Ethnobotany of aromatic plants used by phytotherapists in the district of Glazoue, Ouesse and Save in Benin

Abstract

Aromatic and medicinal plants (AMP) are flora with a fragrant essence. The aim of this study is to identify the aromatic plants used by herbalists in three district of the Departement des Collines. The method of data collection is based on ethnobotanical surveys of herbalists using the Dagnelli formula and pre-established survey questionnaires. The results of the survey of 300 herbalists identified 22 most commonly used aromatic plants, divided into 17 families and 21 genera. The most represented families are: Lamiaceae (15%); Annonaceae (15%). Among the MAPs inventoried, the most cited and used are: Ocimum canum L. Ocimum gratissimum L.; Chenopodium ambrosioides L.; Hyptis suaveolens L.; Xylopia aethiopica (Dunal) A. Rich; Securidaca longepedunculata Fresen. MAPs treat 163 conditions identified in this study. Some of the AMP are used alone or in combination with other plants. AMP drugs are: leaves (64%), roots (23%). The ailments treated by the majority of AMP are: fever; tooth decay; conjunctivitis; constipation; haemorrhoids; hernia; inflammation; skin lesion; stomach ache; snake bite; causes of malaria; sores and painful periods. In view of the proven importance and different uses of AMP, it is necessary to study them further (ecology, distribution and conservation status) in order to better prevent or cure human health.

Key words: Aromatic plants, Useful plants, Diseases, Healing and Benin

Introduction

The floristic resource constitutes a huge reservoir that is very important for health needs (Akognongbe *et al*., 2014; Akodéwou *et al*., 2014). The vast majority of the Beninese population remains dependent on the plant for the satisfaction of daily needs (Wedjangnon *et al.*,2016). Plants, since then, have been used as medicines and even under certain conditions as food (Din *et al*., 2011). According to the World Health Organization (WHO), about 65-80% of the world's population, use medicinal plants in primary health. According to Agbangnan *et al*, (2013), 25-50% of conventional medicines nowadays have the bioactive molecules of medicinal plants as active ingredients. The high cost of modern medicine drugs makes people resort to traditional medicine (medicinal plants) for treatment. Medicinal plants are an inevitable source of medicine (Dougnon *et al.*,2016). Modern medicine has turned to ethnobotanical studies to have a wide range of varieties of molecules from medicinal plants to prevent and fight against diseases (Jiofack *et al*., 2010). In Benin, traditional medicine (medicinal plants) has become increasingly important in the treatment of diseases. The

promotion of aromatic and medicinal plants is a major concern of many researchers and institutional leaders (Adomou *et al*., 2012; Ouinsavi *et al*., 2016). Aromatic and medicinal plants (AMPs) useful to humans can be categorized according to uses: herbal tea plant; hygienic and amenity drink; plant for cosmetic use; plant for aromatic and condiment use; plant for food use; plant for industrial use; medicinal plant. Indeed, aromatic and medicinal plants are used in phytomedicines to bring healing and even preventive (INRA, 2013). Enough authors have demonstrated the therapeutic aspect of aromatic plants (Adomou *et al*., 2012 and Mangambu *et al*., 2014). Some of the MAPs are used in the agricultural field to control crop pests to promote good agricultural yield (Kpatinvoh *et al*., 2017). MAPs are generally used in food for the purpose of flavouring sauce and drink. The recognition of the clinical, pharmaceutical and economic value of MAP-based medicines continues to grow. MAPs are considered a commodity chain in their own right (INRA, 2013). MAPs were at the origin of the first botanical gardens (Tardivon *et al*., 2012; Alfaiz *et al*., 2013; Neffati and Sghaier, 2014). Different ethnobotanical works have been carried out in Benin to document and perpetuate the traditional knowledge of MAPs. These are: Adjanohoun (1999), Houessou (2010), Adomou *et al*. (2012) and Assongba (2014). Beninese plant formations are dwarfed in quality by aromatic and medicinal plants (Neuenschwander *et al*., 2011). A single plant species is used in different ways and in different areas, in different localities where it exists according to the needs and knowledge known about this plant (Ouinsavi *et al*., 2016). Despite the numerous studies on medicinal plants in Africa (Etuk *et al*., 2010) and elsewhere in the world (Pavani *et al*., 2012; Thirumalai *et al*., 2012), it should be noted that enough studies carried out on aromatic plants are not yet done in Benin. As for the one in the hills department, it is the first study of its kind. This is one of the reasons why this study on aromatic and medicinal plants used by phytotherapists in three district of the department of the hills was chosen in order to list these aromatic and medicinal plants with a view to their perpetuation.

Materials and methods

Study environment

The study took place in the Collines Department, which has an area of 13,931 km^2. This Department is composed of six (6) District (Dassa-Zounmè, Glazoué, Ouèssè, Savalou, Savè and Bantè). The district of this department are subjected to the influences of the humid tropical climate of the Sudano-Guinean type with two rainy seasons with hazards. They have a vegetation of wooded forests and shrubby savannahs. The Ouémé River runs through the

study districts. This study took into account three (3) district of the six (6) of the department, which are: the district of Glazoué, Savè, and Ouesse. The districts are selected because of their diversity of languages, plant formations and high human population

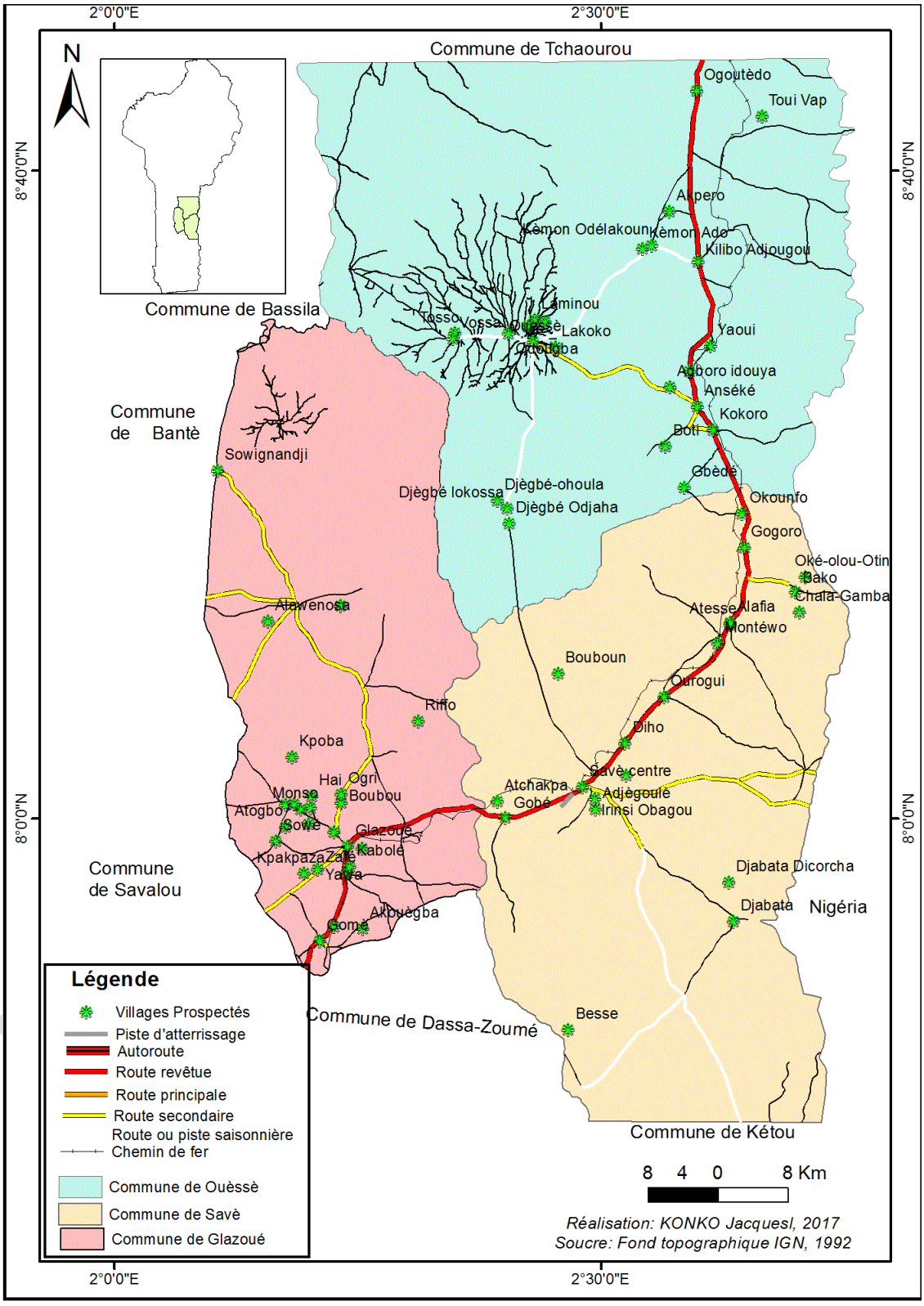


Figure 1: Location of the study area

Study materials

The biological material (plant and human) is made up of the phytotherapists of the three district (Glazoué, Savè and Ouèsse) in which the survey was carried out, as well as all the aromatic and medicinal plants that are listed.

Ethnobotanical survey

The choice of villages was made in the dynamics of having a representativeness of the sociolinguistic groups of the study area. The choice of study villages was based on the existence of herbalist who use medicinal and aromatic plants (Assongba *et al*., 2014; Dougnon *et al*., 2016). A total of 71 villages were visited and 300 herbalists were surveyed by using Dagnilli's (1998) formula at a rate of 100 per district. The herbalists questioned (men and women) were those who had knowledge of plant aromas. The information concerning the symptoms or causes of diseases was confirmed with local doctors, nurses (health agents) and completed by the bibliographical review (Adjanohoun *et al*., 1989). For a practical exploitation of the data and harmonization with the international system.

Data collection

In each district surveyed, two types of data were collected: the first related to the identification of the respondent (ethnicity, sex, age, level of education, religion, marital status, etc.) and the second related to the knowledge of aromatic and medicinal plants provided by the herbalists (vernacular names of the plants, characteristic features of the aromatic plant, difference between aromatic and medicinal plants, plant drugs used). During this phase of field investigation, the various discussions were conducted in an open manner and without time limits to allow the herbalists to freely express their knowledge.

Data processing

The collected data are entered in the Excel spreadsheet to have a database. These data were used to calculate means, variances, frequencies to build tables. R 643.4.0 software is used for linear regression, multivariate analysis etc. The Relative Citation Frequency (RCF) of species (Tardio and Pardo-De-Santaynia, 2008) is calculated as follows

FRC = FC/N; FC: Frequencies of quotations; FRC: Relative Frequencies of Quotation; N: Number of respondents. Jaccard Similarity Index which is calculated to compare sociolinguistic groups. This index measures the similarity of the sociolinguistic groups taken two by two with regard to the knowledge of aromatic plants. It was calculated for each group of species according to the following formula:

J= C/ (A + B - C) with A: number of species of aromatic plants cited by sociolinguistic group A; B: number of species of aromatic plants cited by sociolinguistic group B; C: number of species of aromatic plants common to both groups A and B. If J ≤ 40 %; the ethnic groups have different knowledge about aromatic plants. If on the other hand J > 40 %; the ethnic groups have similar knowledge about aromatic plants**.**

Results

Endogenous knowledge of aromatic medicinal plants

The surveys carried out among the phytotherapists made it possible to note that 98% of the phytotherapists surveyed in the various district know and use aromatic and medicinal plants. Thus, 23 species of aromatic plants are listed and used. They are divided into 17 families and 21 genera (Table 1). The most represented families are Lamiaceae (15%), Annonaceae (15%), Alliaceae (11%) and Rutaceae (7%). According to the results, 100% of five (5) ethnic groups (Idaasha, Mahi, Nago, Fon and Pheul) know and use more plants. The vernacular names of the identified aromatic plants and their frequency of citation are summarized in Table 1. The plants with a frequency of citation (FRC) of more than 50% are*: Ocimum canum; Ocimum gratissimum; Momordica Charantia; Chenopodium ambrosioides; Hyptis suaveolens; Lippia multiflora Moldenke; Lippia rugosa; Xylopia aethiopica; Heliotropium indicum; Securidaca longepedunculata*. These plants are the most frequently used in the treatment of ailments.

Table 1: Vernacular names and citation frequencies of aromatic plants

Scientific names	Idaash	Nago	Mahi	FRC
Ocimum canum L.	Ina-éwé/Hisihisi	Owofi	Akeman	0,88
Ocimum gratissimum L.	Alibara	Simonba	Tchao	0,84
Momordica Charantia L.	Kpalari	Kpalari	Yinssikin	0,82
Chenopodium ambrosioides L.	Odanmaira	Orèdjougou	Godo	0,67
Hyptis suaveolens L.	Ewéidjako	Couloubi	Sansoukpèman	0,66
Lippia multiflora Moldenke	-	-	akalala	0,65
Lippia rugosa L. A.Chev.	Kanhoun	Kinhoun-kinhoun	Aglala	0,62
Xylopia aethiopica (Dunal) A. Rich.	Oroun	Aroun	Kpejelekou	0,58
Heliotropium indicum L.	Ogbolarouko	Igbéako	Koclosoudèkpadja	0,55
Annona senegalensis Pers. Pers.	Otribobo	Ambo	Nyiglwé	0,52
Allium ascalonicum auct. non Strand	Mansa Kpikpa	Amansa elewe	Masa winiwini	0,5
Securidaca longepedunculata Fresen.	Kpatalè	Ikpata	Atakpa Wanlwi	0,49
Ocimum basilicum L.	Akohoun	Akohoun	Kohoun	0,43
Zanthoxylum zanthoxyloides	Eguiatta	Eguiatta	Hetti	0,36

(Lam.)				
Allium sativum L.	Ayo	Ayu	Ayo	0,35
Cymbopogon citratus (DC.) Stapf	Ofrin	Ewéiti	Tcha	0,35
Zingiber officinale Griff.	Atalè	Atalè	Dotan	0,3
Crassocephalum crepidioides (Benth)	Gbolo	Gbolo	Kogbo	0,3
Piper guineense Schum. et Thonn.	Idjayé	Ata iyere	Linlinkou	0,27
Allium cepa L.	Masa	Amansa	Masa	0,25
Olax subscorpiodea Oliv.	Miitin	Akpatcha	Kiviman	0,21
Monodora myristica (Geartn).	Ariwo	Ariwo	Sasalikouin	0,19
Uvaria chamae P.Beauv.	Yaha	Yaha	Yaha	0,17

Jaccard similarity index (J)

The analysis of Table 2 allows us to say that the different sociolinguistic groups have a similar knowledge about aromatic plants ($J \geq 40$), only that the similarity differs according to each sociolinguistic group.

Comparative ethnicities	**Idaasha and Mahi**	**Idaasha and Nago**	**Mahi and Nago**
Index J	86%	90%	95%

Table 2: Jaccard similarity indices

Diseases treated with aromatic and medicinal plants

Table 3 shows the aromatic and medicinal plants with the different ailments treated, the drugs used in the phytomedicines and the modes of preparation of phytomedicines. A total of 24 medicinal plants were identified in the study area. These plants are used daily by the herbalists and the general population to season sauces and to treat ailments.

Table 3. Plants identified, drugs used, preparations made and conditions treated

Species	Families	Org	Preparation	Diseases and conditions
Allium ascalonicum auct. non Strand	**Alliaceae**	**Bu/Fe**	Sauce (gold)	Flavouring, Angina, Aid digestion
Allium cepa L.	**Alliaceae**	**Bu/Fe**	Maceration (Bu/Fe) (Spread) Sauce (gold)	Anti-snake, Infection, Angina
Allium sativum L.	**Alliaceae**	**Bu**	Sauce (gold)	Aromatizing, Cough, aids digestion
Annona senegalensis Pers.	**Annonaceae**	R/Fe/E	Leaves (pocket)	Anti-snake,

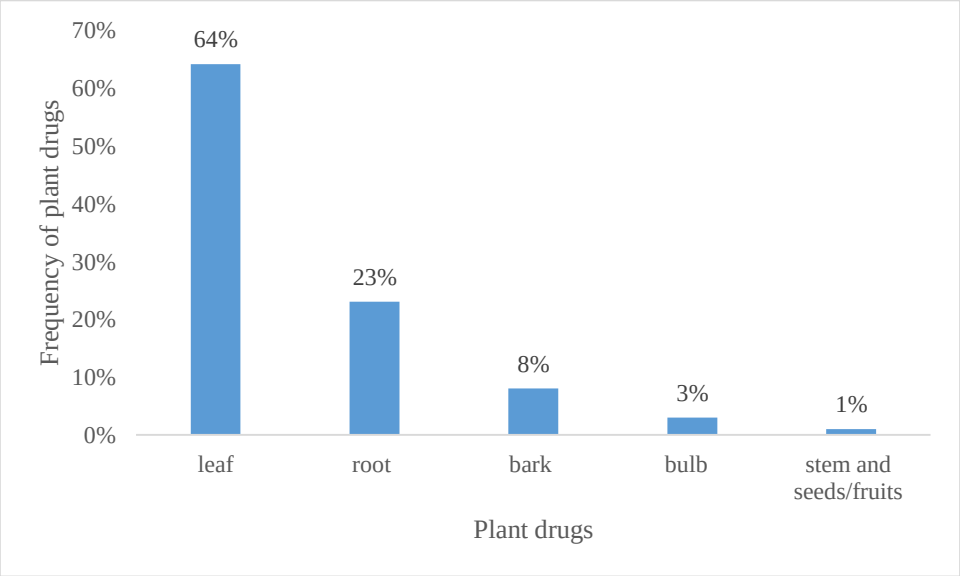
			Decoction (Bath, Gold)	dizziness, stress
Monodora myristica (Geartn).	**Annonaceae**	R/ Fr	Decoction (gold) Market	Intestinal worms, infection, cyst
Uvaria chamae P.Beauv.	**Annonaceae**	R/Fe/E	Decoction (bath, gold)	Fever, body aches, kidney pain
Xylopia aethiopica (Dunal) A. Rich.	**Annonaceae**	Fr/Fe	Sauce (gold) Maceration (gold)	Flavouring, a recipe activator
Crassocephalum crepidioides (Benth)	**Asteraceae**	Fe/R	Sauce (gold) Maceration (gold)	Flavouring, Used by women alert
Heliotropium indicum L.	**Boraginaceae**	Fe/Fl	Decoction or trituration of leaves (gold)	Sexual weakness, Coughing in babies, Hypotension
Chenopodium ambrosioides L.	**Chenopoldiacea e**	Fe/Gr	Trituration (past) Grain (gold)	Skin lesion, abscesses Deworming of poultry,
Combretum collinum Fresen.	**Combretaceae**	R/F/E	Decoction (bath, gold)	Awakening the Baby, Jaundice, Fatigue
Lippia multiflora Moldenke	**Verbenaceae**	Fe / Fr	Sauce / Decoction	High blood pressure
Momordica Charantia L.	**Cururbitaceae**	Fe/Fr	Trituration or maceration	Stomach ache, Hernia, Itching
Hyptis suaveolens L.	**Lamiaceae**	Fe/T	Decoction (bath, gold)	Baby bath, insecticide, jaundice
Ocimum basilicum L.	**Lamiaceae**	Fe/R	Sauce Trituration	Aromatizer Meat preservative
Ocimum canum L.	**Lamiaceae**	Fe/R	Trituration (bath, past)	Purification and disinfectant
Ocimum gratissimum L.	**Lamiaceae**	Fe/Pe	Sauce or trituration	Flavouring, Digestion, Intestinal worms
Khaya senegalensis (Desr.) A. Juss. (Desr.) A. Juss.	**Meliaceae**	E/Fe/R	Decoction/Ma ceration (Gold/Bath)	Purification, Disinfectant, Baby's first bath
Musa sapientum auct. div.	**Musaceae**	Fr/Fl	Powder (Gold)	Memory aid, Sexual weakness, Paralysis
Musa sp L.	**Musaceae**	Fr/Fe/R	Powder (Gold)	Sexual weakness, checklist
Olax subscorpiodea Oliv.	**Olacaceae**	R/Fe	Decoction (bath, gold)	Protection, Child development,

				Palu
Piper guineense Schum. et Thonn	**Piperaceae**	Gr	Decoction (gold)	Flavouring, Angina, Fibroma, Intestinal worms
Cymbopogon citratus (DC.) Stapf	**Poaceae**	Fe/Pe	Decoction or Maceration (Gold)	Flavouring, Convalescence, Lack of blood
Securidaca longepedunculata Fresen.	**Polygalaceae**	R/E	Racine at your fingertips Decoction (Bath, gold)	Antivenomous, Sexual weakness, Protection

Preparations: Gold : Oral; Dec: Decoction; Mac: Maceration

Diseases and ailments treated by the inventoried plants

Table 3 presents the different diseases treated by the 24 plants inventoried with the methods of preparation and use. In total, 20 disease symptoms or conditions were identified. The ailments treated by the majority of the plants are: Fever, attacks and seizures; tooth decay, conjunctivitis, constipation, tastes and their odor, aches, arousals, digestion facilitator, internal and external hemorrhoids, hernia, hypotension and hypertension, inflammation, skin lesion, stomach ache, snake bite, malaria, wounds, painful period, intestinal worms and vomiting. The frequency of plant drugs used is as follows: leaf (64%), root (23%), bark (8%), bulb (3%), stem and seeds/fruits are weakly used. Fugue 2 reflects the frequency of drug use.



Fugue 2. Frequency of drug use

As regards the methods of preparation, trituration is the most used method (46%); decoction (28%). Maceration and powdering of plant drugs are in equal proportion (13%). Infusion is poorly represented.

Some plants like*: Ocimum canum, Ocimum basilicum, Ocimum gratissimum, Zingiber officinale, Lippia multiflora Moldenke; Lippia rugosa, Crassocephalum crepidioides, Allium sativum, Xylopia aethiopica, Allium Ascalonicum, Allium cepa, Piper guineense* are used to flavour sauce and food. *Ocimum canum L.* is used to purify places of worship; *Ocimum basilicum L.* is used by hunters and fishermen to preserve meat and fish respectively. Plants like *Allium sativum L. Xylopia aethiopica (Dunal) A. Rich; Allium ascalonicum auct. non Strand; Allium cepa L and Monodora myristica (Geartn)* are plants used by phyto therapists to accelerate and precipitate the activityof phytomedicines during their use.

Discussion

Strengths and weaknesses of the survey methodology

The ethnobotanical survey method based on individual interviews allowed us to know the importance of the use of aromatic and medicinal plants in the treatment of ailments and diseases in the hills department. This method, which requires the memory of the interviewees, could cause biases related to the personal appreciation of the respondents (Dossou *et al.,* 2012 ; Wedjangnon *et al*., 2016). The importance given to the use of the species is given by individuals who implicitly take into account a personal appreciation; which often refers to their preference. Nevertheless, these methods are widely used in ethnobotany by other authors and have the privilege to bring out quite relevant results, Nguenang (2010); Dahouenon *et al*. (2017). As the frequencies of the different uses of these species for the different uses identified among herbalists are not precise, this could cause errors when assigning scores for the calculation of the various indices that can measure the importance of a species for a given sociolinguistic group or groups. It should also be noted that during the survey, exchanges were made in languages other than those mastered by the respondent, which required interpreters.

Level of knowledge on aromatic and medicinal plants

Ethnobotanical knowledge of aromatic species in the hills varies according to sociolinguistic groups on the one hand and within sociolinguistic groups on the other hand, which means that a small group of community holds most of the knowledge about the plants. These results are similar to those of Quiroz *et al*. (2014); Wedjangnon *et al.* (2016). Other studies have also shown that ethnobotanical knowledge related to plant species varies mostly with age, gender and sociolinguistic group Ekué *et al* (2010); Fandohan *et al* (2010); Gouwaknnou *et al* (2011); Assogbadjo *et al* (2011) and Assongba (2014). This study was conducted among herbalists and it should be noted that these people were reluctant on information, this is

moreover the reason for taking a large enough sample to be able to mobilize enough information, this confirms the results of Adomou (2012), on a study conducted among women plant sellers in the market of Cotonou. The information collected shows that plant species are of great wealth for humans. In general, therefore, it can be said that sociolinguistic groups know and use the plants around them according to their way of life. It is necessary to emphasize that any plant not found in the country is imported. This is similar to that of Adomou *et al* (2012). The botanical families most found are Lamiaceae (15%) and Annonaceae (15%), these results are similar to those of Salhi *et al*. (2010) in a floristic and ethnobotanical study of medicinal plants in Morocco. Some species of aromatic plants such as *Allium sativum; Xylopia aethiopica; Allium Ascalonicum; Allium cepa and Monodaro myristica* has a particular character of accelerating the activity of recipes. This is confirmed by the findings of Adomou *et al* (2012); Dougnon *et al* (2016), which states that some drugs, especially fruits, seeds are used as auxiliary or adjuvant ingredients, enable to enhance the therapeutic action of the main components of the recipes and also enable to treat the secondary symptoms of the disease.

Conclusion

The ethnobotanical survey revealed the existence of numerous aromatic and medicinal plants used by traditional therapists who have medicinal and magico-spiritual knowledge and know well the use of plants as alicaments. The study made it possible to constitute a data base on the main aromatic species used by the phytotherapists of the hills in general and the district of Glazoué, Savè and Ouesse in particular. A total of 23 species of aromatic plants were identified to treat 20 different symptoms of illness. The ethnic groups surveyed were Idaasha, Mahi, Nago, Fon and Peuhl. These sociolinguistic groups know and use the plants for various purposes, which reveals the importance that people give to natural plant resources in the localities. The data collected will be used for the promotion of aromatic and medicinal plants with a view to discovering new active ingredients for use in therapeutics, cosmetics, perfumery and others.

NOTE:

The study highlights the efficacy of "traditional medicine" which is an ancient tradition, used in some parts of Benin. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable.

Bibliographic references

Adjanohoun, E. J., Adjakidje, V., & Ahyi, M. R. A. (1999). Aké assi L. *L., Akoegninou, A., d'Almeida, J., Apovo, F., Boukef, K., Chadare, M., Cusset, G., Dramane, K., Eyme, J., Gassita, J.-N., Gbaguidi, N., Goudote, E., Guinko, P., Houngnon, P., Lo, I., Keita, A., Kiniffo, HV, Kone-Bamba, D., Musampa Nseyya, A., Saadou, M., Sodogandji, Th., de Souza, S., Tchabi, A., Zinsou Dossa, C., Zohoun, Th*, 55-63.

Adomou, A. C., Yedomonhan, H., Djossa, B., Legba, S. I., Oumorou, M., & Akoegninou, A. (2012). Ethnobotanical study of medicinal plants sold in Abomey-Calavi market in Benin. *International Journal of Biological and Chemical Sciences*, *6*(2), 745-772.

Agbangnan, C.P.D., Noudogbessi, J.P., Chrostowska, A., Tachon, C.; Fouquet, E., Sohounhloue, D.C.K. (2013). Phenolic compound of benin's red sorghum and their antioxidant properties. *Asian J Pharm Clin Res*, 6(2): 277-280.

Akodewou, A., Akpavi, S., Dourma, M., Batawila, K., Amegnaglo, K. B., Atakpama, W., & Akpagama, K. (2014). Sorindeia warneckei Engl.(Anacardiaceae), a multi-use species from the Lama depression in Togo. *Africa Science: International Journal of Science and Technology*, *10*(2).

Alfaiz C., (INRA-Edition 2015). Culture et Domestication des Plantes Aromatiques et Médicinales au Maroc. 10p

Assogbadjo, A. E., Glegrave, R., Azihou, A. F., Kyndt, T., & Codjia, J. T. C. (2011). Ethnic differences in use value and use patterns of the threatened multipurpose scrambling shrub (Caesalpinia bonduc L.) in Benin. *Journal of Medicinal Plants Research*, *5*(9), 1549-1557.

Assongba F.Y. (2014). *Ethnobotany, Ecology, Spatial distribution and conservation status of Dialium guineense Willd (Fabaceae) in Benin. Single doctoral dissertation. Aménagement et Gestion des Ressources Naturelles; University of Abomey-Calavi. 245p.*

Dahouenon-Ahoussi, E., Kpatinvoh, B., Adjou, E. S., Konfo, T. C., Atrevi, B., Soumanou, M. M., & Sohounhloue, D. C. (2017). Efficacy of essential oils of three aromatic plants against spoilage mycoflora of cowpea (Vigna unguiculata L., Walp) collected from sales shops in South Benin. *Journal of Applied Biosciences*, *109*(1), 10680-10687.

Diatta, C. D., Gueye, M., & Akpo, L. E. (2013). Medicinal plants used against dermatoses in the Baïnounk pharmacopoeia of Djibonker, Ziguinchor region, Senegal. *Journal of Applied Biosciences*, *70*(1), 5599-5607.

Din N., **Mpondo E**., **Dibong S.D**., **Kwin N.F.**, **Ngoye A. (2011).** Inventory and identification of plants used in the treatment of diabetes in Douala town (Cameroon). European Journal of Medicinal Plant 1: 60-73.

Dougnon, T. V., Agbankpé, A. J., Bankole, S. H., Houngbegnon, O., & Dah-Nouvlessounon, D. (2016). In vitro antibacterial effects of Crateva adansonii, Vernonia amygdalina and Sesamum radiatum used for the treatment of infectious diarrhoeas in Benin. *Journal of Infectious Diseases & Therapy*, *2016*.

Dossou M.E., Houessou G.L, Lougbégnon O.T, Tenté A.H.B., Codjia J.T.C (2012). Ethnobotanical study of woody forest resources of Agonvè swamp forest and related terroirs in Benin. *Tropicultura*, 30, 1, 41-48.

Ekué, M. R., Sinsin, B., Eyog-Matig, O., & Finkeldey, R. (2010). Uses, traditional management, perception of variation and preferences in ackee (Blighia sapida KD Koenig) fruit traits in Benin: implications for domestication and conservation. *Journal of Ethnobiology and Ethnomedicine*, *6*(1), 12.

Fandohan, B., Assogbadjo, A. E., Kakaï, R. G., Kyndt, T., De Caluwé, E., Codjia, J. T. C., & Sinsin, B. (2010). Women's traditional knowledge, use value, and the contribution of tamarind (Tamarindus indica L.) to rural households' cash income in Benin. *Economic Botany*, *64*(3), 248-259.

Gouwakinnou, G. N., Lykke, A. M., Assogbadjo, A. E., & Sinsin, B. (2011). Local knowledge, pattern and diversity of use of Sclerocarya birrea. *Journal of Ethnobiology and Ethnomedicine*, *7*(1), 8.

Houessou, S. (2010). Effects of the reduction of floristic diversity on the health of rural populations in southern Benin. In *Colloque international SIFEE, Paris*.

Jiofack, T., Fokunang, C., Guedje, N., Kemeuze, V., Fongnzossie, E., Nkongmeneck, B. A., ... & Tsabang, N. (2010). Ethnobotanical uses of medicinal plants of two ethnoecological regions of Cameroon. *International Journal of Medicine and Medical Sciences*, *2*(3), 60-79.

Kpètèhoto, W. H., Hessou, S., Dougnon, V. T., Christian, R., Johnson, G. B., Houéto, E. E & Gbénou, J. (2017). Ethnobotanical, phytochemical and ecotoxicological study of Ocimum gratissimum Linn (Lamiaceae) in Cotonou. *Journal of Applied Biosciences*, *109*, 10609-10617.

Mangambu, M. D. D., Mushagalusa, K. F., & Kadima, N. J. (2014). Contribution to the photochemical study of some anti-diabetic medicinal plants from Bukavu city and its surroundings (South Kivu, DR Congo). *Journal of Applied Biosciences*, *75*(1), 6211-6220.

Neuenschwander, P., Milleret, V., Simona, B., & Hall, H. (2011). Tuning electrospinning parameters for production of 3D-fiber-fleeces with increased porosity for soft tissue engineering applications. *Eur Cell Mater*, *21*, 286-303.

Nguenang, G. M., Fedoung, E. F., & Nkongmeneck, B. A. (2010). Importance of secondary forests for the collection of useful plants among the Badjoué of East Cameroon. *Tropicultura*, *28*(4), 238-245.

Ngoule, C. C., Ngene, J. P., Kidik, C. P., Ottou, P. M., Dibong, S. D., & Mpondo, E. M. (2015). Importance in the traditional pharmacopoeia of flavonoid plants sold in the markets of Douala East (Cameroon). *Journal of Applied Biosciences*, *88*(1), 8194-8210.

Neffati, M., & Sghaier, M. (2014). Development and valorization of aromatic and medicinal plants (AMP) at the level of desert areas in the MENA region (Algeria, Egypt, Jordan, Morocco and Tunisia).

WHO (2013). Strengthening the role of traditional medicine in health systems: a strategy for the African region. Secretariat report. 39 pages.

Ouinsavi, C., & Sokpon, N., Alohou, E. C. (2016). Determinants of the fragmentation of the classified forest-sacred forest block in South Benin. *Journal of Applied Biosciences*, *101*(1), 9618-9633.

Pavani, A., Naushad, S. M., Rupasree, Y., Kumar, T. R., Malempati, A. R., Pinjala, R. K., ... & Kutala, V. K. (2012). Optimization of warfarin dose by population-specific pharmacogenomic algorithm. *The pharmacogenomics journal*, *12*(4), 306.

Quiroz, D., Towns, A., Legba, S. I., Swier, J., Briere, S., Sosef, M., & van Andel, T. (2014). Quantifying the domestic market in herbal medicine in Benin, West Africa. *Journal of Ethnopharmacology*, *151*(3), 1100-1108.

Salhi, S., Fadli, M., Zidane, L., & Douira, A. (2010). Floristic and ethnobotanical studies of medicinal plants in the city of Kenitra (Morocco). *Lazaroa*, *31*, 133.

Tardío, J., & Pardo-de-Santayana, M. (2008). Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). *Economic Botany*, *62*(1), 24-39.

Tardivon J., Mohamed C., (2012). Aromatic and medicinal plants, an example of human development in Morocco : the women's cooperative of Ben Karrich - Tetouan, 19p

Thirumalai, T., Beverly, C. D., Sathiyaraj, K., Senthilkumar, B., & David, E. (2012). Ethnobotanical Study of Anti-diabetic medicinal plants used by the local people in Javadhu hills Tamilnadu, India. *Asian Pacific Journal of Tropical Biomedicine*, *2*(2), S910-S913.

Wedjangnon A.A., Houetchegno T., Ouinsavi C., (2016). Ethnobotanical characteristics and socio-cultural importance of Mansonia altissima A. Chev. in Benin, West Africa *Laboratoire d'Études et de Recherches Forestières (LERF), Faculté d'Agronomie, Université de Parakou, Parakou, Bénin*, 22: 4678-469