Investigating the Use Profile of Kigelia africana (Lam.) Benth. through Market Survey in Benin.

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Research Article

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Abstract

The aim was to gather ethnobotanical knowledge on *Kigelia africana* in Benin where it is widely used in traditional medicine but receives little attention and recently recorded as threatened. A semi-structured questionnaire served to collect data from herbal traders. Thirty-six percent of respondents obtained parts of the species by purchase in their own markets and by travelling far. The same proportion travel very far before buying parts. None mentioned harvesting parts from wild populations. A high proportion of informants sold fruits and bark whereas a relatively low proportion of them sold fruits, bark and leaves. Bark was recorded as most sold followed by fruits. Respondents mostly confirmed the species scarcity. Thirteen diseases and disorders were recorded and the majority of traders mentioned the use of bark in treating stomach infections and gynecological disorders. Fruits were mainly used in magic rituals and stomach infections treatment. Five preparations were recorded and 54% of traders mentioned bark decoctions, 27% highlighted infusion of fruits in water. *Kigelia africana* is important in local ethnomedicine; harvesting and trade of its parts are threats and urgent conservation tools are needed.

Introduction

Medicinal plants are so important for human life that it is necessary to investigate ethnobotanical knowledge on the medicinal and medico-magical use of plant species. Cunningham [1] reported that 70 to 80% of the world population use plants for their primary healthcare. Furthermore, plant species harvested from wild populations serve as raw materials for commercial pharmaceutical factories and for local informal trade [2]. Medicinal plants are globally valuable sources of herbal products but many wild populations are under threat and are disappearing at a high speed [3]. The same authors stated that more than one-tenth of plant species are used in drugs and/or health products. Consequently, some authors argue that sustainable harvest is the most important conservation strategy for wild-harvested medicinal species given their contributions to local economies and their long term value to harvesters [4]. Medicinal plants are receiving more attention in many parts of the world. For instance, it has been reported by Chen et al. [3] that China and India have the highest numbers of medicinal plants used, with 11,146 and 7,500 species, respectively.

Regarding the important historical and current use of medicinal plants by African populations, there is a need to undertake research on the medico-magic exploitation of plants species. According to van Andel et al. [5], maintaining cultural identity and resorting to herbal medicine in case of illness motivates migrants to continuously exploit medicinal plants of their origin during their stays in Europe and the United States. In Africa as elsewhere, medicinal plants are collected from various types of plant communities. For example, plants are harvested from sacred groves in India [6], and termite mounds for medicinal and medico-magic purposes in Benin [7]. The medicinal use of mangrove phytodiversity has recently been reported by Dossou Yovo et al. [2].

*Kigelia africana* (Lam.) Benth, sausage tree, belonging to the Bignoniaceae botanical family, is a tree with a low branches, up to 10–12 (-20) m high which establishes in Sudanian and and Guinean savannahs
and in some semi-deciduous forests, mostly on well-drained lands [8]. In the African pharmacopoeia, this species is used in treating different pathologies [9]. Singh et al. [10] also reported the use of *K. africana* in treating skin diseases and other pathologies. In Zimbabwe, bark of the species is used to relieve toothache [11]. The antioxidant, anti-inflammatory, and anti-cancer activities of extracts of the plant have recently been stated [12–13]. Despite much scientific effort, there is a need to conduct more research and to scientifically validate other traditional uses on *K. africana* [14]. Although *K. africana* has recently been recorded among plant species used to treat sterility of women in Benin [15], this species has received very little attention in Benin. *Kigelia africana* is widely used to treat diabetes in Benin where it is recorded as a threatened species [16]. The aim of this research was to assess the use profile of *K. africana* through an ethnobotanical market survey in Benin. This information will contribute to acknowledge the importance of *K. africana* to local populations.

**Material And Methods**

Our study was submitted to and approved by the head of our research institution, Laboratory of Applied Ecology of the Faculty of Agronomic Sciences of University of Abomey-Calavi, Benin who participated in this research, for ethics for ethnobotanical investigations through market surveys. Indeed, the study protocol as well as the full manuscript received the ethical clearance of the Scientific Council of the University of Abomey-Calavi. The aim of our research was explained to the responsible of each market in order to obtain the approval to conduct surveys and all market responsible that we met gave their verbal approval. Similarly, the aim of the study was explained to each trader to get the verbal consent to participate in the research and the informed consent was obtained from all participants. In six markets, based on semi-structured questionnaires, the ethnobotanical uses of *K. africana* were investigated. Surveys were undertaken in some of the most populated towns of southern Benin, and with herbal medicine traders in these markets. These were the Pahou, Zobê and Kpassê markets in Ouidah District, with 445 inhabitants/sq km (the Atlantic Department), the Cococodji market in the Abomey-Calavi District, 1,010 inhabitants/sq km (the Atlantic Department), and Vêdoko and Dantokpa markets in Cotonou district with 8,595 inhabitants/sq km (Department of Littoral). Six traders were interviewed per market. Thirty-six herbal traders were consulted for marketing of medicinal plants, as well as advising on these plants use to multiple customers. All methods were performed in accordance with the relevant guidelines and regulations by following the editorial and publishing policies of Scientific Reports (Nature). Various percentages of traders who mentioned species parts and diseases were calculated using the formula

\[
\frac{\text{Number of respondents mentioning } X}{\text{Total number of respondents}} \times 100.
\]

**Results**
1. Sources of *Kigelia africana* parts sold by medicinal plant traders

Table 1 shows that 36% of respondents confirmed that they purchase *K. africana* plant parts both in the markets where they sell them and after travelling far to make the purchases.

| Sources of *K. africana* parts purchase | In their market and travelling far | Only travelling very far | Exclusively in their market | In their market and nearby market |
|----------------------------------------|----------------------------------|--------------------------|----------------------------|----------------------------------|
| Percentage of respondents mentioning (%) | 36 | 36 | 18 | 10 |

It should be noted that the same fringe of traders mentioned how they only travel very long distances to buy the plant organs they sell. They travel at least 25 km before purchasing their goods from rural areas as well as to other large markets. A relative minority indicated that they obtained these plant organs only from the market where they sold them, and a very small proportion said they obtained plant organs from local and nearby markets.

It is important to note that none of the plant traders reported harvesting the species in the wild despite the proximity of some of the markets surveyed to old fallow land and forests accessible to local people.

2. Ranking and availability of *Kigelia africana* parts sold by traders

Herbal traders mainly sell the bark, fruits and leaves of *K. africana*.

The bark, fruits and leaves of *K. africana* are the most commercialized. The bark is locally called "Yamblikpogoto" in Fon and "Ekpakpahoundoror" in Yoruba. While the whole tree is called "Yamblikpo" in Fon and "Iguikpahoundoror" in Yoruba, its fruits are respectively called "Anonkan" or sometimes "Yamblikpo sin atississin" and "Kpahoundoror".

According to Table 2, the vast majority of the informants sell only the fruits and bark, while a minority sells fruits, bark and leaves of *K. africana*. No trader sells only fruit, only bark or only leaves. Table 3 shows a majority of the interviewees citing bark as the organ most in demand, followed by fruits. Bark and fruits are cited by a minority as being sold in equal parts, while leaves are cited as the least sold part.
Table 3  
showing the ranking of most sold parts of *K. africana*

| Parts mentioned as most sold | Bark | Fruits | Bark equal to fruits |
|------------------------------|------|--------|---------------------|
| Percentage of traders (%)    | 63   | 23     | 14                  |

Based on Table 4, most of traders highlighted that *K. africana* parts available for sale have become very scarce in recent years and a low proportion of them reported availability of the species throughout the year as well as availability during the rainy season.

Table 4  
showing traders’ perception of parts availability in recent years

| Traders’ perception | Parts very scarce | Parts available throughout the year | Parts available in rainy season |
|---------------------|-------------------|-------------------------------------|--------------------------------|
| Percentage of traders (%) | 64 | 18 | 18 |

3. Diversity of diseases, disorders and rituals treated using the species parts according to traders

Globally, thirteen (13) diseases, disorders and magic rituals were recorded. While Eight (8) diseases and disorders are treated with bark, seven (7) diseases, disorders and magical rituals are treated with fruit. Leaves are reported only used in magic rituals. Generally, the use of bark or fruit are specific in curing gynecological disorders and leg infections.

In addition to these diseases, bark of *K. africana* serves to treat stomach infection, stomach ache, anemia during women’s menstrual periods, vomiting, cough and constipation. The greatest percentage of herbal traders (72%) mentioned the use of bark to treat stomach infections followed by gynecological disorders (18% of respondents). Regarding fruit utilization, apart from the two common diseases, treatment of hemorrhoids and obesity, stimulation of breast milk production, wound healing and magic rituals were all reported. The use in magic rituals is locally called “*Vossissa*” or “*Vodounsakpata do ayî*” in Fon, and people put fruits of *K. africana* on firewood gathered in the field or bush to deter others from stealing it. Regarding the importance of fruit use, 27% of herbal traders mentioned the use of fruits in magic rituals followed by stomach infections reported by 18% of them.

4. Diversity Of Preparation Modes According To Herbal Traders

In order to treat the diseases and disorders, and for ritual uses, five (5) types of preparation were reported to treat various pathologies, building decoction, infusion in a traditional local alcoholic beverage locally called “*Sodabi*” in Fon, infusion in water, the direct use of the entire part, and its use as a powder. The first two modes are used for bark whereas the remaining modes as well as decoction are used for fruits. So, decoction was the only common preparation mode recorded for bark and fruits. The leaves, were evoked
as an integral part of the rituals. With regards to the importance of each type of preparation, the greatest percentage of herbal traders (54%) mentioned the use of bark as decoction while infusion of fruits in water was reported by 27% of respondents followed by decoctions and use of the entire plant in rituals (18% of informants for each). It should be noted that the fruit is ground and used to bandage lesions, which was reported by 9% of the medicinal plant traders surveyed.

Discussion

1. Sources of *Kigelia africana* parts sold by herbal traders

A large part of the traders are obliged to travel long and very long distances to acquire the plant organs. Respondents highlighted a critical scarcity of the species in the last few decades. This was confirmed by the fact that none of them mentioned collecting the plant from wild populations. According to Chen et al. [3], medicinal plant resources are being harvested in increasing volumes, largely from wild populations. So, if *K. africana* were readily available in the wild, traders might be expected to collect its parts free of charge for sale. Moreover, some surveyed markets are close to natural forests and old fallows. In addition, the low proportion of herbal traders who mentioned that they are exclusively provided with the species parts in their own markets is a real proof of scarcity. The limitation of this research regarding the sources is that a lot of sellers in the markets may actually harvest this plant from the wild populations but did not admit it since it is scarce.

2. Ranking of *Kigelia africana* parts sold by traders

Many traders sold fruit and bark of the species and in a relatively small proportion. The organs of *Kigelia africana* were often claimed and trade concentrated on the bark, followed by the fruit. The bark harvesting is a serious damage to the species, as indigenous people communities harvest it without taking into account the possible damage to the tree. Additionally, the fruits and leaves collection, as well as the flowers cutting sensitively reduces the reproductive capacity of the species.

Vodouhè et al. [17] confirmed that non-timber forest species cannot be sustainably harvested in the absence of yield studies, harvesting adjustments and monitoring of regeneration. Some years ago, Gaoue and Ticktin [18] noticed a negative impact of bark and foliage harvest on the reproductive performance of *Khaya senegalensis* in Benin. Compared to practices in South Africa, bark is ranked third among the most frequently sold parts of a range of medicinal plants, after roots and bulbs [16]. Similarly, Dossou-Yovo et al [7] examining the uses of medicinal plants related to termite mounds in northern Benin, found that bark was the most commonly used part, followed by leaves. The present results also confirm the work of Gaoue and Ticktin [18] who stated that bark of *K. senegalensis* plays a decisive role in providing medicines to the indigenous populations of Benin.

3. Diversity of illnesses disorders treated, and rituals according to traders
Thirteen (13) diseases, disorders and magic rituals were recorded in this study. This corroborates the findings that African peoples have appropriate knowledge on medico-magic uses of plant species. In other words, the connection between African populations and the uses of medicinal plants to cure illnesses dates from the far past. Among 30 affections and disorders treated using 22 plant species listed by Dossou-Yovo et al. [7], the present study revealed 13 illnesses and disorders cured, and rituals performed using parts of only one plant species, *K. africana*. This finding suggests the great importance of *K. africana* in the local population’s life. *K. africana* is used in African folk medicine and also in Indian traditional medicine showing convergence in the uses of plant parts and diseases treated with it [9–11]. This study focused only on knowledge on *K. africana* of herbal medicine traders; there is a need to conduct other investigations concerning the species use profile from the perspective of traditional healers throughout the country.

4. Diversity Of Preparation Modes

According to Yang and Ross [20], out of all the traditional recipes in China, decoctions show the highest efficacy of action and their preparation requires a reasonable amount of time. Five types of preparation are involved in this study proving the richness diversity of medicinal and medico-magic knowledge of the *K. africana* traders. According to Yang and Ross [20], out of all the traditional recipes in China, decoctions show the highest efficacy of action and their preparation requires a reasonable amount of time. When investigating ethnopharmacological uses of seven medicinal plants in Mali, Togola et al. [21] reported decoction of the leaves as the main form of preparation and leaf powder was mostly used for infusions. Similarly, the present study found decoctions as the predominant type of preparation, indicating the efficacy of decoctions in herbal medicine. The infusion of fruit, which is the second most important, reinforces previous results which stated how decoction and infusion are the main and more effective forms. Indeed, Jackson and Beckett [11] reported from the Zimbabwe, the use of decoctions of *K. africana* bark to treat dental pain, as well as infusions of bark and crushed fruit in the treatment of diseases.

Conclusion

*Kigelia africana* is highly requested for phototherapy in southern Benin. Parts of the species are sought after either for their quality and therapeutic effectiveness or their abilities to confront many diseases, disorders and mystical problems. Harvesting of plant parts from the wild threatens the survival of the tree and there is a need to undertake conservation of the species to allow its long-term sustainable exploitation.

Declarations

*Ethics approval and consent to participate*
Our study was submitted to and approved by the head of our research institution, Laboratory of Applied Ecology of the Faculty of Agronomic Sciences of University of Abomey-Calavi, Benin who participated in this research, for ethics for ethnobotanical investigations through market surveys. Indeed, the study protocol as well as the full manuscript received the ethical clearance of the Scientific Council of the University of Abomey-Calavi. The aim of our research was explained to the responsible of each market in order to obtain the approval to conduct surveys and all market responsibles that we met gave their verbal approval. Similarly, the aim of the study was explained to each trader to get the verbal consent to participate in the research and the informed consent was obtained from all participants.

Consent for publication

Not applicable.

Availability of data and materials

Please contact author for data requests.

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Competing interests

The authors declare that they have no competing interests.

Authors’ contributions

D.Y.H.O. was the originator of the research. He wrote the first draft of the research proposal, participated in the data collection and analysis as well as manuscript writing and its submission. He corrected the manuscript following reviewers’ comments.

V.F.G. participated in proposal writing, collaborated during data collection and contributed to analysis, manuscript writing and editing. He contributed to the manuscript correction following reviewers’ comments.

K.V. participated in the manuscript reading and editing. He contributed to the manuscript correction following reviewers’ comments.

S.B., as head of the laboratory, he read, edited and commented on the manuscript for its improvement. He provided valuable comments that helped improve the quality of this manuscript. He read, and gave approval of the revised version of the manuscript before its submission. All authors reviewed the manuscript.

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