



Ethnomedicinal study of *Ocimum gratissimum* Lin (*Lamiaceae*) in Cotonou

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ABSTRACT

Background: In Benin, *Ocimum gratissimum* is consumed by most of the population. This plant is commonly used in traditional medicine. In the Beninese pharmacopoeia, the use of this plant differs according to the users. In view of these differences, it is essential to elaborate the repertoire of the virtues attributed to this plant by ethnomedicinal exploration.

Materials and methods: This study was conducted for 16 months from February 2018 to May 2019. Ethnomedicine surveys were taken place in thirty-four markets and the thirteen borough of Cotonou. Target groups are herbalists, consumers and sellers. It was based on a knowledge, attitudes and practices survey. It was conducted using a semi-direct interview technique based on a questionnaire administered in local languages. Statistical treatment has been provided by *Epi Info* 3.5.3 and *IBM SPSS Statistics 19*. The Ki^2 test has been used and the statistical significance set at $p < 0.05$.

Results: The conservation methods of *O. gratissimum* induce changes both physical and chemical. The therapeutic and food uses are more cited. Antibiotic property is more recognized. The majority of respondents not respect dosages with reported side effects. Bivariate analyzes revealed significant links between educational level and dosage definition, ethnical groups and commonly used medicinal plants or diseases treated.

Conclusions: This plant is a preventive and curative remedy for some thirty diseases. These results constitute a database in view of the production of improved traditional pharmaceutical based on *O. gratissimum*.

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INTRODUCTION

In history, plants have traditionally remained as remedies for preventing or curing various diseases [1] because they contain several thousand molecules with enormous therapeutic potential [2]. It is used traditionally to defend oneself, to clothe

oneself, to protect the environment [3], to flavor food, to preserve food or corpses [4], to feed oneself, to lodge oneself, to warm oneself, to perfume oneself, maintain one's balance, preserve and cure diseases [5]. According to the literature, 80% of the world's population, compared with 80 to 85% of the

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population of Benin, use traditional medicine to meet their health needs [6, 7].

The African continent is endowed with a very rich biodiversity with many plants used as natural food and for therapeutic purposes. The side effects of synthetic molecules and economic constraints have led in recent years to the use of medicinal plants for therapeutic purposes [8]. The traditional pharmacopoeia is thus strongly involved in the ongoing research for the well-being of the populations. Medicinal plants are the main resource of this popular medicine where several species are used for the treatment of oxidative stress diseases, inflammatory, microbial, cardiovascular, renal, hepatic and viral diseases [9]. This strong propensity for traditional medicine, especially for the poor [10], is justified by poverty, attachment to socio-cultural habits, isolation of rural areas, lack of sanitary or rudimentary infrastructure, the high cost and side effects of conventional drugs and low incomes [11].

Among the most used plants in Benin, *O. gratissimum* Lin for its character for various uses especially medicinal and food is widely consumed. This herbaceous plant with upright habit, quadrangular stem, opposite petrified odorous leaves is perennial and reproduces by seed. An invasive pantropical species, it is native to Asia, India and Vietnam [12]. This study entitled "**Ethnomedicinal study of *Ocimum gratissimum* Lin (Lamiaceae) in Cotonou**" is initiated to elaborate the repertory of the different therapeutic uses of *O. gratissimum*. This inventory of empirical medicinal uses of *O. gratissimum* is based on three axes namely the profile of the actors surveyed, the treatment of medicinal plants and finally the empirical knowledge of the actors investigated on the use of *O. gratissimum* in traditional medicine. These results will serve as a database for the orientation of phytochemical research, biological activities and preclinical tests in the perspective of the production of enhanced traditional medicine based on *O. gratissimum*.

MATERIALS AND METHODS

Materials of study

The survey questionnaires, the digital camera and the recorder constitute the bulk of the material for this work.

Presentation of the study area

This ethnomedicinal research has been carried out in Cotonou, the largest city and the economic capital of Benin. This city is located between latitude 6°21'36 " North and longitude 2°26'24" East along the coastline. Located between Nokoué Lake and the Atlantic Ocean, it is bounded on the north by the municipality of Sô-Ava and Lake Nokoué, on the south by the Atlantic Ocean, on the east by the

municipality of Sèmè-Kpodji and on the West by the municipality of Abomey-Calavi [13, 14]. It has an area of 79 km² with a population of 678.874 inhabitants. Its demographic weight is 6.13% with a density of 8.593 inhabitants per km² [15]. The climate is subequatorial with the alternation of two rainy seasons and two dry seasons [14, 15]. Figure 1 below represents the Cotonou cartography.

(Figure 1)

This study was conducted for 16 months from February 2018 to May 2019. The work was carried out in three phases, namely the documentary research phase, the sampling phase and the investigation phase coupled with the processing of the results.

Methods of study

Choice of markets

All Cotonou markets are taken into account with the exception of six markets because of their sales nature of manufactured products than conventional market [13]. We selected a total of thirty-four markets. Ethnomedicinal information was collected in all these target markets. This was a reasoned choice that did not take into account the size of the markets nor the importance of the number of LV sellers and herbalists present in these markets but which aims for a broad representation and reliability of results. Figure 2 shows the cartography of the positioning of the forty listed Cotonou markets.

(Figure 2)

Choice of sellers, herbalists and consumers

The assessment of the staff of LV vendors and herbalists during the pre-survey phase yielded approximately 60% and 40%, respectively. These rates are maintained for each category. For sample size, we selected 5 respondents composed of 3 LV vendors and 2 herbalists in each of 33 targeted secondary markets. This number was chosen in view of the number of these targeted players in the smallest of these markets. The workforce retained in these secondary markets has been multiplied by 5 in the Dantokpa market because of its international character, the number of LV and PM sales sites, and the number of LV salespeople and herbalists in this market. That makes respectively 99 and 15 sellers of LV in the secondary markets and the Dantokpa market against 66 and 10 herbalists taken in this order at the level of the secondary markets and the Dantokpa market. Regarding the selection of the people surveyed, the first vendor at the main entrance is chosen, if he is available and gives his consent. Otherwise, we move on to the next before making jumps from 05 to Dantokpa and jumps of 03 in the others. The sellers of *O. gratissimum* and herbalists interviewed in these selected markets are therefore one hundred

and ninety (190). To complement the data collected, a convenience sample of 5 respondents randomly selected in each of the 13 districts of Cotonou was adopted. We interviewed 65 consumers in

households. In the end, 255 people are interviewed. The categories of respondents are summarized in table 1 below.

Table 1: Socioprofessional categories of respondents

Sexes	LV Seller	Herbalists	Consumers	Total / Sex
Men	04	31	23	58
Women	110	45	42	197
Total / Category	114	76	65	255

Data Collection

A semi-structured Interview was conducted using a questionnaire designed for this purpose. This descriptive analytic type study is based on a KAP (knowledge, attitudes, practices) survey. It was conducted using the technique of semi-direct interviews and five *focus groups* using a pre-tested questionnaire [10, 16, 17]. The method is based on dialogue in local languages (Fon; Goun; Mina; Manhi; Adja). We used two complementary approaches for two sources of information:

- The semi-direct interview [16, 17] which allowed the collection of information from primary sources "in situ".
- Internet searches that made it possible to have secondary source information related to aspects of the subject.

Statistical treatment of data

Results of univariate analyzes

The collected data is coded and processed using Excel, Word, Epi Info 3.5.3 and IBM SPSS Statistics 19 software.

- *Word* and *Excel* software was used for data entry and the development of the raw and digitized database.

- The statistical software *Epi info 3.5.3* and *IBM SPSS Statistics 19* were used to perform the univariate and bivariate analyzes. The significant links between the variables were highlighted by the " K^2 " test and the statistical significance was set at $p < 0.05$.

RESULTS

The results of the present ethnomedicinal investigation on *O. gratissimum* bring together the results of univariate and bivariate analyzes. These results take into account the identification of the respondents, the conservation and marketing of medicinal plants and the therapeutic potential of *O. gratissimum*.

Table 2a: Results of univariate analysis of herbalists

Variables	Modalities	Frequency	Percentages
Profile of the herbalists surveyed			
Sexes	Feminine	45	59.2
	Male	31	40.8
	Total	76	100
Age groups	30 ≤ Age ≤ 45	12	15.8
	45 ≤ Age ≤ 60	51	67.1
	60 ≤ Age ≤ 75	13	17.1
	Total	76	100
Levels of instruction	None	18	23.68
	Primary	34	44.73
	Secondary	16	21.05
	University	8	10.52
	Total	76	100
Conservation of the medicinal plants			
Duration of conservation	1 - 2 months	32	42.1
	2 - 3 months	34	44.7
	More than 3 months	10	13.2

	Total	76	100
Conservation methods	Drying / Under the dew	15	19.7
	Under the dew / Regular tris / Drying	41	53.9
	Regular tris / Drying	20	26.3
	Total	76	100
Effects of conservation	Physical alteration / Taste loss / Discoloration	17	22.4
	Discoloration / Physical alteration	12	15.8
	Degradative odors / Discoloration / Physical alteration	24	31.6
	Taste loss / Physical alteration / Discoloration / Degradative Odors	23	30.3
	Total	76	100
Therapeutic aspects of <i>Ocimum gratissimum</i>			
Various uses of <i>Ocimum gratissimum</i>	Food / Therapeutic	34	44.7
	Medico-magical / Therapeutic / Food / Biological	14	18.4
	Ornamental / Therapeutic / Food / Biological	17	22.4
	Therapeutic / Food / Biological	11	14.5
	Total	76	100

Table 2b: Results of univariate analysis of herbalists (End)

Variables	Modalities	Frequency	Percentages
Therapeutic Aspects of <i>Ocimum gratissimum</i>			
Diseases treated with <i>Ocimum gratissimum</i>	Asthma / Diabetes / Malaria / Hemorrhoids / Dysmenorrhea / Dystocia	10	13.2
	Diabetes / Hypertension / Malaria / Hemorrhoids / Typhoid / Scabies	17	22.4
	Hypertension / Hemorrhoids / Malaria / Infections / u.Buruli / Intestinal worms	24	31.6
	Hypoglycemia / Hypertension / Malaria / Diabetes / Scabies / Infections	9	11.8
	Abortion / Osteoarthritis / Malaria / Hemorrhoids / Dysmenorrhea	16	21.1
	Total	76	100
	Therapeutic properties	ATB / Carminative / Stomachic	23
	Laxative / ATB / Stomachic / Lactagogue	17	22.4
	ATB / Stomachic / Carminative / Laxative	36	47.4
	Total	76	100
Organs used	Leaves	28	36.8
	Seeds / Stem / Leaves / Roots	16	21.1
	Root / Leaves	9	11.8
	Leaves / Stem	23	30.3
	Total	76	100
Modes of preparation	Decoction / Infusion / Maceration / Sauce	24	31.6
	Infusion / Decoction / Kneading / Sauce	15	19.7
	Maceration / Decoction / Infusion / Kneading	12	15.8
	Sauce / Decoction / Infusion	25	32.9
	Total	76	100
Modes of use	Body bath / Poultice / Fumigation / Oral / Instillation / Massage	32	42.1
	Oral / Body bath / Poultice / Instillation	44	57.9
	Total	76	100
Dosage definition	Defined	46	60.5
	Not defined	30	39.5
	Total	76	100

Posology	Two (02)	15	19.7
	Not defined	30	39.5
	Three (03)	13	17.1
	Single (01)	18	23.7
	Total	76	100
Duration of treatment	Till satisfaction	37	48.7
	Not defined	39	51.3
	Total	76	100
Side effects	None	41	53.9
	Burn / Itching	15	19.7
	Digestive disorders / Itching	20	26.3
	Total	76	100

Table 3a: Results of univariate analysis of LV sellers

Variables	Modalities	Frequency	Percentages
Profile of the LV sellers surveyed			
Sexes	Feminine	110	96.5
	Male	4	3.5
	Total	114	100
Age groups	15 ≤ Age ≤ 30	29	25.4
	30 ≤ Age ≤ 45	64	56.1
	45 ≤ Age ≤ 60	21	18.4
	Total	114	100
Level of instruction	None	17	14.9
	Primary	80	70.2
	Secondary	17	14.9
	Total	114	100
Conservation of the medicinal plants			
Duration of conservation	2 - 3 Days	23	20.2
	3 - 5 Days	53	46.5
	5 - 7 Days	29	25.4
	Not defined	9	7.9
	Total	114	100
Conservation methods	Water sprinkling / Dew / Regular Tris	48	42.1
	Under the dew / Regular Tris	35	30.7
	Regular Tris / Water sprinkling	31	27.2
	Total	114	100
Effects of conservation	Physical alteration / Discoloration	63	55.3
	Degradative odor / Physical alteration	21	18.4
	Degradative odor / Physical alteration / Taste loss	17	14.9
	Taste loss / Physical alteration	13	11.4
	Total	114	100
Therapeutic aspects of <i>Ocimum gratissimum</i>			
Various uses of <i>Ocimum gratissimum</i>	Food / Therapeutic / Medico-magical	23	20.2
	Biological / Therapeutic / Food / Medico-magical	45	39.5
	Ornamental / Food / Therapeutic	19	16.7
	Therapeutic / Food / Biological	27	23.7
	Total	114	100
	Therapeutic properties	ATB / Carminative / Laxative	29
Stomachic / Lactagogue / Carminative / ATB		45	39.5
ATB / Stomachic / Laxative		40	35.1
Total		114	100

Table 3b: Results of univariate analysis of LV sellers (End)

Variables	Modalities	Frequency	Percentages
	Therapeutic aspects of <i>Ocimum gratissimum</i>		
Diseases treated with <i>Ocimum gratissimum</i>	Osteoarthritis / Malaria / Worms / Hemorrhoids / Hypertension / Typhoid / Asthma / Diabetes	15	13.2
	Hemorrhoids / Asthma / u. Buruli / Diabetes / Hypertension / Malaria / Worms / Typhoid	14	12.3
	Typhoid / Diabetes / Dysmenorrhea / Worms / Hypertension / Malaria / Hemorrhoids	18	15.8
	Malaria / Hypertension / Worms / Typhoid / Hemorrhoids / Diabetes	45	39.5
	Bleeding / Abortion threat / Hemorrhoids / Diabetes / Worms / Malaria / Typhoid	22	19.3
	Total	114	100
Organs used	Leaves	50	43.9
	Seeds / Stem / Leaves / Flowers	7	6.1
	Roots / Stem / Flowers / Leaves	18	15.8
	Stem / Leaves	39	34.2
Total	114	100	
Modes of preparation	Decoction / Infusion / Maceration / Sauce	25	21.9
	Infusion / Decoction / Kneading / Sauce	15	13.2
	Maceration / Decoction / Infusion / Kneading	21	18.4
	Sauce / Decoction / Infusion	53	46.5
Total	114	100	
Modes of use	Body bath / Poultice / Fumigation / Oral / Instillation / Massage	28	24.6
	Massage / Oral / Body Bath	10	8.8
	Oral / Body Bath / Poultice / Instillation	76	66.7
Total	114	100	
Dosage definition	Defined	54	47.4
	Not defined	60	52.6
Total	114	100	
Posology	Two (02)	15	13.2
	Not defined	60	52.6
	Three (03)	25	21.9
	Single (01)	14	12.3
Total	114	100	
Duration of treatment	Till satisfaction	37	32.5
	Not defined	77	67.5
	Total	114	100
Side effects	None	41	36.0
	Burn / Itching	34	29.8
	Digestive order / Itching	39	34.2
	Total	114	100

Table 4a: Results of univariate analysis of Consumers

Variables	Modalities	Frequency	Percentages
	Profile of the consumers surveyed		
Sexes	Feminine	42	64.6
	Male	23	35.4
	Total	65	100
Age groups	30 ≤ Age ≤ 45	25	38.5
	45 ≤ Age ≤ 60	28	43.1
	60 ≤ Age ≤ 75	12	18.5
	Total	65	100

Level of instruction	None	6	9.2
	Primary	32	49.2
	Secondary	17	26.2
	University	10	15.4
	Total	65	100
Conservation of the medicinal plants			
Duration of conservation	2 - 3 Days	43	66.2
	3 - 5 Days	8	12.3
	Not defined	14	21.5
	Total	65	100
Conservation methods	Boiling / Cooling / Regular Tris	17	26.2
	Boiling / Regular Tris	8	12.3
	Under the dew / Regular Tris	40	61.5
	Total	65	100
Effects of conservation	Discoloration/ Taste loss / Degradative odor	46	70.8
	Taste loss / Physical alteration	19	29.2
	Total	65	100
Therapeutic aspects of <i>Ocimum gratissimum</i>			
Various uses of <i>Ocimum gratissimum</i>	Food / Therapeutic / Biological / Ornamental	15	23.1
	Biological / Food / Therapeutic	11	16.9
	Medico-magical / Food / Therapeutic / Biological	9	13.8
	Therapeutic / Food	30	46.2
	Total	65	100
Therapeutic properties	Carminative / Laxative / ATB	14	21,5
	Laxative / ATB / Stomachic	22	33,8
	Stomachic / Lactagogue / Carminative / ATB	29	44,6
	Total	65	100

Table 4b: Results of univariate analysis of Consumers (End)

Variables	Modalities	Frequency	Percentages	
Therapeutic aspects of <i>Ocimum gratissimum</i>				
Diseases treated with <i>Ocimum gratissimum</i>	osteoarthritis / Malaria / Hemorrhoids / Worms / Asthma / Hypertension / Typhoid / Diabetes	9	13.8	
	Hemorrhoids / Asthma / Hypertension / u. B / Malaria / Typhoid / Diabetes / Worms	12	18.5	
	Hypertension / Malaria / Hemorrhoids / Worms / Typhoid / Diabetes	13	20.0	
	Malaria / Hypertension / Hemorrhoids / Worms / Typhoid / Diabetes / Dysmenorrhea	22	33.8	
	Bleeding / Abortion threat / Worms / Malaria / Hemorrhoids / Typhoid / Diabetes	9	13.8	
	Total	65	100	
	Organs used	Leaves	30	46.2
		Seeds / Stem / Leaves / Flowers	5	7.7
Roots / Stem / Leaves		11	16.9	
Stem / Leaves		19	29.2	
Total		65	100	
Modes of preparation	Decoction / Infusion / Sauce / Maceration	17	26.2	
	Infusion / Sauce / Kneading / Decoction	20	30.8	
	Maceration / Kneading / Decoction / Infusion	10	15.4	
	Sauce / Decoction / Infusion	18	27.7	

	Total	65	100
Modes of use	Body bath / Poultrice / Fumigation / Oral / Instillation / Massage	18	27.7
	Massage / Oral / Instillation / Body bath / Poultrice	13	20.0
	Oral / Body bath / Instillation / Poultrice	34	52.3
Dosage definition	Total	65	100
	Defined	32	49.2
	Not defined	33	50.8
Posology	Total	65	100
	Two (02)	8	12.3
	Not defined	33	50.8
	Three (03)	18	27.7
Duration of treatment	Single (01)	6	9.2
	Total	65	100
	Till satisfaction	31	47.7
	Not defined	34	52.3
Side effects	Total	65	100
	None	32	49.2
	Burn / Itching	16	24.6
	Digestive disorder / Itching	17	26.2
	Total	65	100

Results of bivariate analyzes

Table 5: Results of bivariate analyzes

Target Groups	Crossed Variables	P-Value
Herbalists	Level of Instruction ✕ Dosing Definition	0.001*
	Ethnics ✕ Types of diseases	0.001*
	Ethnics ✕ Common Medicinal Plants	0.001*
LV sellers	Level of instruction ✕ Dosing definition	0.001*
Consumers LV / PM	level of instruction ✕ Dosing definition	0.003*
	Ethnics ✕ Types of diseases	0.001*
	Ethnics ✕ Common Medicinal Plants	0.001*

N.B: * = Chi-square value of Pearson; ✕ = Crossing between the variables



Figure 1: Location map of Cotonou municipality



Figure 2: Location Map of Cotonou Markets

DISCUSSION

Profile of respondents

The feminine population surveyed largely dominates the male population in the three target

groups. These high percentages of the women surveyed to the detriment of those of men are in agreement with the results of some authors [18, 19, 20, 21]. This testifies to the leading role of women

by custom in the chain of production, marketing and cooking of LV within households. It is also proof of the hegemonic responsibility of women in the marketing and processing of medicinal plants. These results are also in agreement with those of [18] who showed that women constitute the great mass holding traditional phytotherapeutic knowledge. This same trend towards feminization is recorded in southern Benin by [22] in the sale of medicinal plants in Cotonou unlike other communes. Admittedly, [23] in Dakar then [24] in Côte d'Ivoire have shown that men are more numerous in the trade of medicinal plants contrary to our results. This difference could be explained by the difference in the environment and especially the socio-cultural realities between the populations of the cities of Dakar, Cotonou, Zouénoula and elsewhere.

The age range of herbalists (30 - 75 years old) is higher than that of LV salesmen (15 to 60 years old).

In addition, the percentage of illiterates is higher in the rank of herbalists (23.68%) than the sellers of LV (14.9%). These results show that age is a determining factor for holding ethnomedicine knowledge. In a comparative approach, [22] found similar values in their survey where the average age of herbalists was around 65 in southern and central Benin. These results, consistent with the results of some authors [19, 24, 25], raise the issue of maturity in age, experience and wisdom required to hold endogenous knowledge on plants, a traditional know-how that does not take into account the level of education in herbalism or sale of LV. These two sectors of activity are considered as exclusive to the poor and above all the out-of-school populations. Therefore, it is generally accepted in Africa that it is the older, considered wise people who hold the traditional knowledge of medicinal plants [20, 26]. This observation easily explains the undeniable transmittable nature of generations in generations of knowledge in the traditional pharmacopoeia which requires a lot of time. The difference between age groups and levels of education obtained here and in the other studies is the result of divergence in educational backgrounds, socio-cultural characteristics and schooling policies.

Conservation or Treatment of Medicinal Plants

The issue of the conservation of medicinal plants is necessary and should be of great concern. In this work, the evaluation of the conservation of medicinal plants among respondents in Cotonou shows that the shelf life depends on the target group and therefore the uses. Thus, the shelf life of PM in general and *O. gratissimum* in particular is relatively long among herbalists than other targets. In a comparative momentum, the reduction of medicinal

plants in powder makes it possible to ensure a conservation beyond 10 years [27] but it is preferable to renew its supply of medicinal plants every year [28]. The present research reveals that, at the local level, conservation methods for PM and LV are rudimentary, artisanal and very little diversified. The consequences induced by these conservation methods are of a visual, physical, odorous and biochemical nature in variable proportions. These findings affect the medicinal properties and nutritional quality of the plant, according to most respondents. These methods of conservation or treatment of medicinal plants reported in this study are a part of those reported in the literature including sorting and separation, drying in the shade out of moisture, the use of well-adapted cardboard packaging, uses of liquids or preservatives and reduction to powder [27, 28, 29]. The proper application of these enumerated methods aims to safeguard the intrinsic value of biomolecules and the sustainable conservation of plant organs for a healthy, rational and effective use.

Therapeutic importance of *O. gratissimum*

Investigations carried out among the population of Cotonou reveal several uses of *O. gratissimum* namely medicinal, food, medico-magic, ornamental and organic. The statistical treatment of the results shows that among all the uses, the therapeutic-food combination is the most cited in the three target groups. Of these different uses, the properties recognized for *O. gratissimum* by the surveyed population are ATB, stomachic, lactagogue, carminative and laxative in Variables percentages from one target group to another. The results show that *O. gratissimum* is used to prevent or cure several types of metabolic diseases, regulation, function and also affecting the organs. Statistical results, the combination consisting of Hypertension, hemorrhoid, malaria, u.Buruli, and intestinal worms (31.6%) comes first among herbalists. The sellers of LV have more evoked the combination malaria, intestinal worms, high blood pressure, hemorrhoids, typhoid, diabetes, dysmenorrhea, osteoarthritis (39.5%). As for consumers, *O. gratissimum* is more indicated for malaria, hypertension, hemorrhoid, intestinal worms, typhoid, diabetes and dysmenorrhea (33.8%). This difference between these series of head in the same geographical sphere is due either to the socio cultural reflection or to a bad knowledge of the virtues of the plant and underlines the cosmopolitan character of the commune of Cotonou. In a comparative approach, these results are largely concomitant with the results reported by [30] who, beyond the nutritional richness, evoked the medicinal virtues of *O. gratissimum* for the treatment of colic, dysentery, oligospermia, sore eyes, conjunctivitis, typhoid fever, hypertension,

pelvic pain, dysmenorrhea, candidiasis and diarrhea. In their study, [31] reported the treatment of hypertension, epistaxis and malaria through the use of *O. gratissimum*. Along the same lines, [32] reported the use of *O. gratissimum* to treat upset stomach, diarrhea, chronic dysentery, vomiting, bad breath, tooth decay, fungal infections, colds, fever, catarrh, ringworm, scabies, urinary tract infections, gonorrhoea and vaginitis. Similarly, [33] and [34] found similar results showing that *O. gratissimum* in addition to the high protein, fat and fiber content is a vegetable with high antioxidant and phenol-rich activity that is recommended in the fight against many chronic diseases. The respondents generally mentioned four diseases namely enteralgia, epilepsy, Buruli ulcer and dystocia which differ from the results reported by these authors cited above. Similarly, these authors reported several diseases including vaginitis, gonorrhoea, bad breath, catarrh and oligospermia that are not mentioned by the respondents in this study. The similarities and dissimilarities of the conditions reported in these studies can be explained by the convergent and divergent nature of endogenous and empirical knowledge about *O. gratissimum* from one society to another [35]. Malaria and tension are mainly mentioned by the respondents. This result is consistent with that of a study in Nigeria that showed the effectiveness of acetic acid extract of *O. gratissimum* on *Plasmodium falciparum* [36]. A wider range of diseases for which *O. gratissimum* is indicated has been identified in the work of [35]. This gives credibility to the ethnomedicinal information collected on this plant.

For consumption, all organs are used with the first row the leaves followed by the leafy stem. This result is consistent with those reported in the literature [37]. This predominance of the use of the leaves is explained by the ease and speed of its harvest, the short time of regeneration, the role of the harvest in the growth of the plant but also because the leaves are the seat of the plant photosynthesis and often the storage of secondary metabolites responsible for the biological properties of the plant [24, 26, 38].

Regarding the preparation, the dominant combination among herbalists and sellers is sauce, powder reduction, decoction, infusion. At the level of consumers, the modal series is composed of decoction, infusion, sauce and kneading. This results in various drug forms and administration routes. These results are in part consistent with those of some authors who have reported broader ranges of preparation from which various forms of administration are derived with as variable proportions as possible. As an illustration, we have the mode of expression and the galenic forms ablution, brushing and vaginal that are not very

inked in the respondents. For these authors, the best use would be that which preserves the properties of the plant while allowing the extraction and assimilation of active ingredients [20, 24, 38].

The dosage is mostly observed among herbalists as consumers and sellers of LV. This already anticipated result is explained by the prescribing role of the herbalists. These results are not very consistent with those of [26] then [39] who found in many practitioners and consumers literate or illiterate the sense of approximate measurement. The units of measurement are the pinch, the palm of the hand, the peanut or coconut shell, the spoon, the drinking glass and the cup [26, 27]. This raises the problem of precision of dosages or poisoning with regard to the inaccuracy of the units of measurement used in the traditional pharmacopoeia. This is consistent with the statement that "medicinal plants are still used by people to heal themselves without adherence to the principles governing the administration of phytochemicals" [40]. Inobservance of dosage is contrary to the principle of dosage. The majority of respondents indicated a non-specific dosage depending on the time of day (morning; mid-day; evening). The direct consequence is the reported side effects of burns, itching and digestive disorders. The bivariate analyzes of the results made it possible to note the existence of significant links between level of education and definition of dosage for the three target groups surveyed. It is the same between ethnic groups and commonly used medicinal plants and ethnic groups and types of conditions treated by *O. gratissimum* specifically for the target groups of herbalists and consumers. This result confirms that the question of dosage is hardly a concern for most of the traditional medicine actors surveyed in this study area. In view of the results, the definition of the dosage of fractions or mixtures is intimately related to the intellectual level of the respondents. Almost all the respondents who observe the dosing principle have reached the secondary level. The principle of "ancestral know-how that is transmitted from generation to generation" of folk medicine fully justifies the correlation between cultural social groups and medicinal plants on the one hand and then between the nationals of the same cultural area and the various uses of *O. gratissimum* on the other hand. As a result, the majority of Fon, Manhi, Goun, Adja, and Tchi respondents use *O. gratissimum*, especially for these antibacterial, antiviral, digestive, febrifuge, analgesic, anti-inflammatory, antidepressant and euphoric properties opposed to the Dendi, Yoruba and Nago block which beyond the uses related to the properties of the plant also uses it for these magical medical virtues.

CONCLUSION

This ethnomedicinal investigation carried out in Cotonou in the Republic of Benin showed the intrinsic medicinal value of *O. gratissimum* which is the subject of a broad spectrum of uses in traditional medicine. The univariate analysis of the results revealed that, at the pharmacological level, *O. gratissimum* is used by the populations in different forms of medicinal preparations in the prevention and the treatment of about thirty diseases (amenorrhea, asthma, headaches, diabetes, diarrhea, enteralgia, epilepsy, epistaxis, fever, u.Buruli, typhoid fever, hepatitis, hemorrhoids, arterial hypertension, metrorrhagia, bronchitis, cough, dysentery, influenza, abortion threats, intestinal worms, painful periods, infections, migraine, pneumonia, edema, malaria, flatulence, osteoarthritis, rheumatism, conjunctivitis, gastric ulcer) of several types. Bivariate analyzes revealed three significant links. For the three target groups, a link between educational level and dosage definition was identified, followed by sociocultural groups and commonly used medicinal plants. There was also a link between ethnic groups and types of conditions treated by *O. gratissimum* in the herbalists and consumers groups. These ethnomedicinal results collected bridge the profile of the respondents, the level of knowledge and treatment of medicinal plants and finally the therapeutic importance of *O. gratissimum*. In reference to the literature, this information collected from the respondents gives us a great deal of information on the veracity of the results. The dual cultural and religious character doubled by the social dimension attached to the use of *O. gratissimum* in traditional medicine finds its meaning through the various uses of the plant. This ethnomedicinal database on *O. gratissimum* remains scientifically justified by phytochemical studies, biological activities and preclinical tests.

List of abbreviation:

WHO: World Health Organization; LV: Leaf Vegetable; PM: Medicinal Plant; ATB: Conventional antibiotic.

Contribution of the authors:

WH. KPTEHOTO, EEM. HOUETO and RC. JOHNSON ensured the conception, the realization and the writing of the study. ZF. MIGNANWANDE, ASY. HOUNKPATIN and G. BONI contributed to the writing and proofreading of the study. H. YEDOMONHAN and F. LOKO supervised the work.

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