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LOCAL KNOWLEDGE AND ECONOMIC IMPORTANCE OF *MONDIA WHITEI* (APOCYNACEAE), A SEXUAL STIMULANT IN BENIN

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ABSTRACT

Local knowledge of many medicinal lianas that support rural people health in Africa remains poorly documented leaving incomplete understanding of their pharmacological and economic importance. This information is however critical to conserve target species and design formal management strategies. This study aimed at assessing knowledge and uses of *Mondia whitei* (Hook. f.) Skeels and its economic importance for local communities in Benin. We investigated traditional knowledge and contribution of *M. whitei* to rural household's cash income by administering 51 volunteers (farmers, vendors, and folk medicine practitioners) with semi-structured questionnaires. Only one ethnic group was involved and the interviews focused on the uses of *M. whitei*, the purchase and sale price per unit (bunch), the transportation costs from collecting zones to market and the overall quantity sold during the period of investigation. Our findings indicated that the use of *M. whitei* roots against digestive and male genitourinary disorders were the most common. Use diversity and Use equitability values for the abovementioned uses were 0.43 and 0.26, and, 0.99 and 0.62, respectively. Other important uses include flavours for alcohol beverages, treatment of stomach disorders and tooth brush. Use of the species was reported to be age-biased, with old people being the most involved in its exploitation. The average profit margin per piece and a kilogram of roots increased from collectors to retailers. The average retail profit margin was 516 XOF ≈ 1.032 US $ per kilogram of the roots) with collectors earning the lowest profit margin (267 XOF ≈ 0.534 US $ per kilogram of root) indicating that the trade of *M. whitei* roots is not worthwhile in the study area. Since knowledge on the species was held by few people, there may be a risk for knowledge erosion. Active conservation actions are thus suggested to ensure sustainable use of the species.

Keywords : Medicinal plant, use diversity, use equitability, cash income, Benin

CONNAISSANCES ENDOGENES ET IMPORTANCE ECONOMIQUE DE *MONDIA WITHEI* (APOCYNACEAE), UN STIMULANT SEXUEL AU BENIN

RÉSUMÉ

La connaissance endogène de nombreuses lianes utilisées pour les soins de santé par les populations rurales, reste peu documentée, laissant incomplète, la compréhension de leur importance pharmacologique et économique. Cette information est cruciale pour la conservation des espèces cibles et la conception des stratégies officielles de gestion. Cette étude s'est fixée comme objectifs d'évaluer les connaissances et usages de *Mondia whitei* (Hook. f.) Skeels ainsi que son importance économique pour les communautés locales au Bénin. Des entretiens semi-structurés ont été réalisés avec 51 personnes volontaires

(agriculteurs, commerçants et tradithérapeutes) et ont porté sur la connaissance traditionnelle et la contribution de *M. whitei* aux revenus des ménages. Il ressort que l'usage des racines de *M. whitei* pour le traitement les troubles digestives et de l'érection chez l'homme est le plus répandu. La diversité et l'équitabilité des utilisations pour les usages susmentionnés ont respectivement eu pour valeurs 0,43 et 0,26 ; 0,99 et 0,62. Par ailleurs, l'espèce est utilisée comme arômes pour les boissons alcoolisées, comme brosses végétales utilisées et dans le traitement des maux de ventre. Elle est préférentiellement utilisée par les personnes âgées. La marge bénéficiaire moyenne par pièce et par kilogramme de racines de *M. whitei* augmente au fur et à mesure que l'on monte dans la chaîne de commercialisation (du collecteur au détaillant). La marge bénéficiaire moyenne du détaillant était de 516 FCFA ≈ 1,032 US$ par kilogramme de racines contre 267 FCFA ≈ 0,534 US$, la plus faible marge pour les collecteurs, indiquant que la commercialisation ne semble pas équitable dans la zone d'étude. Les connaissances sur l'espèce étant l'apanage d'un petit groupe d'individus, elles pourraient être sujet a une érosion. Nous suggérons alors des actions actives de conservation pour assurer une utilisation durable de l'espèce.

Mots clés **:** Plante médicinale, diversité d'usage, équitabilité d'usage, valeur consensuelle, revenu, Afrique de l'Ouest

INTRODUCTION

Local knowledge of many medicinal plants that support rural people health in the world remains poorly documented. A high proportion (70 to 80 %) of the world population uses medicinal plants or consults traditional practitioners for their primary healthcare (Pei, 2001 ; Olsen, 2005). In Africa, as many as 5000 plants species are used medicinally (Taylor *et al.,* 2001) with at least 814 medicinal species listed in Benin (Sinsin & Owolabi, 2001). Among medicinal species, lianas have received exceptionally little attention, despite their abundance, diversity and pharmacological importance (On *et al.* 2001; Schnitzer & Bongers 2002). *Mondia whitei* (Hook. f.) Skeels (Apocynaceae formely Asclepiadaceae) is a liana species that grows from a tuberous rootstock in tropical moist forest (McGeoch *et al.,* 2008). Traditionally, *M. whitei* roots are used as aphrodisiac for men and for the treatment of erectile dysfunction and impotence. They were also reported to be used as food additive to stimulate appetite, treat gonorrhoea and schistosomiasis, increase milk production in mothers and cattle, improve sexual performance, boost energy and treat colds, coughs and stomach disorders (Venter & Verhoeven, 2001 ; Mukonyi *et al.,* 2002 ; Matu & van Staden, 2003). In Kenya, *M. whitei* is largely harvested from the Kakamega rainforest and there is information that the supply of *M. whitei* is being threatened by over-harvesting (Watai, 2003). It faces unsustainable harvesting all over its African distribution range for national and international sale (Godfrey *et al.,* 2008). It is reported to be extinct from the wild in its main area of exploitation in the Tugela River in South Africa (McCartan & Crouch, 1998). Studies funded by African Academy of Sciences put *M. whitei* in number one slot as a medicinal plant

that can fetch more money for people in Western Kenya than any other medicinal herb (Okwemba, 2002). In order to ensure the sustainable use of this medicinal plant, it is necessary to have baseline information about its status, ethno-uses and market profiles. In this study, we examine socio-economic status of *M. whitei* in Benin where the species is known from only two phytogeographic districts (Zou and Plateau within the Guineo-Congolian zone) (Akoegninou *et al.,* 2006), and used as aromatic, sexual stimulant, and in treatment of many diseases (Adjanohoun *et al.,* 1989). Due to its medicinal and commercial value, *M. whitei* is subject to over-extraction for sale in the main market of the study area (Vodouhè *et al.,* 2008). Yet, quantitative data on its contribution to local economy is not available. Such information is however important to design effective management plans. This study aimed at assessing knowledge and uses of *M. whitei* and its socioeconomic importance.

METHODS

Study species

Mondia whitei (Hook. f.) Skeels (Apocynaceae) is a woody climber with false stiff fimbriate stipules around each pair of leaves; it grows over trees and shrubs in tropical rain forests. Mature adults are generally 3-6 m long (Beentje, 1994), but can occasionally exceed 10 m high. Under favourable conditions, a single mature individual can produce more than fifty large (8 cm x 3 cm), fleshy follicles annually; each follicle to release numerous hair-tufted, wind-dispersed seeds.

Study area

This study was performed in the rural district of Zagnanado located within the Guineo-congolian region of the republic of Benin between 7°-7°30 N and 2°15-2°30 E representing the main distribution range of the species in Benin (Akoegninou *et al.,* 2006). Zagnanado is located 182 km from the state capital (Porto-Novo) (Figure 1). The mean annual rainfall is about 1100 mm while the mean annual temperature varies between 25°C and 31°C.

The major activity in the area is small scale-agriculture. The Mahi (90.5 %), Yoruba and others (8.1 %) are the main ethnic groups that are involved in *M. whitei* extraction in the study area.

Sampling and data collection

Traditional leaders of the study area were contacted to secure prior consent to implement the study. Our fieldwork was divided into two stages. In the first stage, exploratory research was undertaken with 109 local people (50 women and 59 men) randomly chosen within the four villages known to house the species and questioned about knowledge and use of the species. Of the 109, 51 (48 men and 3 women) were familiar with and / or used *M. whitei*. In the second phase, ethnobotanical data were collected through semi-structured interviews with these 51 villagers and variables including age, civil status, and profession were recorded as well. Then, the interviewees were questioned in more details about the plant, specifically about the types and forms of its use, the number of people in the house who were involved in harvesting roots, and where the collecting was conducted.

At this stage, we also noticed that most of them were informed about the specie but only traditional healers gave substantial information about it. So, in order to have insight into important knowledge and uses of the specie, the sampling was traditional healers oriented (on a volunteered basis). Based on this sampling method, 31 informants (3 women and 28 men) composed of both family and community healers were selected. Family healers include people healing diseases and giving advice at a family level whereas community healers are those treating the whole community. These people were then submitted to further questioning based on their previous answers. Questions included specific ailments treated and corresponding forms of use.

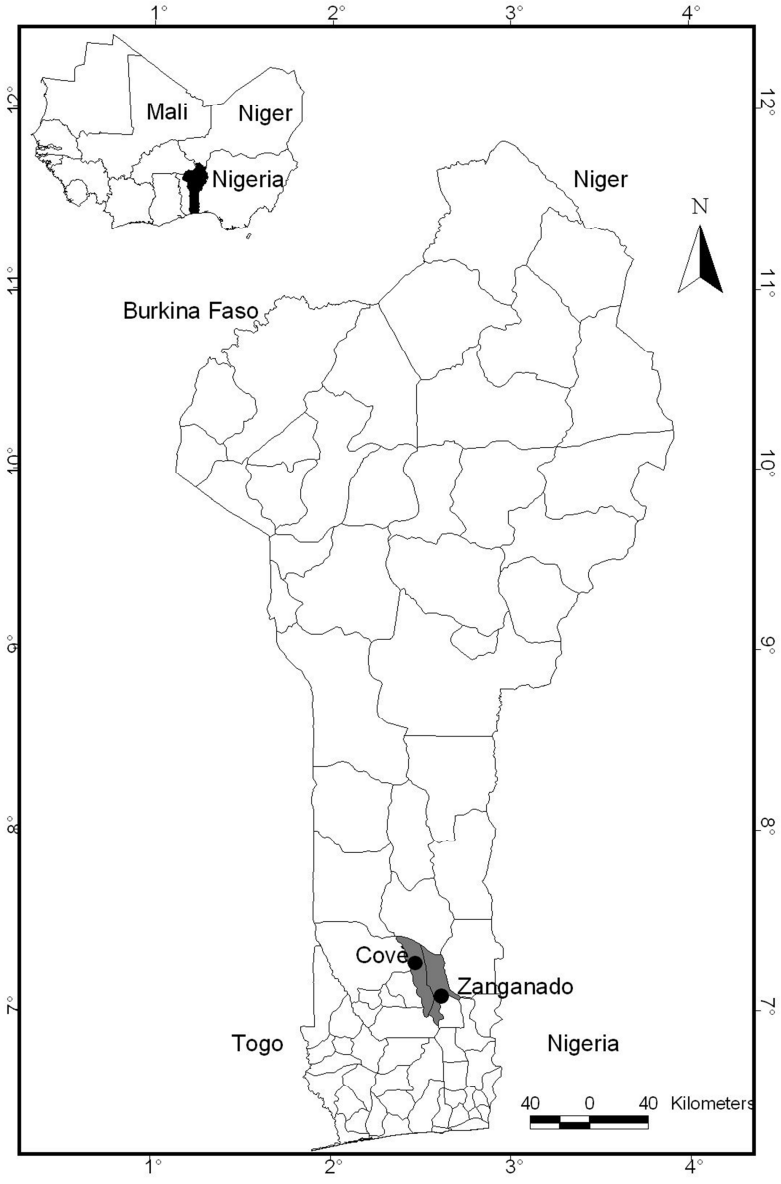

Figure 1. Study site (the dots indicate the localities where data collection took place)

We supplemented our ethnobotanical survey by talking with four harvesters and 11 vendors of *M. whitei* with the help of traditional healers and roots appeared to be the only commercially valuable part of the liana. Eleven semi-structured intercept interviews with these vendors selling fresh *M. whitei* roots in the rural market of Covè, one of the main rural markets in Benin (Vodouhè *et al.* 2008). Interview questions focused on the uses of *M. whitei*, the buying and selling price per bunch, the transportation costs from collecting zones to market and the overall quantity sold. Four *M. whitei* harvesters allowed us to spend some hours talking with them and observing *M. whitei* harvesting. Recorded information included the price per unit, and the harvesting costs. To establish relationship between roots quantity sold and prices, sample bunches have been collected for weighing in laboratory. A bunch is defined hereafter as a bundle of roots of medicinal plants for sale. We used information from harvesters and vendors to assess local perceptions on the scarcity of the of *M. whitei*. Data on root sales were weekly collected to reduce estimation errors.

Data analysis

In order to assess how knowledge and use of *M. whitei* is distributed among people in the study area, a quantitative analysis based on the diversity value (ID), the equitability value (IE), and the consensus value of use types (CTU) was performed (Byg & Balslev, 2001 ; Monteiro *et al.,* 2006). Details on the indices used and their application can be found in Table 1. To this end, the interviewees were grouped into age classes (Adults > 40 and adults < 40 years), sex and profession (traditional healers farmers, only traditional healers, traditional healers plants traders, male traditional healers, female healers and others). We expected that such grouping could unfold plausible effects of sociocultural characteristics on knowledge of *M. whitei*, as showcased elsewhere (Monteiro *et al.,* 2006).

Table 1. Measures of the local uses and knowledge of *M. whitei*

Index	Calculation	Description	Reference
Interviewee diversity value (ID) ID = Ux/Ut	ID, number of use citations by a given informant (Ux) divided by the total number of uses (Ut).	Measures how many interviewees used a given species and how this knowledge is distributed among the interviewees. Values range between 0 and the number of the informants using it	Byg & Balslev 2001
Interviewee equitability value (IE), IE = ID/IDmax	IE, diversity value (ID) divided by the highest value diversity index found (IDmax).	Measures the degree of homogeneity of the interviewee's knowledge Values range between 0 and 1	Byg & Balslev 2001
Consensus value of use types (CTU) = (TU/Ut)/S	CTU, number of times a given use is reported (TU) divided by the total number of uses (Ut). This value is then divided by the types of use separated within each category (food, coal, firewood, etc.) (S).	Measures the degree of concordance among the interviewees in regards to the uses of a given species. Values range between −1 and +1	Monteiro *et al.* 2006
Consensus value for the collection site (CCS), CCS = Sx/St	CCS, number of times that a certain area (managed area and native vegetation) was mentioned (Sx) divided by the total number of citations for all the areas (St).	Measures the degree of concordance among the interviewees in regards to the areas where the species is collected. Values range between 0 and 1	Monteiro *et al.* 2006
Use–diversity value (UD), UD = Ucx/Uct	UD, the number of indications registered for each category (food, construction, fuel, etc.) (Ucx) divided by the total number of indications for all of the categories (Uct).	Measures the importance of the use–categories and how they contribute to the local use value. Values range between 0 and number of use categories for which it is used	Byg & Balslev 2001
Use equitability value (UE), UE = UD/UDmax	UE, use diversity value (UD) divided by the highest use diversity index found (UDmax).	Measures the degree of homogeneity of knowledge in regards to the use categories.	Byg & Balslev 2001

Index	Calculation	Description	Reference
		values range between 0 and 1	
Consensus value for the manner of usage (CMU) CMU = Mx/Mt	Consensus value for the manner of usage (CMU) CMU = Mx/Mt	Measures the level of agreement between the interviewees in terms of the forms of use of a given plant. Values range between 0 and 1	Monteiro *et al.* 2006

The profit margins of actors (collectors and vendors) in the supply-chain were assessed as estimated by Vodouhè *et al.* (2008) using the following formula :

GM_1 = Selling Price – Buying Price – Transportation Costs where, GM_1 is the vendor's unitary Gross Margin (margin per kg of roots). As for collectors, it was estimated as :

GM_2 = Selling Price – Collection costs (where collection costs are costs covering equipment and labor).

Roots are directly and freely harvested in vegetation by collectors. Collection costs were estimated taking into account wage rates for farm activities as the labour opportunity cost (Vodouhè *et al.,* 2008). The formula is :

Collection cost = (Total man days involved*Wage rate + cost of equipment) / Total quantity sold)

A student *t* test was used to compare Gross Margin among actors of commercialization at 5 %.

RESULTS

Local knowledge and use forms

A total of 51 informants were interviewed. Of these, only 31 people (28 men and 3 women) all traditional healers gave substantial information about the species. The local names of the liana are *Tchigoun* (Mahi) and *Esheegoun* (Hôli). The Mahi, more represented in the study area reported almost all the specific uses of the species.

Roots of *M. whitei* were found to be the only valuable part used according to local people. The use of the roots as sexual stimulant (100 % of informants), flavouring for drink (52 %), and in controlling stomach-ache and intestinal

worms (35 %), managing allergy disorders (16 %) and assuaging diabetes (29 %) were the most reported uses among all the interviewees (Table 2). Men of 40 years and above seemed to be more involved in the extraction and use of *M. whitei* roots.

Table 2. Categories of use and specific uses of *M. whitei* in the study area (not referred in the text)

Category of use	Specific uses
Medicine	Male impotence
	Female impotence
	Laxative
	Anorexia
	Malaria
	Cough
	Stomach ache
	Snake bite
	Purgative
Drink additive	Flavouring for drink
Commerce	Selling
Brush	Toothbrush

Quantitative measures of local knowledge of M. whitei

Regardless of socio-professional, gender and age categories, Informant Diversity values were very low (ID < 0.5), indicating that few people knew about *M. whitei* and that this knowledge is poorly distributed among the interviewees. Similarly, equitability values were overall low (< 0.5), suggesting that local knowledge of this liana is held by few people in the community (Table 3).

Table 3. Quantitative measures of the knowledge of *M. whitei*

Measured variables	Corresponding values
Total number of interviewees	31
Number of use citations	91
Types of use	3
Diversity Value of the Informant (ID)	Average ± standard error
Overall ID	0.03±0.00
ID for men	0.03±0.00
ID for men < 40 years old	0.03±0.01
ID for men > 40 years old	0.03±0.00
ID for women	0.02±0.01
ID for women > 40 years old	0.02±0.01
ID total for "farmers traditional healers"	0.03±0.00
ID total for "only traditional healers"	0.04±0.01
ID for "medicinal plants traders traditional healers"	0.03±0.02
ID for other categories of traditional healers	0.02±0.00
Equitability Value of the informant (IE)	Average ± standard error
Overall IE	0.42±0.04
IE for men	0.43±0.04
IE for men < 40 years old	0.43±0.10
IE for men > 40 years old	0.44±0.05
IE for women	0.29±0.14
IE for women > 40	0.29±0.14
IE for "farmers traditional healers"	0.37±0.05
IE for "only traditional healers"	0.57±0.09
IE for "medicinal plants traders traditional healers"	0.36±0.21
IE for other categories of traditional healers	0.29±0.00

Roots were mainly collected from farmlands and fallows. Farmlands and fallows presented the highest consensus value (0.483 and 0.416 respectively) for harvesting sites among all of the informants in the community (0.1) (Table 4).

Table 4. Collecting sites and consensus values of *M. whitei (n=31)*

Collection sites	CCS
Fallows	0.483
Farmlands	0.416
Woodlands	0.1

Four forms of use represented by the consensus value for the forms of use (CMU), were reported *for M. whitei*, with the most important being the use of the roots in mixture with alcohol as sexual stimulant (0.735), as tooth brush, predominantly fresh (0.058), or in powder (0.058) (Table 5).

Table 5 – Consensus Value for the forms of use (n=31)

Forms of use	CMU
Consumption of the roots in powder	0.058
Consumption *in natura*	0.058
Consumption in alcohool	0.735
Consumption in water	0.147

Similarly, medicinal uses had the greatest values for the consensus value for the types of uses (CTU) (Table 6), as well as the use diversity (UD), where the ailments related to the digestive and genitourinary systems showed the highest values and contributed most to the total use-value (Table 7). The use equitability (UE) also revealed the digestive and genitourinary systems (0.62 and 0.99 respectively) to be the most valued and common uses (Table 7).

Table 6. Consensus Value for the types of use of *M. whitei* (n=31)

Types of use	CTU
Medicinal	0.322
Brush	0.007
Aromatic	0.003

Table 7. Use Diversity Value (UD) and Use equitability Value (UE) for the indicated use categories of *M. whitei* (n=31)

Use categories	UD	UE
Digestive system disorder	0.26	0.62
Genitourinary system disorder	0.43	0.99
Cardio- vascular disease	0.06	0.15
Eyes pains	0.01	0.03
Muscular disorder	0.07	0.15
Brush	0.02	0.05
Aroma	0.01	0.03
Others	0.13	0.31

Market margin, marketing chain and flow of Mondia whitei *roots in the district*

Trade in M. whitei roots were mainly characterized by retailers who buy roots directly from collectors and later sell them to consumers. The average price per bunch of root (diameter : 0.01 – 0.03 m ; length : 0.2 – 0.3 m) and per kilogram of roots increases from collectors to the retailers. The average retail profit margin was 516 FCFA (≈1.032 US $ per kilogram of the roots). Collectors earned 267 FCFA (≈ 0.534 US $ per kilogram of root), so their profit margins remained the lowest. The profit margins varied significantly between actors ($t_c = 3.29$; $t_{5\%} = 1.86$), with retailer's profit margin being twice greater than collector's.

DISCUSSION

Knowledge, use, supply chains and profit margins of M. whitei

Our results indicate that use of the species against digestive and genitourinary disorders are the most common within the sample population. The consensus value for collection sites indicate that main sites are out of forest reserves. This may be imputable to the high rate of deforestation in the area which could have result in drastic decline of the species in natural vegetation.

Roots of *M. whitei* plant are widely used by old men in the Guineo- Congolian zone of Benin. The roots are largely valued as sexual stimulant and flavours. An increase in serum and intratesticular testosterone levels after treatment in rats was reported (Watcho *et al.,* 2004) suggesting an androgenic effect of the *M. whitei* aqueous extract. The same authors went on to further report that *M. whitei* had the ability to reduce α-adrenergically stimulation of the corpus cavernosum tissue without the involvement of nitric oxide or prostaglandins.

Using a laboratory *in vitro* test, Lampiao *et al.* (2008) illustrated positive effect of aqueous extract of *M. whitei* on motility of human spermatozoa (Lampiao *et al.,* 2008).

Local knowledge of *M. whitei* roots was not well distributed among the members of the community of Covè and Zagnanado, both in terms of gender and age. This apparent heterogeneity of knowledge is associated with the fact that the species was more valued by males of 40 years of age and over.

Our findings illustrated little homogeneity regarding the distribution of knowledge among the informants. Differences in knowledge among and within human groups were previously reported (Begossi *et al.,* 2002 ; Amorozo, 2004). Factors such as gender or age biased distribution of knowledge could result in knowledge erosion (Begossi *et al.,* 2002). In such system, loss of a single person with great knowledge of medicinal plants could greatly affect local treatment systems especially if this knowledge was not passed along.

M. whitei roots trade in the study area is more or less worthwhile although largely informal and underdeveloped, with limited value-adding taking place. The trade is mainly characterized by retailers and collectors. This suggested that the supply chain of *M. whitei* roots is short in the study area (Vodouhè *et al.,* 2008). The average price per kilogram of roots increases from collectors to the retailers. There is a common assumption in much of the non-timber forest product literature that traders exploit producers (Neumann & Hirsch, 2000). The findings of this study show that the collectors (gatherers) received the lowest price per kilogram of roots; so their profit margins remained the lowest. It should, however, be noted that these also derived from the fact that collectors support more expenses (transportation and collection costs).

CONCLUSION

This study documents the importance of *M. whitei* to the livelihoods of rural local communities in Benin. Results showed that *M. whitei* roots are used by local people in different ways, including *in natura*, medicine, aromatic and others. A risk of knowledge erosion exists on the species due to the fact that it is more valued by old men. Public policy regarding conservation agricultural development should consider the relevance of this part of the population for conservation of such an important medicinal liana. Protection strategies should favour regeneration processes and cultivation (vegetative propagation), proposing alternative agricultural activities which can favour the conservation of the species.

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