An ethnobotanical survey of seventeen plants species used against diarrhoea and other diseases in southern Benin (West Africa)

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Abstract

Many plants are widely used in traditional medicine across Africa. In Benin, practitioners of Beninese traditional medicine make use of diverse medicinal plants in the traditional management of various diseases including diarrhoea. This study aimed at highlighting the ethnomedicinal uses of 17 plants in the traditional treatment of diarrhoea and other diseases in southern Benin. An ethnomedicinal survey was carried out using the semi-structured interview method among practitioners of traditional medicine in Benin. This allowed for the identification of the traditional uses of these plants. The ethnobotanical data collected was analyzed using indices such as Use Value, Informant Consensus Factor and Fidelity Index of medicinal plants. A total of 72 informants participated in this study, including 52 market herbalists and 20 traditional healers. The cited plants were involved in the treatment of 39 diseases and symptoms of diseases, which have been divided into 15 categories. The most frequently mentioned disease categories were infectious, blood and digestive diseases,offering treatement for malaria, diarrhoea and fever amongst others. These plants have maximum potential for the treatment of infectious diseases, as well as metabolic, respiratory, skin, blood, digestive and circulatory diseases. This study revealed that interviewed informants (market herbalists and traditional healers) had good knowledge of the treatment of several diseases using the 17 plants. It confirmed that the 17 selected plants are used in the traditional treatment of diarrhoea as well as other diseases. This study provided a database for future pharmacological investigations on the basis of this ethnobotanical documentation.

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Introduction

Traditional medicine has a prominent place in the primary health care of people around the world. According to the World Health Organization (WHO), more than 80% of the African population use traditional medicines for their well-being.[1] This very ancestral medical practice, transmitted from generation to generation, is based on the use of medicinal plants.[2] the high cost of antibiotics and failure of modern treatments due to antimicrobial resistance, ancestral heritage, access to traditional treatments at lower cost and the real efficacy of medicinal plants are all factors that justify the wider use of traditional medicine by the majority of the African Population for the treatment of diseases.[3] These medicinal plants, very rich in active molecules, have shown their effectiveness in the treatment of various pathologies.

In the case of diarrhoeal diseases, traditional medicine offers a credible alternative for the management of diarrhoeal patients in view of the prevalence and difficulties inherent in the management of these diseases.[4] Indeed, diarrhoeal diseases are one of the main causes of mortality, especially among children under five years old.[5] They are responsible for 1.8 million deaths each year worldwide, 90% of which are children under the age of five years, most of whom live in developing countries.[6] According to the WHO, diarrhoeal diseases are the third leading cause of death among infectious diseases at all ages.

In Benin, diarrhoeal diseases are one of the main causes of

morbidity. Approximately 7,000 Beninese, including 4,300 children under five years of age, die every year from diarrhoeal diseases.[7] This has a direct impact on the costs associated with seeking health care, including several factors such as consultation, medication, transportation and, in some cases, hospitalization, which is a burden on household and government spending.[7] Etiologically, bacterial, viral and parasitic infections are the most indexed. Infectious agents most involved in diarrhoeal diseases are *Salmonella enterica* and *Escherichia coli.*[8] These data, reinforced by the emergence of antimicrobial resistance, place diarrhoeal diseases as a major public health problem. Indeed, most of the bacteria responsible for diarrhoeal episodes develop resistance to commonly used antibiotics.[9] This multi-resistance phenomenon is a major problem in the effective management of infectious diseases in general and diarrhoea in particular. With this clinical picture, it seems necessary to explore alternative solutions for the discovery of new bioactive molecules that are effective against multi-resistant strains. The use of medicinal plants in traditional medicine might be a credible solution; one which could be greatly enhanced by selection for the quality of efficacy within the intraspecific variation of these plants, especially at the level of individual plants, especially the trees.

The African flora is known to have a variety of medicinal plants with unsuspected therapeutic properties. *Allium sativum* L., *Alchornea cordifolia* (Schumach. & Thonn.) Müll.Arg., *Philenoptera cyanescens* (Schumach. & Thonn.) Roberty, *Azadirachta indica* A. Juss, *Bambusa vulgaris* Schrad. ex J.C. Wendl., *Nigella sativa* L., *Uvaria chamae* P. Beauv., *Vernonia amygdalina* Delile, *Ocimum gratissimum* L., *Manihot esculenta* Crantz, *Anacardium occidentale* L., *Diospyros mespiliformis* Hochst. ex A.DC, *Daniella oliveri* (Rolfe) Hutch. & Dalziel, *Pterocarpus erinaceus* Poir., *Senna italica* Mill., *Rauvolfia vomitoria* Afzel. and *Khaya senegalensis* (Desr.) A. Juss. are some of the plants identified in the scientific literature that are used in several African pharmacopoeias in the treatment of several diseases.[10] Data from Niger,[11] Ivory Cost,[12] and Nigeria,[13] suggest the use of some of these plants in the traditional treatment of diarrhoea. Literature reports from other African countries support these observations.[14,15]

The total Beninese flora is rich, with 2807 plant species, and according to Akoègninou *et al.*[16] offers the possibility of using several plants in traditional medicine. For this purpose several ethnobotanical surveys have been conducted on the traditional treatment of various diseases in Benin.[17–21] However, in spite of this plurality of ethnomedical data available in the Beninese scientific literature, rare are the data that have mentioned the specific use of the 17 before mentioned plants in the traditional treatment of diarrhoea. In addition, few ethnobotanical investigations have specifically investigated all of the ethnopharmacological potentials of these 17 medicinal plants; in order to preserve endogenous knowledge in Benin. The hypothesis was that Benin's proximity to other African countries (Nigeria, Niger, Ivory Coast), in which traditional uses concerning diarrhoea have been reported, favored the same ethnobotanical uses in Benin. From these observations emerge the following questions:

What is the level of knowledge of traditional Beninese medicine players on the use of selected plants in the treatment of diarrhoeal disease? Which diseases are traditionally treated using these species?

This study therefore aimed to document the ethnobotanical knowledge of the traditional medicine practitioners of southern Benin on the endogenous use of the 17 selected plants, with particular focus on the treatment of diarrhoea.

Materials and Methods

Study area

An ethnomedicinal survey was conducted in four cities in southern Benin over a period of three months (June to August 2020). These were Cotonou, Ouidah, Abomey-Calavi and Porto Novo (Figure 1). The southern Benin region is located between 6°25 N and 7°30' N and covers an area of 17109 km^2. The climate is sub-equatorial, characterized by a bimodal rainfall regime with two rainy seasons alternating with two dry seasons. The average annual temperature is 28°C and air humidity varies between 69% and 97%.[22] Dominant soils are ferralitic soils on clay sediments, hydromorphic soils in valleys, shallows and alluvial plains, vertisols in the Lama depression and tropical eutrophic brown soils. It belongs to the Guinean-Congolese zone which includes a mosaic of islands of dense rainforests, savannahs, grasslands, mangrove swamps and fallow land. The total flora of southern Benin counts 1170 plants species.[23] The population of southern Benin is 536,9774 with a density ranging from 100 inhabitants/km^2 in general to 322 inhabitants/km^2 in the Atlantic department. The dominant ethnic groups are the Fon and related cultures (39.2%), Adja and related cultures (15.2%), and Yoruba and related cultures (14.5%).[24]

The dominant economic activities are trade and agriculture. Market gardening, livestock farming, fishing, crafts and tourism are also practiced.

Ethical clearance and consent

This study is part of a Thesis. The committee of the "Doctoral School Life and Earth Science (ED-SVT)" of the University of Abomey-Calavi (UAC-Benin) under the number 11480412 has authorized this study. Verbal consent was obtained from the participants. This choice is justifed by the fact that the study population consists mainly of illiterates.

Data collection

An ethnobotanical survey targeting traditional healers and market herbalists was conducted in Benin using the semi-structured interview method described by several authors.[2,18] Market herbalists were surveyed in 13 markets located in the Abomey-Calavi, Cotonou, Porto novo and Ouidah towns. These were Calavi kpota, Cococodji, Cocotomey, Glo, Ouèdo and Godomey markets for the Abomey-Calavi town; Ouando and Agbokou markets for the Porto Novo town; Ouidah and Kpahou markets for the Ouidah town and Vedoko, Menontin, Fifadji markets for the Cotonou town. The traditional healers also were surveyed in the same communes. These informants were randomly selected and interviewed with the help of guides and interpreters in the local languages (Fon, Goun, Mahi, Aïzo, and Adja) using a survey questionnaire. The information collected were related to socio-demographic data (origin, gender, age, ethnic, level of education, source of knowledge) and ethnobotanical data (diseases treated, parts used).

Data analysis

The data recorded through the survey forms were entered into Microsoft Excel 2016 spreadsheet and subjected to statistical analysis using SPSS.26.0. Quantitative descriptive statistics were used to analyze the socio-demographic data.

The analysis of ethnobotanical data took into account Use Values, Fidelity Index of medicinal plant Informant Consensus

Factor (ICF). Pearson- and Spearman's correlation tests allowed for the evaluation of i) the dependency between the consensus of the informants (one value per disease category) and the number of mentions of plants per disease category and ii) the dependency between the consensus of the informants (one value per disease category) and the number of mentions of each disease category. The significance threshold was set at 5% ($p < 0.05$).

Medicinal plants use value

The Use Value (UV) is the number of times a plant has been cited to treat a given category of diseases.[25] It was determined from the disease categories. Diseases or conditions and symptoms were categorized according to the system or organ that is affected.[26] The following formula was used to assess the use value of medicinal plants:

$$UV = \frac{NC}{NT} * 100$$

NC: Number of plant citations for the disease categories in which the plant is solicited.
NT: Number of citations of all plants for all disease categories in which the plant is cited.

Informant consensus factor and fidelity index of medicinal plants

The cultural importance of plants is based on the consensus of informants, which reflects the degree of agreement among different informants regarding the use of a medicinal plant.[27] In this study, consensus was reached through two approaches namely the Informant Consensus Factor (ICF) and the plant Fidelity Index (FI). The ICF allows for an assessment of the consistency of informants' knowledge based on the diseases they treat and the plants they use.[28] A high ICF for a given disease category suggests a consensus among informants about the plants they use for the diseases they treat; but also that this category contains diseases that are common in the community.

If high, it reflects a well-defined tradition related to medicinal plants associated with these disease categories.[29] This consensus factor of informants expresses their "approval rate" on the basis of the number of mentions of a category of diseases and the total number of plants used to treat diseases grouped in the given category. The index is calculated by category of disease using the following formula:

$$ICF = \frac{nr - nt^{30}}{nr - 1}$$

where nr is the number of mentions of the diseases in the category;

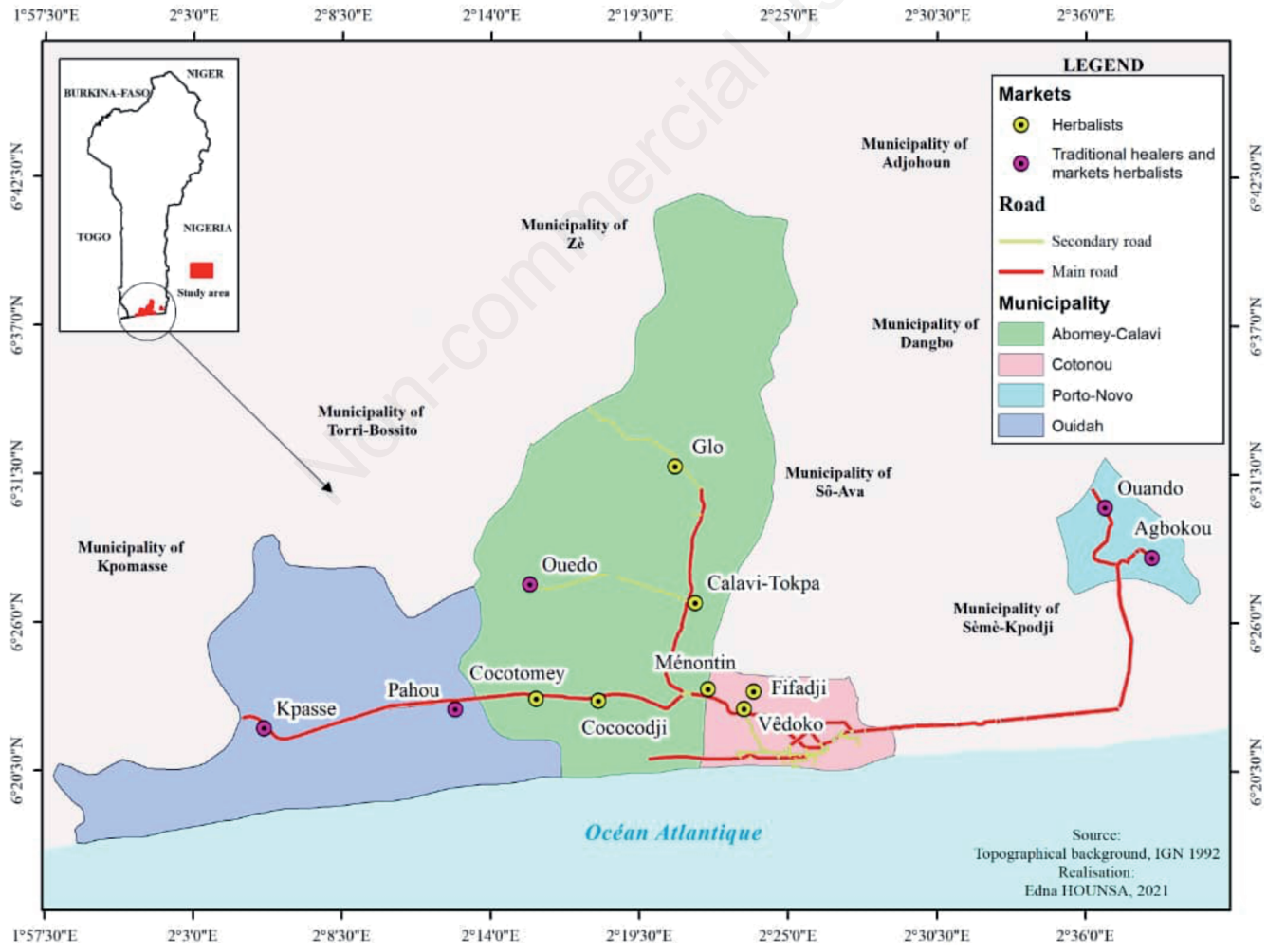

Figure 1. Localization of survey sites of an ethnobotanical survey in southern Benin.

nt is the total number of mentions of the plants used to treat the diseases identified in the category.

The ICF varies from 0 to 1: i) The value 0 is the lowest degree and corresponds to different points of view of the use of plants to treat a given category of disease; ii) Values below 0.5 are considered to be low and indicate a low consensus of plant use; iii) 0.5 is the average degree of the factor and indicates an average consensus of plant use; iv) The values between 0.5 and 1 are relatively strong and show a relatively high degree of agreement in the use of plants to treat the given disease category; v) A value of 1 is the highest value and shows total consensus in the use of plants to treat the given category of disease.

The Fidelity Index (FI) helps to assess the intensity of the relationship between a medicinal plant and its role in a given category of disease. This index is based on the percentage of informants who confirmed the use of a plant in the treatment of a particular category of disease. It was calculated by the following formula:

$$FI(\%) = \frac{Ip}{Iu} * 100$$ [31]

where Ip is the number of informants who used the given species to treat a given disease category; Iu is the total number of traditional healers who cited the same species at least once for any disease category. This gives a value for each pair of disease categories and species.

Results

Socio-demographic data

A total of 72 informants were surveyed in this study. These included 20 traditional healers and 52 herbalists. The socio-demographic data of these informants are summarized in Table 1. Informants have considerable experience [the majority (46%) has more than 10 years of experience] in the practice of traditional medicine in southern Benin. They belonged to different age groups. Those between 40 and 60 years of age were in the majority (51%), followed by those aged 20 to 39 years (29.17%). Most informants (68.06%) reported having inherited the medicinal knowledge of the plants studied. Regarding the informants' level of education, the majority were illiterate (37%) followed by informants with primary education (30%). In addition, the informants who participated in this study belong to ten different ethnic groups. The majority of informants belong to the Fon (45.83%) and Goun (15.28%) ethnic groups (Table 1). These data show that medicinal knowledge of the plants studied is not restricted to a particular ethnic group.

Ethnobotanical data

The analysis of the ethnobotanical data collected made it possible to identify the frequencies of use, the fidelity indices of medicinal plants and the consensus of the informants. In total, the plants studied were involved in the treatment of 39 diseases and disease symptoms divided into 15 categories. The categories of diseases most frequently mentioned are infectious diseases (185 mentions), blood and digestive disorders (144 mentions). Within these disease categories, the plants studied were used in the traditional treatment of diseases such as malaria (126 mentions), miscellaneous infectious diseases (76 mentions), fever (73 mentions), diabetes (67 mentions), stomachaches (67 mentions) and diarrhoea (45 mentions, Table 2). It should also be noted that the seventeen plants studied here are all indicated in the treatment of diarrhoea by informants.

Table 1. Socio-demographic characteristics of 72 informants (traditional healers and market herbalists) who participated in an ethnopharmacological survey in southern Benin, West Africa.

Variables	Categories	Total	Percentage (%)
Gender	Male (Traditional healers)	20	28
	Female (Market herbalists)	52	72
Year	20 -39 years	21	29
	40-60 years	37	51
	> 60 years	14	19
Number of years of experience	0-10 years	25	35
	11-20 years	33	46
	> 20 years	14	19
Source of knowledge	Heritage	49	68
	Learning from practitioners	22	30
	Scientific documentation	1	1
Education level	Illiterate	27	37
	Primary	22	30
	Secondary	19	26
	Academic	4	5
Ethnic	Fon	33	46
	Aïzo	4	5
	Mahi	4	5
	Oueme	3	4
	Adja	7	10
	Bariba	1	1
	Goun	11	1
	Yoruba	6	8
	Toffin	2	3
	Dendi	1	1

Use value of medicinal plants

The seventeen plants that were the target of this study have several ethnobotanical applications. They were cited in the treatment of 39 diseases and disease symptoms and had with different use values (Table 3).

K. senegalensis (20.14%), *K. indica* (12.12%), *B. vulgaris* (10.88%) were the species with the highest use values. The species used in the most disease categories were *B. vulgaris, B. cordifolia and K. senegalensis* (Table 3). Species with low use values included *N. sativa* (2.37%), *A. occidentale* (3.27%) and *A. sativum* (3.77%). However, across all 15 disease categories, leaves (60.86%) followed by stems (17.39%) were the plant parts most used in treatments by the informants.

Informant consensus factor and fidelity index

This study found that 33.33% of the disease categories identified (metabolic, circulatory system, blood and infection conditions) had a high informant consensus factor (ICF > 0.70). Disease categories with a medium ICF (0.70 - 0.50) represent 26.66% while 40% had a low ICF (< 0.50) (Table 4). The high ICF disease categories each have one high fidelity medicinal plant, while 50% of the medium ICF categories have at least one dedicated medicinal plant (Table 4). Pearson's correlation test ($r_s = 0.597$; $p<0.05$) revealed that the consensus rate of informants is high even though the number of plants used to treat a disease category is high. Similarly, Spearman's correlation test ($r_s = 0.861$; $p<0.05$) showed that the higher the informant consensus rate, the higher the number of mentions of each disease category. These significantly positive linear correlations suggest that the more a disease category is treated, the more the indicated plants are used. In addition, plant fidelity rates to disease categories ranged from 1.21% to 44.64%. The plants had a maximum fidelity to disease categories such as infections, metabolic, respiratory, respiratory, skin, blood, blood, diges-

Table 2. Categorization of diseases with their number of use-records by informants who participated in an ethnopharmacological survey in southern Benin.

Disease Categories	Pathologies	Mentions
Infections (I) (185)	Fever	73
	Typhoid fever	12
	Measles	10
	Hepatitis	7
	Sexually Transmitted Diseases	7
	Other kind of infections	76
Blood disorders (AS) (161)	Hemorrhage	1
	Malaria	126
	Anemia	34
Diseases of the digestive system (AD) (144)	Ulcer	15
	Diarrhea	45
	Stomach aches	67
	Hemorrhoids	7
	Constipation	10
Metabolic disorders (AM) (73)	Diabetes	67
	Obesity	1
	Icter/Jaundice	5
Respiratory disorders (AR) (50)	Angina	4
	Asthma	5
	Cough	41
Circulatory system disorders (AAC) (33)	High blood pressure	33
Skin disorders (AC) (31)	Hives	1
	Skin rashes	2
	Dermatosis	28
Inflammatory Syndrome (SI) (31)	Rheumatism	25
	Inflammation	6
Cultural Syndrome (SC)(18)	Poisoning	1
	Protection	17
Sexual and Reproductive Disorder (TSR) (16)	Infertility	3
	Easy childbirth	6
	Gonorrhea	1
	Prostatitis	1
	Painful menstruation	6
Poorly defined disease (MMD) (9)	Pain	3
	Tiredness	6
Nervous disorder (TNE) (8)	Headaches	8
Nutritional disorders (TNU) (2)	Malnutrition	2
Urinary tract disorders (AAU) (1)	Kidney failure	1
Visual disorders (TV) (1)	Blindness	1

tive and circulatory system disorders. *O. gratissimum*, *B. vulgaris*, *P. cyanescens* and *M. esculenta* were respectively used the most specific for the treatment for infectious, metabolic, digestive and blood diseases (Table 4). In addition, all the plants studied except *M. esculenta* and *A. indica* had a fidelity of at least 15% for infectious diseases. *O. gratissimum*, *A. cordifolia*, *V. amygdalina*, *R. vomitoria* are the most indicated medicinal plants for the treatment of infectious diseases. For the blood disorders, all the plants, except *A. sativum* and *D. mespiliformis*, had a fidelity of at least 5%. *M. esculenta* (61.9%) and *A. indica* (59.74%) had a fidelity of more than 50% for the diseases of this category (Table 4).

Discussion

This study targeted two categories of informants who are at the forefront when it comes to the practice of traditional medicine in southern Benin. They were market herbalists (all female) and traditional healers (all male). The majority of these informants, aged from 40 to 60 years, were illiterate and had at least 10 years of professional experience. Similar data have been reported by other authors in the same study area.[18,20,21] These results indicate that older people hold a large share of the traditional medicinal knowledge that is part of the oral tradition. Dougnon *et al.*[32] reported that in Africa the medicinal knowledge of plants has an ancestral character and that it is the sages (older people) who hold the traditional knowledge to treat diseases. This seems to be confirmed in this study since 68.06% of the informants reported having inherited their knowledge from the elders. Tamboura *et al*. [33] also supported this idea and pointed out that traditional ethnomedicine is a social science and its content remains a family heritage. However, these data reveal a threat to the sustainability of ethnomedicinal knowledge. Indeed, the reluctance of young people today to take an interest in phytotherapy due to the influence of modernization and exotic culture constitutes a threat to the intergenerational transmission of traditional knowledge.[2] In addition, Fah *et al.* [20] explained that in Benin, the sale of items at the market is usually reserved for women. This study revealed the same result. The illiteracy levels of the informants in the study area has been reported since 1989.[18,34] Such observations suggest that the practice of traditional medicine in southern Bénin remains the prerogative of the majority illiterate populations. Moreover, UNPD BENIN justifies the non-literacy of these women by the fact that the sale and use of traditional plants are reserved for people of modest socio-economic status.[35] The majority of the informants are from the Fon ethnic group. These data are consistent with the findings of the INSAE Population Survey report in 2013.[24] This report indicates that in southern Benin the dominant ethnic groups were Fon and related cultures (39.2%), Adja and related cultures (15.2%), and Yoruba and related cultures (14.5%).

The ethnobotanical data collected in this study provide information on the use of 17 medicinal plants and 39 diseases and symptoms of diseases divided into 15 categories. The most fre-

Table 3. Use value and used parts of medicinal plants and their disease categories as revealed by an ethnopharmacological survey in southern Benin.

Medicinal plants	Botanical families	Vernacular name (Fon)	Use value (%)	Parts used	Disease categories
Alchornea cordifolia (Schumach. & Thonn.) Müll.Arg.	Euphorbiaceae	Klanmadou	7.32	Leaves	AM, AR, AC, AD, AAC, AS, I, TSR SC, SI, MMD
Allium sativum L.**	Amaryllidaceae	Ayo	3.77	Pods	AM, AR, AD, AAC, I, SC, SI
Anacardium occidentale L.**	Anacardiaceae	Cajou tin	3.27	Leaves; stems	AM, AC, AD, AS, I, SI, MMD, TV
Azadirachta indica A.Juss.**	Meliaceae	Kinnin tin	12.12	Leaves	AR, AC, AD, AS, I, SI, MMD
Bambusa vulgaris Schrad. ex J.C.Wendl. **	Poaceae	Dawetin	10.88	Leaves	AM, AR, AC, AD, AAS, AS, I, TRS, SC, SI, TNE
Daniellia oliveri (Rolfe) Hutch. & Dalziel	Leguminosae	Zaman, Zatin	7.85	Leaves	AR, AC, AD, AAC, AS, I, SC, SI, TNE, TNU
Diospyros mespiliformis Hochst. ex A.DC.	Ebenaceae	Kainoui	2.55	Leaves	AC, AD, I, SI
Khaya senegalensis (Desr.) A.Juss.	Meliaceae	Zouzatin	20.14	Bark	AM, AR, AC, AD, AAC, AS, I, TSR, SC, SI, TNE
Manihot esculenta Crantz **	Euphorbiaceae	Fenyen	2.95	Leaves; stems	AM, AR, AD, AS, I
Nigella sativa L.**	Ranunculaceae	Nigelle kuin	2.37	Seeds	AM, AR, AC, AD, AS, I, SI
Ocimum gratissimum L.	Lamiaceae	Tchiayo	6.11	Leaves	AR, AD, AAC, AS, I, SI, AAU
Philenoptera cyanescens (Schumach. & Thonn.) Roberty	Leguminosae	Aho man	7.54	Leaves	AM, AR, AC, AD, AS, I, SI, TNE
Pterocarpus erinaceus Poir.	Leguminosae	Kosso, gbèngètin	3.72	Leaves; stems	AM, AR, AC, AD, AS, I, TSR ,SI, TNE
Rauvolfia vomitoria Afzel.	Apocynaceae	Kouessoman	4	Leaves; stems	AM, AR, AC, AD, AAC, AS, I, SI, MMD
Senna italica Mill.**	Leguminosae	Agouègbè; Amasu agweton	4.88	Leaves	AM, AC, AD, AS, I
Uvaria chamae P.Beauv.	Annonaceae	Aylaha	5.56	Leaves; roots	AR, AD, AAC, AS, I, TSR, SI, TNE
Vernonia amygdalina Delile	Compositae	Amanvivè	8.5	Leaves	AM, AR, AC, AD, AS, I, SC

Metabolic disorders (AM); Respiratory disorders (AR); Skin disorders (AC); Diseases of the digestive system (AD); Circulatory system disorders (AAC); Blood disorders (AS), Infections (I); Sexual and Reproductive Disorder (TSR); Cultural Syndrome (SC); Inflammatory Syndrome (SI); Poorly defined disease (MMD); Nervous disorder (TNE); Nutritional disorders (TNU) Urinary tract disorders (AAU); Visual disorders (TV); *naturalised.exotic; **Cultivated exoti.c NB: some ** below may be * *i.e.*, naturalized in Benin.

quently mentioned disease categories are infectious diseases, and blood and digestive disorders, malaria, miscellaneous infectious diseases, fever, diabetes, stomachaches and diarrhoea are the most common diseases treated with these plants in the study area. The precarious quality of water, insanitary conditions and poor food hygiene partly explain the prevalence of these categories of diseases and are common problems in many developing countries.[36,37] In addition, Shayoub *et al.*0 reported that malaria is the most prevalent disease in Africa. This may explain the high rate of mention of malaria in the study area. The high mention of infectious diseases in this study would be mainly related to the emergence of multi-resistant bacteria. Indeed, antimicrobial resistance is a real public health problem limiting the range of antibiotic molecules to be used. The use of traditional medicine is proving to be useful in the treatment of infectious diseases.[21] The data collected in this study explain the good knowledge of the informants on the use of medicinal plants in infectious diseases. The informants reported that all the plants species in this study are used in the treatment of infectious diseases with maximum fidelity for *O. gratissimum, A. cordifolia*, *D. mespiliformis*, *N. sativa*, *R. vomitoria*, *S. italica*, *U. chamae* and *V. amygdalina*. These plants are also indicated in the treatment of diarrhoeal diseases. In the literature several reports have established the antimicrobial and antidiarrhoeal potential of most of these plants. Agbankpe *et al.*[17] reported that the most commonly used leafy vegetables in southern Benin for the treatment of diarrhoeal infections are *O. gratissimum* and *V. amygdalina*. A study conducted in Ivory Coast on plants used in the treatment of diarrhoea identified *A. cordifolia, K. senegalensis* and *O. gratissimum* as anti-diarrhoeal species.[38] Similarly, pharmacological investigations conducted in Sudan by Idu *et al.*[38] reported the antibacterial activity of extracts of *K. senegalensis* bark on bacteria responsible for diarrhoeal episodes.

Concerning the other diseases identified in this study, various reports in the literature have indicated the pharmacological potential of the studied medicinal plants species. For example, the use of *K. senegalensis*, *R. vomitoria* and *B. vulgaris* in the treatment of metabolic disorders including diabetes is reported here. This antidiabetic potential of *K. senegalensis* is also stated in the literature.[39] A pharmacological investigation carried out on the stem bark of *K. senegalensis* revealed a hypoglycemic activity favorable to an effective traditional management of diabetes.[40]

In addition to metabolic disorders, *B. vulgaris* is apparently also usedin the treatment of several other conditions such as malaria, high blood pressure, diarrhoea and typhoid fever. Similar observations have been reported by Hessavi *et al.*[41]

Scientific evidence is presented here regarding the rich knowledge held by market herbalists and traditional healers in southern Benin about the medicinal plants that are used for a range of ailments.

Conclusions

This study identified the ethnomedicinal knowledge of traditional healers and market herbalists in southern Benin on 17 plants species used in traditional African medicine. These 17 species are involved in the treatment of 39 diseases and symptoms of diseases classified into 15 categories of use. Infectious, metabolic, digestive and blood diseases are the categories of diseases most treated by these plants. *O. gratissimum*, *B. vulgaris*, *P. cyanescens* and *M. esculenta* are respectively used the most specific treatments for

Table 4. Informant consensus factors and fidelity indices of medicinal plant as revealed by an ethnopharmacological survey in southern Benin.

Disease Categories	AM	AR	AC	AD	AAC	AS	I	TSR	SC	SI	MMD	TNE	TNU	AAU	TV
Number of use records plants/categories	16	19	16	41	8	24	46	10	5	16	7	5	2	1	1
Number of use records of diseases/categories	73	50	31	114	33	161	185	16	18	31	9	8	2	1	1
Informants Consensus Factor (ICF)	0.8	0.63	0.5	0.65	0.78	0.85	0.75	0.4	0.76	0.5	0.25	0.42	0	0	0
Medicinal Plants	**Fidelity index/disease category**														
Alchornea cordifolia (Schumach. &Thonn.) Müll.Arg.	8.92	12.5	1.78	7.14	5.35	5.35	44.64	1.78	1.78	5.35	5.35	0	0	0	0
Allium sativum L.	7.14	10.71	0	21.42	25	0	21.42	0	7.14	7.14	0	0	0	0	0
Anacardium occidentale L.	0	30	10	10	0	5	25	0	0	15	5	0	0	0	0
Azadirachta indica A.Juss.	15.58	0	1.29	6.49	0	59.74	12.98	0	0	1.3	1.3	0	0	0	1.3
Bambusa vulgaris Schrad. ex J.C.Wendl.	33.33	2.46	1.23	2.46	18.51	7.4	18.51	9.87	2.47	2.47	0	0	1.23	0	0
Daniellia oliveri (Rolfe) Hutch. & Dalziel	0	4	22	2	2	18	18	0	24	4	2	2	2	0	0
Diospyros mespiliformis Hochst. ex A.DC.	0	0	7.14	28.57	0	0	28.57	28.57	0	7.14	0	0	0	0	0
Khaya senegalensis (Desr.) A.Juss.	5.45	3.63	1.82	24.84	1.21	26.66	26.06	3.63	0	3.63	1.21	1.81	0	0	0
Manihot esculenta Crantz	9.52	9.52	0	9.52	0	61.9	9.52	0	0	0	0	0	0	0	0
Nigella sativa L.	5.88	5.88	5.88	11.76	11.76	5.88	29.41	0	0	17.64	5.88	0	0	0	0
Ocimum gratissimum L.	0	2.7	0	16.21	5,4	13.51	56,75	0	0	2.7	0	0	0	2.7	0
Philenoptera cyanescens (Schumach. & Thonn.) Roberty	6.52	6.52	2.17	52.17	0	8.69	19.56	0	0	2.17	0	2.17	0	0	0
Pterocarpus erinaceus Poir.	11.53	11.53	3.84	26.92	0	19.23	15.38	3.84	0	3.84	0	3.84	0	0	0
Rauvolfia vomitoria Afzel.	14.81	11.11	3.7	18.51	0	11.11	33.33	0	0	7.4	0	0	0	0	0
Senna italica Mill.	6,89	0	3.45	37.93	0	17.24	34.48	0	0	0	0	0	0	0	0
Uvaria chamae P.Beauv.	0	12.82	0	23.07	2.56	25.64	23.07	2.56	0	7.69	0	2.56	0	0	0
Vernonia amygdalina Delile	5.26	14.03	10.52	22.8	0	10.52	33.33	0	1.75	0	0	1.75	0	0	0

infectious, metabolic, digestive and blood diseases. Data from this study confirmed the use of all seveteen plants studied here in the traditional treatment of diarrhoea.

In-depth pharmacological and toxicological tests are necessary to attest to the efficacy and safety of these plants in order to ensure better management of the various diseases mentioned here, including diarrhoeal infections. This could then lead to the domestication of the these plants as new medicinal crops to diversify agriculture.

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