



Ethnobotanical Survey and Phytochemical Screening of Some Plants used in the Management of Erectile Dysfunction in Bwatun (Mali)

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ABSTRACT

Erectile Dysfunction (ED) is a sexual disorder that has a strong impact on the patient's life quality and can threaten the stability of the couple's relationship. The current study aimed to document medicinal plants used in the management of erectile dysfunction in Bwatun, Mali. An ethnobotanical survey was conducted among twenty traditional practitioners using a semi-structured interview. Then, a phytochemical screening using standard methods was carried out on the three most cited plants. From the analysis of the survey sheets, 16 plant species belonging to 11 families were recorded. Fabaceae family represented the most cited with 31.25%, followed by Poaceae (12.50%). About plant parts, roots were the most used organs with 45%. The commonly used methods of preparation were: chewing (43.75%) and decoction (37.50%); the method of administration was oral exclusively. Phytochemical analysis of the three most cited plants (*Tamarindus indica* L., *Guiera senegalensis* J.F. Gmel and *Ximenia americana* L.) revealed the presence of secondary metabolites such as alkaloids, coumarins, saponins, tannins, terpenes, flavonoids and reducing sugars that support the use of these plants in the management of erectile dysfunction.

Keywords: Medicinal plants, Erectile dysfunction, Phytochemistry, Bwatun-Mali.

INTRODUCTION

Erectile dysfunction (ED) is defined as "a persistent or recurrent inability for a man to achieve or maintain an erection of the penis sufficient to allow sexual activity" [1,2]. ED is a sexual disorder that has a strong impact on the patient's life quality and can threaten the stability of the couple's relationship [3]. The prevalence varies from country to country and can be attributed to different risk factors and living conditions such as obesity, diabetes, dyslipidemia, metabolic syndrome and unhealthy lifestyles such as lack of physical exercise, social problems and smoking [4]. Worldwide, an estimated 150 million men suffer from ED, this figure is expected to double by 2025 and the majority of cases will be recorded in developing countries [5].

Many treatments with synthetic molecules are currently available to alleviate these disorders, but their ability to cause serious undesirable side effects: such as vision disorders, heart disorders, give a new impetus to natural substances [6-10]. In addition, the high cost of health benefits and medicines, as well as socio-economic factors, pushes a large proportion of the population in some countries to use medicinal plants for health care [11-13]. In Mali, for example, 80% of the population uses traditional medicine to treat many diseases [14]. Although many plants or natural products claim to prove their effectiveness without scientific evidence, a number of them are active and possess biological activity, proven by scientific evidence [8,10]. The Bwatun, an area in south-eastern Mali, is an area where the local population uses medicinal plants a lot and gender issues are still taboo. This is why we initiated this study to document the medicinal plants used by traditional Bwatun practitioners for managing ED and other erectile problems in the populations of this locality.

MATERIALS AND METHODS

Ethnobotany survey

Study area

The study was conducted in the Tominian circle ($13^{\circ}17'15''$ N, $4^{\circ}35'35''$ W) which is a part of the Bwatun ("Bwa land" in Bomu) located both in Mali and Burkina Faso. The locations where the survey is being conducted are Mandiakuy, Dora, Diarrakongo, Fiéssou and Jaochinlo (Figure 1). The inhabitants of this area belong mainly to the Bwa tribe and they are generally rural and also use plants to treat many diseases such as erectile dysfunction problems.



Figure 1: Location of the survey sites: Tominian Circle, Segou Region, Mali. Pink dots designate the involved localities

Data collection

The information collection was performed in two weeks extended from 1 to 15 September 2018 from traditional healers. The mode used is the individual survey in which the investigator asks questions to a person [15]. It was conducted in the local language "Bomu" using semi-open questions. The interviews were conducted separately and the investigator went to the traditional practitioners' homes. The questions addressed to the traditional practitioners related to the recipes used for the treatment of erectile dysfunction, the names of the plants, the parts of the plants, the methods of preparation and the methods of use. A sample of each plant used was brought back to the Tropical Ecology Laboratory of the University of Sciences, Techniques, and Technologies of Bamako for identification by a plant taxonomist. Voucher specimens were deposited at the herbarium of the Tropical Ecology Laboratory. Plant names in Bamanan were also noted.

Phytochemical screening

Three plants selected on the basis of the frequency of citations in the management of erectile dysfunction were subjected to phytochemical analyses. The collected plant samples were dried at laboratory temperature under the shade, powdered and subjected to phytochemical screening to determine the major chemicals involved in the erectile activity. Thus, the identification of these chemical groups of the different extracts of the three samples was carried

out using conventional methods based on coloring and precipitation reactions with specific chemical reagents according to the protocols described by Diarra N. et al. and Erasmus L.J.C. et al. [16-18]. The alkaloids were detected by the Dragendorff reagent and the tannins were characterized by ferric chloride. For the determination of triterpenes, we used acetic anhydride and concentrated sulfuric acid. Diluted hydrochloric alcohol, magnesium chips and amyl iso alcohol were used to search for flavonoids. The coumarins test was carried out using the 365 nm UV fluorescence method. The foam test revealed saponins. The identification of reducing sugars was carried out with Fehling liquor.

Data analysis

The SPSS Statistics 23 software was used to analyze the data from the ethnobotanical survey.

RESULTS AND DISCUSSION

Ethnobotanical survey

In Bwatun, the ethnobotanical survey on medicinal plants used in the treatment of erectile dysfunction was conducted with twenty traditional practitioners. All of these respondents were male (100%) and their ages ranged from 45 to 75 years. This presence of only male traditional healers could be explained, on the one hand, by the fact that ED is not only a sensitive and taboo subject but also a health problem that men are often embarrassed and afraid to share [19]. According to our investigations, it seems inconceivable in the Bwatun to confide in a woman to treat ED. The interview with these traditional practitioners made it possible to record recipes containing 16 plant species, belonging to 11 families (Table 1). Figure 2 shows that the Fabaceae is the most represented with a percentage of 31.25%. These results are similar to those obtained from ethnobotanical surveys obtained by Baljinder S. et al. [9] in India and [7] in sub-Saharan African countries. The predominance of erectile plants belonging to the Fabaceae family may be due to the fact that the Fabaceae is the third largest flowering plant family [7]. In addition, members of this family are known to contain active metabolites, which may also explain their effectiveness in the treatment of erectile dysfunction [7]. Fabaceae are known for their high alkaloid and phenolic compound content [20].

In Bwatun, trees and shrubs are the most represented in the treatment of erectile dysfunction (Table 1). According to Havinga RM et al. [21], the high percentage of trees and shrubs could be due to their year-round accessibility, unlike grasses which can only be available in the rainy season. In this study, almost all plant organs are used in the traditional treatment of ED (roots, fruits, seeds, stems, tubers, bark). However, there is a high root use with 45% of used parts (Figure 3). The predominance of roots over other parts of the plant is due, according to Homayounfar A et al. [22], to the fact that traditional healers have the impression that roots contain the greatest healing power compared to other organs. The efficacy of the root in the treatment of erectile dysfunction may also be explained by the fact that it is the part of the plant richest in active metabolites [22,23]. Also according to Kenjale R et al. [24], the most plausible explanation is the cultural belief that underground parts, because of their close contact with the ground, contain the highest concentration of bioactive compounds. In contrast, in Western Uganda [25] found high leaf used in the treatment of ED. However, the high solicitation of roots could lead to the extinction of some species [26,27].

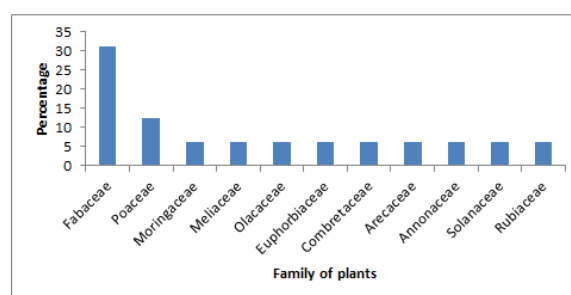


Figure 2: Plant families used in the treatment of ED in Bwatun and their percentage

This study also showed that *Tamarindus indica* L., *Guiera senegalensis* J.F.G., and *Ximenia americana* L. were the most used with 15.50%, 12.68% and 12.6% citation frequencies respectively. In total, this represents a frequency of 40.86% for all three plants. But the least used plants were: *Arachis hypogea* L., *Capsicum pubescens* Ruiz et Pav., *Gardenia ternifolia* S. et T., *Khaya senegalensis* (Desr) A.J., and *Prosopis africana* G. with a frequency of 2.82% each. The use of *Tamarindus indica* L. as a plant involved in ED has been reported by several authors [28-31]. In

Nigeria in Katsina State, the roots of *Guiera senegalensis* J.F.G. are used in the treatment of ED [32-35] reported the use of the same plant in the treatment of sexual impotence. According to Soro TY et al. [36], *Ximenia americana* L. would be used against sexual impotence.

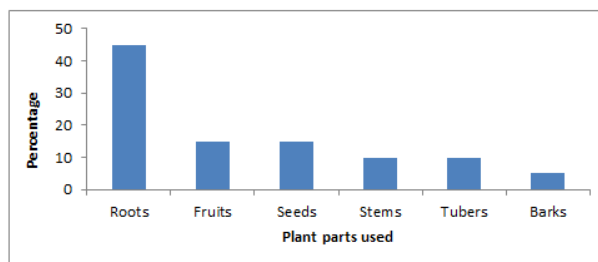


Figure 3: Distribution of plant parts used in the treatment of DE and their percentages

The methods of preparation of erectile plants used in Bwatun are mainly chewing (43.75%) and decoction (37.50%) (Figure 4) and their method of administration is per oral exclusively. In Uganda, the most common methods of preparation are: decoction, chewing and pounding [25]. In Africa, earlier work [37] has shown that in this area the most commonly used method for preparing these plants is still pounding and would be taken with local porridge or hot water.

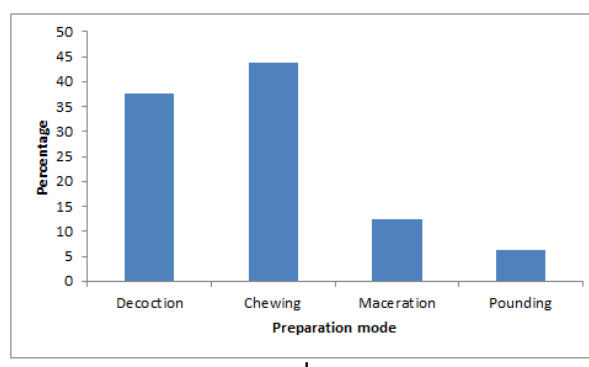


Figure 4: Mode of the preparation of the plants used in the treatment of ED and their percentages

Phytochemical screening

The chemical profile of the aqueous extracts of the roots of *Tamarindus indica* L and *Guiera senegalensis* J.F. Gmel and the trunk bark of *Ximenia americana* L. is reported in Table 2. The analysis revealed the presence of alkaloids, flavonoids, tannins, coumarins, saponins in these three plants. On the other hand, terpenes were absent in the roots of *Tamarindus indica* L. The use of these plants against ED could be related to the presence of these compounds. Indeed, these metabolites are sexual stimulants, endowed with androgenic and aphrodisiac potential [38-43]. Previous studies [44] revealed the ability of alkaloids to stimulate Leydig cells and increase serum testosterone levels. Also, alkaloids, by their ergogenic properties, can act either by inducing vasodilation through NO production and ultimately lead to erection; or by stimulating *steroidogenesis* in the testicles [6]. Flavonoids, through their selective inhibitory effect on phosphodiesterase5 (PDE5), potentially improve erectile function [8]. Tannins are phenolic compounds considered to be free radical scavenging antioxidants [45] and are known to have astringent properties and are used to treat and cure hemorrhoids which are the main cause of sexual dysfunction [46]. As for saponins (terpenes), they have a pronounced anabolic and spermatogenic effect [8].

Table 1: Medicinal species used, plant parts used in the extract preparation and administration by Bwatun healers

Scientific name (Family)	Local names	Part used	Preparation mode	Administration dosage form and	Frequency of citation (%)
	Bamanan	Bomu			

<i>Annona senegalensis</i> Pers (Annonaceae)	Mandé Sunsun	Wanubodo	Root	Decoction	Oral One teacup of 75 ml once a day	8.45
<i>Arachis hypogaea</i> L. (Fabaceae)	Tiga	Cimi	Seed	Chewing	Oral One pinch once a day	2.82
<i>Borrassus aethiopicum</i> Mart. (Areraceae)	Sébé	'oro	Tuber	Chewing	Oral 3 tubers once a day	5.63
<i>Capsicum pubescens</i> Ruiz et Pav. (Solanaceae)	Foronto	'epèru	Fruit	Decoction	Oral put it in a sauce	2.82
<i>Cassia sieberiana</i> (Fabaceae)	Sindjan	'E'émabiru	Root or fruit	Maceration	Oral One teacup of 75 ml once a day	7.04
<i>Gardenia ternifolia</i> (Fabaceae)	M'boure tiè	Cun-bè	Root	Decoction	Oral One teacup of 75 ml once a day	2.82
<i>Guiera senegalensis</i> (Combretaceae)	Koundie	Suncawe	Root	Chewing	Oral Use as a toothpick in the evening	12.68
<i>Khaya senegalensis</i> (Meliaceae)	djala	N'Penu	Root	Decoction	Oral One teacup of 75 ml once a day	2.82
<i>Manihot esculenta</i> Crantz (Euphorbiaceae)	Banankou	Bana'un	Tuber	Chewing	Oral Eat raw once a day	4.22
<i>Moringa oleifera</i> Lam. (Moringaceae)	Basijirini	Masayiri	Seed	Chewing	Oral 3 seeds once a day	5.63
<i>Sarcocephalus latifolius</i> Bruce (Rubiaceae)	Baro	Sasaho	Root	Decoction	Oral One teacup of 75 ml once a day	4.22
<i>Pennisetum typhoides</i> L. (Poaceae)	Sagnô	Dufu'a	Seed	Pounding	Oral Pounded material taken with warm water	4.22
<i>Piliostigma reticulatum</i> DC. (Fabaceae)	Gnama	Luho	Fruit	Pounding	Oral One tablespoon once a day	5.63
<i>Prosopis africana</i> (Fabaceae)	Guélé	'An'annu	Root or Stem	Chewing	Oral Use as a toothpick in the evening	2.82
<i>Tamarindus indica</i> L. (Fabaceae)	N'tomi	So'o	Root or Stem	Chewing	Oral Use as a toothpick in the evening	15.5
<i>Ximenia americana</i> L. (Olacaceae)	N'tonkè	Cocognanwe	Bark or Root	Decoction	Oral One teacup of 75ml once a day	12.6

Table 2: Results of the phytochemical screening of the three plants mentioned above

Bioactive metabolites	Plants used		
	<i>Tamarindus indica</i> L.	<i>Guiera senegalensis</i> JFG	<i>Ximenia americana</i> L.
Alcaloids	+	+	+
Flavonoids	+	+	+
Tannins	+	+	+
Coumarins	+	+	+
Reducing sugars	+	+	+
Saponins	+	+	+
Terpens	-	+	+
(+) = Present ; (-) = Absent			

CONCLUSION

The ethnobotanical survey revealed the use of plant species against erectile dysfunction in Bwatun, Mali. The Fabaceae family is the most represented and roots are the most used organs. The study revealed four modes of

preparation: chewing, decoction, maceration, and spraying. Phytochemical analysis of the three most cited plants in Bwatun revealed the presence of alkaloids, tannins, flavonoids, saponins, terpenoids, coumarins and reducing sugars. This richness in bioactive metabolites may explain the use of these plants in the management of erectile dysfunction.

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