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Endogenous knowledge evaluation on *Spondias mombin* L. in Benin

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Abstract

This study aims to assess ethno botanical knowledge on *Spondias mombin* L. in Benin. Informants were identifying randomly in eleven departments. Data were collected from 1320 informants basis on individual interviews and focus-groups. Results showed that *S. mombin* is used in seven use categories. Food and medicinal uses were mostly cited. *S. mombin* parts were used to treat fifty-seven ailments and symptoms of which malaria was the most represented. Otamari and Peulh sociocultural groups use the species more as a vegetable brush and for magical purposes. While Dendi and Adja groups use the species for food and medicinal uses. Commercial use of *S. mombin* is more common for those of Yoruba and Otamari groups. Diversity values revealed a variability of informants knowledge concerning the species uses, while equitability index values showed homogeneous distribution of knowledge (IE between 0.63 and 0.80 bits). Leaves were the most commonly used drugs. Decoction and oral route were respectively the main modes of preparation and administration of all recipes from species. This study suggests that wild fruit trees with several uses should be taken into account in programs and projects for the sustainable management of these natural resources.

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Introduction

In Africa, wild fruit species provide local populations with basic food, medicinal and technological products to satisfy their primary needs (Djihounouck *et al.,* 2018). They are more use in rural areas where several people depend on them for their subsistence needs (Malela, 2016). Indeed, apart from wood that is exploited to cover energy and construction needs in rural areas (Dieng *et al.,* 2016a), fruits and leaves are well marketed in local, national, regional and international markets (Kouebou *et al.,* 2013; Dieng, 2017). But population growth, the search for new agricultural and pastoral land, the massive use of wood resources (firewood and construction wood) and climate change are threatening the disappearance of forest relics, along with the residual species they hold that are source of non-timber forest products (GIEC, 2013; Fachola *et al.,* 2019 and Lawin *et al.,* 2019). Among these species is *Spondias mombin*, a wild fruit tree belonging to the Anacardiaceae plant family (Ayoka *et al*., 2008; OOAS, 2013).

Basis this situation which compromise forest resources in future especially *S. mombin*, it is urgent to make it a permanent concern by quantifying the level of importance and use of this species by local populations. However, the management of these plant genetic resources can only be sustainable if they integrate social, cultural and economic values that local communities associate with them (Masengo *et al.,* 2021 a, b).

In this way, ethnobotanical studies appear as a good approach to understand the uses as well as socio-cultural perceptions of forest resources by local populations (Agbogidi, 2010), in a given region. In fact, *S. mombin* is native from tropical America, including the West Indies, but has been naturalized in parts of Africa, India and Indonesia. (Akoègninou *et al.,* 2006, Ayoka *et al.,* 2008 and OOAS, 2013). Pharmacological studies have shown that *S. mombin* parts are used in the treatment of several pathologies (Igwe *et al.,* 2010; Olaïtan *et al.,* 2012; Ibegbu *et al.,* 2018). It has also been demonstrated that the fruit pulp, the seed kernel and the leaves have a high nutritional potential (Akouèdégni *et al.,* 2013; Esua *et al*., 2016). In Benin, *S. mombin* still being neglected and underutilized species (Konfo *et al.,* 2022). Its ethnobotanical aspect remains less studied and deserves to be deepened. It is in this perspective that this study was initiated and aimed to document ethnobotanical knowledge of *S. mombin* through within socio-cultural groups in Benin in order to enhance and sustainably use the species.

Materials and methods

Study area

The study was carried out in Benin (extended over 114,763 km²), located between the meridians 0°40' and 3°45' of longitude East and the parallels 06°15 and 12°25' of latitude north. Throughout the country, the annual temperature average varies between 26 and 28°C. The annual thermal amplitude is low in the southern part (5 to 10°C) while it is higher (11 to 13°C) in the northern part (from latitude 8°N towards the north; INSAE , 2013). Rainfall is between 900 and 1,400mm per year with a west-east gradient and a south-north gradient. The population of Benin is estimated at 10,008,749 inhabitants (INSAE, 2016). They are divided into a mosaic of sociolinguistic groups.

Sampling

Choice of localities surveyed

From the administrative division map of Benin and the ethnolinguistic map, two districts were chosen per department so as to cover the entire national territory and have a great linguistic diversity. Per district, three survey localities were selected according to two main criteria: sociolinguistic variability and importance of the species for the populations determined by an exploratory survey. In total, 66 localities were prospected at the rate of 6 per department except the coastal department which is highly urbanized and where the species is almost non-found. Fig. 1 illustrates the geographical distribution of the surveyed localities.

Choice of respondents

The stratified random sampling technique (Albuquerque *et al.,* 2014; Houéhanou *et al.,* 2016) was used to identify informants. The sample size for the study was determined according to Dagnelie

(1998) formula used by Lawin *et al.* (2019) whose composition is as follows:

$$n = \frac{U_{1-\alpha/2}^2 \times P(1-P)}{\alpha^2}$$

With, n the size of the sample to be considered; p the proportion of people who know and use *S. mombin* for various purposes (food, medicine, crafts, etc.); U1-α/2 = 1.96 as the value of the normal random variable for a probability value of α = 0.05; d is the error margin fixed at 8%.

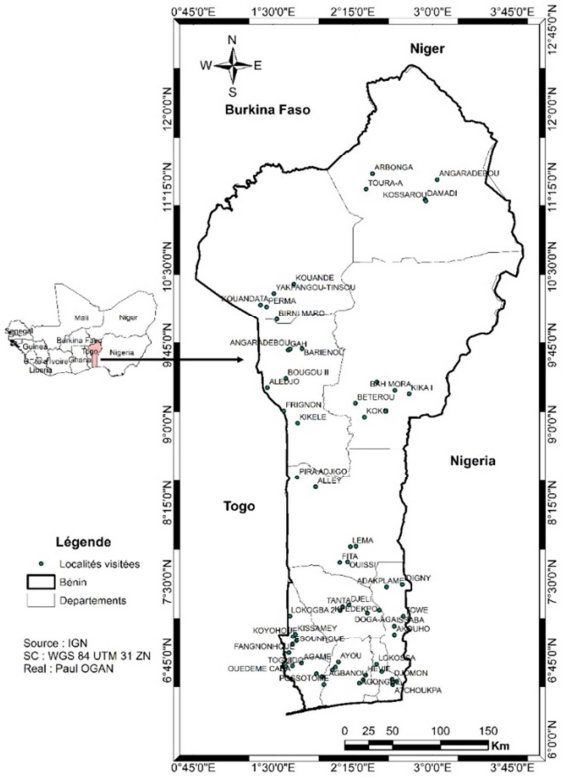

Fig. 1. Study environment and geographical distribution of localities visited.

Collection of data

Data were collected from ethnobotanical surveys. The semi-structured individual interview technique (Albuquerque *et al.,* 2014) based on a questionnaire was used to collect the data. Data collection included informant identity, species recognition (local names and their meanings, favorite area, forestry, propagation), different uses (ecology, religion, food, traditional pharmacopoeia and trade), parts traded as well as the threats and species conservation. The questionnaire was administered in the local languages of the informants, if necessary, in the presence of a translator. A focus group was conducted at the end of the survey in each village visited to harmonize the information collected. Throughout the survey, plant material (picture, herbarium) was showed to respondents for a better known of the species and to facilitate interviews.

Data processing

Respondents were classified by ethnicity, age categories and gender (young man, young woman, adult man, adult woman, old man, old woman) based on the structure proposed by Assogbadjo *et al.* (2008). This structuration assumes that young are people under 30 of age, adults are those between 30 and 60 of ages and the old are those over 60 of age.

Survey sheets have been analyzed and data collected were entered into Excel spreadsheet to have a database. Calculations of means, variances, frequencies, the construction of tables, histograms, graphs have been carried out. To detect the existence of links between the organs of *S. mombin* used and the ethnic groups, the consensus values of different parts of the plant (CPP) used by ethnic groups were subjected to a principal component analysis (PCA) in R 4.1.1 software. In order to access the diversity and distribution of endogenous knowledge of different ethnic and socio-professional groups on various uses of *S. mombin,* the diversity (ID) and equitability (IE) index were calculated with Excel 2013 spreadsheet. The frequencies of plant parts use, the forms, the preparation and administration modes were determined.

Ethnobotanical data processing

To know the level of knowledge and use of this species through the respondents, a quantitative analysis based on the calculation of the following index was made:

The consensus value for the form of use (CMU)

This value measures the degree of acceptability of respondents on the forms of use of the species. Its value is obtained by the number of times one category of use (Mx) is cited divided by the total number of categories of use (Mt). It is given by:

$CMU = \frac{M_x}{M_t}$ (Dadjo *et al.,* 2012; Assongba, 2014).

The consensus value for plant parts (VCPP). This value measures the degree of acceptability of respondents on plant parts categories of use. Its value is obtained by the number of times a part of the plant is cited (Px) divided by the total number of citations of all the parts (Pt). It is given by the formula $VCPP = \frac{P_x}{P_t}$ Monteiro *et al.* (2006) and used by (Koura, 2011).

The interviewee diversity value (ID) and the interviewee equitability value.

The interviewee diversity value (ID) by gender, age and sociolinguistic group was calculated. In fact, the diversity value measures the diversity of use categories of species and shows how this knowledge is distributed among the respondents (Byg and Baslev, 2011; Assongba, 2014). However, Shannon's diversity index was used instead of Simpson's index to calculate the diversity value (Lougbégnon *et al.,* 2015).

It is less if the species is widely used in one or two use categories and high when the species is multiple uses. It is between [o and n]. It is given by the formula:

$$ID = -\sum \frac{ni}{N} \ln(\frac{ni}{N}) \; ; \text{D} \in [o, n]$$

Where *ni* is the number of use categories cited by an interviewee and *N* is the sum of the total number of use categories cited by all respondents for the species.

The interviewee equitability index is the diversity value (ID) divided by the maximum index (IDmax) of the diversity value obtained. It is given by: IE =ID/ IDmax and measures the degree of homogeneity of the knowledge of the respondents. Hiss values are between 0 and 1. If IE < 0.5 the diversity of respondents' knowledge is not homogeneous but if IE ≥ 0.5 this diversity is homogeneous.

This means an equitable distribution of knowledge within the populations surveyed for the use of the species.

Relative Frequency of Citation of Uses (FRCU). The importance of *S. mombin* is calculated based on the relative frequency of citation of uses (Yétein *et al.,* 2012; Lawin *et al.,* 2019).

The FRCU is calculated as follows: number of people who mentioned the use of the species in each category of use (Uc) divided by the total number of respondents (N).

$$FRCU = \frac{Uc}{N}$$

FRCU is between] 0-1]. When FRCU is less than 0.25 then few informant know about this use; if it is equal to 0.5 then the knowledge of this use is average and when it is greater than 0.5 then the use is known by a large number of people. FRCU is calculated by socio-professional category.

Fidelity level (FL) of *S. mombin* use. The fidelity level (FL) was calculated in order to appreciate the fidelity allocated to the use of *S. mombin* parts in the ailments treatment. This index was used by the authors Tardio and Pardo- De Santayana (2008) and Yétein *et al.* (2012). It is calculated as follows: frequency of citation for an ailment (FRCU), divided by the total number of ailments treated by the species (Na).

$$FL = \frac{FRCU}{Na} \times 100$$

It measures the degree of *S. mombin* use for each ailment treatment.

Results and discussion

Socio-demographic characteristics of surveyed users of S. mombin

Table 1 presents the socio-demographic characteristics of the respondents. In fact, a total of 1320 informants were surveyed. Analysis of this Table reveals a large variation in proportions among respondents according to the different variables (qualitative and quantitative). The species is equally used well by social actors of both genders. Men (67.20% of the sample) are the majority social users of the species. The highest diversity found for adults and old people could be explained by the fact that knowledge is acquired and accumulated over the years. Bio *et al.* (2015) also found that older people have more knowledge about medicinal plants. These results also confirm the conclusion of Olou *et al.* (2018) who affirmed that the endogenous knowledge valorization level increases with age.

Several other authors have pointed in the same direction and have proven that endogenous knowledge is often hold only by aged people at least 50 (Mpondo *et al.,* 2012).

Table 1. Socio-demographic characteristics of respondents.

Settings	Factors	Effective	Percentage (%)
Sex	Female	433	32.80
	Male	887	67.20
	Young people <30	104	7.88
Age class	Adults [30; 60]	1003	75.98
	Old > 60 years old	213	16.14
Ethnic group	adja	241	18.26
	Bariba	113	8.56
	Dendi	79	5.98
	fon	414	31.36
	Lokpa	81	6.14
	Otamari	99	7.50
	Fulani	45	3.41
	Yoruba	248	18.79
Primary activity	Farmer	689	52.20
	Learner	20	1.52
	Artisan	150	11.36
	Hunter	78	5.91
	Trader	246	18.64
	Official	34	2.58
	Phytotherapist	103	7.80
Educational level	Literate	221	16.74
	uneducated	712	53.94
	Primary	191	14.47
	Secondary	143	10.83
	University	53	4.02
Marital status	Single	111	8.41
	Divorce	30	2.27
	Married	1131	85.68
	Widower widow	48	3.64
Religion	Animism	276	20.91
	Others	88	6.67
	Christianity	637	48.26
	Islam	319	24.17

NB: Young: age < 30 years; Adult: 30 years ≤ age ≤ 60 years; Old: age > 60 years

Use categories and S. mombin organs used

Seven use categories were identified for the species in Benin (Fig. 1). Among these, two (food and medicinal) were the most common (cited by more than 95% of respondents). This reflects the food and medicinal importance of *S. mombin* for the population.

The results obtained are congruent with those of previous studies that have reported various uses of *S. mombin* (Ayoka *et al.,* 2008; Olaïtant *et al.,* 2013; Esua *et al.,* 2016; Adeniyi *et al.,* 2018).

The food value of *S. mombin* has previously been reported by Tiburski *et al.* (2011) who showed that the fruit pulp contains protein (2.60%), carbohydrates (13.90%) and ash (1.00%) and is essentially rich in calcium (1562.20mg/kg), magnesium (4650.0mg/kg), manganese (10.80mg/kg), iron (145.90mg/kg), copper (10.0mg/kg) and zinc (10.80mg/kg). This high food value can justify the relative importance of the consumption of the fruit by the local populations.

Regarding the organs, the analysis of Fig. 2 reveals that all parts of the species are used as NTFPs in Benin. Organs are harvested according to the usefulness sought by the population as well as the endogenous knowledge related to the use of the organ. This observation was also made by Dossou *et al.* (2012) regarding the ethno botanical uses of woody plant species by the local populations of the Agonvè forest, one of the swamp forests of southern Benin. Leaves were the most used parts (98.71% of informants). This predominance could be explained by the fact that the leaves are the site of the plant's secondary metabolites synthesis. Consequently, they contain several chemical groups responsible for the virtues and biological properties of the plant (Mangambu *et al.,* 2014).

The ethno botanical studies carried out by Ambé *et al.* (2015), Kipre *et al.* (2017) also reported that leaves are the most widely used plant organs in traditional medicine for the treatment of various ailments. In addition, ethnobotanical studies have also shown that the leaves are the parts mainly used in various therapeutic preparations (46% of respondents, Diatta *et al.,* 2013; 79.11%, Gbémavo *et al.,* 2014 and 68% according to Lawin *et al.,* 2019).

One might be concerned about the excessive use of the leaves of medicinal plants, but the studies carried out by Ouattara *et al.* (2006) showed that removing 50% of a tree's leaves does not significantly affect its survival. However, this collection induces a reallocation of available resources among species. Also, the high frequency of use of leaves can be explained by the ease and speed of harvesting but also by the fact that they are the seat of photosynthesis and the storage of secondary metabolites responsible for biological properties of the plant (Kouadio *et al.,* 2016).

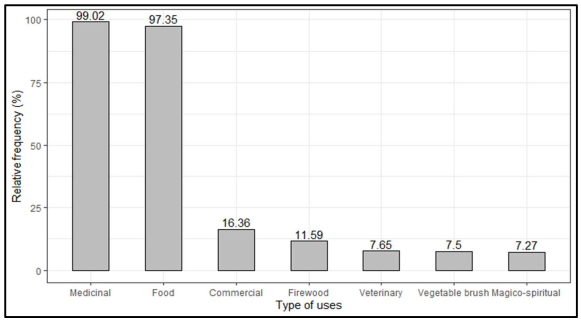

Fig. 2. Proportions of responses linked to the different categories of use of *S. mombin*.

Consensus value of the different parts of the plant (VCPP)

Knowledge about the use of *S. mombin* organs varies according to gender, age group and ethnic group (Table 2). Indeed, there is a broad consensus on the level of use of the leaf, pulp and bark organs (VCPP ≈ 1). The socio-linguistic groups then have a good knowledge of the use of these organs of *S. mombin*. However, the consensus value remains slightly low at the level of Otamari and young people for pulp and bark organs with respective VCPP of 0.56 and 0.85. This shows that the Otamari and young people agree less to the use of the pulp and bark of the species compared to adults, the elderly and other ethnic groups. Contrary to the consensus obtained at the level of the leaf, pulp and bark organs of the species, the consensus at the level of the respondents remains very low for the other organs (VCPP ≈ - 1) whatever the variables considered (ethnic groups, sex and age) .

Table 2. Consensus value of the different parts of the plant (VCPP).

Factors	Leaf	Pulp	Bark	Root	Branch	Seed	Flower
Gender							
Female	0,96	0,88	0,88	-0,71	-0,89	-0,96	-0,97
Male	0,98	0,88	0,88	-0,71	-0,92	-0,98	-0,97
Classe d'âge							
Adults	0,97	0,87	0,87	-0,70	-0,90	-0,97	-0,97
Old	0,97	0,95	0,95	-0,76	-0,91	-0,98	-1,00
Youth	0,98	0,85	0,85	-0,73	-0,96	-0,96	-0,94
Ethnic groups							
Adja	1,00	0,90	0,90	-0,82	-0,98	-0,98	-1,00
Bariba	0,98	0,91	0,91	-0,58	-0,93	-0,98	-0,98
Dendi	1,00	0,92	0,92	-0,72	-0,97	-0,97	-0,92
Fon	0,97	0,89	0,89	-0,71	-0,92	-0,98	-0,97
Lokpa	1,00	0,93	0,93	-0,75	-0,78	-0,98	-0,98
Otamari	0,86	0,56	0,56	-0,80	-0,82	-0,92	-0,92
Peulh	0,96	0,91	0,91	-0,91	-0,87	-0,96	-0,96
Yorouba	0,99	0,93	0,93	-0,58	-0,88	-0,98	-0,97

Relationship between socio- cultural groups and categories of use

The results of the principal component analysis (PCA) carried out to describe the relationship between the socio- cultural groups surveyed and the types of use of *S. mombin* showed that the first two components explain 77% of the information sought. Indeed, the use category correlation circle (Fig. 4.a) shows that vegetable brush and magico-spiritual uses are positively correlated with the first component, unlike food and medicinal uses which are negatively correlated with the same component. In addition, commercial use is positively correlated with the second component, unlike energy wood use, which is negatively correlated with the same component. The projection of the ethnic groups surveyed in the system of the first two components (Fig. 4.3) shows that the use of *S. mombin* as a vegetable brush and in magic is much more common among the Otamari and Peulh ethnic groups unlike food and medicinal uses which are much more common among the Dendi and the Adja, and to a lesser extent among the Lokpa and the Fon. Finally, the commercial use of *S. mombin* is much more frequent among the Yorouba and Otamari, unlike the much more frequent use of energy wood among the Fulani.

We therefore deduce that the different uses of *S. mombin* depend on socio-cultural groups. Similar observations were made by Lawin *et al.* (2019) on *Cola millenii* in Benin. The diversity of uses would be due to the needs of local populations (Houètchégnon

et al., 2015 ; Assogba *et al.,* 2017) but also by the local availability of other species fulfilling the same functions (Houètchégnon *et al.,* 2015).

Relationship between sociocultural groups and S. mombin parts

Results of the principal component analysis (PCA) carried out to describe the relationship between the sociocultural groups and the organs of *S. mombin* used showed that the first two components explain 77.18% (>50%) of the information sought.

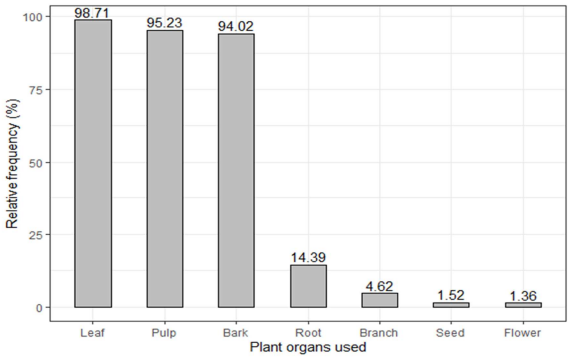

Fig. 3. Proportions of responses related to the different organs of *S. mombin*.

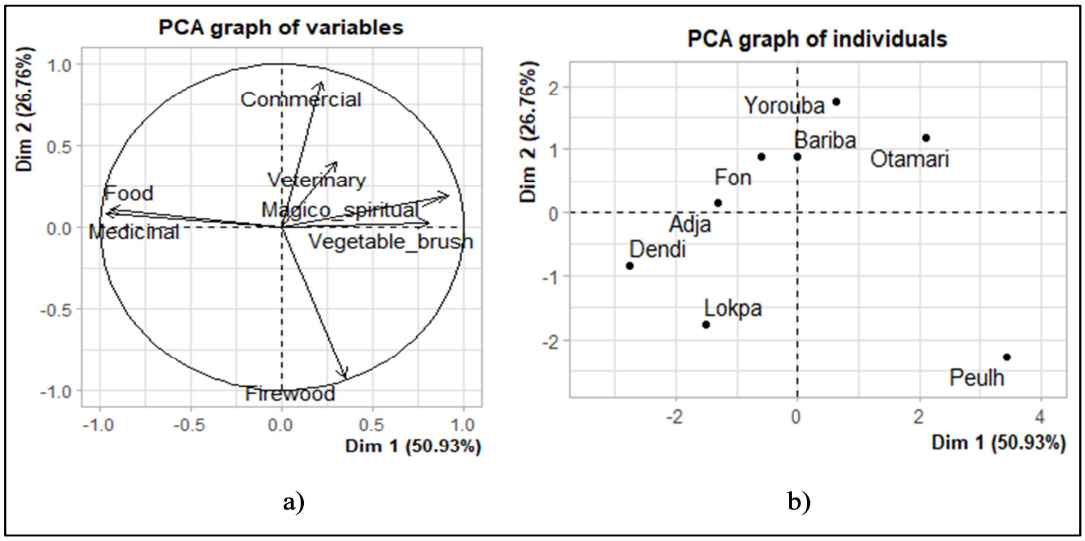

Fig. 4. Results of principal component analysis; a) Correlation circle of the frequency of the types of uses; b) Projection of the ethnic groups surveyed in the first factorial plane formed by components 1 and 2 defined by the types of use.

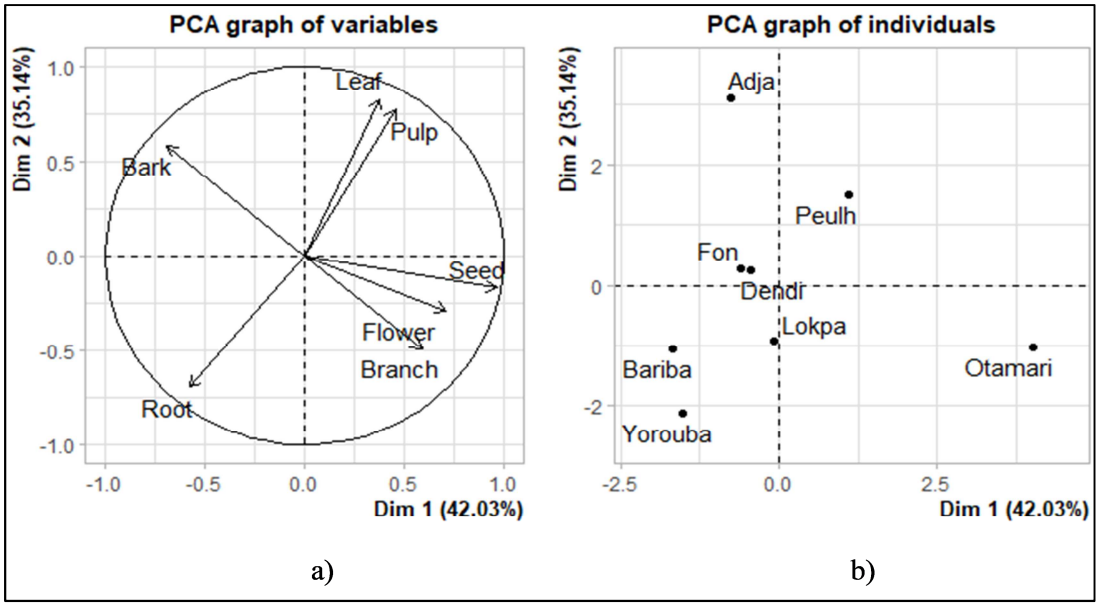

Fig. 5. Results of principal component analysis; a) Correlation circle of the frequency of the organs used; b) Projection of the ethnic groups surveyed in the first factorial plane formed by components 1 and 2 defined by the organs used.

These two components are therefore sufficient to describe the relationship between the ethnic groups surveyed and the *S. mombin organs* used. Thus, the correlation circle of the organs used (Fig. 5a) shows that the seed, flower and branch organs are positively correlated with the first component while the root and bark organs are negatively correlated with this same component. Moreover, the leaf, pulp and bark organs are positively correlated with the second component while the root organ is negatively correlated with this same component. The projection of the ethnic groups surveyed in the system of the first two components (Fig. 5b) shows that the seed, flower and branch organs are used much more by the Otamari, unlike the root and bark organs which are used much more by the Bariba and Yoruba. Finally, the leaf, pulp and bark organs are used more by the Adja and Peulh ethnic groups.

Consensus values of the way of use (CMU) of respondents

The ethno botanical knowledge of the populations of the study area on *S. mombin* is rich because of the diversity types of uses and socio-linguistic groups. Thus, knowledge of the types of uses varies according to ethnic groups, gender and age group (Table 3). It appears from this table that there is a broad consensus in terms of the food and medicinal uses of the species (CMU ≈ 1).

The socio-lingustic groups then have a good knowledge of the types of use of *S. mombin*. Moreover, whatever the variables considered (ethnic groups, gender and age), the consensus value of the way of use remains very low for all the forms of use listed (CMU ≈ - 1).

Table 3. Consensus values of the way of use (CMU) of respondents.

Factors	Ali	Méd	Bois_én	Vét	Mag_sp	Bros_v	Com
Adja	1,00	1,00	-0,76	-0,93	-0,90	-0,92	-0,73
Bariba	1,00	0,98	-0,81	-0,88	-0,86	-0,79	-0,61
Dendi	0,92	1,00	-0,72	-0,90	-0,95	-0,90	-0,82
Fon	0,94	0,98	-0,85	-0,86	-0,86	-0,90	-0,68
Lokpa	0,95	1,00	-0,46	-0,88	-0,93	-0,90	-0,83
Otamari	0,80	0,90	-0,82	-0,33	-0,82	-0,82	-0,66
Peulh	0,91	0,96	-0,07	-0,82	-0,73	-0,73	-0,78
Yorouba	0,95	0,99	-0,85	-0,91	-0,79	-0,81	-0,52
Female	0,94	0,97	-0,74	-0,88	-0,82	-0,86	-0,56
Male	0,95	0,98	-0,78	-0,83	-0,87	-0,87	-0,73
Adults	0,94	0,98	-0,78	-0,85	-0,86	-0,86	-0,66
Old	0,97	0,97	-0,72	-0,86	-0,85	-0,87	-0,70
Youth	0,96	1,00	-0,77	-0,81	-0,85	-0,90	-0,71

NB: Ali = Food, Med = Medicinal, Bois_én = Energy wood, Vét = Veterinarian, Mag_sp = Magico-spiritual, Bros_v = Vegetable brush, Com = Commercial

Interviewee diversity and equitability value of uses of the species by gender, age and sociolinguistic group

The analysis of the Table 4 shows us that the value of diversity of use of the species is slightly higher in women (ID = 1.41 bits) than in men (ID = 1.34 bits) suggesting that women use the species more in the treatment of several diseases unlike men. The higher knowledge of women on *S. mombin* could be linked to the fact that the species is much more used in the treatment of benign diseases that children develop, namely: malaria, cough, fever and measles. The first care of these diseases is often left to women of the households (Olou *et al.,* 2018). These resultsare in agreement with those of Mehdioui and Kahouadji (2007) who found that women have a little more knowledge than men about medicinal plants. In addition, the possession of endogenous knowledge varies according to socio-cultural groups. The Bariba, Otamari, Peulh and Yoruba hold more knowledge of the species unlike other socio-cultural groups. This could be related to the presence of these socio-cultural groups in the majority of the study area. Compared to the main activities, housewives, civil servants, phytotherapists and farmers have a diversity of knowledge on the use of the species. Indeed, the knowledge of the uses of medicinal plants and their properties is generally acquired following a long experience accumulated and transmitted from one generation to another (Benlamdini *et al.,* 2014).

Thus, they remain a heritage either of the family, or of a particular social group of the village or the region. Consequently, the risk of disappearance of this endogenous knowledge is very great if it is not documented (Devendrakumar and Anbazhagan, 2012). This ancestral transmission, which does not necessarily require schooling, could justify the fact that the majority of the people surveyed are illiterate. Moreover, we observe that knowledge on the use of the species is homogeneous at the level of all levels of socio-demographic factors. This means an equitable distribution of knowledge within the populations surveyed for the use of the species regardless of the parameter considered. This result can be linked to the cultural link between the eight socio-cultural groups studied. This could be explained by the fact that today, the different socio-cultural groups due to social mobility, urbanization, etc. are often mixed and most often share traditional knowledge, values and rituals with regard to many social practices. Consequently, insofar as ethno botanical knowledge is also taken into this Universalist current of diffusion and cultural mixing, it follows that cultural origin could be an important factor to take into account in the evaluation of the medicinal value of plants.

Diseases and symptoms treated by S. mombin according to the population surveyed

The results of this study showed that the species is used in the treatment of 57 ailments and symptoms (Table 5). Among the diseases and symptoms identified, malaria is most treated (40.53%) due to the presence of alkaloids, flavonoids, anthraquinones, berberine, tannins and saponin in species leaves (Aromolaran *et al.,* 2014; Igwe *et al.,* 2010; Ibegbu *et al.,* 2018).

Table 4. Diversity and equitability of uses of the species by gender, age, ethnic group and main activities.

Settings		ID (bits)	IE
Sex	Female	1.41	0.72
	Male	1.34	0.69
Age class	Adult	1.37	0.70
	Old	1.37	0.70
	Young	1.35	0.70
Ethnic group	adja	1.26	0.65
	Bariba	1.38	0.71
	Dendi	1.24	0.64
	fon	1.31	0.67
	Lokpa	1.32	0.68
	Otamari	1.52	0.78
	Fulani	1.55	0.80
	Yoruba	1.39	0.71
Primary activity	Agriculture	1.40	0.72
	Learner	1.17	0.60
	Artisan	1.28	0.66
	Hunter	1.23	0.63
	Trade	1.32	0.68
	Official	1.43	0.74
	Household	1.52	0.78
	Phytotherapist	1.41	0.73

In addition, the hight number of diseases cited by the population whose treatment requires the use of *S. mombin* organs would be justified by the high cost of ailment treatment with modern medicine. This point of view was approved by FAO (2012) who asserted that in a difficult economic context where the majority of households cannot afford drugs from the pharmaceutical industry because of their high cost, medicinal plants have a major role in traditional health systems.

Table 5. Some medicinal remedies based on *S. mombin.*

Category	Diseases	organ used	Method of preparation	Route of administration	Frequency (%)
Cardiological	Hypertension	Sheet	Decoction	Oral	2.05
	Hypotension	Bark	Maceration	Oral	1.21
Dermatological	Scabies	Bark	Pounding	Dermal	0.45
	Smallpox	Bark	Decoction	Body bath	2.35
	Measles	Sheet	Decoction	Oral	0.91
Digestive	Constipation	Sheet	Decoction	Oral	3.26
	Diarrhea	Bark	Maceration	Oral	0.08
	Dysentery	Bark	Maceration	Oral	0.15
	Abdominal infection	Bark	Decoction	Oral	3.03
	Oral infection	Flower	Infusion	Oral	0.23
	Ulcer	Bark	Decoction	Oral	2.12
	Vomiting	Pulp	Infusion	Oral	0.68
	Nausea	Sheet	Infusion	Oral	0.98
	Stomach aches	Bark	Decoction	Oral	0.23
	bad breath	Root	-	Tooth cooker	1.89
	intestinal worm	Bark	Decoction	Oral	0.98
endocrine	Diabetes	Sheet	Decoction	Oral	0.45
Genetic	sickle cell disease	Root	Decoction	Oral	0.38
	Early abortion	Bark	Infusion	Oral	0.06

Category	Diseases	organ used	Method of preparation	Route of administration	Frequency (%)
Gynecological	Oligospermia	Sheet	Trituration	Oral	0.38
	Semen reflux	Bark	Decoction	Oral	0.08
	pregnant woman bleeding	Bark	Maceration	Oral	0.30
	Female sterility	Bark	Maceration	Oral	2.20
	Male infertility	Bark	Maceration	Oral	0.76
	painful menstruation	Bark	Maceration	Oral	2.58
	Irregular rules	Sheet	Decoction	Oral	4.02
	Early menopause	Sheet	Decoction	Oral	0.76
	White loss	Sheet	Decoction	Oral	0.08
	Calving ease	Sheet	Decoction	Oral	2.58
Haematological	Anemia	Bark	Maceration	Oral	6.29
neurological	Epilepsy	Root	Decoction	Oral	0.23
	Headache	Sheet	Trituration	Oral	1.14
	Paralysis	Bark	Decoction	Oral	0.08
Psychological	premature ejaculation	Root	Maceration	Oral	1.06
Stomatological	Tooth decay	pulp	Infusion	Oral	0.61
Traumatic	Abscess	Flower	Pounding	Dermal	1.06
	Hernia	Seed	Maceration	Oral	0.30
	Internal hemorrhoid	Bark	Decoction	Oral	1.59
	External hemorrhoid	Bark	Decoction	anal	0.08
	Wound	Bark	Pounding	Dermal	0.23
Others					
	Angina	Sheet	Decoction	Oral	1.36
	Asthma	Seed	Decoction	Oral	0.15
	Aches	Root	Decoction	Body bath	0.83
	body swelling	Bark	Decoction	Body bath	1.14
	bewitchment	Bark	Decoction	Body bath	0.91
	sexual weakness	Root	Maceration	Oral	0.68
	Lassitude	Root	Maceration	Body bath	0.76
	Fever	Sheet	Infusion	Oral	14.39
	Thyphoid fever	Sheet	Decoction	Oral	1.29
	Hepatitis B	Sheet	Decoction	Oral	1.67
	Jaundice	Pulp	Infusion	Oral	0.53
	Malaria	Sheet	Decoction	Oral	40.53
	Whitlow	Root	Pounding	Dermal	0.30
	Common cold	Sheet	Infusion	Oral	0.68
	Cough	Sheet	Infusion	Oral	3.18
	Vertigo	Sheet	Maceration	Oral	2.95

Methods of preparation and routes of administration of the recipes

Several preparation modes were cited by respondents, namely: decoction (72%), maceration (12%), infusion (9%), pounding (5%) and trituration (2%) (Fig. 6).

The decoction was the most represented. His commonly use as recipes preparation mode could be justified by the fact that the decoction allows the extraction of the most active ingredients and the warmth attenuates toxic effect of some recipes (Salhi *et al.,* 2010).

Several authors have observed in their work the strong use of the decoction in the treatment of several ailment in traditional medicine (Gnagne *et al.* , 2017). This result is also corroborated with the work of Zerbo *et al.* (2011) 58%, Lawin *et al.* (2019) 73% and Masengo *et al.* (2022) 55.6% who showed that the decoction is the most requested pharmaceutical form. Among the routes of administration recorded, the oral route (89%) was the most used (Fig. 7).

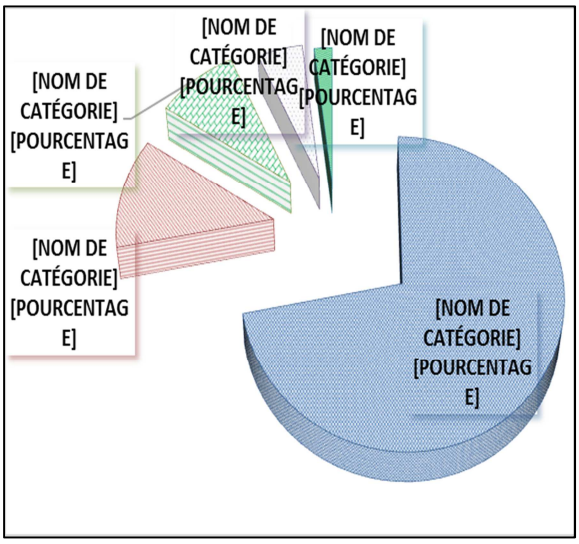

Fig. 6. Proportions of responses related to preparation methods.

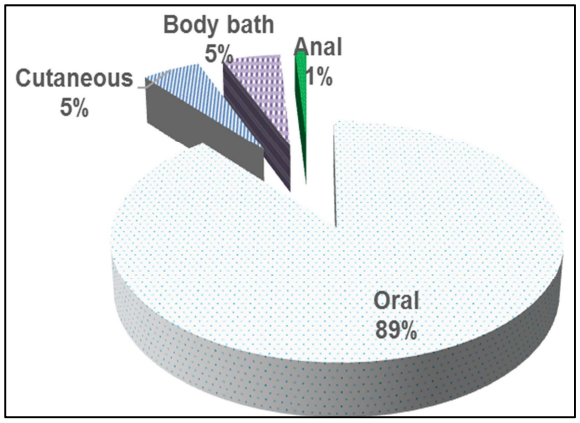

Fig. 7. Proportions of responses related to routes of administration of the recipes.

Conclusion

This ethno botanical study carried out in Benin shows that all parts of *S. mombin* are used for seven different uses. The leaf was the most used organ by the population for the treatment of nearly fifty-seven diseases and symptoms. Its fruits are widely consumed by the local population, in particular because of its aroma and its pleasant acid taste. Local knowledge of *S. mombin* is diverse and varies by gender, age, and socio-cultural group. Thus, knowledge of the species was more diversified and more distributed among the elderly. The disease most cured by this plant is malaria. The decoction is the most used method of preparation, orally. Despite its importance, the rarity of the species in the wild requires research into its silviculture for conservation measures. It is also essential to carry out the phytochemical screening of *S. mombin* in order to obtain a maximum of information relating to the plant to its toxicological, physiological, pharmacodynamic efficacy, correlated by the active principles contained in the species. Such studies should allow the development of drugs that can be used in primary health care at a lower cost. They should make it possible to highlight the local knowledge collected on the medicinal value of *S. mombin* in the field.

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