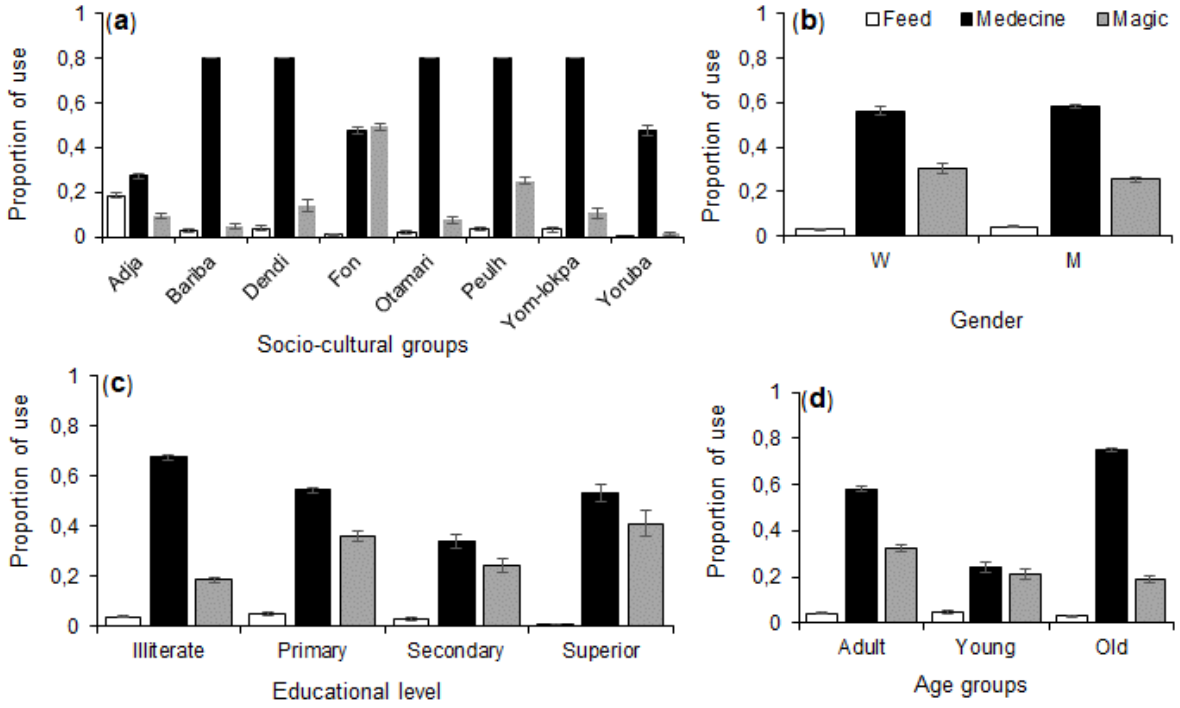

Figure 4. Degree of use of *Kigelia africana* by category of use according to GSC (a), gender (b), level of education (c) and age group (d).

The information consensus index of respondents on the medicinal use of *K. africana* (Figure 5) shows that the diseases and/or symptoms most cited by the species are stomach aches, hemorrhoids, hernia, ulcer, infections, deworming, breast cancer, epilepsy, penis development, painful menstruation, edema. The least cited diseases or symptoms are navel pain, tuberculosis, vertigo.

There are mainly two modes of acquisition of *K. africana* organs: collection from the wild and purchase from vendors of medicinal plants (Figure 6). The harvest mode of acquisition is the most common mode for all socio-cultural groups except the Fon and the Dendi (Figure 7). The most widespread harvesting equipment is the hand, followed by machete and axe. Women use the hand more than men for the harvesting technique (Figure 7). As for the use of machetes for the harvesting of *K. africana* organs, it is young people followed by adults and old people who practice it (Figure 7).

The organs of *Kigelia africana* collection mode and tools

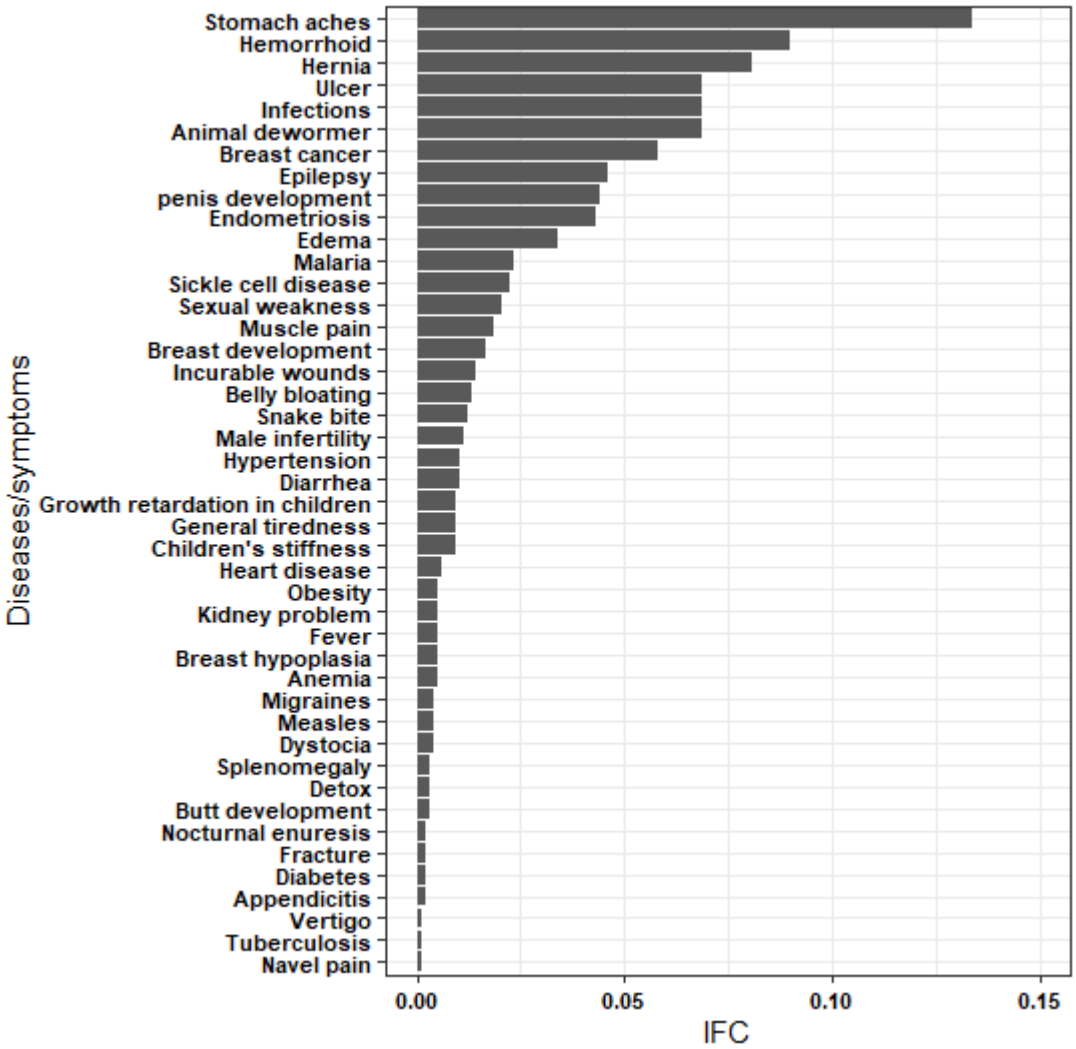

Figure 5. Information consensus index of respondents on the medicinal use of *K. africana*

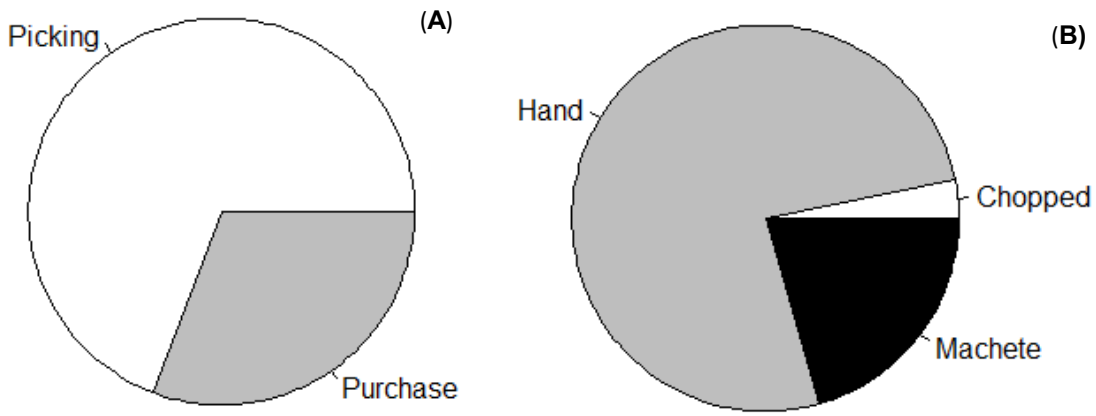

Figure 6. Frequency distribution of the mode of acquisition (A) and the technique of obtaining (B) the organs of *K. africana*

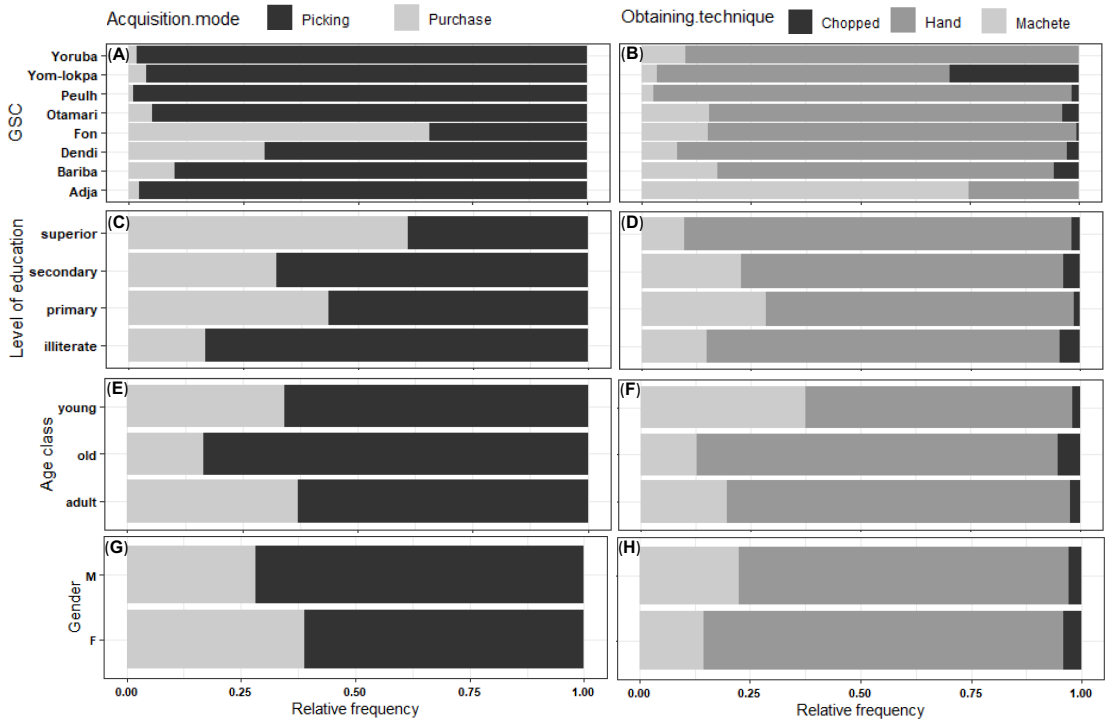

Figure 7. Frequency distribution of the mode of acquisition (A,C,E,G) and the technique of obtaining (B, D, F, H) organs of *K. africana* according to the GSC, gender, level d education and gender age group.

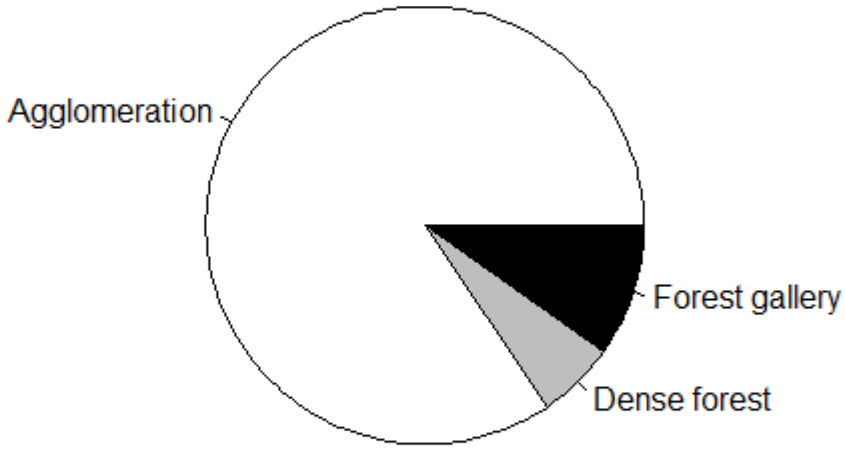

Figure 8. Perception of respondents on the habitat of *Kigeia africana*

Local perception of favorable habitat for the conservation of *Kigelia africana*

The perception of the habitat of *Kigelia africana* is globally significant according to socio-cultural groups, gender, age and level of education ($P < 0.001$). The majority of respondents perceive that *K. africana* is encountered more in built-up areas than in dense forests and gallery forests (Figure 8). The Adja, the Fon and the Bariba perceive that the species is found more in built-up areas, unlike the Ditamari, Dendi and Peul who think that *Kigelia africana* is more present in gallery forests than in other habitats, namely dense forests and built-up areas (Figure 9). According to the same figure 9, in terms of education, almost all people at all educational levels (higher, secondary, primary and illiterate) say that the species is mainly found in agglomerations.. This is so according to gender. On the other hand, according to the age group, the old perceive less than the adults and the young that *K. africana* is in the agglomerations. The old people think that the gallery forests also abound in the species in a not negligent way after the agglomerations (Figure 9).

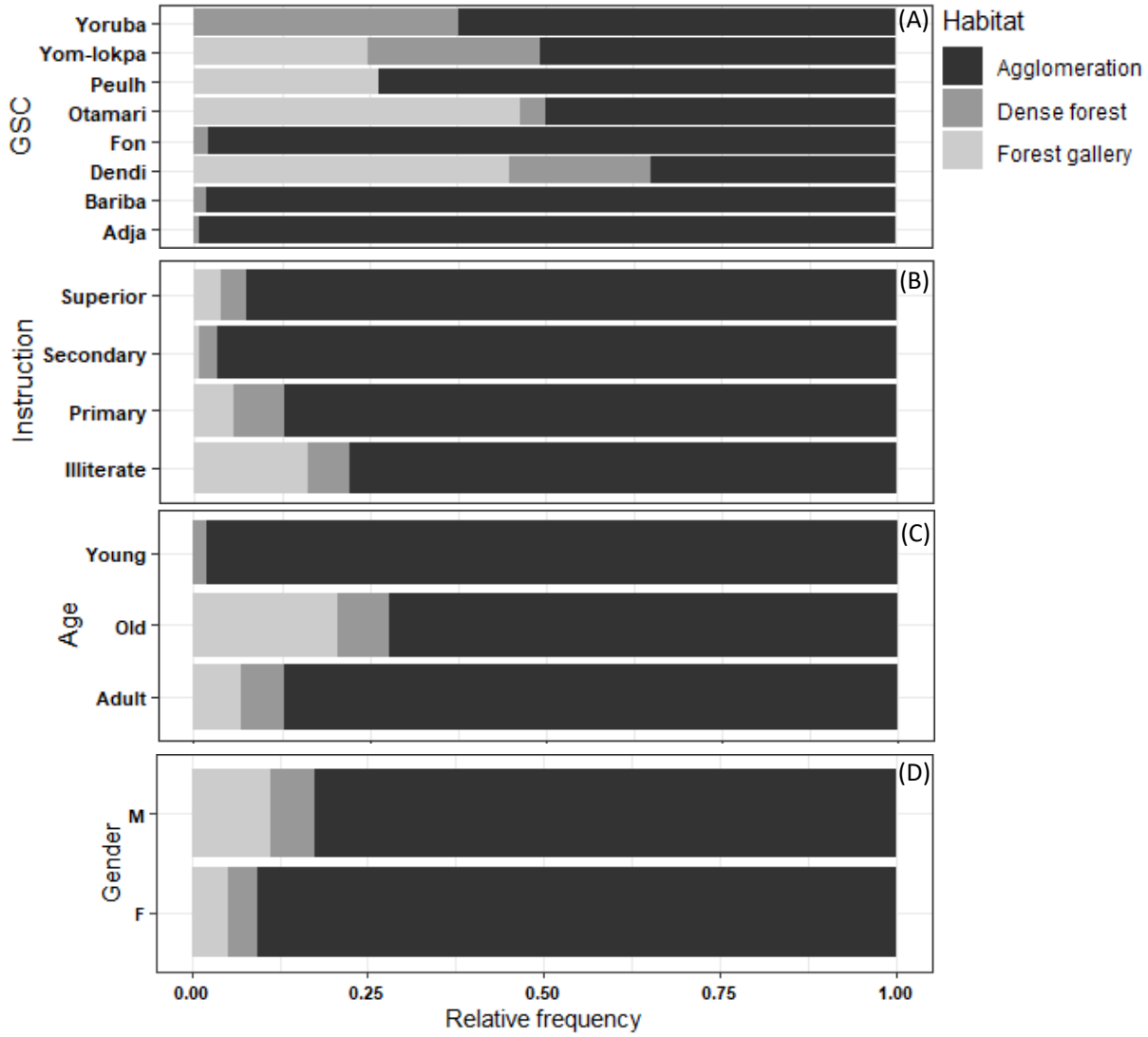

Figure 9. Local perception of *Kigelia africana* favorable habitat according to GSC (A), level of education (B), age class (C) and sex (D).

Bark collection (more than 50%) is the highest citation for threats to the species (Figure 10). Culling is no less of a threat (nearly 30%). Bushfires are minor threats.

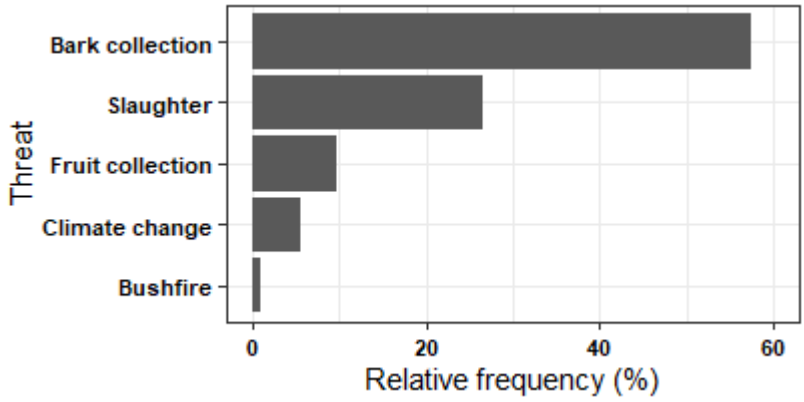

Figure 10. Frequency of citing threats to *Kigelia africana* in Benin.

Discussion

The study revealed that there is a strong relationship of organs used to socio-cultural groups and a high level of knowledge and use of *K. africana* in medicine, food and magic. A relationship is also noted at the level of *Prosopis africana* in Benin (Houètchégnon et al. 2015) and *Cola millenii* in Benin (Lawin et al. 2019). Kebenzikato et al. (2015) believe that the socio-cultural group remains a major factor of difference in the uses and knowledge of plants between communities. The strong link of the organs of *K. africana* to socio-cultural groups gives hope for the conservation of knowledge and uses of this species because the transmission of knowledge is done from generation to generation within socio-cultural groups (Ngbolua 2020). The results of this study corroborate those of Masengo et al. (2021) who show that knowledge about the use of *Lippia multiflora* Moldenke is equitably distributed among the different socio-cultural groups in Congo. The knowledge and use in medicine, food and magic revealed by the present studies on *K. africana* relate more to diseases and or symptoms such as stomach aches, hemorrhoids, hernias, ulcers, infections, deworming, breast cancer, epilepsy, penis enlargement, painful menstruation, edema. The results are similar to those of Dossou-Yovo et al. (2022), Grâce et al. (2002) on this same species. When we consider the age of the respondents, the elderly use the organs of *K. africana* more in medicine, followed by adults and young people. Indeed, people aged 60 and over have the highest level of knowledge. This result would be due to the fact that they hold a good part of the ancestral knowledge which is most often transmitted orally. The transmission of this knowledge is currently in danger because it is not always ensured (Orch et al. 2015). In addition, the experience accumulated with age is the main source of information at the local level about the use of wild plants. The results obtained corroborate those reported by N'zebo et al. (2018) and Lougbégnon et al. (2015) who showed that the age of the respondent is a factor influencing the level of knowledge of plants.

In terms of level of education, illiterates followed by people at primary, secondary and higher levels are respectively the most knowledgeable in medicine. According to INSAE (2016) more than 40% of the population are illiterate and live mainly in rural areas. This implies that a large part of the population of Benin, mainly the rural population, uses *K. africana* in medicine and will be favorable to the conservation of the species. These results corroborate those of N'zebo et al. (2018). According to Kébenzikato et al. (2015) who worked on Adansonia digitata L.in Togo the high level of knowledge of harvested plants is linked not only to cultivation, but also to the increased poverty level of the populations and the low urbanization of these environments. Indeed, people in rural areas are more dependent on natural resources, which they use for economic, medicinal and food purposes (Ganglo et al. 2017, Kaoma and Shackleton 2014). Knowledge of the uses of the organs of *Kigelia africana* is an asset for actions to conserve the species.

Taking gender into account, the study revealed that the levels of knowledge of *K. africana* organs between men and women are different. The highest level of knowledge is obtained with the masculine gender. This could be explained by the fact that the man could be looking for remedies for the ailments he suffers from because there are more men suffering from ulcers, hernias and hemorrhoids than women (Sambu 2021, Diarra 2018, Zahra and Sarra 2020).

These results disagree with those of Ndjouondo et al. (2015) and Lagou et al. (2016) who noted that women have more knowledge of medicinal plants than men following a study on the role of women in local development and the preservation of forest resources. The advantage of knowledge at the level of men is that they are more owners of land than women in Benin and will be more favorable to the safeguarding of the species.

The collection of bark according to more than 50% of the respondents is a threat to the species. The present results are similar to those of Savadogo et al. (2019) who show that the species are more debarked for medicinal uses in Kokologho and Tenado in Burkina Faso. The results obtained are corroborated by those of Yaméogo et al. (2013) who revealed in their study that, on average, the samples taken for medicinal uses relate to bark. The proportions found are justified by the fact that the peripheral parts (barks and leaves) of the plants are recommended for care. This, which is confirmed by the work of Ngene et al. (2015), which stipulate that these parts constitute the places of storage of secondary metabolites or materials of base, protectors of the organism. These parts are therefore the most popular (Adomou et al. 2012). But it should be recognized that all the debarking carried out is not only for medicinal care.

The results of this manuscript show that all socio-cultural groups in Benin know *Kigelia africana* and use it in various forms and for different needs (health, food, etc.). These different socio-cultural groups are aware of the threats weighing on the species to the point where almost all of them preserve this wild plant in their towns. This shows the adoption of the species by local populations, and this signals the beginning of domestication of the species. It would be fairer for future research to assess the availability of the species in its preferred habitats on the one hand and the climatic impacts on the other hand for its sustainable conservation. Furthermore, research into its regeneration should not be overlooked.

Blessing in the eastern region of Santa Catarina Island is performed mainly by older women, highlighting the….

Conclusion

The study of the state of knowledge and use of the organs of *K. africana* made it possible to know that the characters socio-cultural groups, age group, level of education and gender influence the levels of knowledge and use of the organs of *Kigelia africana*. Also, the study showed that the elderly use more *K. africana* in medicine followed by adults and young people. The majority of people who know better and use the organs of *Kigelia africana* much more are illiterate. In addition, the survey revealed that the barks are the most used. According to the gender, it turns out that the man knows better and uses the said organs much more than the woman. In addition, it appears from the study that the different types of use of the organs of *K. africana* relate to traditional medicine, food and magic. The acquisition of organs is much more by picking and is done mainly by hand and machete.

Declarations

List of abbreviations: p : probabilité**;** ≤ : less or equal**;** GSC : socio-cultural groups**;** Pt : total population**;** n : sample size**;** % : percentage**;** < : inferior**;** > : superior**;** Std : standard deviation**;** M : man**;** W : woman**;** IFC: Information consensus index

Ethics approval and consent to participate: This study did not involve the export of any animal or plant material. Information was obtained from the participants. All informants were orally consented.

Consent for publication: Oral permission was taken from all the authors.

Availability of data and materials: The manuscript contains all the data.

Competing interests: We declare that there is no conflict of interest.

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Author contributions: This work is a combined effort of all of the authors. Charlotte YAMONTCHE and Christine OUINSAVI designed this work. It conducted by Charlotte YAMONTCHE and Towanou HOUETCHEGNON. Data analysis was carried out by Thierry HOUEHANOU and Towanou HOUETCHEGNON. Charlotte YAMONTCHE and Towanou HOUETCHEGNON wrote the manuscript. All authors read and approved the final manuscript.

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Literature cited

Adomou AC, Yedomonhan H, Djossa B, Legba SI, Oumorou M, Akoegninou A. 2012. Ethnobotanical study of medicinal plants sold in the Abomey-Calavi market in Benin. International Journal of Biological and Chemical Sciences 6(2):745-772 doi.org/10.4314/ijbcs.v6i2.18.

Alyegba SS, Dagba MR, Ioryem B. 2013. Ethnobotanical Survey of Edible Wild Plants in Tiv Communities of Benue State, Nigeria. Journal of natural sciences research 3(7):17-23.

Ancha PU, Ikyaagba ET, Tee TN, Angwe HT, Tume TC. 2015. Ethnomedical Survey of Plant Species Used for the Treatment of Various Diseases in Mbalom Council Ward of Gwer East Local Government Area of Benue State, Nigeria. International Journal of Forestry and Horticulture 1(1):18-29.

Cribari-Neto F, Zeileis A. 2010. Beta regression in R. Journal of statistical software 34: 1-24.

Dassou HG, Ogni CA, Yédomonhan H, Adomou AC, Tossou M, Dougnon JT, Akoègninou A. 2014. Diversity, veterinary uses and vulnerability of medicinal plants in North Benin. International Journal of Biological and Chemical Sciences 8(1):189-210. doi.org/10.4314/ijbcs.v8i1.18

Djaha AJ, Gnahoua GM. 2014. Contribution to the inventory and domestication of wild food species in Ivory Coast: Case of the Departments of Agboville and Oumé. Journal of Applied Biosciences 78: 6620-6629. doi.org/10.4314/jab.v78i1.8

Diarra MH. 2018. Perception and management of hemorrhoidal disease in Commune I of the District of Bamako. Doctorate Thesis in Medicine, University of Sciences, Techniques and Technologies of Bamako, Mali.

Dossa AJ, Amanoudo JM, Houetchegnon T, Ouinsavi C. 2018. Socioeconomic and Ethnobotanical Importance of the Breadfruit Tree (Artocarpus communis J. G & G. Forster) in Benin. European Scientific Journal, 14(24), 447-463.

Dossou-Yovo HO, Kindomihou V, Sinsin B. 2020. Application of ethnobotanical indices to assess the diversity of medico-magic knowledge on four herbaceous species in Benin. Research square this work is licensed under a CC BY 4.0 License. doi.org/10.21203/rs.3.rs-96891/v1

Dossou-Yovo HO, Vodouhè FG, Kindomihou V, Sinsin B. 2022. Investigating the Use Profile of *Kigelia africana* (Lam.) Benth. through Market Survey in Benin. Conservation 2 : 275–285. doi.org/10.3390/conservation2020019

Fandohan AB, Chadare FJ, Gouwakinnou GN, Tovissode CF, Bonou A, Djonlonkou SFB, Houndelo LFH, Sinsin CLB, Assogbadjo AE. 2017. Traditional uses and economic value of *Synsepalum dulcificum* in South Benin. Woods and Forests of the Tropics 332 : 17-30.

Ganglo C, Dan C, Aoudji AK, Gbetoho AJ, Ganglo JC. 2017. Socio-economic importance of *Xylopia aethiopica* (Dun) A. Rich. for the populations of South Benin. European scientific journal 13 : 187-201. doi.org/10.19044/esj.2017.v13n33p187

Ganka G, Salako VK, Fandohan BA. 2022. Importance of cults in the preservation of tree species, the case of samba (*Triplochiton scleroxylon* K. Schum.) in Benin. Tropical Woods & Forests 351: 53-65.

Gaoue OG, Coe MA, Bond M, Hart G, Seyler BC, McMillen H. 2017. Theories and major hypotheses in ethnobotany. Economic Botany 71(3): 269–287.

Samuel NA, Koura K, Ganglo CJ. 2021. Ethnobotanical assessment of *Diospyros mespiliformis* Hochst. ex A. DC (Ebenaceae) in the classified forest of Wari-Maro (Sudano-guinean area of Benin, West Africa). Ethnobotany Research and Applications, 22, 1-12. http://dx.doi.org/10.32859/era.22.45.1-12

Grâce OM, Light ME, Lindsey KL, Mulholland DA, Van Staden J, Jager AK. 2002. Antibacterial activity and isolation of active compounds from fruit of the traditional African medicinal tree *Kigelia africana*. South African Journal of Botany 68(2) 220-222 doi.org/10.1016/S0254-6299(15)30424-5

Houéhounha R. 2009. Analysis of the ecological and socio-cultural impacts of the exploitation of *Daniellia oliveri* (rolfe) hutch products. & dalz. on the viability of its populations in Benin. Doctoral thesis, University of Abomey-calavi.

Houètchégnon T, Gbèmavo DSJC, Ouinsavi C, Sokpon N. 2015. Ethnobotanical knowledge and traditional management of african mesquite (*Prosopis africana* Guill., Perrot. et Rich.) populations in Benin, West Africa. The journal of ethnobiology and traditional medicine 125 : 1124-1135

Houmènou V, Adjatin A, Assogba F, Gbénou J, Akoègninou A. 2018. Phytochemical and cytotoxicity study of some plants used in the treatment of female sterility in South Benin. European scientific journal 14(6): 1857-7881 doi.org/10.19044/esj.2018.v14n6p156

Husseini AU, Nina PM, Maxmillan CN. 2020. Ecological Distribution of Sausage Tree (*Kigelia africana*) In Murchison Falls National Park. African Journal of Environment and Natural Science Research 3(1): 50-62

INSAE. 2016. Population size of villages and city neighborhoods in Benin, (RGPH4, 2013).

Kaoma H, Shackleton CM. 2014. Collection of urban tree products by households in poorer residential areas of three South African towns. Urban Forest & Urban Green. 13 : 244–252 doi.org/10.1016/j.ufug.2014.02.002

Kebenzikato AB, Wala K, Atakpama W, Dimobe K, Dourma M, Woegan AY, Batawila K, Akpagana K. 2015. Ethnobotanical knowledge of the baobab (*Adansonia digitata* L.) in Togo. Biotechnology, Agronomy, Society and Environment. 19(3): 247-261

Lagou SML, Bi FHT, Yao K, Bakayoko A, Kone M W. 2016. Obstetric fistulas in the Abidjan district, Ivory Coast: level of knowledge and plants traditionally used in treatment. International Journal of Biological and Chemical Sciences 10(3):1273-1285.

Lawin IF, Laleye OAF, Agbani OP. 2016. Vulnerability and endogenous conservation strategies of plants used in the treatment of diabetes in the communes of Glazoué and Savè in Central Benin. International Journal of Biological and Chemical Sciences 10(3): 1069-1085 doi.org/10.4314/ijbcs.v10i3.14

Lawin IF, Houètchégnon T, Fandohan AB, Salako VK, Assogbadjo AE, Ouinsavi CAIN. 2019. Knowledge and uses of *Cola millenii* K. Schum. (Malvaceae) in the Guinean and Sudano-Guinean zones of Benin. Woods and Forests of the Tropics 339: 61-74 doi.org/10.19182/bft2019.339.a31716

Lougbégnon TO, Nassi KM, Gbesso FGH. 2015. Quantitative ethnobotany of the use of *Chrysophyllum albidum* G. Don by local populations in Benin. Journal of Applied Biosciences 95: 9028– 9038 doi.org/10.4314/jab.v95i1.12

Masengo CA, Bongo GN, Robijaona B, Ilumbe GB, Ngbolua Koto-Te-Nyiwa J-P, Mpiana PT. 2021. Quantitative ethnobotanical study and sociocultural value of *Lippia multiflora* Moldenke (Verbenaceae) in Kinshasa, Democratic Republic of Congo. Moroccan Journal of Agricultural and Veterinary Sciences 9(1) : 93-101

Mbunde MV, Innocent E, Mabiki F, Andersson PG. 2016. Ethnobotanical survey and toxicity evaluation of medicinal plants used for fungal remedy in the Southern Highlands of Tanzania. Journal of Intercultural Ethnopharmacology 6(1): 84-96. doi: 10.5455/jice.20161222103956.

Ndjouondo GP, Ngene JP, Ngoule CC, Kidik P, Ndjib R, Dibong SD, Mpondo ME. 2015. Inventory and characterization of medicinal plants in the Kambo and Longmayagui sub-watersheds (Douala, Cameroon). Journal of Animal and Plant Sciences, 25(3) : 3898-3916.

Ndwandwe KC. 2019. In vitro evaluation of nutritional content and anthelmintic values of *Kigelia africana* fruit to domesticated ruminants. Doctoral dissertation, University of Zululand.

Ngbolua KN, Molongo MM, Libwa MTB, Amogu JJD, Kutshi NN, Masengo CA. 2020. Ethnobotanical survey of wild food plants in the territory of Mobayi-Mbongo (North Ubangi) in the Democratic Republic of Congo. Moroccan Journal of Agricultural and Veterinary Sciences 9(2) : 259-265.

Ngene JP, Ngoule CC, Kidik CP, Ottou PM, Dibong SD, Mpondo EM. 2015. Importance in the traditional pharmacopoeia of flavonoid plants sold in the markets of Douala-Est (Cameroon). Journal of Applied Biosciences 88: 8194-8210. doi.org/10.4314/jab.v88i1.6

Neuenschwander P, Sinsin B, Goergen G. (eds). 2011. Protection of Nature in West Africa: A Red List for Benin. Nature Conservation in West Africa: Red List for Benin. International Institute of Tropical Agriculture, Ibadan, Nigeria. Chapitre 4, 21-46.

N'zebo J-M NZ, Dje KM, Ahi AP. 2018. State of knowledge and traditional uses of the fruits of *Tetrapleura tetraptera* ((Schumach. & Thonn.) Taub., 1891), spontaneous aromatic food plant from the South-East of Ivory Coast. Journal of Animal & Plant Sciences, 38(1) : 6190-6205.

Ouinsavi C, Kuiga B NS, Wedjangnon A, Houetchegnon T, Yanik AKIN, Dossou J. 2021. Traditional Knowledge and Medicinal Importance of African Rosewood (*Pterocarpus Erinaceus* Poir, Fabaceae) Across Sociolinguistic Groups in Benin. License: This work is licensed under a Creative Commons Attribution 4.0 International License.

DOI: https://doi.org/10.21203/rs.3.rs-341387/v1

Orch H, Douira A, Zidane L. 2015. Ethnobotanical study of medicinal plants used in the treatment of diabetes and heart diseases in the Izarene region (Northern Morocco). Journal of Applied Biosciences 86 : 7940– 7956 doi.org/10.4314/jab.v86i1.3

Sambu FY. 2021. Study of the frequencies and contributing factors of hernia in rural areas in the DRC: Case of the Pandji general reference hospital in Tshela from 2009 to 2013. International Journal of Innovation and Applied Studies 34(3) : 698-702

Savadogo S, Ouoba PA, Da DEC. 2019. Extraction of NTFPs and threat to supplier species in Burkina Faso: Case of Kokologho and Tenado in the central-western region. Ivorian journal of Science and Technology 33: 240-258.

Soha SAS, Dougnon TJ, Ohouko FHO, Kpodekon MTT, Youssao AKI. 2019. Biological activities and uses of *Elaeis guineensis* (Jacq) and *Khaya senegalensis* (Desr) in traditional human and veterinary medicine. International Journal of Biological and Chemical Sciences, 13(1), 525-542.

Sourou BN, Yabi J, Ouinsavi CAIN, Sokpon N. 2016. Socio-economic importance of the red plum (*Haematostaphis barteri* Hook F.) in Benin. International Journal of Biological and Chemical Sciences, 10(1), 326-343.

Sylla Y, Silue DK, Ouattara K, Kone MW. 2018. Ethnobotanical study of plants used against malaria by traditional therapists and herbalists in the district of Abidjan (Ivory Coast). International Journal of Biological and Chemical Sciences 12(3): 1380-1400.

Wédjangnon AA, Houètchégnon T, Ouinsavi C. 2016. Ethnobotanical characteristics and socio-cultural importance of *Mansonia altissima* A. Chev. in Benin, West Africa. Journal of Animal & Plant Sciences 29(3): 4678-4690.

Yaoitcha AS, Houéhanou TD, Fandohan BA, Zoffoun AG, Houinato MRB, Mensah GA, Sinsin B. 2016. Prioritization for the conservation of useful woody species in the Wari-Maro Forest Reserve. Legal deposit No. 9002 of October 25, 2016, National Library (BN) of Benin, 4th quarter, ISBN : 978–99919–2–568–4

Yaméogo JT, Somé AN, Mette Lykke A, Hien M, Nacro HB. 2013. Restoration of the potential of degraded soils using zaï and stone lines in western Burkina Faso. Tropicultura 31(4): 224-230.

Yèvidé SIA, Gbesso GHF, Aïdjihoundé SVN, Djossa BA. 2022. Ethnobotanical study and conservation of *Beilschmiedia mannii* (Meisn.) Benth. and Hook. F. in the South-East of Benin. Moroccan Journal of Agronomic and Veterinary Sciences, 10(2): 312-318.

Zahra F, Sarra B. 2020. Peptic ulcer: Epidemiological aspect in the Guelma region. Master thesis at the University of Guelma in Algeria.