



Ethnobotanical Assessment of *Moringa oleifera* Lam. in Southern Benin (West Africa)

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Research

Abstract

For decades, plant species, particularly those used as non-tree forest products (NTFPs), have been known to play an important role in the livelihood of local populations, particularly in rural Africa. The present study investigated the uses of various parts of *Moringa oleifera* Lam. in southern Benin. It aimed at capturing indigenous knowledge on the uses of *M. oleifera* as a preliminary step toward future efforts to devise better management options of this plant species. An ethnobotanical survey was carried out in southern Benin (Guineo-Congolese zone) with a sample of 439 informants (201 women and 238 men) belonging to Fon, Waci, Xwla, Sahouè, Djerma, Kotafon, Aïzo, Goun, and Yoruba socio-cultural groups. It was found that *M. oleifera* is known in South Benin under different local names depending on the socio-cultural group. Leaves were the most used part followed by roots, bark, seeds, and pods. Leaves are eaten as a vegetable and also used for medicinal purposes. They are consumed fresh or dried and reduced to powder. Different parts of *M. oleifera* are used to treat up to 34 diseases according to the local populations. Leaves are also used as fodder for pigs, sheep, and rabbits. The seeds are used to carry out rites for blessing and attracting customers. The study showed that *M. oleifera* plays an important role in rural areas of South Benin where it is used as a nutritional and medicinal plant. Local populations could benefit by further adoption of the species in agroforestry systems.

Resume

Depuis des décennies, les espèces végétales, particulièrement celles utilisées comme produits forestiers non ligneux (PFNLs) sont connues pour le rôle important qu'elles jouent dans la vie des populations locales. La présente étude a porté sur les utilisations

faites des différentes parties de *Moringa oleifera* Lam. au Sud-Bénin. L'objectif de l'étude était de capitaliser les connaissances endogènes sur les utilisations de *M. oleifera* au Bénin afin de contribuer à une meilleure gestion de cette ressource. Il a été effectué une enquête ethnobotanique au Sud du Bénin (Zone Guineo-Congolaise) auprès d'un échantillon de 439 personnes (201 femmes et 238 hommes) appartenant aux ethnies Fon, Waci, Xwla, Sahouè, Djerma, Kotafon, Aïzo, Goun, Yoruba. L'enquête ethnobotanique a montré que *M. oleifera* est connu sous différentes appellations locales en fonction des groupes socio-culturels présents dans le sud Bénin. Les feuilles sont les organes les plus utilisés suivies des racines, l'écorce, les graines et gousses. Les feuilles sont utilisées fraîches comme légume-feuilles ou séchées et réduites en poudre. L'étude révèle que *M. oleifera* est utilisé dans le traitement de trente-quatre maladies selon les populations locales. Les feuilles sont aussi utilisées comme aliment dans l'élevage du porc, du lapin et de la volaille. Les graines sont utilisées pour faire des ri-

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tuels dans le but d'attirer la clientèle ou le sexe opposé. *Moringa oleifera* joue un rôle très important pour les populations rurales du Sud-Bénin, surtout au plan nutritionnel et médicinal. Les populations locales devraient donc opter pour son intégration dans les systèmes agroforêtiers.

Background

Numerous studies have shown the importance of non-tree forest products (NTFPs) in the livelihood of local populations, particularly in rural Africa, both for their nutritional and income security (Aubé 1996, Dethier 1998, Kouyaté 2005, Sunderland *et al.* 2000). In Benin, NTFPs are known for their multipurpose uses including nutrition, animal feed, medicine, and being sources of income. Although NTFPs contribute to household incomes and to economic development, the quantitative assessment of the products used have never been studied exhaustively; only the products which are subject of export were studied, such as *Vitellaria paradoxa* C.F.Gaertn. (Agbahungba & Depommier 1989), *Adansonia digitata* L. (Assogbadjo *et al.* 2005a,b,c, 2006, 2008, Codjia & Assogbadjo 2001, Codjia *et al.* 2003), *Jatropha curcas* L. and other edible trees (Assogbadjo *et al.* 2009, 2012), *Parkia biglobosa* (Jacq.) G.Don (Agbahungba & Depommier 1989), and the edible mushrooms (Yorou & De Kersel 2000). The increase in demand and the trade of NTFPs poses a problem for sustainability of the existing resources (Kimba 2010, Verdcourt 1985). This problem would be more easily solved if such resources are assessed and new production systems developed, hence the need for the assessment and valuation of plant resources.

Among NTFPs, moringa (*Moringa oleifera* Lam.) is a multipurpose tree introduced into Africa and now very widespread. It is used by rural populations for nutrition, medicinal purposes, and as hedges for house and farm demarcation. Recently, *M. oleifera* has gained interest especially because of its nutritional and medicinal value. Indeed, in several African countries such as Sudan, Tanzania, Niger, Senegal, Nigeria, Ghana, and Burkina Faso, leaves and seeds of *M. oleifera* are considered as important sources of proteins, lipids, vitamins, and essential minerals for human health (Afuang *et al.* 2003, Leonard 2006, Oliveira *et al.* 1999, Sreelatha & Padma 2009). Although *M. oleifera* is integrated into several programs of food assistance for preventing malnutrition of children and nursing mothers (Afuang *et al.* 2003, Leonard 2006, Sreelatha & Padma 2009), a lack of information still persists for this species, notably concerning local knowledge of uses. Kumar *et al.* (2007) showed that the seeds of *M. oleifera* have antioxidant properties and thus possess possible anticancer potential. Antispasmodic activity and hypotensive components of *M. oleifera* provide a scientific basis for the plant's traditional uses in the management of gastro-intestinal motility disorders (Gilani *et al.* 1994). Kalogo *et al.* (2000)

also indicated that antibacterial properties of *M. oleifera* make it a useful medicinal plant.

In assessing the inhibition potential of combined extracts of *J. curcas* and *M. oleifera* on saprophytes and fungal contaminants, Ayanbimpe *et al.* (2009) concluded that these easily accessible, cheap extracts could be substitutes for antibiotics and antifungals frequently used in laboratories such as chloramphenicol and cycloheximide. However, in spite of these authors' interest in nutritional and medicinal aspects of *M. oleifera*, their work did not address traditional methods of use, manufacture of remedies, or dosages. The introduction of fresh leaves of *M. oleifera* in Nile tilapia [*Oreochromis niloticus* (Linnaeus 1758)] dishes is also known to cause a substantial drop in the cholesterol rate in plasma and muscles (Afuang *et al.* 2003), but no study informs about its uses in the breeding of poultry, pigs, rabbits, etc.

Studies on *M. oleifera* in Benin are limited to an unpublished work (Kogblevi 1983) regarding adaptation of *M. oleifera* in dry areas, its nitrogen, phosphorous, and potassium content. This study aimed at filling this gap through documenting the indigenous knowledge on *M. oleifera* in southern Benin.

Methods

Study area

The study took place in southern Benin between 6°25' and 7°30'N in the Guineo-Congolese zone. In Benin the Guineo-Congolese area is subdivided into four phyto-districts which are: Plateau, Coast, Ouémé, and Pobè (Figure 1). The pluviometry is bimodal with an annual average of 1200 mm. The annual average temperature ranges between 25 and 29°C and the relative humidity between 69 and 97%. The climate is subequatorial, characterized by four more or less marked seasons. The main ethnic groups are Fon (and other assimilated groups), Adja (and assimilated groups), and Yoruba (Floquet & Van den Akker 2000).

Data collection

Data were collected through interviews with individuals and groups of individuals chosen at 11 townships. The localities were rationally chosen using three criteria: the presence of the species (the species was considered as present where it was met in 10 different places within a locality), the existence of a market in which its products are commercialized, and the main ethnic groups. The choice of the surveyed persons was at random, the sample size determined using the normal approximation of binomial distribution (Dagnelie 1998):

$$n = U^2_{1-\alpha/2} \times P(1-P) / d^2$$

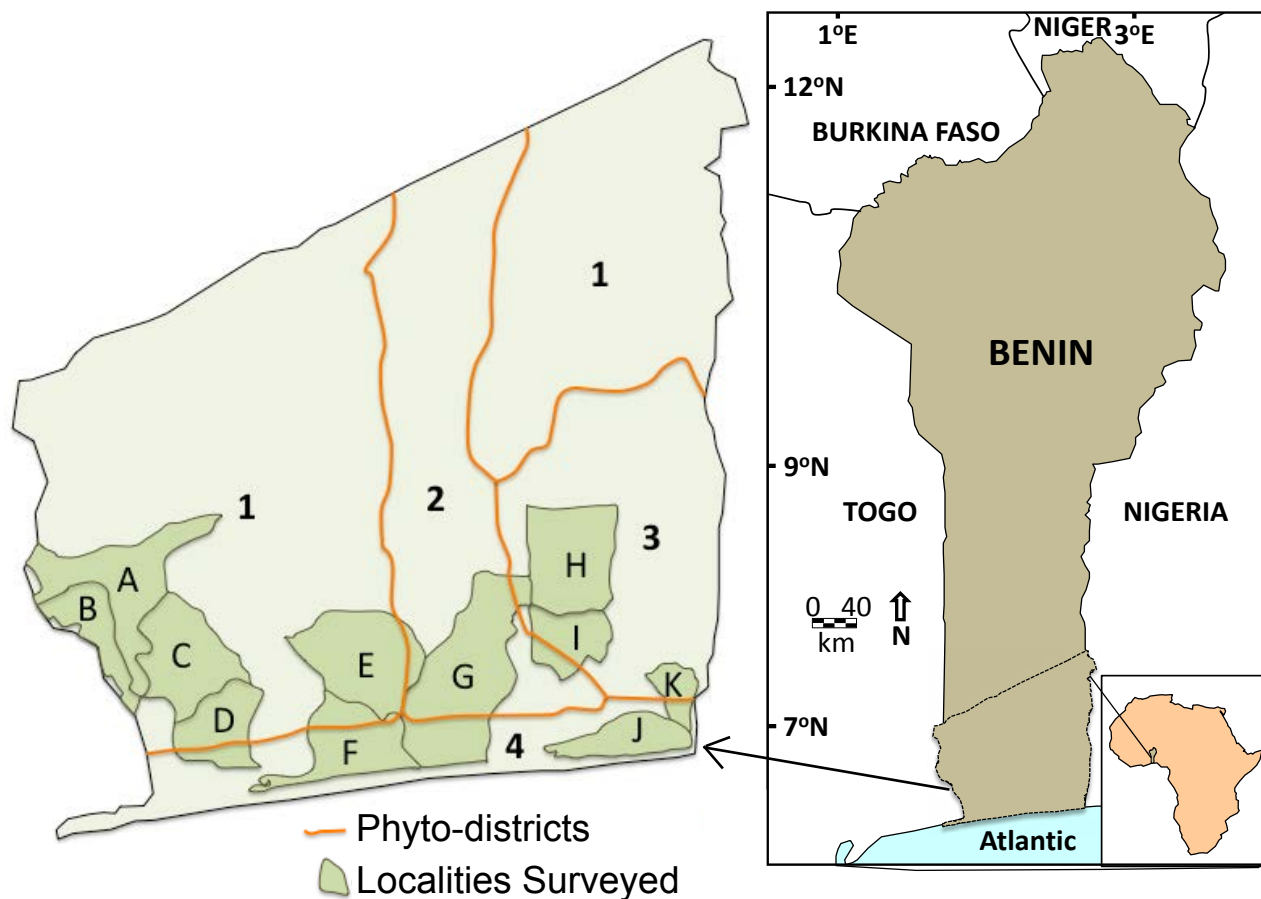


Figure 1. The study area in South Benin surveyed for ethnobotanical uses of *Moringa oleifera* Lam. Phyto-districts: 1) Plateau, 2) Ouémé, 3) Pobè, and 4) Coast. Guinea-Congolese Zone townships: A) Lokossa, B) Athiémè, C) Houéyogbé, D) Comé, E) Tori-Bossito, F) Ouidah, G) Abomay-Calavi, H) Adjohoun, I) Dangbo, J) Adjarra, and K) Sèmè-Kpodji.

Where n is the size of the sample and P is the proportion of informants who know and use the species. To compute the size of the sample, a brief pre-survey of 100 persons per locality was carried out. The pre-surveyed persons had to say whether they have used, at least once, a product of *M. oleifera*. Only the proportion of positive answers was considered. $U_{1-\alpha/2}$ is the value of the normal random variable where, for a probability value of $1 - \alpha/2$, $U^2 \approx 1.96$ with $\alpha = 0.05$. A 5% margin of error (d) was considered.

On this basis a total of 439 persons were interviewed, of which 201 were women and 238 were men. Individual semi-structured interviews were used to collect data from the sampled participants. However, some focus group discussions were also done to check the reliability of the information gathered during the individual interviews. The discussion groups were often composed of 5 to 7 individuals.

Data analysis

Data were encoded after counting survey forms. Frequencies were attributed to the various organs used for medicine purposes to assess their contribution. The consensus value of use-manner (CMU) was expressed for the medicinal uses by the formula $CMU = Mx / Mt$ (Byg & Baslev 2001). Where Mx is the number of people who quote a use-manner (recipe) for a given sickness and Mt is the total number of people who quoted any use-manner for this sickness. The CMU ranges between 0 and 1 to measure the degree of consensus on each recipe in traditional medicine and then can be used to assess the relative efficacy of each recipe, assuming that the more a recipe is commonly quoted, the more effective it is.

Table 1. Local names for *Moringa oleifera* Lam. in South Benin, West Africa.

Ethnicities	Local names	Literal translations
Aïzo	Kpatima ou kpatovigbé	Leaves of demarcation plants
Djerma	Sibkaali ou Zogala	Undetermined
Fon	Kpatimawiniwini	Demarcation plants with small leaves
Goun	Amaflinflin ou Kpatimaflinflin	Small leaves or demarcation plants with small leaves
Kotafon	Kpatoma ou kpaounbovi	Fencing tree
Sahouè	Kpatama	Fencing tree
Waci	Yovovigbé, yovovitin, kpatovigbé	Small leaves of demarcation plants for yovo (white people)
Xwla	Kutin ou amawiniwini	Plant with very small leaves
Yoruba	Ewé ilé	House tree

Results

Moringa oleifera is known under different local names (Table 1) depending on the socio-cultural group. These local names are generally derived from either the small size of leaves, its use as a demarcation plant, or the foreign origin.

Moringa oleifera common uses

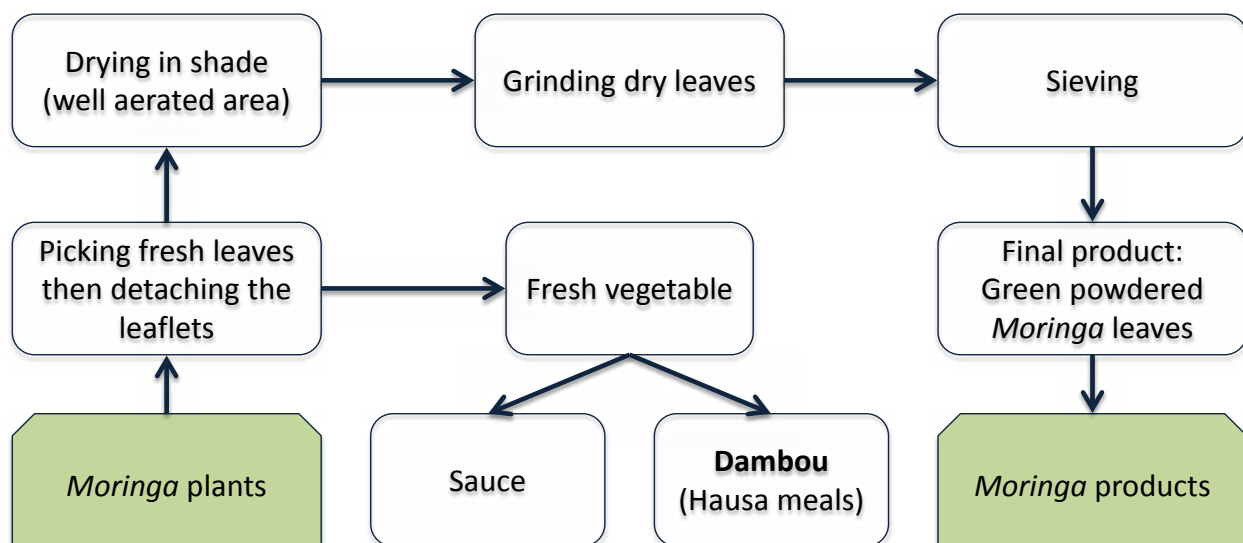
It was observed that the leaf is the most-used organ followed by the root, bark, seeds, and pods. The rural communities use the leaves as a vegetable and other meals or for medicinal purposes. The species is planted in gardens as a vegetable plant or in quickset hedges to delimit plots of land and houses or in plantations by those who market the leaves fresh or in the form of powder.

Consuming and processing *Moringa oleifera* leaves

Leaves are prepared for nutritional use according to two methods: leaves are consumed fresh as a vegetable or dried and reduced into powder. In the latter case it serves as nutritional powder recommended for children, pregnant women and nursing mothers, persons living with HIV/AIDS, or aging persons experiencing a nutritional deficit. The procedure of processing the leaves of *M. oleifera* is shown in Figure 2.

Medicinal uses of *Moringa oleifera*

Surveys revealed that *M. oleifera* is used to treat up to 34 diseases according to the local populations. Different parts of the *M. oleifera* tree are used for this purpose; leaves are the most used followed by roots and bark, with pods and seeds less utilized (Figure 3).

**Figure 2.** Processing of *Moringa oleifera* Lam. leaves in South Benin. Source: Ethnobotanical inquiries.

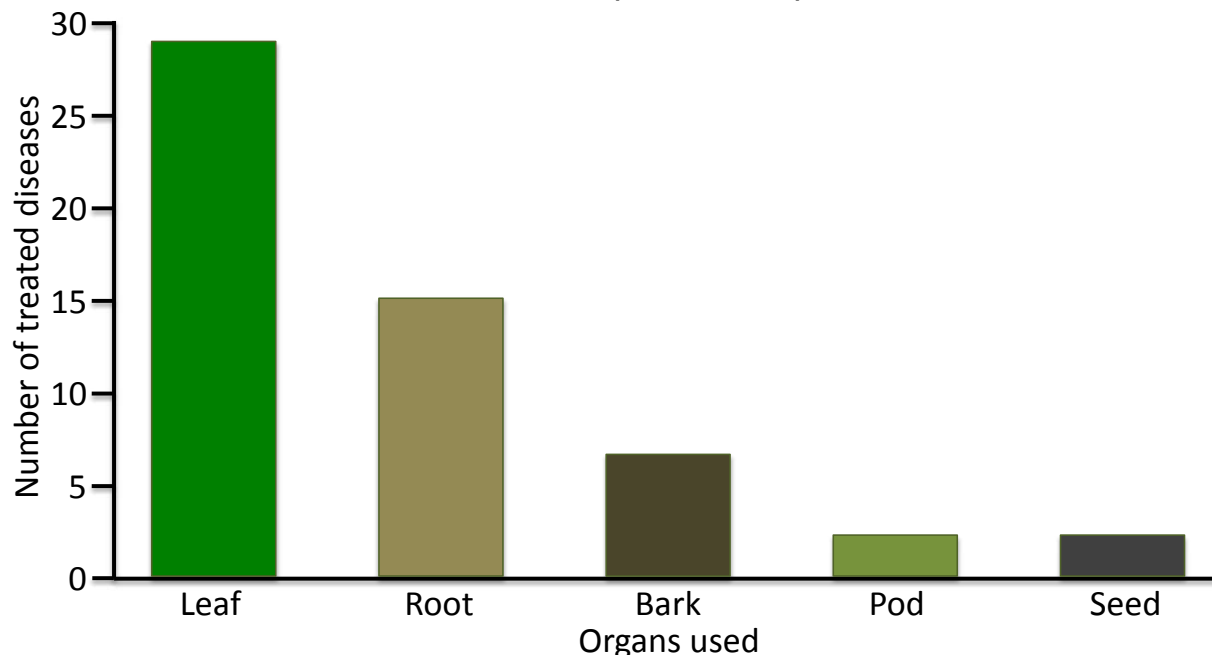


Figure 2. Contribution of *Moringa oleifera* Lam. organs in treatment of different illnesses in South Benin.

The choice of plant part depends on the disease to be treated, the mode of administration, and the additive chosen. Several recipes were recorded for the 34 illnesses, with a high consensus value of certain recipes showing the relative efficacy of those more commonly known and used among the populations. The manufacturing process-

es, the guidelines for use, and the consensus values are summarized in Table 2.

Other uses of *Moringa oleifera*

After processing (as outlined in Figure 2), the fresh leaf can also be fed to mammals such as pigs, rabbits, and

Table 2. Therapeutic uses of *Moringa oleifera* Lam. organs in South Benin. CMU = consensus value of use-manner (values range 0–1).

Parts used			
Illnesses treated	Recipes	Guidelines for use	CMU
Leaves			
Abscess	Ground leaf + potassium hydroxide	Apply on the abscess until well	1
Asthenia	Powder of leaves	Put in the meals (not very hot) in case of attack	1
Cough	Infusion of leaves + leaves of <i>Newbouldia laevis</i> (P.Beauv.) Seem. + lemon	Drink regularly	1
Gonorrhea oligospermia	Fresh leaves + 7 small hot peppers + salt + wine combined in a bottle	Drink one small glass of the potion in the morning and evening until 15 days after recovery	1
Hemorrhoids	Powder of leaves	Put in the meals (not very hot) regularly	1
Hernia	Root cut in small pieces + root of <i>Carica papaya</i> L. + slices of orange + seed of <i>Xylopia aethiopica</i> (Dunal) A.Rich. + white onion + seed of <i>Monodora myristica</i> (Gaertn.) Dunal (calabash nutmeg) + water	Drink 3 glasses/day for 30–45 days	1
High blood pressure	Powder of leaves	Put in the meals (not very hot) at will	1

Parts used			
Illnesses treated	Recipes	Guidelines for use	CMU
Immune deficiency caused by the HIV	Powder of leaves	Put in the meals (not very hot) regularly	1
	Fresh leaves	Eat regularly as vegetable	1
Infection	Dried leaves or powder of leaves + alcohol	Drink 3 small glasses/day in the morning, afternoon, and evening for 7–10 days	1
Infertility	Powder of leaves	Put in the meals (not very hot) until the conception	1
Intestinal worms	Powder of leaves	Put in the meals (not very hot) every day for 7 days	1
Varicella	Grind leaves and press out the juice + palm oil	Pass on the body of the sick child until totally healed	1
Fever	Grind, boil, or soak leaves in water	Bathe with the potion	1
	Grind fresh, carefully washed leaves; press out the juice	Drink 3 teaspoons/day of juice until recovered	0.05
Eyesight problems	Grind fresh, carefully washed leaves; press out the juice	Put some drops in the eyes	0.9
	Leaves + roots + bark + alcohol combined in a bottle	Drink one small glass of the potion morning and evening until improved	0.2
Icterus	Crushed leaves + milk “peak” + other species leaves	Drink the mixture for 10–15 days	0.89
Stomach pains	Powder of leaves	Put in the meals (not too hot) for 2–3 days	0.83
Malaria	Infusion of leaf + leaves of <i>Spondias mombin</i> L. + lemon	Drink regularly	0.78
	Ground leaves + little water	Drink regularly 3 small glasses/day until well	0.08
Headaches and migraine	Grind fresh, carefully washed leaves; press out the juice	Put some drops in the eyes or massage the forehead in case of pain	0.77
Typhoid fever	Infusion of leaf in association with other leaves	Drink regularly for 7–10 days	0.74
	Powder of leaves	Put in the meals (not very hot) until cure	0.17
	Grind leaves and press out the juice	Drink 3 teaspoons/day until well	0.22
Anemia	Crushed leaves + bissap + beer	Drink 3 small glasses/day at will	0.71
	Crushed leaves + water + 2 lumps sugar + condensed milk	Drink 3 small glasses/day at will	0.65
	Powder of leaves	Put in the meals (not very hot) regularly	0.16
Indigestion	Sauce with leaves	Consume at will	0.67
	Dried leaves + alcohol	Drink at will	0.29
Sexual weakness	Powder of leaves	Put in the meals (not very hot) at will	0.67
Diabetes	Powder of leaves	Put in the meals (not very hot) in case of attack	0.55
	Infusion of leaves	Drink regularly	
Flu and sinusitis	Grind fresh, carefully washed leaves; press out the juice	Put some drops of the juice in nostrils in case of attack	0.54
Otitis	Grind fresh, carefully washed leaves; press out the juice	Put some drops in ears morning evening for 5–7 days	0.44

Parts used			
Illnesses treated	Recipes	Guidelines for use	CMU
Dysmenorrhea	Powder of leaves	Put in the meals (not very hot) for 30–45 days	0.4
Roots			
Articular pains	Crushed root + lemon	Massage the painful joint with the paste until well	1
Dysentery	Crush fresh root and press out the juice	Drink 2 teaspoons/day for 5–7 days	1
Prostatitis	Root + hot pepper (crushed whole) + strong alcohol + roots of <i>Caesalpinia bonduc</i> (L.) Roxb.	Drink 3 small glasses/day for 45–60 days	1
Stomach pain	Powder of dried roots + water or alcohol or crushed fresh roots + alcohol	Drink 3 small glasses/day morning, afternoon, and evening until well	1
Swellings	Crush fresh root	Apply the paste to the swelling morning and evening until well	1
Tooth decay	Wash, scratch the root and cut it in small pieces	Put a piece on the decayed tooth in the evening at bedtime until well	0.90
Otitis	Crush fresh root and press out the juice	Put some drops in ears morning, afternoon, and evening until well	0.88
Headaches and migraine	Crush fresh root and press out the juice	Put some drops in the eyes and massage the forehead with it in case of attack	0.80
Dysmenorrhea	Cut root in small pieces + white onion + seed of <i>X. aethiopica</i> + cola nut + alcohol or water	Drink 3 small glasses/day in the morning, afternoon, and evening for 45–60 days	0.6
Flu and sinusitis	Scrape root and put in a handkerchief	Inhale the smell in case of attack	0.54
Sexual weakness	Root + hot pepper (crushed whole) + strong alcohol + roots of <i>C. bonduc</i>	Drink regularly at will	0.17
	Root + young leaves of <i>Coldenia procumbens</i> L. (crushed whole) + some slightly acidic water (“guissin”) and filter	Drink 3 small glasses/day at will	0.17
	Infusion of root + fresh groundnut + onion	Drink 3 small glasses/day at will	0.05
Fever	Crushed root + water	Bathe with the potion in case of attack	0.11
Bark			
Icterus	Infusion of bark + root + leaf + citronella	Drink regularly for 10–15 days	0.68
	Cut bark as chew stick	Chew on chew stick and swallow the juice for 10–15 days	0.16
Tooth decay	Cut bark as chew stick	Chew on chew stick and hold the juice for some time in the mouth morning and evening until well	0.39
Fever	Soak bark in water	Use water for bath for 3–5 days	0.15
Stomach pains	Cut bark as chew stick	Chew on chew stick and swallow the juice at will	0.18
	Infusion of bark + root of <i>Uvaria chamae</i> P.Beauv.	Drink at will	0.03
Malaria	Soak bark, collect the mousse, and add sugar	Drink 2 small glasses/day for 5–7 days	0.15

Parts used			
Illnesses treated	Recipes	Guidelines for use	CMU
Indigestion	Cut bark as chew stick	Chew on chew stick and swallow the juice morning, afternoon, and evening until well	0.11
Pods			
Malaria	Dry carefully washed pods without seed and soak it in water	Drink 3 glasses/day morning, afternoon, and evening 5–7 days	0.11
Fever	Soak pod in water	Bathe with it for 3–5 days	0.01
Seeds			
Diabetes	Remove the winged shell of the seed	Eat 2 kernels a day regularly	0.6
Sexual weakness	Remove the winged shell of the seed	Eat 2 kernels in the morning, afternoon, and evening at will	0.41

sheep, while powder is put in water for poultry. According to 49% of the population surveyed this mode of nutrition favors good growth of these animals, eases births, and improves the litter. Regularly drinking water with the powder of *M. oleifera* leaves protects poultry from diseases and favors bigger and more numerous eggs. In addition to these uses, the seeds of moringa are used to carry out rites for certain purposes, either to attract the opposite sex or clients, to protect oneself against witchcraft, or even to utter blessings on persons.

Discussion

Most of the local naming hints at the ancient use of the plant for the demarcation of fields and houses; they are thus generic names. None of the local naming is based on the food and medicinal uses, suggesting that these uses are relatively recent in the rural communities of the South Benin.

The use of *M. oleifera* products in traditional medicine and in human and animal nutrition is confirmed by most of the authors on the subject. The nutritional properties of leaves and seeds of *M. oleifera* were shown by Sreelatha and Padma (2009) and Afuang *et al.* (2003). Thirty-four diseases are treated with various products of *M. oleifera*, as shown by the works of several authors who provide a scientific basis of these uses (Anwar *et al.* 2006, Anwar *et al.* 2007, Ayanbimpe *et al.* 2009, Beltrán-Heredia *et al.* 2009, Gilani *et al.* 1994, Kalogo *et al.* 2000, Kumar *et al.* 2007, Lea 2010). The massive use of leaves in human and animal nutrition and in traditional medicine implies premature and continuing harvests, which constitutes a pressure on the foliar biomass and consequently on the species. As a result, the populations are not given enough time to flower and thus they fail to produce seeds. It was noticed that the efficacy of remedies quoted by the populations is not always relevant because of weak consensus values (<0.25) in some cases. However a weak consensus value is not always synonymous with ineffectiveness of the remedy,

because, for some diseases, only traditional practitioners have the proper knowledge of remedies and don't want to share their knowledge. This may explain the low consensus values of these recipes.

Our results did not reveal a developed trade with *M. oleifera*'s products. This is due to the fact that the cultivation of *M. oleifera* is not carried out on a large scale and the fresh leaves are largely consumed as vegetable-leaves. This business is thus little developed compared to that in Niger and Nigeria where leaves of *M. oleifera* are the subject of international trade, mostly during Muslim fasting periods. In fact, in 2010 the Cooperative League of the United States of America, which provides technical assistance to the production of *M. oleifera* in Niger, estimated that Niger imports up to 10,000 tons of dried leaves annually from Nigeria, although Nigeria also experiences high demand during the Muslim fasting period (Kimba *et al.* 2010). This constitutes a loss of income for Benin which, due to its geographical position, should be the main supplier of these nearby countries with high populations of Muslims.

Conclusion

Moringa oleifera is a botanical species well-known in Benin in the Guineo-Congolese area and appreciated for its leaves, roots, pods, seeds, and bark. The leaves are used by various ethnic groups as a source of food (vegetable-leaves). They are consumed fresh or reduced to powder. The various organs of the plant are used to help in the cure of various diseases such as venereal diseases, cardiovascular diseases, infectious diseases, tropical diseases, inflammatory complaints, oto-rhino-laryngological complaints, skin infections, digestive diseases, infertility disorders, etc. All the organs of the species are used to various degrees, and the leaf is the most used organ. The leaves are also used as fodder, and they are included in compounds used in animal production to increase the production.

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