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ETHNOBOTANICAL STUDY OF PLANTS USED TO TREAT ASTHMA IN THE MARITIME REGION IN TOGO

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Abstract

Background: Asthma is one of the most common chronic diseases in modern society and it is evident that its incidence and severity are increasing, however very little is known about the plants used in the management of the disease. This study therefore aimed to document the plants usage in the Togolese traditional medicine to treat asthma.
Methodology: From January to June 2015, an ethnobotanical survey was conducted using a semi-structured questionnaire with traditional healers (THs) in the southern region of Togo. The importance of the plants species was assessed by the calculated use values.
Results: In Total, 121 THs (92 males and 29 females) were interviewed and 98 plants species belonging to 54 families were identified as curing asthma. The most represented families were: Leguminosae with 7 species followed by Euphorbiaceae and Rutaceae contributing with 6 and 5 species respectively. Based on the calculated use values the most important species were *Carcica papaya* L., *Cataranthus roseus* L., *Eucalyptus camaldulensis* Dehnh., *Piper guineense* Thonn., *Eucalyptus citriodora* Hook., *Eucalyptus globules* Labill. and *Euphorbia hirta* L. The leaves and the root were the parts predominantly used to prepare the formulations, mainly decoctions, administrated by oral route. Clinical manifestations such as wheezing (91.74%), difficulty as speaking or coughing (73.55%), dyspnea (66.94%), dry cough (52.89%), sweating and increased heart rate (52.07%) were used by TH to diagnose the disease.
Conclusion: This study showed initial evidence of the use of plant materials by Togolese TH to heal asthma. These results could be a starting point for laboratory screenings.

Key words: Asthma, traditional medicine, medicinal plants, survey, Togo.

Introduction

Asthma is a chronic disease characterized by variable airflow limitation and/or airway hyper-reactivity with symptoms causally related to family history, environmental influences, exposure to viruses and allergens as examples (Yunginger et al., 1992). The high economic burden linked with asthma is associated primarily with health care costs, missed work or school days (Singh et al., 2007). The treatment of asthma in the modern medicine is based on the use of beta agonists, leukotriene modifiers and inhaled corticosteroids that allowed an acceptable control of the main symptoms. However, this therapy could not suppress all the symptoms although the better understanding of the pathophysiology of the disease (Yang et al., 2016). On the other hand, the requirement for daily inhalation with glucocorticoids is often a cause for patient discomfort, limiting the use of glucocorticoids in asthma therapy. In addition, the current therapy is not affordable for the patients in developing countries, who rely on the traditional medicine. Therefore, there is a significant need for new medications for the treatment of asthma that are highly efficacious, with low cost, easily managed and with few adverse effects.

In the search for new medications for asthma, plants through the traditional medicine are a credible alternative. Hence, plant have been used to treat several diseases for thousands of years. And nowadays following the traditional use of plants, some pharmacological screenings have led to new drugs discovery. Indeed, plants have been the leads of about 25% of drugs introduced into the market during the last 20 years (Vuorela et al., 2004; Basso et al., 2005).

In the particular case of asthma, there is a high prevalence of usage of complementary medicine. Herbal preparations have been cited as the third most popular complementary treatment modality by British asthma sufferers (Huntley and Ernst, 2000; Urata et al., 2002). Consequently, in the recent decades, the medicinal plants used in the management of the disease have attracted the attention of some authors, through the screening for immunomodulatory activity of plant extracts. However, data on the ethnobotany of plants used in the management of asthma are scanty. The present study was undertaken to investigate the treatment of asthma by traditional practitioners in the Southern region of Togo.

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Materials and methods

Study area

Togo is a western African country lying between Burkina Faso in the North, Benin in the East, Ghana in the West and the Atlantic Ocean in the South. The country is divided into five economic regions namely Savannah Region, Kara Region, Central Region, Plateau Region, and Maritime Region. The present study was carried out in the Maritime Region (figure 1). It stands between 1°20'-1°50' east and 6°10'- 6°60' north of the equator and bordered to the north, West, East and the South by Plateau Region, Republic of Ghana, Republic of Benin and the Atlantic Ocean respectively. This study area is 6100 km^2 big and occupies approximately 10.78% of the country. The climate is sub-equatorial. The region is inhabited by 1.828.000 people (density of 50 -200 persons/km^2), the main ethnic groups being *Ewe, Ouatchi, Mina, Fon, Adja*.

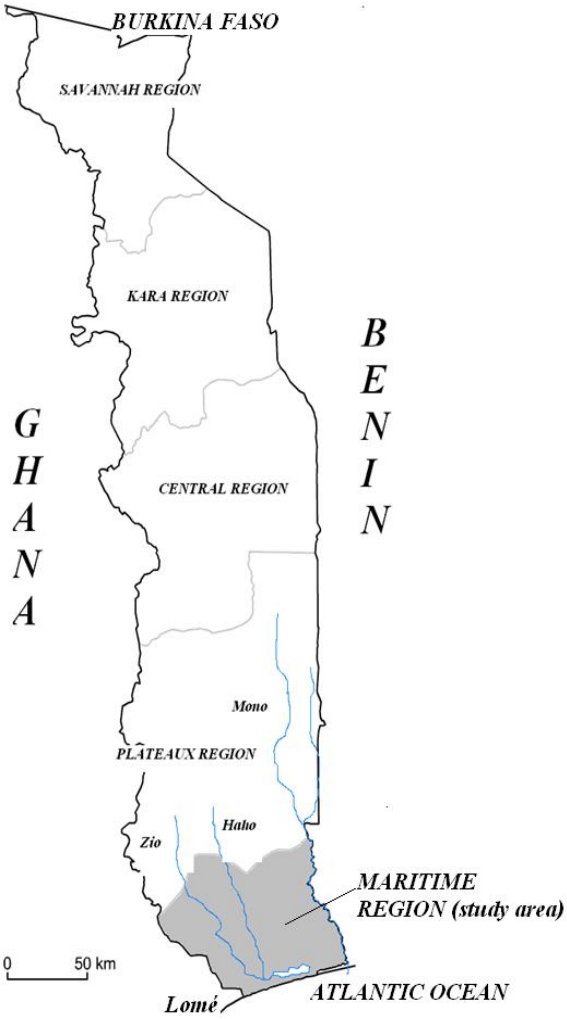

Figure 1: Map of Togo showing the Maritime Region

Data collection

Direct interviews with traditional healers (TH) were conducted between January and June 2015 using a semi-structured questionnaire.

Each TH gave a verbal consent certifying his/her agreement with the form issued to explain the importance of the information they would provide prior to interviews. Questions asked were about (i) the TH identity, i.e. name and surname, sex, age, level of education; (ii) the origin of their knowledge; (iii) the status of the TH, i.e. full-time professional TH or part-time professional TH; (iv) the disease, i.e. name of the disease in the local language; (v) the diagnosis, i.e. main symptoms; and (vi) the remedies, i.e. the number of plants in the remedy, the local names of the plants, the used parts, the remedy formulation, and the administration route.

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Plant identification

After interviews, preliminary identification of the plants was done in the field by a botanist. Afterward, voucher specimens were prepared and pictures were taken to help in the confirmation of the identity of the plants. Plant identities were confirmed by comparison with available voucher specimens in the Herbarium of the Botany Department, University of Lomé, using taxonomic keys of online databases of West African Plants – A photo Guide on the website: http://www.westafricanplants.senckenberg.de/root/index.php. Nomenclature of species was done using the online data base of IPNI website: http://www.ipni.org/ipni/plantnamesearchpage.do.

Statistical analysis

Excel spread sheet was used to make simple calculations and to determine plant frequencies. The use value (UV), a quantitative method that demonstrates the relative importance of species known locally, was calculated according to the following formula (Aburjai et al., 2007; Hudaib et al., 2008):

$UV = \Sigma U/n$

Where, UV is the use value of a species; ΣU the total number of citations per species; n the number of informants. The other analyses were performed using PRISM 5.02 program (GraphPad Software, Inc., La Jolla, USA). Since most of the variables did not show a normal distribution, the following tests were chosen: to compare three groups a Kruskal-Wallis-test was performed and, if significant, followed by a Mann-Whitney–U test for a further comparison of the groups. P-values of 0.05 or less were considered significant.

Results

Socio demographic profile of the traditional healers

This study included 121 traditional healers, 92 men and 29 women. Table 1 displays the socio demographic profile of the traditional healers. The THs were arbitrary divided into four age groups notably the ≥ 30 years,]30-50years],]50-70] and the <70 years accounting respectively for 15, 42, 41 and 23 THs. For the in educational level, 19.01% of the THs were illiterates while 46.28% attended at least the primary school. The rest were either secondary. We assess the descent of the knowledge for the treatment of asthma. Family heritance (47.11%) and traditional initiation (42.15%) followed the same trend and were the best means for the transmission of the knowledge compared to others ($p<0.0001$). In contrast, the THs who got the knowledge by divine revelation were fewer compared to those who got it by family inheritance and traditional initiation ($p<0.0001$). In addition, most of the healers were full time professionals (40.50%), exerting exclusively the healing as the main source of revenue. The THs in the formal sector were more represented in the asthma treatment compared to either artisans ($p<0.0001$) or farmers and herders ($p=0.0002$). This indicates that not only THs are educated but also are well organized in a formal sector.

Table 1: Sociodemographic data of the traditional healers

Sex	Males		Females	
N	91		30	
%	75,21		24,79	
Age groups	≤30 years	[30-50 years]	[50-70 years]	≥70-90 years
N	15	42	41	23
%	12,40	34,71	33,88	19,01
Educational level	illiterates	Primary	Secondary	University
N	23	56	29	13
%	19,01	46,28	23,97	10,74
Origin of the knowledge	Familial inheritance	Divine revelation	Initiation with a TH	Other
N	57	7	51	6
%	47,11	5,79	42,15	4,96
Professional status	Full time	Farmer	Trader	Artisans
N	49	17	42	13
%	40,50	14,05	34,71	10,74

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Plant harvest

We were then interested to know at which season of the year and at which moment of the day the plants were collected for the preparation of the recipes. Regarding the season of the year, most of the THs (36.63%) harvest plant materials in the rainy season while 3.31% of them harvest in the dry season ($p<0.0001$). We observed that collecting plant materials all the season of the year (60.33%) is statistically more common than both rainy and dry season ($p=0.0002$ and $p<0.0001$ respectively). Concerning the moment of the day the collect was carried, the morning hours is the most common compared to midday and the evening ($p<0.0001$). In addition, more TH collected plants materials all the time of the day (figure 2).

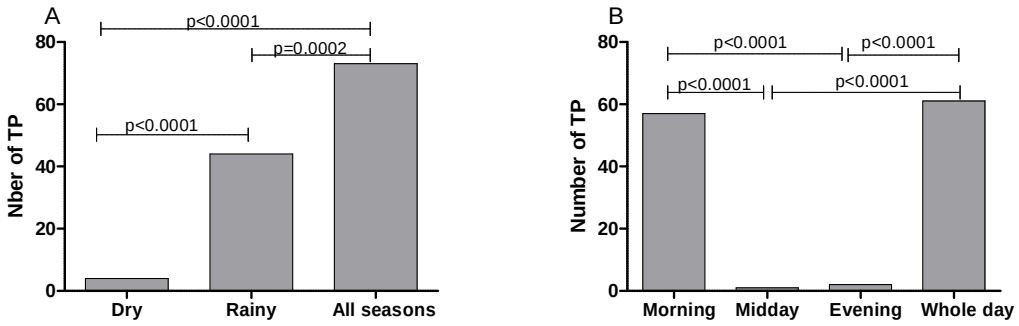

Figure 2: Period of plant materials collection.
(A): Seasons of plant materials collection. (B): Moment of the day for the plant materials collection. Bars indicate the number of THs collecting the plant materials for each season of the moment of the day.

Symptoms used by TH for the diagnosis of asthma

A total of 13 symptoms were identified (figure 4). In the order of importance the symptoms were ranked as follows: the wheezing , difficulty at breathing, dyspnea, chest tightness, dry cough, sweating and increased heart rate, difficulty at speaking or coughing, anxiety, confusion and agitation, disorders of consciousness, bluing and blackening of lips and nails, difficulty walking, dilated nostrils and loss of consciousness.

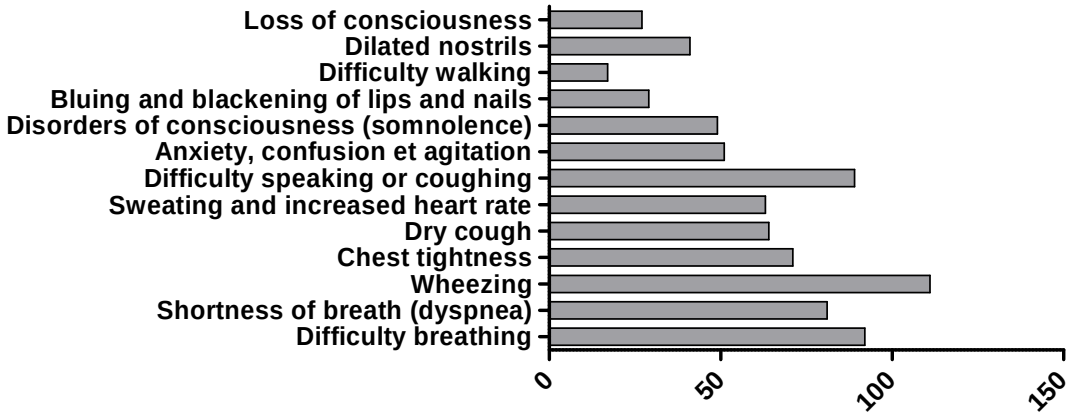

Figure 3: Diagnosis of asthma by Traditional practitioners

The THs were interviewed about the diagnosis of asthma. The bars represent the number of TP using the indicated clinical manifestation for the diagnosis of asthma.

Diversity of medicinal plants and their usage in the treatment of asthma in the maritime region

A total of 98 plants species distributed in 54 families were recorded in the present study. The plants consisted of trees, herbs, lianas and shrubs; the most frequent growth habits being the trees and shrubs, accounting for 42% and 32% respectively (figure 4). The species were diversely distributed among botanical families. Thus, some families were more represented than others. The most represented family was the Leguminosae that contributed with 7 species namely *Acacia albida* Rojas, *Acacia erythrocalyx* Brenan, *Albizia adianthifolia* W.Wight, *Desmodium gangeticum* DC

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, *Erythrina senegalensis* DC., *Parkia biglobosa* Benth. and*Tetrapleura tetraptera* Taub. This was followed by Euphorbiaceae and Rutaceae contributing with 6 and 5 species respectively. The other families contributed with less than 5 species each.

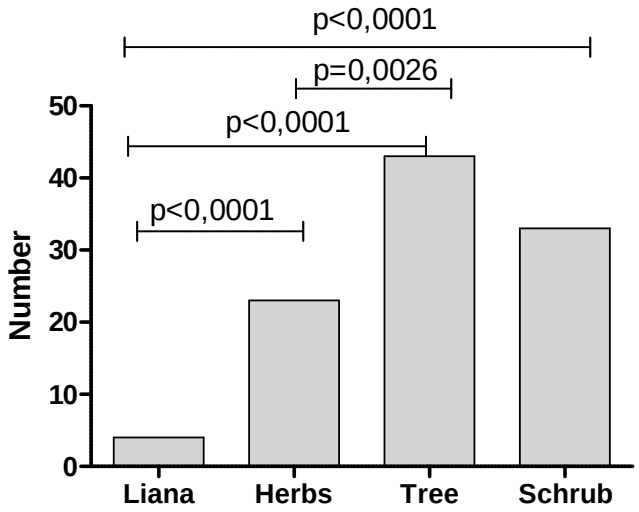

Figure 4: Growth habits of medicinal plants used in the management of asthma

The importance of medicinal plant was assayed by use values (UV) that were ranged between 0.03 for the less used species and 0.09 for the most used species (table 1). Considering these UV, the following species appeared to be of great importance for the management of asthma in the surveyed region: *Abruspreca torius* L. (UV=0.07), *Desmodium gangeticum* DC (UV=0.07), *Allium cepa* L. (UV=0.08), *Allium sativum* L. (UV=0.08), *Annona muricata* L. (UV=0.08),*Guiera senegalensis* J.F.Gmel (UV=0.08), *Securidaca longepedunculata* Fresen (UV=0.08), *Zingiber officinale* Roscoe (UV=0.08), *Carcica papaya* L. (UV=0.09) *Cataranthus roseus* L. (UV=0.09), *Eucalyptus camaldulensis* Dehnh. (UV=0.09), *Piper guineense*Thonn. (UV=0.09), *Eucalyptus citriodora* Hook. (UV=0.09), *Eucalyptus globules* Labill. (UV=0.09) and *Euphorbia hirta* L. (UV=0.09).

The TH in the maritime region of Togo were found to use various parts of plant in the treatment of asthma. Figure 5 displays the trends of use of the various plants parts. No statistically difference was observed between the use of leaves (26%) and root (20%) for the treatment of asthma. Interestingly, leaves were more used compared to leafy stems ($p<0.0001$) and fruit ($p<0.0001$). In addition, bark was also less used compared to the root ($p=0.0015$). Almond, kernel, latex and inflorescence followed the same trend and were less used for the healing of asthma.

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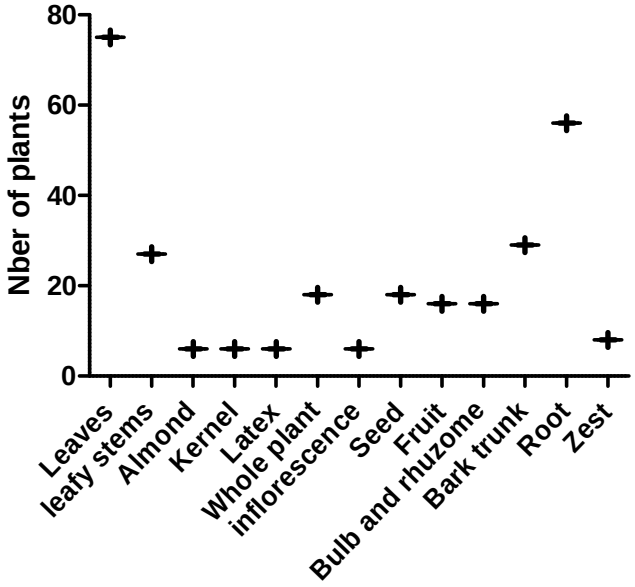

Figure 5: Parts of the plants used for the treatment of asthma.

The parts of the plant used to prepare the recipes were investigated. Each dot shows the number of plant in relation with the part used for the preparation of recipe.

Fourteen formulations were identified. Decoction was more used by TH compared to the powder form (p=0.15). Both were predominantly used by TH compared to other galenic forms (Figure 6). More interestingly, most of the galenic forms were administrated by the oral route (57%), p<0.0001). This was followed by massage (19%). In contrast, few TH preferred bandage, oral sucker and smoking.

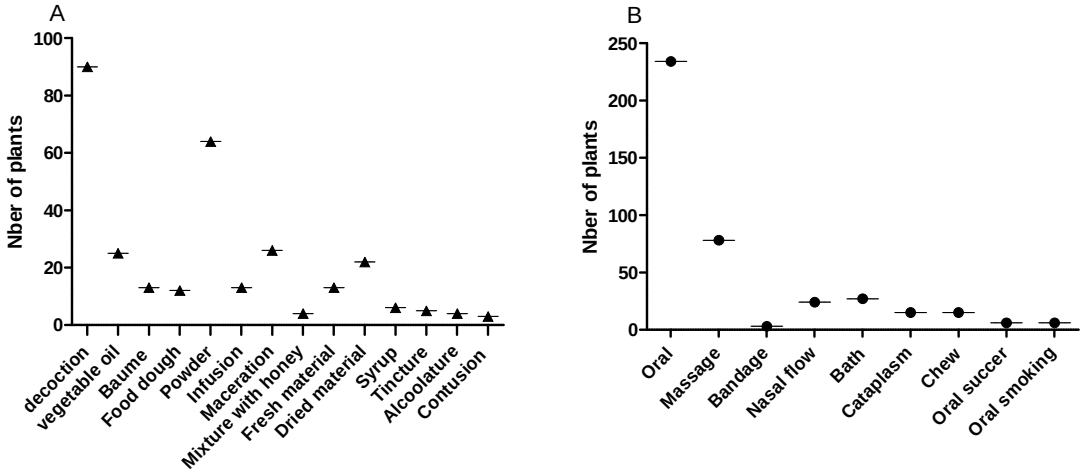

Figure 6: Formulations and administration route

Fourteen formulations were identified (A). Each dot represents the number of formulations for each plant candidate. (B) Indicates the administration route of the formulations. The dots represent the number of administration route of each plant candidate.

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Table 2: Diversity of medicinal plants and their uses for the treatment of asthma in the Maritime Region

Species	Local name	Voucher N°	UV	Used parts	Habits	Mode of preparation	Mode of administration
ACANTHACEAE							
*Hygrophila spinosa*T.Anderson	Tomeamudja	22FDS/UL	0,03	Le, LS	Herb	Dec, Pow	Oral
AMARYLLIDACEAE							
Hymenocallis littoralis (Jacq.) Salisb.	Tomeyedo	338FDS/UL	0,04	WP	Herb	Dec, Pow	Oral
ANACARDIACEAE							
Mangifera indica Blume	Amangoti, yovoslatin,	1157FDS/UL	0,05	Le	Tree	Dec	Oral,
ANNONACEAE							
Spondias mombin L.	Aklikon, djogbema	371FDS/UL	0,03	Le	Tree	Pow	Oral
Annona muricata L.	Nyigli	536FDS/UL	0,08	Le	Shrub	Dec	Oral
Hexalobus monopetalus Engl. &Diels	Akpado	56FDS/UL	0,03	TF, Ro	Tree	Tea	Massage
*Uvariachamae*P.Beauv.	Agbannaagbanan	43FDS/UL	0,03	Le, Ro	Tree	Pow, Tea	Oral, bath
*Xylopia aethiopica*A.Rich.	Eso, esokwi, kpejelekun	53FDS/UL	0,03	Fr, Ro	Tree	Dec, Tea Pow	Oral
APIACEAE							
Centella asiatica (L.) Urb.	Ewekaro	287FDS/UL	0,04	LS	Shrub	Dec, Pow	Oral
APOCYNACEAE							
Catharanthus roseus (L.) G.Don	Ganéméflava	95FDS/UL	0,09	Le, Ro	Shrub	Dec, Pow	Oral
Plumeriarubra L.	Azuinto	209FDS/UL	0,04	Latex	Tree	Balsam	Massage
Rauvolfia vomitoria Wennberg	Adbloti, dodemakpo-we	1FDS/UL	0,03	Ro	Tree	Alcohol	Oral
Voacanga africana Stapf ex Scott Elliot	Atakpariobuko, ako dodo	87FDS/UL	0,03	Ro	Shrub	Tea, Alcohol	Oral
ARALIACEAE							
Cussonia arborea Hochst. ExA.Rich.	Adinmiwe, yovoklo, toflogunton	356FDS/UL	0,03	Ba	Tree	Alcohol	Oral
Cussonia barteri Seem.	Adinmiwe, yovoklo, toflogunton	299FDS/UL	0,03	Ba	Tree	Alcohol	Oral
ARECACEAE							
Cocos nucifera L.	Neti, yovoneti	1188FDS/UL	0,04	Fr	Tree	Pow	Oral

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*Elaeis guineensis*A.Chev.	Deti	155FDS/UL	0,05	Am	Tree	Pow	Massage
ASCLEPIADACEAE							
Calotropis procera W.T.Aiton	Pommier de sodome	78FDS/UL	0,03	Le	Tree	Dec, Pow	Oral
ASTERACEAE							
Ageratum conyzoides L.	Mima, ogboma, jinukunsi	839FDS/UL	0,03	Le	Herb	Alcohol	bandage
Artemisia annua L.	Artemisia	847FDS/UL	0,05	Le	Tree	Dec	Oral,
Tagetes erecta L.	Tagète	887FDS/UL	0,05	Le	Tree	Dec	Oral
BALANITACEAE							
Balanites aegyptiaca Delile	Egungun	221FDS/UL	0,03	Ro	Tree	Dec, Pow	Massage, Scarification
BIGNONIACEAE							
Newbouldia laevis Seem.	Kpatima, hunmati	337FDS/UL	0,03	Le	Tree	Tea	Massage
BOMBACACEAE							
Adansonia digitata L.	Baobab	1190FDS/UL	0,05	Le	Tree	Pow	Oral
BRASSICACEAE							
*Brassica oleracea*Lour.	Chou	396FDS/UL	0,05	Le	Shrub	Dec	poultice
CAESALPINIACEAE							
Erythrophlaeum guineense G.Don	Obo		0,04	St	Tree	Balsam, Alcohol	Massage, poultice
CAESALPINIACEAE /LEGUMINOSAE							
Caesalpinia pulcherrima (L.) Sw.	Orgueil de chine	431FDS/UL	0,04	LS	Shrub	Dec, Pow	Oral
Cassia absus L.	Madosoxome	376FDS/UL	0,04	LS	Shrub	Dec, Pow	Oral
Senna alata (L.) Roxb,)	Yovologbo	378FDS/UL	0,04	LS	Shrub	Dec, Pow	Oral
CAPPARACEAE							
Ritchiea reflexa (thonn.) &Gilg-Ben.	Atissougoun	183FDS/UL	0,03	Le, LS	Shrub	Tea	Oral
CARICACEAE							
Carica papaya L.	Adubati	1036FDS/UL	0,09	Le, Fr, Se, Ro	Tree	Dec, Pow,	Oral, smoking
COMBRETACEAE							
*Guiera senegalensis*J.F.Gmel	Nguère, hlikon	675FDS/UL	0,08	Le	Tree	Dec, Pow	Oral,bath, massage

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Pteleopsis suberosa Engl. &Diels	Kulukuli, klwi	509FDS/UL	0,03	Ro	Tree	Dec, Pow	Massage,scarification
COMMELINACEAE							
Commelina benghalensis L.	Awlokisixengbe	41FDS/UL	0,03	WP	Herb	Dec	Oral
COSTACEAE							
Costus afer Ker Gawl.	Tetegugu	683FDS/UL	0,05	Le, St	Shrub	Dec	Oral,
CUCURBITACEAE							
Cucurbita maxima Duchesne	Kpen, ayikpen, okpe	151FDS/UL	0,04	Se	Liana	Dec, Pow	Oral
Cucurbitapepo L.	Kpen, ayikpen, okpe	1010FDS/UL	0,04	Se	Liana	Dec, Pow	Oral
DROSERACEAE							
Drosera indica L. (Droseraceae)	Amadjeye	282FDS/UL	0,04	WP	Tree	Dec, Pow, Pow	Oral, bath, Massage
EBENACEAE							
Diospyros mespiliformis Hochst. ex A.DC.	Gubaga, kenu	672FDS/UL	0,03	St, LS	Tree	Dec, Pow	Oral, Massage
EUPHORBIACEAE							
Acalyphawilkesiana Müll.Arg.	Plante cuivre	817FDS/UL	0,04	Le, Ro	Tree	Dec, Pow	Oral
Alchornea cordifolia (Schumach.) Müll.Arg.	Avovlo	170FDS/UL	0,03	Le	Shrub	Dec	Oral
Bridelia ferruginea Benth.	Akamesi, hunsukokowe	511FDS/UL	0,05	Le	Shrub	Dec	Oral
Euphorbia hirta L.	Hundihundi, anonsika, nosiwé,godota	454FDS/UL	0,09	WP, Le	Shrub	Dec,	Fumigation,bath
*Hymenocardia acida*Tul.	Atinjen, sogbeti	256FDS/UL	0,03	Ro	Herb	Tea, Pow	Oral
Phyllanthus amarus Schumach. &Thonn.	Hlenwe	421FDS/UL	0,03	Le	Shrub	Dec	Oral
FABACEAE/LEGUMINOSAE							
Abruspreca torius L.	Vivima, jinjinkudjin, amavivi, ojuologbo	472 FDS/UL	0,07	Le, LS, Ro	Liana	Dec, Pow	Oral, bath, massage
Canavalia ensiformis (L.) DC.	Ayivi, legbakpakun	404FDS/UL	0,4	Se	Herb	Dec, Pow	Oral
HYACINTHACEAE							
Urginea indica Kunth	Henhume, gunaru	333FDS/UL	0,04	Rh	Tree	Balsam, Alcohol	Massage
LAMIACEAE							
Ocimum basilicum L.	Ahameyovoto	04199TGClt/AK	0,03	In	Shrub	Dec, alcohol	Massage, Poultice
Ocimum gratissimum L.	Esrou,Deveti	1197FDS/UL /3892 FDS/UL	0,04	WP	Shrub	Dec, Pow	Oral, bath, massage

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LAURACEAE							
Persea americana Mill.	Peyati,		0,05	Le	Tree	Dec	Oral
LEGUMINOSAE							
Albizia adianthifolia W.Wight	Agla	137FDS/UL	0,03	Le	Herb	Dec	Oral
Desmodium gangeticum DC.	Zen'ali, eweenmo	327FDS/UL	0,07	Ro	Herb	Dec, Pow, Tea	Oral
Erythrina senegalensis DC.	Kpaklesi	413FDS/UL	0,03	Ro	Tree	Tea	Oral
*Parkia biglobosa*Benth.	Ahwati, ahwatin, klwisavo (In), afiti (Gr)	329FDS/UL	0,03	St	Shrub	Tea	Oral, bath
Tetrapleura tetraptera Taub.	Lelegbleati	395FDS/UL	0,04	St, Ro	Liana	Dec, Pow	Oral, bath,
Acacia albida Rojas	Hlafen	59FDS/UL	0,05	Ba	Herb	Tea	Oral
Acacia erythrocalyx Brenan	Hlafen	546FDS/UL	0,05	Ba	Herb	Tea	Oral
LILIACEAE/ALLIACEAE							
Allium cepa L.	Sabulè	300FDS/UL	0,08	Rh	Herb	Tea	Oral
Allium sativum L.	Ail, ayo	296FDS/UL	0,08	Rh	Herb	Tea, Pow	Oral,
LOGANIACEAE							
Usteria guineensis Willd.	Kansuve, akporo	55FDS/UL	0,03	Ro	Herb	Dec	Oral
LORANTHACEAE							
Tapinanthus dodoneifolius (DC.) Danser	Lèma		0,03	LS	Tree	Pow	Massage
MALVACEAE							
Gossypium arboreum L.	Cotonnier	693FDS/UL	0,04	Se	Shrub	Dec, Pow	Oral
Hibiscus esculentus L.	Fevi, ajatukan	696FDS/UL	0,05	Ro	Herb	Dec	Mouth wash
*Sida acuta*Burm.f.	Ademesu, aflideme	147FDS/UL	0,04	WP	Shrub	Dec	Oral
MELIACEAE							
Azadirachta indica A.Juss.	Kininuti	221FDS/UL	0,04	Se	Tree	Pow	Oral
MENISPERMACEAE							
Cissampelos mucronata A.Rich.	Kasaxe (mâle)	11FDS/UL	0,03	LS, Ro	Shrub	Tea	Oral, massage
Cissampelos owariensis Beauv. ex DC.	Jokoje (femelle)	100FDS/UL	0,03	LS, Ro	Shrub	Tea	Oral, massage
MIMOSACEAE/LEGUMINOSAE							

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Acacia pennata Willd	Hlafen	1090FDS/UL	0,05	Ba	Herb	Tea	Oral
MORACEAE							
Ficus gnaphalocarpa Steud. ex Miq.	Kelele, hongbwe	113FDS/UL	0,03	Ro	Shrub	Tea	Oral
MORINGACEAE							
Moringa oleifera Lam.	bèn ailé, yovoviti, yovovigbé, yovovikpati	398FDS/UL	0,05	Se, Fl	Tree	Dec, Tea	
MUSACEAE							
Musa paradisiaca L.	Banane	1043FDS/UL	0,05	Pu	Tree	Dec	Oral
MYRTACEAE							
Eucalyptus camaldulensis Dehnh.	Eucalyptus	220FDS/UL	0,09	Le	Tree	Dec, Pow	Oral
*Eucalyptus citriodora*Hook.	Eucalyptus	235FDS/UL	0,09	Le	Tree	Dec, Pow	Oral
Eucalyptus globulus Labill.	Eucalyptus	121FDS/UL	0,09	Le	Tree	Dec, Pow	Oral
*Psidium guajava*L.	Goyavier	470FDS/UL	0,05	Le	Tree	Tea	Oral
NYCTAGINACEAE							
Boerhavia diffusa Engelm. &A.Gray	Herbecochon, ahozemeklo,handoukpo, afokpadin-wa	259FDS/UL	0,04	Ro	Shrub	Dec	Oral
Boerhavia erecta Elliott	Herbecochon, ahozemeklo,handoukpo, afokpadin-wa	41FDS/UL	0,04	Ro	Shrub	Dec	Oral
NYMPHAEACEAE							
Nymphaea lotus L.	Tobolo	511FDS/UL	0,04	Rh	Herb	Dec, Pow	Oral
OXALIDACEAE							
Biophytum petersianum Klotzsch	Patonmo	81FDS/UL	0,03	WP	Shrub	Tea	Oral
PAPAVERACEAE							
Argemone mexicana L.	Ahunja	508FDS/UL	0,04	LS	Shrub	Dec, Pow	Oral
PASSIFLORACEAE							
Passiflora incarnata L.	Dagura	959FDS/UL	0,05	Le	Shrub	Dec	Oral
PEDALIACEAE							
Harpagophytum procumbens DC.	Bedja	257FDS/UL	0,05	Ro	Tree	Dec	Oral

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Piliostigma thonningii (Schumach.) Milne-Redh.	Klon		0,05	Le	Shrub	Dec	Poultice
PIPERACEAE							
*Piper guineense*Thonn.	Poivrier	19FDS/UL	0,09	Fr, Se, WP	Shrub	Dec, Pow, Pow, Balsam	Oral, massage
POACEAE							
Cymbopogon citratus Stapf	Tigbe	357FDS/UL	0,05	Le	Shrub	Dec	Oral
POLYGALACEAE							
Securidaca longepedunculata Fresen.	Kpata, atakpa, kpeta	275FDS/UL	0,08	Le, Ro, Ba	Tree	Dec, Pow	Oral, nasal, poultice, massage
RUBIACEAE							
Fadogia agrestis Schweinf. ex Hiern	Dusu mante	154FDS/UL	0,03	Ro	Shrub	Dec, Pow	Massage, scarification
RUTACEAE							
Citrus aurantium L.	N'ti, n'tisi, bodo n'tisi	782FDS/UL	0,04	Fr, Ze	Tree	Jus	Oral
Citrus grandis Hassk.	Azongbo	44FDS/UL	0,03	Ze	Tree	Dec	Oral
Citrus limon (L.) Burm.f.	N'tisiti	173FDS/UL	0,05	Le, Fr, Ze	Tree	Dec, Jus	Oral
Citrus sinensis Pers.	N'titi	74FDS/UL	0,05	Le	Tree	Dec	Oral
Zanthoxylum zanthoxyloides (Lam.) B.Zepernick & Timler	Ganhopovi, xetin, druba, xeti		0,03	St	Tree	Pow	Massage
SAPOTACEAE							
*Vitellariaparadoxa*C.F.Gaertn	Yokumiti	205FDS/UL	0,03	Ro, St	Tree	Tea	Oral, bath
SOLANACEAE							
Capsicum frutescens L.	Pilipili, wuli-wuli, yebesevi, yebesi	189FDS/UL	0,05	Fr	Herb	Pow	Massage
ZINGIBERACEAE							
Aframomum melegueta K.Schum.	Atakun, oburo	204FDS/UL	0,03	Se	Herb	Dec, Tea	Oral
Curcuma longa L.	Curcuma, dote djin	2FDS/UL	0,05	Rh	Shrub	Pow	Oral
Zingiber officinale Roscoe	Dotè, atalè, gbatakwui, ataribo	348FDS/UL	0,08	Rh	Shrub	Dec, Tea, Alcohol	Oral

Le (Leaves), WP (Whole plant), Ro (Roots), St (Stem), Ba (Bark), Rh (Rhizome), Fr (Fruit), LS (leafy Stem), Jus (Juice), Dec (decoction), Pow (Powder).

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Table 3: Literatures reporting on relevant ethnomedicinal uses, toxicity and immunomodulatory studies on the most important plants used to treat asthma in Maritime region of Togo.

Species	Relevant ethnobotanical citations	Toxic effects	Relevant pharmacological reference to immunomodulatory citations
Abrus precatorius	Asthma (Sonibare and Gbile, 2008 ;Olowokudejo, Kadiri and Travih, 2008 ; Emmanuel noumi, 2009 ; Makinde et al.,2015).	Chloroform and ethanol extracts of leaves tested for in vitro cytotoxic activity by MTT assay on human cancer cell lines, (A549) lung cancer, (hepG2) liver cancer, (HCT116) colon cancer, (HeLA) cervical cancer (Scudiero et al., 1988) The ethanol extract showed better cytotoxic effect than chloroform extracts against the above mentioned cancer cell lines (Manoharan et al., 2011).	The ethanol extract of leaves showed marked effect on milk-induced leukocytosis and eosinophilia in the management of asthma (Choi et al., 1989 ; Anant Solanki and MaitreyiZaveri, 2012). The ethanol extract of leaves significantly decreased milk -induced leukocytosis and eosinophilia in mice in a dose dependent manner when compared with control group (Yadava and Reddy, 2002 ;Taur and Patil, 2011 ; Solanki and Zaveri, 2012). Evaluation of the methanol extract of the leaves for bronchodilator activity by using various in vivo and in vitro models in guinea pigs (Mensah et al., 2011 ; Solanki and Zaveri, 2012). The extract offered a maximum degree of protection comparable to that of salbutamol (Wingard et al., 1991). The methanol extract produced dose-dependent bronchodilator activity (Wambebe and Amosun, 1984).
Allium cepa L. (Liliaceae/Alliaceae)	-	-	Reduction in the production of inflammatory cytokines, a relaxation of tracheal rings, and a reduction in total number of cells in broncho-alveolar lavage and eosinophil peroxidase in lungs by treatment (Oliveira et al., 2015).
Allium sativum L. (Liliaceae/Alliaceae)	Asthma (Sonibare and Gbile, 2008; Olowokudejo et al., 2008; Noumi, 2009).	-	-
Annonamuricata L. (Annonaceae)	Asthma (Noumi, 2009 ; Makinde et al., 2015)	-	-
Caricapapaya	-	Not toxicity effect (Afzan et al., 2012).No significant toxic effect of the oral administration of the aqueous extract of leaves (Ismail et al., 2014)	-
Catharanthusroseus	-	-	-
Desmodiumgangeticum	Asthma (Mainen et al., 2006 ; Towns et al, 2014)	Toxicity against brine shrimp larvae, with LC50 values equal to 33.1 µg/ml (Mainen et al., 2006)	-

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Eucalyptus camaldulensis	Asthma (Noumi, 2009)	-	-
Eucalyptus citriodora	Asthma (Noumi, 2009)	-	-
Eucalyptus globulus	Asthma (Noumi, 2009)	-	-
Euphorbiahirta	Asthma (Sonibare and Gbile, 2008; Noumi, 2009 ; Mohammed et al., 2014).	Effects of extracts on the ultrastructure of the murine liver (Wong et al., 2013); acute and subchronic toxicity of methanol extract in rats (Yuet Ping et al., 2013); Cytotoxicity (Kwan et al., 2015); leucocytosis, dullness, anorexia, stairyhaircoat and 20% mortality in rat (Adedapo et al., 2004 ; Tangjitman et al., 2015)	Ethanol extract of whole aerial part of the plant at doses (100-1000 mg/kg) shows antihistaminic and antiallergic activity by inhibiting inhibited the passive cutaneous anaphylaxis and paw anaphylaxis reaction; protection of mast cell from degranulation (Youssouf et al., 2007).
Guiera senegalensis	Asthma (Fatou et al., 2010)	-	Effect of in vitro exposure of the leaves of Guiera senegalensis, at 0.01 mg/ml or 0.1 mg/ml for 30 min on acetylcholine-induced contraction of isolated rat trachea (Fatou et al., 2010).
Piper guineense	Asthma (Towns et al., 2014)	-	Ethanol and aqueous extract of leaves at doses 100 and 200mg/kg possesses antiasthmactic activity on histamine induced bronchoconstriction in guinea pig and histamine induced dose dependent contraction of guinea pig tracheal chain and isolated guinea pig ileum preparation (Jawale et al., 2009).
Securidaca longepedunculata	Asthma (Sonibare and Gbile, 2008 ; Towns et al., 2014)	-	-
Zingiber officinale	Asthma (Sonibare and Gbile, 2008 ; Olowokudejo, Kadiri and Travih, 2008 ; Emmanuel noumi, 2009).	Embryo toxic to pregnant rats (Weidner and Sigwart , 2001; Tangjitman et al., 2015).	

- Non available dat

Discussion

The present survey was undertaken to identify medicinal plants used in the south of Togo for the treatment of asthma. Asthma is a chronic disease involving the airways in the lungs (Holgate et al., 2010). Asthma symptoms include coughing, wheezing, and chest tightness, and the diagnosis is based on several factors such as a detailed medical history, a physical exam and symptoms (Yunginger et al., 1992). Southern Togolese medicine practitioners diagnose asthma on the basis of clinical manifestations. We observed that wheezing, difficulty of breathing, coughing, chest tightness and dyspnea were commonly used by TH to diagnose the disease before the treatment. Different plants species were used by Togolese TH to heal asthma attack. There were 98 species of plants such as *Eucalyptus camaldulensis Dehn.*,*Eucalyptus citriodora Hook.*,*Eucalyptus globulus* Labill., *Bridelia ferruginea* Benth. , *Carica papaya* L., *Catharanthus roseus* (L.)G.Donand *Piper guineense* Thonn.,*Zingiber officinale* Roscoe, *Securidaca longepedunculata* Fresen, *Guiera senegalensis* J.F.Gmel ,*Annonamuricata* L. *Allium sativum L.* and *Allium cepa L.* that were more cited by TH for the treatment of asthma.

A literature review was made for the most important species (UV>0.08) to assess the previous relevant ethnobotanical citations related to asthma, the toxicity data and the screening reports for immunomodulatory activities. The recorded data are displayed in table 2. According to the data in the table, there was no available relevant ethnobotanical citation related to asthma for *Allium cepa*, *Cataranthus roseus* and *Carica papaya*, although these plants recorded respective use values of 0.08, 0.09 and 0.09. The other plants were cited at least once as curing asthma in ethnobotanical reports. Among these plants, *Abrus precatorius* is the plant with a great number of citations, thus there are four available ethnobotanical reports referring to the use of the plant in the traditional medicine for the management of asthma (Olowokudejo et al., 2008; Sonibare and Gbile, 2008; Noumi, 2009 ; Makinde et al.,2015). *Allium sativum* and *Zingiberofficinale* recorded three reports (Olowokudejo et al., 2008; Sonibare and Gbile, 2008; Noumi, 2009). These findings demonstrate that the traditional healers in the southern Togo share some similarities with others in the management of asthma. For the toxicity, data were available for the *Abrus precatorius*, *Carica papaya*, *euphorbia hirta*, *Desmodium gangeticum* and *Zingiber officinale*. Most of the tests were made on cell lines with crude extracts. Only *Carica papaya* was demonstrated to be nontoxic in vivo (Afzan et al., 2012; Ismail et al., 2014). Five of the abovementioned plants were tested for their possible anti asthmatic potentials. These are *Abrus precatorius*, *Allium cepa*, *euphorbia hirta*, *Guiera senegalensis* and *Piper guineense*. Of these plants, *Abrus precatorius* received more attention through several laboratory screenings for immunomodulatory activity (table 2), however any antiasthmatic molecule was not yet isolated or identified from the plant.

The use of herbal-derived medicines is increasing in therapies of immune disorders such as allergy and chronic inflammatory and asthma (Huntley and Ernst 2000). Herbal medicines have the advantage of being cheap and are associated with fewer incidences of adverse reactions when compared to current pharmaceutical treatment. Therefore ongoing research tries to identify new molecules that either treat or provide benefit for individuals with such illnesses. Plants are an important source of these molecules and about 50% of drugs introduced into the market during the last 20 years have been derived directly or indirectly from small biogenic molecules (Vuorela et al., 2004; Basso et al., 2005). The anti-inflammatory, anti-allergic and immunomodulatory properties of plant extracts have been widely shown in several studies(Kim et al., 2004; Jeon et al., 2014). For instance, the use of herbal products, coffee or black tea, and over-the-counter medications as self-treatments among adults with asthma was shown (Blanc et al., 1997). Xui-Min Lu *et al*. have demonstrated the efficacy and the mechanism of action of traditional Chinese medicines for the treatment of asthma (Li and Brown, 2009). In our study,*Bridelia ferruginea* Benth. was also used for the healing of asthma. Interestingly, *Bridelia ferruginea* produces antineuroinflammatory activity through the inhibition of nuclear factor-kappa B and p38 MAPK signaling (Olajide et al., 2012). This inhibition of MAP-kinases signaling may contribute in the dampening of asthmatic reactions. Knowledge of toxicity is crucial to decrease the risk/benefit ratio. This defines appropriate conditions for use and strategies for development of safer products.In contrast of being cheap and widely use in treatment of various disease, medicinal plant were observed to be toxic (Bateman et al., 1998; Sheehan et al., 1998). In murine model, acetate fraction from *Bridelia ferruginea* Leaves were shown to be cytotoxic (Fabiyi et al., 2012). Essential oil from *Eucalyptus camaldulensis* Dehn. was observed to be toxic for insect. In the present study we observed that oral administration of decoction was more used for the treatment of asthma. The oral administration of Japanese herbal complex *Saiboku-to* (TJ-96) significantly decrease asthma symptoms, blood eosinophils and serum eosinophilic cationic protein (Urata et al., 2002). In addition, herb decoction could improve airway hyper-responsiveness in stabilized asthmatic children (Chan et al., 2006). More interestingly, we highlighted that herbal leaves and root were more utilized for the healing of asthma. This makes sense some researcher argued that Luteolin from *Perilla. frutescens L.*leaves also significantly reduced the histamine release from rat peritoneal mast cells stimulated (Jeon et al., 2014) Antihistamine role in the management of asthma is widely documented (Wilson et al., 2006). In addition Lim *et al* demonstrated the inhibition of airways inflammation by the root of *Angelica decurciva* (Lim et al., 2014). It was shown that seasonal variation has an

impact on the composition of plant extract (Jerkovic et al., 2001; Hess et al., 2007). Regarding this aspect Togolese TP mostly collect their plant material all season but we noticed that the collection during morning time and rainy season were preferred compared to midday, evening and dry season.

This survey provides initial evidence of the ability of Togolese traditional medicine practitioners to heal asthma and this by family inheritance in traditional initiation manner. This raises the question of the ignorance of the exact bioactive molecules, the side effect and the dosage. It is therefore necessary for scientist to go further in characterization of this biomolecules. To that end our group is currently investigation the ability of plants-derived molecules to modulate the immune response.

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