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Ethnobotanical Study of Plants Used to Treat Erectile Dysfunction in Cotonou and Abomey-Calavi (Benin)

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Abstract

Introduction: Erectile dysfunction represents a major public health problem in Benin, with a prevalence ranging from 15.2% to 31.7% depending on age groups. Faced with the inaccessibility of conventional pharmaceutical treatments, the Beninese population massively resorts to traditional phytotherapy. This study aims to evaluate the therapeutic potential of plants traditionally used in the municipalities of Cotonou and Abomey-Calavi to treat erectile dysfunction. **Materials and Methods:** An ethnobotanical survey was conducted from October to December 2022 among 29 herbalists from traditional markets. The TPMR (Triplet's Purchase of Medicinal Recipes) methodology was applied, consisting of three successive visits spaced one week apart to progressively identify the most effective plants according to traditional practitioners. **Results:** The study identified 47 plant species belonging to 28 botanical families during the first visit, which was reduced to 13 species during the third visit. The three most frequently cited species are *Acridocarpus smeathmanii* (26.92%), *Garcinia kola* (11.54%), and *Voacanga africana* (11.54%). The most represented botanical families are Leguminosae (21.27%), Apocynaceae (12.76%), and Annonaceae (6.38%). Roots constitute the most used plant parts (61.70%), mainly prepared as decoctions or macerations. **Conclusion:** This first systematic survey reveals the richness of the Beninese pharmacopoeia for treating erectile dysfunction. The identification of the three main species offers a promising direction for future pharmacological research. However, in-depth scientific studies, including phytochemical analyses, pharmacological evaluations, and clinical trials, are essential to validate the efficacy and ensure the safety of these plants before any therapeutic application.

Keywords

Erectile Dysfunction, Medicinal Plants, Cotonou, Abomey Calavi

1. Introduction

Erectile dysfunction (ED) is defined as the consistent inability to achieve or maintain an erection sufficient for satisfactory sexual performance. According to Natchagandé *et al.* [1], the prevalence of erectile dysfunction in Benin ranges from 15.2% to 31.7% depending on age groups, with higher rates observed in men over 40 years old. This prevalence is comparable to global estimates, which range from 10% to 52% worldwide, but represents a significant public health concern in the Beninese context due to limited access to conventional medical treatments.

In Benin, due to its high prevalence [1] and adverse psychosocial effects [2], erectile dysfunction is a problem that deserves attention. The socioeconomic burden of ED in sub-Saharan Africa is particularly pronounced, as conventional pharmaceutical treatments remain largely inaccessible due to cost and availability constraints. To deal with it, the majority of Beninese, like populations in other developing countries, turn to traditional medicine, particularly herbal medicine [3].

Despite the widespread use of traditional medicinal plants for ED treatment in Benin, there remains a significant knowledge gap regarding the systematic documentation and scientific evaluation of these practices. While several ethnobotanical studies have been conducted in neighboring West African countries, no comprehensive study has specifically investigated the plants used by traditional healers in the Cotonou and Abomey-Calavi regions for ED treatment. This study addresses this gap by providing the first systematic ethnobotanical survey of ED-treating plants in these municipalities, employing a rigorous methodology to identify the most promising species for future pharmacological investigations.

2. Materials and Methods

The survey was conducted from October to December 2022. The investigative method adopted for the ethnobotanical survey was that of Triplet's Purchase of Medicinal Recipes from market herbalists, as described by several authors [4] [5].

In this method, the same herbalist was visited three times in succession to purchase three medicinal recipes for the treatment of erectile dysfunction. Two consecutive visits were separated by a one-week interval.

At the first meeting, the herbalists were asked to propose an herbal remedy to treat a mystery patient of around 40 years old suffering from erectile dysfunction. All herbal recipes have been purchased. This visit serves to establish contact and build a relationship of trust with the herbalists.

On the second visit, the herbalists had to reduce the number of plants included in their recipe by eliminating those that were least effective. Finally, on the third

visit, he asked them to reduce the number of plants to a strict minimum to ensure that the recipe would still work, always concentrating on the most effective plants.

For each purchase, information on the local language names of the plants, the method of preparation, and the part of the plant used was requested and recorded for each recipe using a survey form. This information was collected using the Kobocollect application.

2.1. Identification of Plant Species Collected

All plant species proposed by the respondents were purchased. Samples were identified (scientific name, botanical family) using the analytical flora of Benin by Akoègninou *et al.* [6]. The botanical nomenclature of "The Plant List" database (http://www.theplantlist.org/) was used to certify the complete identification of all medicinal plants listed in this study.

2.2. Statistical Data Analysis

Data recorded on the Kobocollect application were subjected to analysis using SPSS 26.0 and GraphPad Prism 7 software. Quantitative descriptive and inferential statistics were used to analyze socio-demographic data. Ethnopharmacological data were analyzed using Citation Frequency (CF).

The frequency of citation for each of the species surveyed was determined by the formula used by several authors [4] [5] [7]-[9]:

$$FC = NP/NT$$

NP: Number of times the plant in question is cited; **NT**: Total number of citations for all plants.

3. Results

3.1. Socio-Demographic Data

A total of 29 market herbalists took part in the study. They were all female and came from different socio-cultural groups, the most represented group being the Fons (80%), followed by the Nagos (16%) and the Adjas (4%). In terms of age, the most represented group was between 31 and 40 (**Figure 1**).

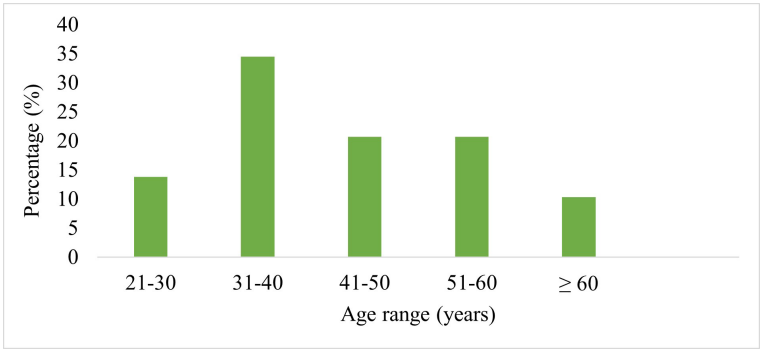

Figure 1. Distribution of herbalists by age group.

Similarly, the majority of herbalists surveyed (82.76%) have more than 05 years of professional experience (Table 1).

Table 1. Distribution of herbalists according to their professional experience.

Experience (years)	Number (n)	Percentage (%)
1 - 5	05	17.24
5 - 10	14	48.28
10 - 15	04	13.79
15 - 20	02	06.90
20 - 25	02	06.90
25 - 30	02	06.90
Total	**29**	**100.00**

3.2. Ethnobotanical Data

The information gathered covered a wide range of recipes and medicinal plants. After the first visit, a total of 47 medicinal plant species were identified for use in 31 recipes. These plants belong to twenty-eight botanical families, with forty-two genera and forty-three species. Following the second visit, the number of plants was reduced to twenty-three. The third visit recorded a final total of 13 medicinal plants (Table 2, Figure 2).

Table 2. Medicinal plants identified after the 3rd visit with preparation methods and plant parts used.

N˚	Scientific name	FCR (%)	Plant parts used	Preparation methods
1	*Acridocarpus smeathmanii*	26.92	Roots, bark	Decoction, maceration in palm wine
2	*Garcinia kola*	11.54	Seeds	Chewed fresh, powdered and mixed with honey
3	*Voacanga africana*	11.54	Root bark, seeds	Decoction, alcoholic maceration
4	*Caesalpinia bonduc*	07.69	Seeds	Ground into powder, mixed with local gin
5	*Carissa spinarum*	07.69	Roots	Decoction, maceration
6	*Mondia whitei*	07.69	Roots	Chewed fresh, decoction
7	*Bridelia ferruginea*	03.85	Root bark	Decoction
8	*Carpolobia lutea*	03.85	Roots	Decoction, maceration
9	*Morinda lucida*	03.85	Leaves, bark	Decoction, infusion
10	*Olax subscorpioidea*	03.85	Roots	Decoction
11	*Securidaca longipedunculata*	03.85	Root bark	Decoction, powder mixed with food

Continued

12	*Uvaria chamae*	03.85	Root bark	Decoction, maceration
13	*Zanthoxylum zanthoxyloides*	03.85	Root bark	Decoction, chewed fresh

The plant species most popular with herbalists are *Acridocarpus smeathmanii*, *Garcinia kola* and *Voacanga africana*. Various plant organs or parts are used in the preparation of recipes. The most commonly used are roots (61.70%), followed by stems and seeds. Moreover, of the 28 botanical families listed, the most commonly used were Leguminuseae, Apocynaceae and Annonaceae.

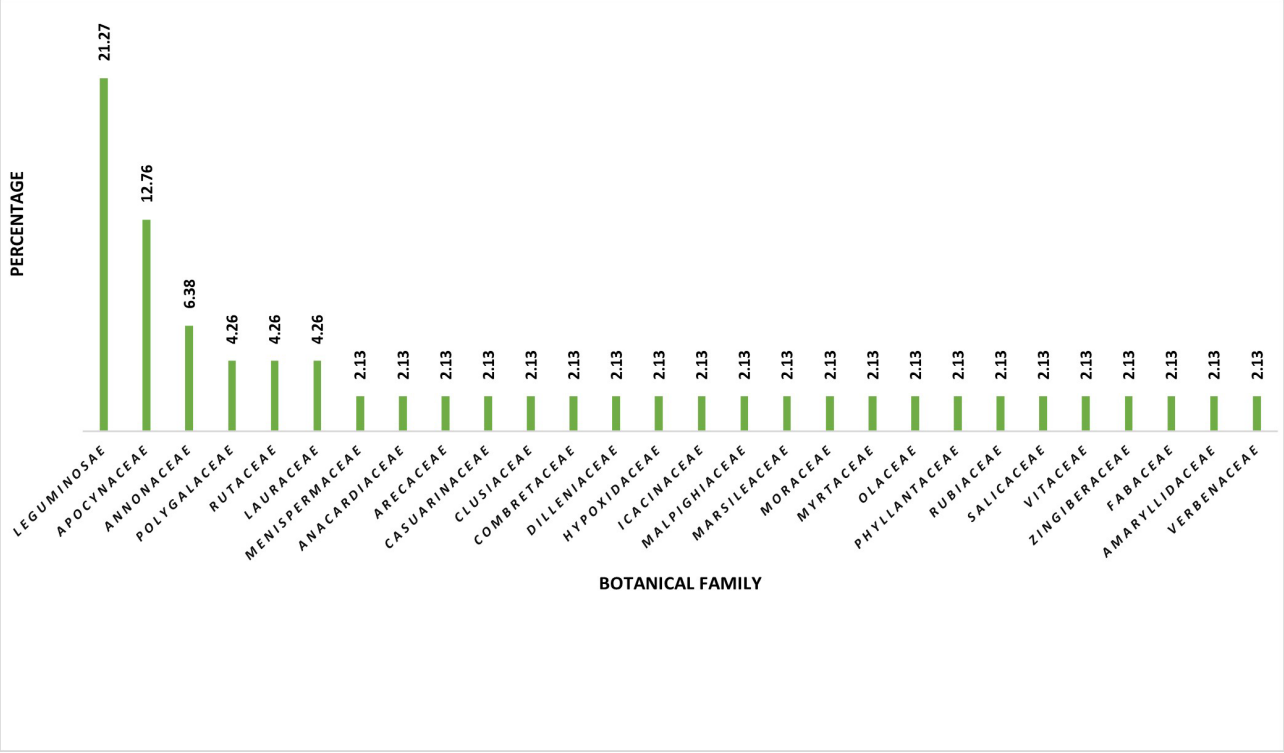

Figure 2. Distribution of botanical families by RCF.

3.3. Phytochemical Considerations of the Most Commonly Used Plants

Based on existing literature, the three most frequently cited plants contain bioactive compounds that may explain their traditional use in ED treatment.

Acridocarpus smeathmanii: This plant contains phenolic compounds, including flavonoids and tannins, which have been associated with vasodilatory effects. The presence of alkaloids and saponins has also been reported, compounds known for their potential effects on smooth muscle relaxation and blood circulation.

Garcinia kola: The seeds contain biflavonoids such as kolaviron, which possess antioxidant and anti-inflammatory properties. These compounds may contribute to improved endothelial function and nitric oxide bioavailability, mechanisms

crucial for erectile function. Additionally, the presence of caffeine and theobromine may contribute to its stimulant effects.

Voacanga africana: This species is rich in indole alkaloids, particularly voacangine and voacamine, which have been shown to possess cardiovascular and neurological activities. These alkaloids may influence neurotransmitter pathways involved in sexual function and penile blood flow regulation.

4. Discussion

In our study, the age range most represented among herbalists was 31 to 40 (34.48%), followed by 41 to 50 and 50 to 60, with 20.69% each. These results confirm that in Africa, as elsewhere in the world, the practice of traditional medicine is generally entrusted to mature individuals, judged to be more capable because they are more experienced.

On the other hand, all our herbalists were female, in total contrast to Kattuoa *et al.* [10] (in Jordan), where herbalists are exclusively male. This illustrates the cultural differences between the Middle East and Africa. Indeed, while in sub-Saharan Africa trading is the preserve of women, in Arab countries it is an activity reserved for men.

The families most represented in our study were Leguminosae (21.27%), Apocynaceae (12.76%), and Annonaceae (6.38%).

The predominance of *Acridocarpus smeathmanii* in our study (26.92% citation frequency) is particularly noteworthy. This plant belongs to the Malpighiaceae family and has been traditionally used across West Africa for various medicinal purposes. The high citation frequency suggests strong cultural consensus regarding its efficacy. Preliminary phytochemical studies indicate the presence of bioactive compounds that could theoretically support erectile function through vasodilation and improved blood flow mechanisms [7] [8].

The significant citation of *Garcinia kola* (11.54%) aligns with its widespread use across sub-Saharan Africa as an aphrodisiac. The biflavonoid compounds in *G. kola* seeds, particularly kolaviron, have demonstrated antioxidant properties that may protect against oxidative stress-induced endothelial dysfunction, a key pathophysiological mechanism in ED. Furthermore, the stimulant properties of its methylxanthine content may contribute to increased libido and sexual performance [7] [8].

Voacanga africana, with equal citation frequency to *G. kola* (11.54%), represents another promising candidate. The indole alkaloids present in this species, particularly voacangine, have been studied for their cardiovascular effects. These compounds may influence the nitric oxide-cGMP pathway, which is fundamental to the physiological mechanism of penile erection. The traditional preparation methods involving root bark and seeds align with parts of the plant known to contain the highest concentrations of these bioactive alkaloids [7] [8].

Certain plant species belonging to these botanical families are used in other countries for the treatment of erectile dysfunction. These include Leguminosae in

the Democratic Republic of Congo (DRC), according to studies by Ipona *et al.* [11] and Mbanga Mbola *et al.* [12]. Apocynaceae are also used in the DRC by the Bapedi of the Limpopo region of South Africa [13].

The cross-cultural use of plants from the Leguminosae family for ED treatment across different African regions suggests the presence of conserved bioactive principles within this botanical family. Plants in this family often contain isoflavones and other phenolic compounds that can act as phytoestrogens, potentially influencing hormonal balance and vascular function. The widespread traditional use of Apocynaceae species, particularly those containing cardiac glycosides and indole alkaloids, may be attributed to their effects on cardiovascular function, which is intrinsically linked to erectile performance.

It is therefore possible that plant species belonging to these botanical families share phytochemical groups whose pharmacological action is of interest in the treatment of erectile dysfunction [11]-[13].

The preparation methods documented in this study reveal important insights into the traditional understanding of optimal bioactive compound extraction. The predominant use of decoctions (water-based extractions) for most plants suggests that the active compounds are likely water-soluble or can be effectively extracted through thermal treatment. The use of alcoholic macerations, particularly for *Voacanga africana*, indicates traditional knowledge of alcohol's superior extraction efficiency for alkaloids and other lipophilic compounds.

The practice of combining plant materials with palm wine or local gin may serve multiple purposes: these alcoholic beverages may act as extractive solvents, preservatives, and potentially synergistic agents that enhance the bioavailability or efficacy of the active compounds [4] [5] [9].

Finally, several of the 13 plant species identified during the last visit to herbalists have documented use by other authors for the treatment of erectile dysfunction. These are: *Garcinia Kola* and *Mondia Whitei*, which are plants used in the treatment of erectile dysfunction in the DRC [11], as well as *Carissa spinarum*, which is used in Ethiopia [14] in the treatment of male sexual disorders. The use of these plants by different peoples, separated by thousands of kilometers, is a strong argument in favor of their efficacy in the treatment of erectile dysfunction. These plant species probably carry substances that stimulate erections in men.

While this study provides valuable ethnobotanical data, several limitations must be acknowledged. The reliance solely on herbalist testimony without clinical validation represents a significant limitation. Future research should include in vitro and in vivo pharmacological studies to validate the traditional claims. Additionally, safety profiles of these plants need to be established through toxicological studies before any clinical application can be considered. The absence of quantitative phytochemical analysis in this study represents another limitation. Future investigations should include detailed phytochemical screening and quantification of bioactive compounds in the most frequently cited species. This would provide a scientific foundation for the standardization of preparations and dosage

recommendations [3] [6].

5. Conclusion

This study highlighted the wide variety of plants with a potentially favorable effect on erectile dysfunction included in the Beninese pharmacopoeia. The identification of *Acridocarpus smeathmanii*, *Garcinia kola*, and *Voacanga africana* as the most frequently cited species provides a focused direction for future pharmacological research. The documented preparation methods and plant parts used offer valuable insights into traditional pharmaceutical practices that could inform modern drug development approaches. This represents a first step towards the production of local, effective solutions for this ailment. However, before this step can be taken, in-depth research into the efficacy and safety of these plants is essential. Future studies should prioritize comprehensive phytochemical analysis, pharmacological evaluation, and clinical trials of the most promising species identified in this survey.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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