

Ethnobotanical Survey of Three Species of *Desmodium* genus (*Desmodium ramosissimum*, *Desmodium gangeticum* and *Desmodium adscendens*) Used in Traditional Medicine, Benin

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Abstract: In Africa, conventional medicines are not within the reach of everybody. High costs of classic treatment lead 82% of the patients to traditional remedies. The study was aimed at identifying and documenting these plants used in the traditional medicine of Benin. Between December 2017 and March 2018, an ethnobotanical study was conducted in the markets of Cotonou, Abomey–Calavi, Porto-Novo and Pobè using a semi-structured questionnaire. A total of 100 respondents which included 91% of females and 9% of males were interviewed. These three species are involved in the treatment of 19 categories of diseases. The respondents are mostly females. It appears from this survey that the *Desmodium ramosissimum* is the most represented species in Benin (85%). The parts of the plant used are the stem with leaves (98%) and roots (2%). The recipes are prepared mainly by a decoction and administered orally. The price of samples sold varies from 200F cfa to 1000F cfa. The herb teas are cooked with one herb or a combination of several herbs. In terms of knowledge, information on plants was handed down from one generation to another orally through the word of mouth or without any published records. The ethnobotany survey revealed that no prohibitions or side effects are linked to the use of these plants. The three species of *Desmodium* occupy an important place in the therapeutic arsenal of Benin. These results constitute an essential tool for the experimental evaluation of the potentialities of these plants in order to make available for the Beninese population, new improved traditional medicines.

Keywords: *Desmodium*, Herbalist, Herbal, Medicine, Benin

Introduction

Consumption of fruits and vegetables is considered by many authorities as a public health stake and is the subject of many nutritional recommendations at the global level by FAO and WHO (INRA, 2007). For You et al. (2010), 8.8 million of children die each

year before their fifth birthday and the causes of these deaths are multiple. Benin, likewise all developing countries, has a high prevalence rates of malnutrition. The main determinant of the high prevalence of chronic malnutrition is the persistence of inadequate feeding practices of young children and

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poorly supplemented feeding. Nowadays, the treatment of diseases remains a crucial problem of humanity, especially in developing countries with insufficient resources following weak economic systems (Mangambu, 2013). In Africa, conventional medicines are not available to everybody; its high costs of treatment lead 82% of the patients to traditional remedies (WHO, 2011). Patients often combine ethno-medical and pharmaceutical treatments to hope for a quick cure (Mangambu et al., 2012, Singh & Singh, 2012). The use of plants for medicinal and food purposes dates back to prehistory and this tradition has been passed on from generation to generation (Soh et al., 2007). Africa abounds with a multitude of food and therapeutic plants. They improve the nutritional quality of diets because of their chemical composition and medicinal properties (Tchiegang and Kitikil 2004, Dansi et al., 2008). In fact, out of 300 000 plant species recorded on the planet, more than 200 000 species are found in the tropical countries of Africa and have medicinal properties (Souad et al., 2010). In Benin, out of the 3000 species of plants listed in the forest ecosystems (MEHU, 2002), 172 are consumed by local populations as food plants (Codjia et al., 2003) and 814 as medicinal plants (Sinsin and Owolabi, 2001). Among these plants figure the genus *Desmodium* with more than 46 species listed as medicinal plants in the world, likewise in Africa (Central African Republic, Gabon, Ghana, Cameroon, Congo, Ivory Coast, Equatorial Guinea, Senegal, Sierra Leone, Benin and Togo), in America South (Peru, Bolivia, Ecuador, Brazil, Venezuela, Guyana, Nicaragua), in Southeast Asia (Japan, Burma, Indonesia, Malaysia, Philippines, Cambodia, Vietnam), India, Indian Ocean (Rodrigues, Mauritius), in the Pacific (Vanuatu, New Caledonia, Guadalcanal, Salomon, Palau) and finally to Taiwan and China. Some of these species notably *Desmodium adscendens*, *Desmodium gangeticum*, *Desmodium styracifolium* and *Desmodium gyrans* are part of the official national pharmacopoeia in South America and China (Pierre et al., 2015).

In Benin, herbal medicine occupies an important place. But the use of plants is empirical and abusive, often resulting in a panoply of side effects, even the disappearance of the species. The work on the inventory of medicinal plants sold in local markets is scarce in sub-Saharan Africa (Maiga et al., 2005). Thus in Benin scientific data concerning the three species of *Desmodium* genus are almost non-existent, while these plants are the subject of several therapeutic uses in Benin (Akoègninou et al., 2006). *Desmodium* leaf sap instilled in the eyes would relieve headaches and seizures, while ingestion of watery macerate from leafy stems calms

pain, treats ulcers, eases delivery, etc. Recently, some nutritional studies have been initiated on plants to extract foliar proteins. Indeed, *Desmodium* is very rich in nutrients (vitamins, minerals and proteins). Further studies on the itinerary of these extracts have been carried out at the medicinal and sanitary levels for the purpose of their more rational use. Some authors have reported that the powder obtained from dry leaves of *Desmodium* has a higher nutrient concentration than fresh leaves. It is therefore used more and more as a food supplement by rural populations.

It is then essential for scientists to carry out ethnobotanical studies to find out how Beninese people are using these plants. It's also compulsory to create a synergy between traditional medicine and conventional medicine; especially now that we are witnessing a decline of some species including the three kinds of *Desmodium* considered as more important according to the indigenous knowledge of local populations due to the strong human pressure.

We therefore propose in this present work to carry out an ethnobotanical study in the communes of Abomey-calavi, Cotonou, Porto-Novo and Pobè; in order to identify the different usages of these three species for sustainable management and safe use in Benin.

2- MATERIAL AND METHODS

2-1 Material

The three plants were previously identified at the National Herbarium of Abomey-Calavi University using Benin's analytical flora (Akoègninou et al., 2006). To carry out this ethnobotanical study certain elements were used: an audio device for recording interviews; a digital camera and plastic bags.

2- 2 Method

2- 2- The Study Area

The surveys were carried out in four (4) communes (Abomey- Calavi, Cotonou, Porto-Novo and Pobè) located at the south of Benin (Figure 1) in the departments of Atlantic, Coastline, Ouémé, Plateau respectively. These communes are inhabited by people of different ethnic groups for whom the use and marketing of plants are ancestral activities.

Our study area is located at the level of the Guinea Gulf. It lies between 110°0' and 140°0' W, 60°0' S and 80°0'N.

Rainfall is binomial (from April to June and September to November) with an annual average of 1200 mm. The average temperature varies from 25 °C to 29 °C and the relative humidity is 69%

to 97% (Sinsin et al., 2004). The vegetation in the study area has been heavily impacted by various agricultural activities and now forms a mosaic of cropland and small patches of relict forest. (Assogbadjo, Sinsin, & Van Damme, 2005).

The Atlantic Department has equatorial climate with an alternation of two rainy seasons and two dry seasons. The average rainfall is 1200 mm per year, with an average daily temperature ranging from 25 °C to 29 °C and relative humidity ranging from 69% to 97% (Sinsin et al., 2004). The soil is reddish with tree vegetation. There is also the presence of clear forests.

The coastal department is located in the coastal sector. This sector extends over a length of 120 km and a variable width between 3 km to the west (towards Grand -Popo) and 10 km to the east (south of Porto-Novo) with an altitude less than 50 metres (Akoègninou et al., 2006). Recent and old barrier beaches are distinguished along the sea, interspersed by the lagoons and fluvial-lacustrine complex of Ouémé, Nokoué's Lake, Couffo, Lake Ahémé and Mono (Akoègninou et al., 2006). We meet various types of non-sandy substrates or rarely flooded, periodically flooded sands, clays prolonged flooding, submerged freshwater substrates and substrates inundated with brackish water. (Akoègninou et al., 2006). The climate is Guinean with a rainfall gradient from western (Grand-Popo) east (Porto-Novo), respectively 900 mm per year (Grand-Popo) and 1300 mm per year (Porto-Novo). The average annual temperature is 26.6 °C. This sector is marked by a mosaic of plant formations and plant groups, whose floristic composition varies according to the type of substrate and the degree of flooding.

The department of Ouémé is especially characterized by a reddish soil, ferruginous, clay, alluvial and co-alluvial with vegetation formed of forest relicts, expanses of grass, raphias and some mangroves.

In the Department of plateau climate is Sudano-Guinean type with a shrubby savannah vegetation

dominated by *Daniellia oliveri*. There are ferruginous and clay soils. We also note the presence of some relict forests (INSAE, 2004).

2-2-2. Exploratory investigation

After the documentation phase, a preliminary study was realized on the Geographic's distribution of the three species of *Desmodium* concerned by our study. A prospective study was also made. The aim was the meeting of resources' people that are able to give us reliable information about the three plants. This study also allowed us to refute our questionnaires, identify target groups concerned by this study. The methodology used in this prospective study was based on the ethno-ecological approach (relational study of the society with its natural environment) described by Bilaso (2008). After this exploratory survey, 12 markets were identified to conduct this work.

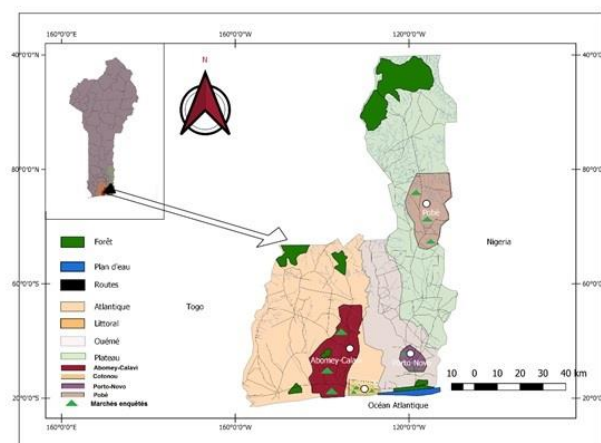


Figure 1: Map of the study area showing the communes and markets involved in the survey (Topographic IGN, 1992)

2- 2-3. Ethnobotanical survey

Surveys based on structured interview methods (Dibong et al., 2011, Klotoé et al., 2013) were conducted in 12 markets distributed equitably across four communes from December 2017 to March 2018, see Table (1).

Table 1: Communes and markets involved in the investigation

Communes	Market
Abomey	- Akassato - Glo - Calavi-kpota
Cotonou	- Gbégamey - Védoko - Dantokpa
Porto-Novo	- Agbokou - Adjara - Ouando
Pobè	- Odja Obada - Odja Ogori - Odja Igana

The registration of herbals' practitioner was previously done in order to obtain their consent to participate to our studies. Their selection resided essentially in the wealth of their display. The interview was based on a dialogue in the local language (Fon, Yoruba, Mina and Goun). Information collected from them include; the profile of the resource person (age, sex, level of study) and ethno-pharmacological data such as the vernacular name, uses of the plants, method of preparation and also administration, prohibitions and side effects related to each recipe. The data were collected using a survey sheet designed to assess the knowledge's level of herbal's practitioners on the different plants involved.

2- 2-4. Socio-economic survey

This survey was conducted using structured interview methods (Dibong et al., 2011, Klotoé et al., 2013). The survey concerned plant sale prices, quantities sold per day, storage methods, etc.

2- 2- 5. Data processing:

The collected data were coded and inserted in excel 2016 databases and then analysed by the software Minitab 17.0 and Graph pad 2017. The frequency of quotation (Fc) of each plant was determined by the formula:

$$F_c = \frac{\text{number of quotation of the main plant}}{\text{total number of quotation for all plants}} \times 100$$

Results and discussion

Strengths and weaknesses of the survey method used

In this study, ethnobotany data were collected in the field through a retrospective method based on an ethno-ecological approach. But this retrospective method requesting the memory of respondents could induce biases related to personal appreciation of the respondent (Lykke et al., 2004). The importance

given to the general use of *Desmodium* species is given by individuals who, in the first place, implicitly take into account a personal appreciation; which often refers to their preference or experience. Despite these few biases, this method is widely used in Ethnobotanical study by many authors (Nguenang et al., 2010, Gouwakinnou et al., 2011, Dah Nouvlessounon et al., 2016, Agbankpé et al., 2017) and has the privilege of highlighting rather conclusive results of the moment when the persons involved in the investigation are the actors of traditional medicine.

Sociodemographic Characteristics of the Respondents

Table 2 presents characteristics relating to age, sex and levels of schooling. In average, 91% of the surveyed herbalists are female compared to 9% of males. The same observation had been made by Fah et al. (2013) and ADIKO et al. (2013) who pointed out in their studies that the number of women herbalists was higher than the number of men. This observation is explained by the fact that the surveys were carried out in the markets. In addition, it confirms the sociological reality of some African countries, where selling in the market is an activity reserved mainly to women.

The age range of the respondents is between 30 and 95 years old with an average age of 55 years. Subjects with at least sixty (60) years old represent more than the third of the study population. These results are explained by the fact that in Benin, the sale of medicinal plants is reserved to people of advanced age.

The investigation revealed that 92% of respondents are illiterate. These results are close to the national data (PNUDBENIN, 2009) and show that

the use of medicinal plants remains mostly the preserve of the illiterate.

From the analysis of Table 2, it appears that the Gouns represent the majority ethnic group (40%) while the Minas represent the minority ethnic group (8%) of the people surveyed. This could be explained by the fact that the surveys were carried out in southern Benin precisely in regions where Gouns are mainly represented (Cotonou, Porto-Novo) and the

fact that Gouns are somewhat dispersed in other departments of southern Benin.

For all the ethnic groups surveyed, none of the plants has an importance related to traditional gods. These results are consistent with those of Francois Nsemi MUANDA (2010) in Mali who made no comment about the use of *Desmodium* in traditional rites.

Table 2: Sociodemographic characteristics of the respondents

Feature	Modality	respondents%					Average
		Atlantic	Littoral	Ouémé	tray		
Sex	Male	4	0	20	12	9	
	Female	96	100	80	88	91	
Age	[30-40 [	30	18	15.50	22.22	21.43
	[40-50 [	10	15	3	10.08	9.52
	[50-60 [	40	25	30	38.2	33,30
	[60-95]	20	42	51.5	29.5	35.75	
Level of study	Illiterate	92	84	92	100	92	
	Primary	8	16	8	0	8	
	Secondary	0	0	0	0	0	
Religion	animist	72	40	88	80	70	
	Christian	16	48	6	10	20	
	Muslim	12	12	6	10	10	
Ethnic Group	fon	45	25	10	0	20	
	Mina	15	17	0	0	8	
	yoruba	20	18	30	60	32	
	Goun	20	40	60	40	40	

Different species of *Desmodium* used in traditional medicine in the study area

The data collected made it possible to identify three species of the genus *Desmodium* (Table 3). These species are the most sold by herbalists for traditional treatments. The frequency's quote of each species varies according to their locations. Nevertheless *D. ramosissimum* is the most cited specie in all markets (Table 3). Other authors like Fah et al. (2013) noticed that *Desmodium ramosissimum* was the only species of this genus present in the commune of Abomey-Calavi during a census of medicinal plants used in the treatment of gestational diabetes. These observations show that *Desmodium ramosissimum* could be the most dominant species and the one with the high frequency of use compared to other species of the same genus. This dominance of *Desmodium*

ramosissimum might be justified by the fact that it is an herb built, semi-woody that grows everywhere on ferruginous soils in Benin throughout the year (Akoègninou et al., 2006). Indeed, in the tropical countries *D. ramosissimum* grow on shrubby savannah vegetation where one finds ferruginous and clay soils (Akoègninou et al., 2006). Unlike previous comments, Muanda (2010) reported in an ethnobotanical study in Mali that among all species of *Desmodium*, *D. adscendens* is the most cited species in traditional medicine. This difference could be explained by the difference of geographical factors and soil between Benin and Mali. The reality with regard to the use of plants is therefore different in other countries. In addition, the present study strictly concerns the plants used in southern Benin while that of MUANDA (2010) took into account all of Mali.

Table 3: Quotation frequencies and vernacular names of the three species of *Desmodium*

Commons	Frequency of quotation (%)		
	<i>D. ramosissimum</i>	<i>D. adscendens</i>	<i>D. gangeticum</i>
Abomey-calavi	85	10	5
Porto-Novo	80	14	6
Cotonou	85	10	6
Pobè	90	6	4
Total	85		5.25
Vernacular names	zèn 'ali/zed ali	epa ilè	ewè omo

Different uses of *Desmodium*

The three species of *Desmodium* are used exclusively for therapeutic purposes. No food or veterinary use was reported during the survey. These species are generally used in traditional medicine in many forms. The recipes are prepared mainly by a decoction and administered exclusively orally. They consist of single plants (15%) or a combination of two to eleven plants (85%). The part of the plant most used is the leafy stem (Figure 2).

The three plants have the same therapeutic virtues. The mentioned diseases are: Hepatitis, Gastritis, Ulcers and Heartburn, Diarrhoea, Dysentery, Allergies, Asthma, Cancer, Delivery Complications, Hypertension (Table 4). The most cited diseases have been: Hepatitis (30%); delivery complications (14%); Gestational Diabetes (11%) and cancer (10%).

On the other hand, the least cited diseases have been snakebites (2%), dysmenorrhoea (1%) and osteo

pathy's traumatism (1%). The study revealed that the treatment of certain diseases involves several plant species while hepatitis, cancer, childbirth complications are only processed by the plant species alone.

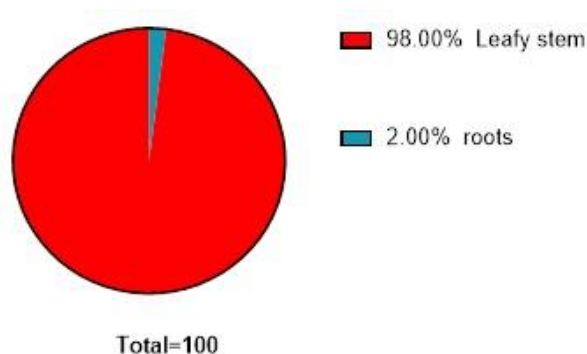


Figure 2: The different organs used

Table 4: the different diseases treated by the three species of *Desmodium*

Category of Disease	Diseases treated	Species and organs used			Method of preparation
		<i>D. ramosissimum</i>	<i>D. adscendens</i>	<i>D. gangeticum</i>	
Disorders of the digestive system And respiratore	Diarrhoea	Leafy stem	Leafy stem	Root, stem	Decoction
	Stomach aches	Leafy stem	Leafy stem	Root, stem	
	Angina	Leafy stem	Leafy stem	Root, stem	
	Dysentery	Leafy stem	Leafy stem	Root, stem	
	Ulcer	Leafy stem	Leafy stem	Root, stem	
	gastritis	Leafy stem	Leafy stem	Root, stem	
	Asthma	Leafy stem	Leafy stem	Root, stem	
Obstetric disease	Painful rule	Leafy stem	Leafy stem	Root, stem	Decoction
	Difficulty of delivery	Leafy stem	Leafy stem	Root, stem	
	Early menopause	Leafy stem	Leafy stem	Root, stem	
Blood disease	Diabetes	Leafy stem	Leafy stem	Root, stem	Decoction
	Hypertension	Leafy stem	Leafy stem	Root, stem	
	Hepatitis	Leafy stem	Leafy stem	Root, stem	
other		Leafy stem	Leafy stem		Decoction
	Urinary infection	Leafy stem	Leafy stem		
	Headache	Leafy stem	Leafy stem	Root, stem	
	Tired	Leafy stem	Leafy stem	Root, stem	
	Cancer	Leafy stem	Leafy stem	Root, stem	

Socio-economic values of *Desmodium*

The three species of *Desmodium* sold in the market are available as leafy stems or roots. But only the leafy stem is subjected to intensive trade for the three species. About 87.5% of respondents indicated that the availability of *Desmodium* species compared to previous years is significantly lower. Nevertheless, this availability varies depending on the species. For *D. adscendens*, local

production is low, most of the plant marketed in the study area is imported from Nigeria. This observation is due to the soil conditions of the study area which would not be favourable to the cultivation of this species. Although the production of *D. ramosissimum* and *D. gangeticum* is low, 98% of the herbalists get their supplies from Pobè.

The average purchase and selling prices of each plant recorded during the study period as well as the gains varied significantly depending on the level of involvement of the actors. In general, the gains range from 3000 FCFA to 4000 CFA per 50 kg bag, depending on the sector actors (Table 5). The producers are the main beneficiaries of the products in the study area and can realize the benefits of 1000f to 3000 f a day on a 50 kg bag. For others (wholesalers, semi-wholesalers and retailers) involved in detail selling, prices vary between 100f and 200f. They get a bigger profit. Finally, although the species is the least profitable for certain importers in the sale, *Desmodium ramosissimum* remains the best-selling species in terms of quantity. This economic potential must be considered for the development of herbal genetic resources in Benin.

Table 5: Economic values of *Desmodium*

Actors	Buying price	Selling price	Gain
producers		3000per bag of 50kg	3000
wholesalers	3000 per bag of 50 kg	4000 per bag of 50kg	1000
Semi-wholesalers	1000/lot of 50	2000 for 50 pieces	1000
retailers	2000/lot of 50	100-200per set of 3	2000-4000

CONCLUSION

This study highlighted the essential role of traditional healers in the treatment of diseases in South Benin. It appears that the three species of the *Desmodium* genus play a major role in Benin's therapeutic arsenal. Frequently cited diseases have been: hepatitis; complications of childbirth; Gestational diabetes and cancer. The data revealed that *Desmodium ramosissimum* is the most common species in the four communes (Abomey-Calavi, Cotonou, Porto Novo and Pobè). Such information requires the implementation of a laboratory photochemical screening, to isolate the bioactive compounds in these plants, which could be responsible for biological activities. This will enable the production of improved traditional medicines at a lower cost in Benin.

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