International Journal of Medicinal Plants Research ISSN 2169-303X Vol. 14 (6), pp. 001-0009, June, 2025. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Ethnobotanical Uses and Cultural Significance of *Caesalpinia bonduc L.* across Different Ethnic Groups in Benin

Achille Ephrem Assogbadjo[1], Romain Glèlè Kakaï[1], François Houtoutou Adjallala[1], Akomian Fortuné Azihou[1], Gbèlidji Fifanou Vodouhê[1], Tina Kyndt [2]* and Jean Thimothée Claude Codjia[1]

[1]Faculty of Agronomic Sciences, University of Abomey-Calavi, 05 BP 1752 Cotonou, Benin.
[2]Department of Molecular Biotechnology, Ghent University (UGent), Coupure Links 653, B-9000, Ghent, Belgium.

Accepted 1 April, 2025

African communities traditionally use medicinal plants for their primary healthcare. To ensure the sustainable use of these species one of the crucial issues is to document African communities' indigenous medicinal knowledge. To achieve this goal, the present study evaluated the use frequency and the knowledge of local Beninese communities on the endangered scrambling shrub (*Caesalpinia bonduc*). Results revealed that local populations use 20 properties from the leaves, roots and seeds of the species to fight against childbirth, to treat burns and for cultural practices like games, weddings and the Fâ ritual. The global credibility level of these properties equalled to 75%, indicating that *C. bonduc* is perceived as very important for local populations. Roots are more intensively used than leaves and seed respectively. The study clearly showed ethnic and age differences in use value and patterns of the species. For example, *Kotafon* ethnic group had a fair knowledge on the species while *Fon* and *Bariba* ethnic groups hold the lowest number of users.

Key words: Medicinal plant, *Caesalpinia bonduc*, endangered species, endogenous knowledge, use frequency, Benin.

INTRODUCTION

Traditional medicine, an important element of the cultural inheritance, remains until now the principal resource for a major part of African populations to treat diseases (Hamilton, 2004). Indeed, many plants are harvested in the wild and used by local people as medicines, next to their source of food and income (Assogbadjo et al., 2008; 2009; Vodouhê et al., 2009). Unfortunately, deforestation, changing climatic conditions, overexploitation, agriculture, demographic pressure, grazing, bush fires, etc., contribute to the loss of indigenous plants and hence endanger traditional and biodiversity dependent community medicines. As an example, from 1990 to 1995, a total of 298, 000 ha of Benin forest cover has been lost (FAO, 1999). As a consequence, many plants species are threatened and disappear more and more from their natural ecosystems (Adomou et al., 2005). The present study focuses on the endangered scrambling shrub (*Caesalpinia bonduc*), a multipurpose, widely-used species with cultural and medicinal properties (Harden, 2002; Hessou et al., 2009). The species is widely distributed in the tropics and subtropics, where it occurs especially in disturbed sites. The species has been cited as a cure for cutaneous eruptions and stomach-ache (Kerharo and Adams, 1974).

It is one of the seven most commercialized medicinal

*Corresponding author. E-mail: tina.kyndt@ugent.be. Tel. +3292645967. Fax: +3292646219.

plants in the southern part of Benin (Vodouhê et al., 2008). Its hard seeds are roasted, ground and then boiled for medical treatments including a diuretic for diabetes and a cure for malaria (Chakrabarti et al., 2005). The seeds are also used in a traditional game widely played throughout West Africa and India. Next to habitat fragmentation, the long-term viability of *C. bonduc* sub-populations is also threatened by overexploitation of its roots (Hutton, 2001), which are mainly used against prostate gland disease in traditional pharmacopoeia in Africa (Upadhyay et al., 2001; Hessou et al., 2009). *C. bonduc* is classified as rare and endangered species in the world (Harden, 2002). To restore the populations of the species, an interdisciplinary approach is recommended, including data from different research areas. Recently, Hessou et al. (2009) provided some interesting data on seed conservation and seed germination of the species.

Also, our research group has performed a study on the distribution of the species in order to show its status in Benin, on its genetic diversity and on the morphological variation among the populations in Benin (Assogbadjo et al., submitted). Studies related to the impact of the harvesting methods of the species, ethnobotanic knowledge on the use and the domestication of the species, are however needed to complement these data in order to set up an efficient conservation and domestication programme. Ethnomedical surveys leading to documentation of Indigenous Medicinal Knowledge (IMK) is one of the basic requirements in the development of standardized phytomedicines. The present study aims at filling this gap for *C. bonduc* and addresses the following research questions: what ethnobotanic knowledge do local communities have on the use and the domestication of *C. bonduc*? What factors (age, sex and ethnic groups) predict farmer's knowledge on the use and domestication of *C. bonduc*?

METHODS

Study site

The study was done in five phytodistricts of Benin (Coastal, Plateau, Pobè, Zou and Borgou-Sud) representing the distribution range of the species in the country (Assogbadjo et al., submitted). Coastal, Plateau and Pobè phytodistricts belong to the sub-humid Guinean zone between 6°25' and 7°30' N while Zou and Borgou-Sud phytodistricts are located in the Sudan-Guinean zone between 7°30' and 9°45' N (Adomou et al., 2005) (Figure 1). In the Guinean zone, the rainfall is bimodal with a mean annual rainfall of 1200 mm. The mean annual temperature varies between 25 and 29°C and the relative humidity between 69 and 97%. The soils are either deep ferrallitic or rich in clay, humus and minerals. The primal vegetation consists of dense semi-deciduous forests and Guinean savannas. The rainfall in the Sudan-Guinean zone is unimodal, from May to October, and lasts for about 113 days with an annual total rainfall varying between 900 and 1110 mm. The annual temperature ranges from 25 to 29°C and the relative humidity from 31 to 98%. The soils in this zone are ferruginous with variable fertility. The vegetation of the Sudan-Guinean transition zone is characterized by a mosaic of woodland, dry dense forests, tree and shrub savannas and gallery forests.

Sampling

A preliminary survey revealed that in the study area, half of the people had already grown *C. bonduc*. This information was used to calculate the sample size to be used in the full study, according to the formula of Dagnelie (1998):

$$n = \frac{U^2_{1-\alpha/2} \cdot p(1-p)}{d^2}$$

where, n is the total number of surveyed people in the study that is, the sample size; $U_{1-\alpha/2}$ is the value of the normal random variable for a probability value of $\alpha = 0.05$, $U_{1-\alpha/2} = 1.96$; p is the proportion of people who had already grown *C. bonduc* (p = 0.5; result from a preliminary survey) and d is the expected error margin of any parameter to be computed from the survey, which is fixed at 0.08.

Under those assumptions, the sample size equalled to 150 people and round to 156 for practical patterns of the survey. The number of people surveyed per phytodistrict was proportionally determined taking into account the registered total number of planters of *C.bonduc*.

Surveys

Structured interview surveys were conducted among various people from 10 ethnic groups selected in both climatic zones: *Adja, Aïzo, Bariba, Fon, Idatcha, Goun, Kotafon, Mahi, Mina* and *Nago* (Figure 1). From the preliminary surveys, we noticed that these ethnic groups use *C.bonduc* on a daily basis and have an important knowledge on the species.

The ethnobotanical survey was carried out between October 2009 and January 2010. Although the questionnaire was in French, the interviews were conducted in local languages. The questionnaire evaluated information concerning the biodata (name, sex, age, ethnic group and main activity), the endogenous practices related to the species domestication (origin of propagules, year of plantation, farming techniques and spatial distribution) and the use forms of the species (mutilated organs, aims of mutilations and frequency of use). The discussion with farmers was completed with direct observations on the fields.

Data analysis

The importance of the species for the interviewed populations was determined through the computation of the use frequency of plant properties (FUP), the specific use frequency of properties by old men and women (SFUP), the global credibility level of these plant properties (GCLP), the identification of the most used organ, the importance of these plant properties according to ethnic groups and the index of global knowledge possession on *C.bonduc*. The use frequency of properties was calculated as indicated by Camou-Guerrero et al. (2008) using the following formula:

$$FUP = \frac{R_v + R_{ah} + R_{af}}{N_e} \cdot 100 ;$$

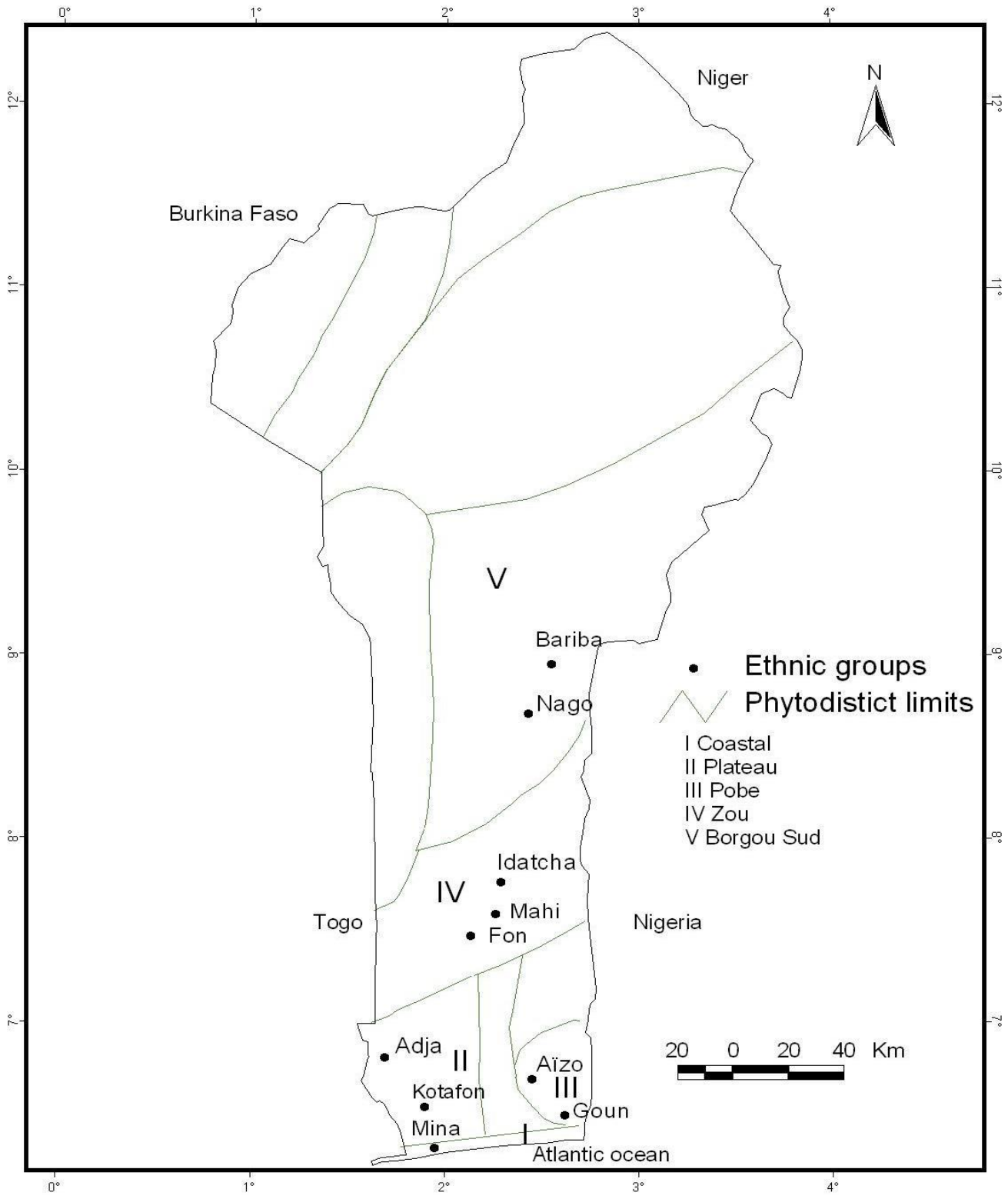

Figure 1. Study area and studied ethnic groups in Benin.

N_e being the total number of interviewees and R_v, R_{ah} and R_{af} the number of old, adult and young interviewees that use the property, respectively. A property is considered as 'credible' in case FUP is above 50%.

The specific use frequency of properties by old men and women was computed for interviewees over 70 years old as follows:

$$SFUP = \frac{RV}{N_{VE}} \cdot 100 ;$$

where N_{ve} and R_v are the total number of old men and women interviewed and the number of old men and women that use the property. A property is considered to be 'probably credible' in case SFUP is higher than 50%.

The global credibility level of the evaluated plant properties was calculated as follows:

$$GCLP = \frac{(N_{vc} + N_{vpc})}{N_{tv}} \cdot 100 ;$$

N_{vc}, N_{vpc} and N_{tv} being the number of 'credible', 'probably credible' and total number of identified properties, respectively. The GCLP-value shows the importance of an evaluated plant property: GCLP < 25%: little important; 25 ≤ GCLP < 50%: fairly important; 50 ≤ GCLP < 75%: enough important and 75 ≤ GCLP < 100%: very important.

The most used plant organ was identified through the computation of the index value related to useful organs (IVO) that include the roots, leaves and seeds index values. The IVO is calculated as:

$$IVO = \frac{N_{vo}}{N_{tv}} \cdot 100 ;$$

where N_{tv} stands for the total number of identified properties and N_{vo} the number of properties involving the organ.

The importance of plant properties according to different ethnic groups was determined through the computation of the use frequency of properties for each ethnic group (FUPE) as:

$$FUPE = \frac{R_{ge}}{N_e} \cdot 100 ;$$

R_{ge} being the number of properties identified in the targeted ethnic group.

The index of global knowledge possession (IGKPC) on *C. bonduc* was computed as:

$$IGKPC = \frac{V_m}{N_e} \cdot 100 ;$$

where V_m is total mean users value that is, the mean value of old, adult and young users of *C. bonduc* properties.

The IGKPC indicates the global level of knowledge on *C. bonduc* according to ethnic groups: IGKPC < 10%: mediocre level of knowledge, 10 ≤ IGKPC < 20%: fair level of knowledge, 20 ≤ IGKPC < 30%: medium level of knowledge, 30 ≤ IGKPC < 40%: good level of knowledge, 40 ≤ IGKPC < 50%: very good level of knowledge and 50 ≤ IGKPC: excellent level of knowledge.

In order to assess and describe the linkages among the ethnic groups, the *C. bonduc* use forms and endogenous domestication strategies of the species in the study area, the interviewees were grouped according to ethnic group, sex, and age so that in each ethnic group, six subgroups were defined: young men (M1), adult men (M2), old men (M3), young women (F1), adult women (F2), and old women (F3). Therefore, within the ten ethnic groups, a total of 60 subgroups were constituted. Because the size of subgroups differed and an interviewee could choose more than one use and domestication variable, the relative frequency of each variable was determined for each of the 60 subgroups. This parameter is defined as the proportion of interviewees belonging to the subgroup who identified the particular use or domestication variable. A data matrix comprising the relative frequencies of *C. bonduc* use and domestication according to the 60 subgroups was then submitted to principal component analyses (PCA) using SASv9 software. This statistical method was used at each step of this study to describe linkages between use and domestication of *C. bonduc* by different local populations. It was also used to identify variables that best explained the patterns of variation according to the different subgroups. For graphic purposes, the subgroups are labelled by a prefix for each ethnic group followed by the label of one of the six subgroups defined above. For example, a young man from the *Adja* ethnic group is labelled *Adja*M1, whereas an old woman from the same ethnic group is labelled *Adja*F3.

RESULTS

Ethnobotanical knowledge on *Caesalpinia bonduc* in Benin

Ethnobotanical knowledge on *C. bonduc* varied from one ethnic group to another. Local populations of the 10 investigated ethnic groups in Benin used 20 properties from the leaves, roots and seeds of the species. These properties were applied to treat diseases, burn, to prevent from childbirth and for cultural practices like games, weddings and the Fâ ritual. Table 1 shows the use frequency of these 20 plant properties (FUP), the specific use frequency of properties by old men and women (SFUP) and the index value related to useful organs (IVO). Among the identified properties, 11 were determined to be 'credible' (FUP > 50%) (Table 1). The global credibility level of all these plant properties equalled to 75%, indicating that *C. bonduc* is perceived as very important for local populations. The IVO showed that roots are the most useful organ of this species, followed by leaves and seeds, respectively.

Table 2 shows the total mean users value (V_m) and the index of global knowledge (IGKPC) possession on *C. bonduc* within each ethnic group. We found out that only the *Kotafon* ethnic group had a fair level of knowledge on the species, while all others have only mediocre knowledge. The *Kotafon* ethnic group proved to hold the highest number of real users of properties of *C. bonduc*. They were followed by the *Nago* and *Mahi* ethnic groups. The *Aïzo, Adja, Bariba and Idatcha* ethnic groups hold the lowest number of real users.

Table 1. Use frequency of plant properties for *C. bonduc* in different ethnic groups from Benin. FUP: Use frequency of plant property; SFUP: specific frequency of plant property by old adults; IVO: Index value for useful organs.

Organ	Use form	FUP (%)	SFUP (%)	IVO (%)
Root	Edematous	27.56	31.25	41.66
	Sexual weakness	100.00	81.25	
	Hernia	09.61	93.75	
	Prevention of prostate gland diseases	100.00	93.75	
	Blackwater fever	09.61	93.75	
	Angina	08.97	87.50	
	Chicken pox	61.53	93.75	
	Stomachache	73.71	87.50	
Leave	Memory weakness	10.25	18.75	37.50
	Painful menstruation	18.58	93.75	
	Weakness after delivery	42.94	93.75	
	Hyperthermia	99.35	81.25	
	Burn	32.62	75.00	
	Candidose	96.79	81.25	
	Stomachache	100.00	87.50	
	Malaria	75.64	81.25	
	Hypertension prevention	05.76	56.25	
Seed	Candidose	100.00	87.50	20.83
	Game *Awalé*	91.02	93.75	
	Fa ritual	100.00	87.50	

Table 2. Total mean value of users (V_m) and index of global knowledge possession (IGKPC) on *C. bonduc* within each evaluated ethnic group from Benin.

Ethnic group	V_m	IGKPC (%)
Bariba	2.30	1.47
Fon	4.03	2.58
Aïzo	2.30	1.47
Goun	7.42	4.75
Kotafon	21.57	13.82
Adja	2.30	1.47
Mahi	8.74	5.60
Idatcha	2.30	1.47
Mina	7.21	4.62
Nago	9.54	6.11

Domestication strategies and use forms of *Caesalpinia bonduc*

The questionnaire revealed that local communities in Benin used different methods to manage, restore or conserve the species at village and ethnic group level. A principal component analysis (PCA) was performed on these domestication strategies and the use forms of *C. bonduc.* The first three axes explained 76.8% of the observed variation. Table 3 shows the coefficients of correlation between the different domestication strategies and these three PCA axes. We notice from this table that the harvesting of branches for the development of roots is often associated with the use of organic matter and the commercialization of the roots, whereas people who often harvest branches to avoid space obstruction used roots for medicinal practices (axis 1) and do not use organic matter. Axis 2 shows that transplanting as domestication strategy is often associated with the use of household as planting area and the use of leaves for medicinal

Table 3. Correlations between domestication and use forms of *C. bonduc* in Benin for the first 3 PCA axes.

Axis 1	Correlation	Axis 2	Correlation	Axis 3	Correlation
Branches harvesting for roots development	0.93	Tranplanting as domestication strategy	0.70	Provenance other than village	0.70
Branches harvesting to avoid space obstruction	- 0.93	Seeding as domestication strategy	- 0.70	Provenance from village	- 0.70
Medicinal uses of roots	- 0.93	Leave uses for medicinal purposes	0.72	Farm as planting area	- 0.54
Roots commercialisation	0.93	Leave commercialisation	- 0.72	Household as planting area	0.54
Non use of organic matter	- 0.85	Farm as planting area	- 0.57		
Use of organic matter	0.85	Household as planting area	0.57		

purposes. On the contrary, the use of farm as planting area is often associated with the commercialization of leaves and seeding as domestication strategy.

Axis 3 completes the above description between the variables and shows that the use of household as planting area is also associated with the use of seeds from other villages whereas the use of farm as planting area is associated with the use of seeds that come from the same village. Figure 2a and b show the projection of the different socioethnic subgroups in the system axes 1 and 2 and 1 and 3, respectively. Taking into account these figures and data from Table 3, we deduced that old men from the *Kotafon* ethnic group cut branches to promote the development of roots which will be further commercialized. They also use organic fertilisers in their fields. The young *Nago* buy propagules to grow them in their fields. The *Fon* and old men from *Idatcha* ethnic groups receive their propagules from other villages and grow them in their home gardens to prevent roots from being robbed. The *Idatcha*, *Fon* and *Aïzo* ethnic groups cut branches to avoid space obstruction, use roots for medicinal purposes and grow plants without fertilisers. Young *Nago* and old *Idatcha* buy seeds that they use as propagule to grow *C. bonduc* in their fields. On the contrary, young *Idatcha* and *Hlwa* and *Aïzo* use seedlings as propagules, grow *C. bonduc* in home gardens and use the plant roots for medicinal purposes.

DISCUSSION AND CONCLUSIONS

To our knowledge, this is the first time that the use value and domestication strategies according to various ethnic groups in Benin have been evaluated in detail for *C. bonduc*. The species plays an essential role in maintaining the livelihood of a lot of rural communities. Throughout its distribution area in Africa its leaves, bark and roots are used to cure fever, headache and chest pain and as an anthelminthic (Oudhia, 2007). In West Africa it is used as a rubefacient and as a tonic in the treatment of jaundice, diarrhoea and skin eruptions (Oudhia, 2007). At the Kenyan coast the seed and decoctions of the leaves and roots are taken to treat asthma and complications during menstruation, to avoid miscarriage and as eye-drops to treat internal blood clots in the eye (Oudhia, 2007). In Tanzania the powdered kernel of the seed is taken with water to treat diabetes mellitus while in Somalia the oil from the seeds is used to treat rheumatism (Oudhia, 2007). A bitter extract from the seeds is known as ‘poor man’s quinine’ and is used against malaria e.g. in India (Oudhia, 2007).

In tropical Asia and the Pacific Ocean islands *C. bonduc* is an important medicinal plant as well, with largely similar uses as in Africa (Oudhia, 2007). Biochemical analysis has evidenced active compounds in different organs which explain and confirm several indigenous medicinal uses, such as seeds as a cure for malaria (Chakrabarti et al., 2005) and roots as a product used against prostate diseases (Hutton et al., 2001). Several of the compounds found in the seeds have confirmed antifungal and antibacterial activity, while an aqueous extract of the roots, stems and leaves was found to have antiviral and anticancer activity (Oudhia, 2007). The seed contains about 20% oil that is especially rich in linoleic acid (68%) and has vesicant properties. According to Oudhia (2007), several of the compounds found in the seeds, notably bonducellin and β-caesalpin, have confirmed antiplasmodial activity. Therefore, *C. bonduc* has medicinal potential on which research and development could be based to develop standardized

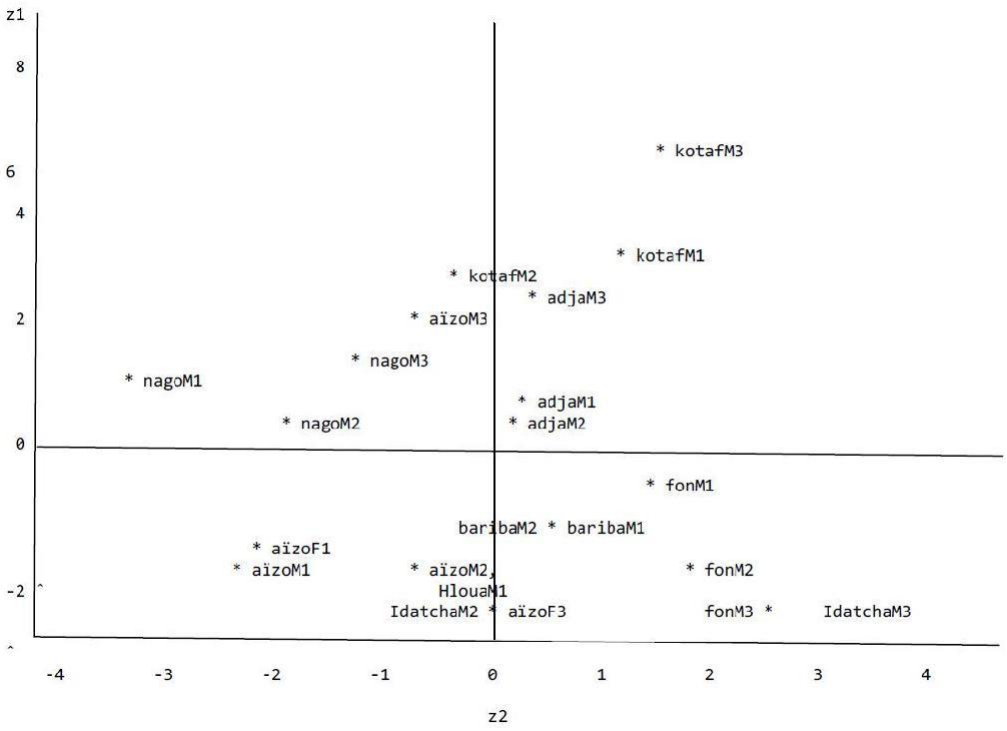

Figure 2A. Projection (Axis 1 and 2) of socio-ethnic subgroups in the PCA axes defined by ethnobotanical characteristics (domestication and use forms) of *C. bonduc* in Benin.

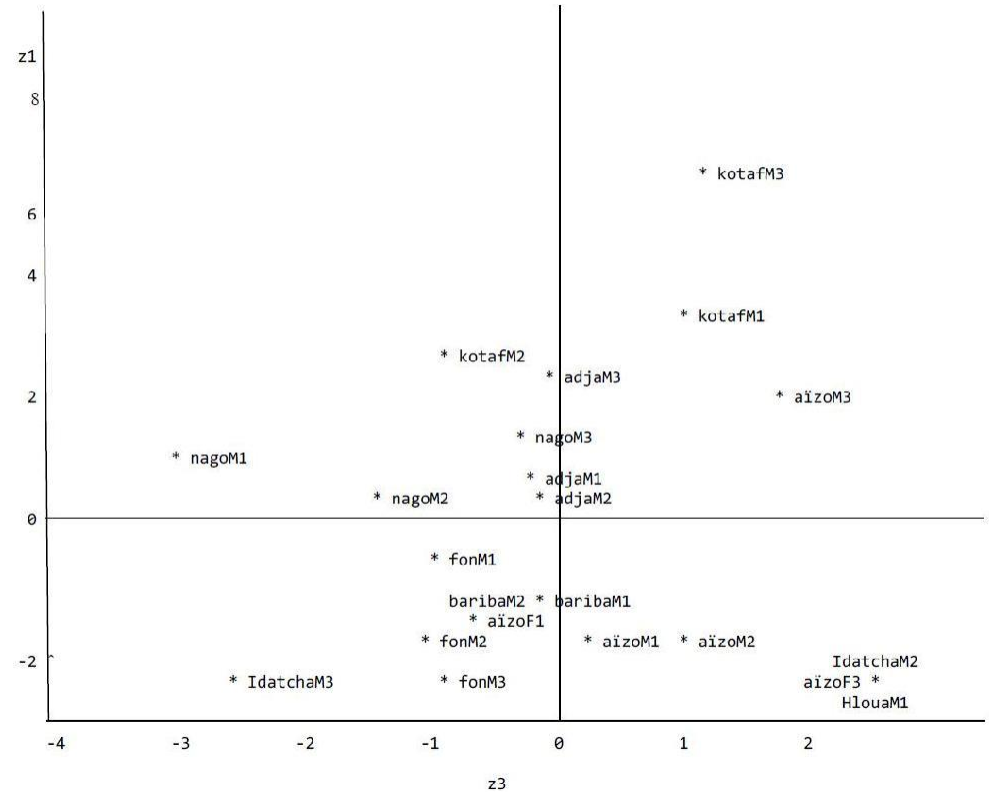

Figure 2B. Projection (Axis 1 and 3) of socio-ethnic subgroups in the PCA axes defined by ethnobotanical characteristics (domestication and use forms) of *C. bonduc* in Benin.

phytomedicines and reduce the pressure on the species in its natural habitats.

Ethnic differences in use value and patterns of the species were clearly observed in this study: among all the studied ethnic groups, the *Kotafon* had the highest level of knowledge on the species while the *Aïzo, Adja, Bariba and Idatcha* ethnic groups hold the lowest number of real users.

Local use forms and domestication strategies vary not only according to different ethnic groups but also according to the age and sex of individuals. For instance, the young *Nago* buy propagules and grow them in their fields. On the contrary, *Fon* and old men from the *Idatcha* ethnic group receive propagules from other villages and grow them in their home gardens to prevent roots from being robbed. This result confirms the significant age and gender differences in the use of medicinal plants shown by Hanazaki et al. (2000), Augustino and Gillah (2005), Müller-Schwarze (2006) and Camou-Guerrero et al. (2008).

This study confirms that almost all *C. bonduc* plant parts (leaves, roots and seeds) are being used by local people in Benin and this for a wide range of purposes, from medicine, over commercialization to cultural practices and other domestic uses. Local people use 20 properties based on leaves, roots and seeds of the species, of which 11 were determined to be credible in the current study. The use frequency is a key tool that indicates the importance of the targeted species for local populations (Camou-Guerrero et al., 2008). Only three use properties of *C. bonduc* were formerly described in Benin: treatment of candidose, the prevention of prostate gland diseases and the ritual fâ (De Souza, 2006; Hessou, 2009). The present study revealed 17 new useful plant properties with a global credibility level of 75% confirming that *C. bonduc* has high medicinal, social and economic importance. The index value related to useful organs showed that roots are the most useful organs. As a consequence, the species is highly threatened since the removal of this organ causes the species death and this can lead to the extinction of wild populations of *C. bonduc,* as already reported by Adomou (2005).

In conclusion, the high cultural value as demonstrated by this study indicated that preservation of ethnobotanical knowledge on *C. bonduc* and exchange between communities is critical. Based on the existing scientific knowledge on its propagation by seeds (Hessou et al., 2009) and with the help of the local knowledge gathered in the current study and the distribution and diversity patterns previously investigated by our research group (Assogbadjo et al., submitted), an efficient conservation and domestication programme of *C. bonduc* should be set up. Such programme will specify the rate of harvesting of each organ and prevent the overexploitation

to have negative impact on species sustainability, especially in long term. Indeed, the species is characterized to date by a very low density and limited distribution of its populations in the wild. The participatory domestication of indigenous trees has been proposed as an appropriate means to alleviate poverty (Poulton and Poole, 2001), and could also have positive benefits on the environment since new plantings of *C. bonduc* would help to restore the declining resources of this important species.

ACKNOWLEDGEMENTS

This work is financially supported by the People's Trust for Endangered Species (United Kingdom) provided to Dr. Ir. Achille E. Assogbadjo. We thank this institution and its donors. Our acknowledgements also go to Hessou C. and Fandohan B., as well as to the local people for their help during the field works.

REFERENCES

Adomou CA (2005). Vegetation Patterns and Environmental gradients in Benin. Implications for biogeography and conservation. PhD dissertation. Wageningen University, Wageningen, The Netherlands.

Assogbadjo AE, Glèlè Kakaï R, Chadare FJ, Thomson L, Kyndt T, Sinsin B, Van Damme P (2008). Folk classification, perception and preferences of baobab products in West Africa: consequences for species conservation and improvement. Econ. Bot., 62: 74-84.

Assogbadjo AE, Glèlè Kakaï R, Kyndt T, Hardy OJ, Gheysen G, Sinsin B (submitted). Metapopulation structure of the rare and declining scrambling shrub *Caesalpinia bonduc* L., demonstrated by distribution, morphological and genetic variation. Submitted to Human Ecology.

Assogbadjo AE, Kyndt T, Chadare FJ, Sinsin B, Gheysen G, Eyog-Matig O, Van Damme P (2009). Genetic fingerprinting using AFLP cannot distinguish traditionally classified baobab morphotypes. Agrofor. Syst., 75: 157-165.

Augustino S, Gillah PR (2005). Medicinal plants in urban districts of Tanzania: plants, gender roles and sustainable use. Int. For. Rev., 7: 44-58.

Camou-Guerrero A, Reyes-García V, Martínez-Ramos M, Casas A (2008). Knowledge and Use Value of Plant Species in a Rarámuri Community: A Gender Perspective for Conservation. Hum. Ecol., 36: 259–272.

Chakrabarti S, Biswas TK, Seal T, Rokeya B, Ali L, Azad Khan AK, Nahar N, Mosihuzzaman M, Mukherjee B (2005). Antidiabetic activity of *Caesalpinia bonducella* F. in chronic type 2 diabetic model in Long-Evans rats and evaluation of insulin secretagogue property of its fractions on isolated islets. J. Ethnopharm., 97: 117-122.

Dagnelie P (1998). Statistiques théoriques et appliquées. Brussels: De Boeck et Larcier.

De Souza S (2006). Le Domaine Médico-Magique et les Gris-Gris du Bénin. Riez: Editions Simone de Souza.

FAO (1999). State of the world's forests. Doc. FAO.

Hamilton AC (2004). Medicinal plants, conservation and livelihoods. Biodiv. Cons., 13: 1477-1517.

Hanazaki N, Tamashiro JY, Leitão-Filho HF, Begosi A (2000). Diversity of plant uses in two *Caiçara* communities from the Atlantic Forest coast, Brazil. Biodiv. Cons., 9: 597-615.

Harden GJ (2002). Flora of NSW, Vol. 2, second edition. Sydney: UNSW Press.

Hessou C, Glele Kakaï R, Assogbadjo AE, Odjo T, Sinsin B (2009). Test de germination des graines de *Caesalpinia bonduc* (L.) Roxb au Bénin. Int. J. Biol. Chem. Sci., 3: 310-317.

Hutton I (2001). Rare plant surveys: Lord Howe Island. Report to NSW Scientific Committee, Sydney.

Kerharo J, Adam JG (1974). La pharmacopée sénégalaise traditionnelle, plantes médicinales et toxiques. Paris : Editions Vigot frères.

Müller-Schwarze NK (2006). Antes and Hoy Día: Plant knowledge and categorization as adaptations to life in Panama in the twenty-first century. Econ. Bot., 60: 321-334.

Oudhia P (2007). *Caesalpinia bonduc (*L.) Roxb. In: Schmelzer GH, Gurib-Fakim A (eds). Prota 11(1): Medicinal plants/Plantes médicinales 1. [CD-Rom]. PROTA, Wageningen, The Netherlands.

Poulton C, Pool N (2001). Poverty and fruit tree research: Issues and options Paper. DFID Forestry Research Programme, Wye College, Ashford, UK.

Upadhyay L, Tripathi K, Kulkarni KS (2001). A Study of Prostane in the Treatment of Benign Prostatic Hyperplasia. Phytother. Res., 15: 411-415.

Vodouhê F, Coulibaly O, Assogbadjo AE, Sinsin B (2008). Commercialization of Medicinal Plants: Impact of Sales and Profit Margin Distribution across actors on the Sustainable Use of Harvested Species in Benin (West Africa). J. Med. Plants Res., 2: 331-340.

Vodouhê FG, Coulibaly O, Greene C, Sinsin B (2009). Estimating the Local Value of Non-Timber Forest Products to Pendjari Biosphere Reserve Dwellers in Benin. Econ. Bot., 63: 397-412.