Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2016; 5(6): 430-436
Received: 25-09-2016
Accepted: 26-10-2016

Seindé Espérance Mèdoatinsa
(a) Laboratoire d'Etude et de Recherche en Chimie Appliquée, Ecole Polytechnique d'Abomey-Calavi, Université d'Abomey-Calavi (LERCA/EPAC/UAC)
(b) Laboratoire d'Enzymologie et de Biochimie des Protéines, Faculté des Sciences et Techniques (LEBP/FAST/UAC)

Cokou Pascal Agbangnan Dossa
Laboratoire d'Etude et de Recherche en Chimie Appliquée, Ecole Polytechnique d'Abomey-Calavi, Université d'Abomey-Calavi (LERCA/EPAC/UAC)

Hounnankpon Yédomonhan
Laboratoire de Botanique et d'Ecologie végétale, *Faculté des Sciences et Techniques*, Université d'Abomey-Calavi (LBEV/FAST/UAC)

Hyacinthe Ahissou
Laboratoire d'Enzymologie et de Biochimie des Protéines, Faculté des Sciences et Techniques (LEBP/FAST/UAC)

Virginie Gbohaïda
Laboratoire d'Etude et de Recherche en Chimie Appliquée, Ecole Polytechnique d'Abomey-Calavi, Université d'Abomey-Calavi (LERCA/EPAC/UAC)

Dominique Sohounhloué
Laboratoire d'Etude et de Recherche en Chimie Appliquée, Ecole Polytechnique d'Abomey-Calavi, Université d'Abomey-Calavi (LERCA/EPAC/UAC)

Correspondence
Cokou Pascal Agbangnan Dossa
Laboratoire d'Etude et de Recherche en Chimie Appliquée, Ecole Polytechnique d'Abomey-Calavi, Université d'Abomey-Calavi (LERCA/EPAC/UAC)

Ethnobotanical study of plants used by the lacustrine population of southern Benin in the treatment of malaria

Seindé Espérance Mèdoatinsa, Cokou Pascal Agbangnan Dossa, Hounnankpon Yédomonhan, Hyacinthe Ahissou, Virginie Gbohaïda and Dominique Sohounhloué

Abstract
This study aims to identify the plants used by the South Benin lacustrine population in the treatment of malaria. From august to October 2014, the population of "Ganvie" and "Aguegues-Daho" were interviewed by means of survey forms during a series of interviews. It appears from this study that the southern Benin lacustrine population hasn't antimalarial plants in their immediate environment and purchases them on two markets, Ouando (Aguegues-Daho) in Porto-Novo and Calavi Topka (Ganvie) in Abomey-Calavi. The majority of population (Ganvie: 51.85%; Aguegues-Daho: 65.38%) associates the plants to drugs in the treatment of malaria to palliate inefficiency and inaccessibility of antimalarial drugs. In total 47 species of medicinal plants have been identified, distributed in 44 genera and 27 botanical families. The most represented are the Rubiaceae (6 genera and 7 species), the Papilinoideae, the Sterculiaceae and the Bignoniaceae (3 genera and 3 species). These plants enter in the formulation of 12 recipes in the treatment of malaria in children, pregnant women and adults. These recipes are prepared by decoction and administered orally.

Keywords: Ethnobotanical investigation, plant, malaria, recipe

Introduction
In many tropical countries and especially in the rural areas, health facilities are less developed and even non-existent. Despite the advent of generic drugs, many treatments are still financially unattainable even to economically disadvantaged populations [1]. To all this is added the insufficiency and maldistribution of health personnel, well as sociocultural attitudes, which make more than 80% of the African population resort to traditional medicine [2]. Among the tropical diseases treated by plants, figure malaria, which occurs in tropical regions and subtropicales [3]. The 2014 report by the World Health Organization (WHO) on malaria over the world from 2013 data confirms that malaria remains a major public health problem, even if the figures are encouraging. More than 3.2 billion people live in areas at risk of malaria, considered as high risk for 1.2 billion. In 2013 [4], an estimated 198 million the number of cases which 584.000 have been fatal, children representing 78% of cases and African region 90%. The resistance of Plasmodium to anti-malarials (chloroquine, artemisinin) [5] and that of the vector to insecticides make this epidemic a major public health problem. The prospecting of new sources of natural substances endowed with antimalarial activity then becomes a priority. The present study aims to identify the plants used by the South Benin lake population in malaria treatment in order to confirm or disprove the traditional use made of the Benin flora by pharmacological and toxicological studies.

Materials and Methods
Place of investigation
This study was realized in the lake cities of Ganvie (municipality of So'ava, Atlantic Department) and Aguegues-Daho (municipality of Aguegues, Oueme Department) located in the southern Benin which is a country of West Africa. Figure 1 shows the map of Benin and the habitations of the lake populations, while the map of Ganvie and Aguegue-Daho is presented in Figure 2.

Aguegues-Daho Ganvie Map of Benin

Fig 1: Map of Benin, habitations of the population (MEDOATINSA, 2014)

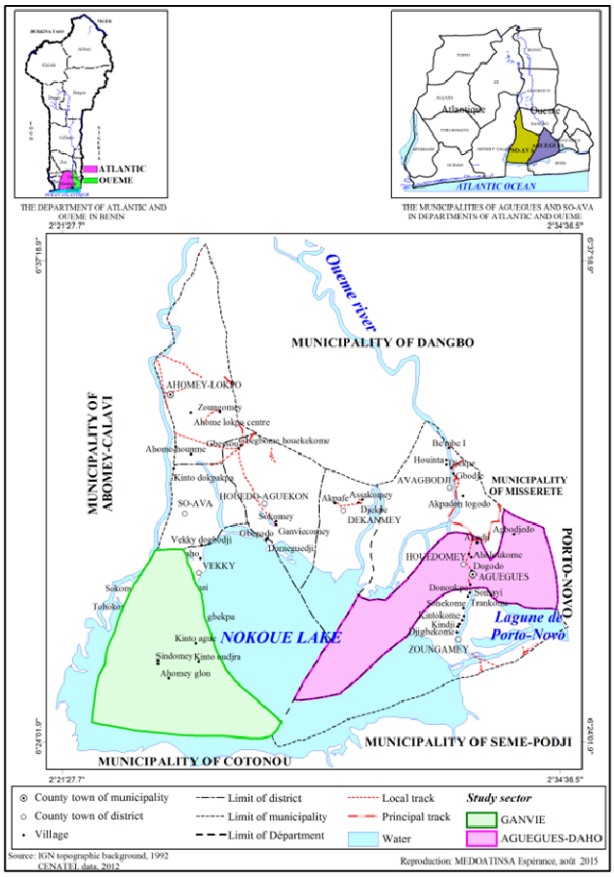

Fig 2: Map of Ganvie and Aguegues-Daho

Methods

This study has been carried out from a series of ethnobotanical investigation using semi-structured interview from a pre-drawn up questionnaire. The questions have been asked in the local language spoken in Benin everywhere but mainly in southern Benin. We interviewed the population of Ganvie and the Aguegues-Daho which are lacustrine populations in the ecosystem favorable to the development of mosquito vector of malaria. During the ethnobotanical investigation we sought to know the plants they use for the treatment of malaria in children, pregnant women and adults. It is of knowing the local name and plant parts used, therapeutic indications, recipes, methods of administration, side effects if any, etc. The lacustrine population without antimalarial plants within reach has directed us to the Ouando market (Aguegues-Daho) in Porto-Novo and Calavi Topka market (Ganvie) in Abomey-Calavi, which are cities not far from the lake population. Once in these markets, we have paid these plants with four saleswomen with two vendors per market and 3 Recipes by saleswoman on a one recipe for the treatment of malaria in children, pregnant women and adult. The scientific identification of plants was made at the national herbarium of the University of Abomey-Calavi. The citation frequency (CF) of each plant was determined by the formula:

$$CF = \frac{\text{Number of citation for the plant considered}}{\text{Total citation for all plants}} x100$$

Results and Discussion

On completion of the ethnobotanical investigation, the results are presented as follows:

Matrimonial status

The figures below show the marital status of the population surveyed both at Aguegues-Daho to Ganvie. The fact finding is that the majority of respondents live in cohabitation (73.08% Aguegues-Daho and 81.48% Ganvie).

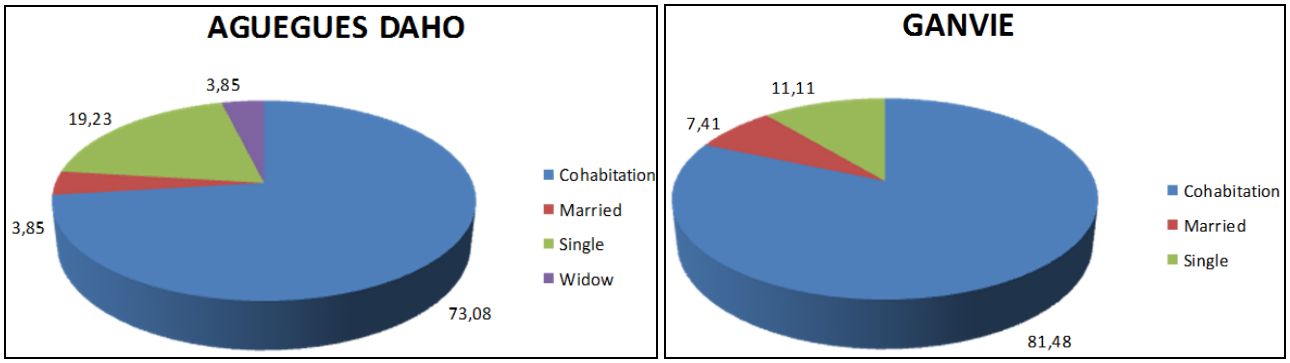

Fig 3: Marital status of the population of Ganvie and Aguegues-Daho

Socio-demographic data

Level of training:

South Benin the lake population is mostly without education (Aguegues-Daho: unschooled 38.46% against 62.97% of Ganvie; figure 4).

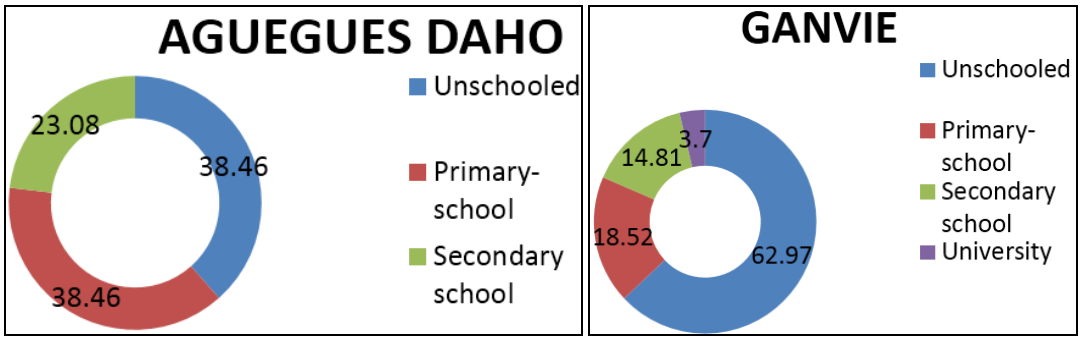

Fig 4: Level of training

Socio-sanitary information in case of suspected malaria

The table 1 chose the socio-sanitary information in case of suspected malaria.

Table 1: Socio-sanitary information in case of suspected malaria

		Aguegues-Daho	Ganvie
Visit to the Hospital	Yes	38.46%	14.81%
	No	34.62%	22.22%
	Occasionally	26.92%	51.85%
Kind of treatment	Plant	15.38%	14.81%
	Drug	19.23%	22.22%
	Plant+drug	65.38%	51.85%
Plant efficiency	Good	65.38%	59.25%
	Average	07.69%	07.69%
	Bad	26.93%	33.06%

38.46% of the population of Aguegues-Daho go to the hospital in case of suspected malaria against 34.62% who don't go at all. Among the respondents in Ganvie, 51.85% occasionally go to the hospital in case of suspected malaria after having tried everything without successful at home. The population associate medicinal plants to drugs in the treatment of malaria (65.38% Aguegues-Daho; 51.85% Ganvie), because of the efficiency of plants (65.38% Aguegues-Daho, Ganvie 59.25%), to overcome the inefficiency, inaccessibility and the high cost of antimalarial drugs (46.15% Aguegues-Daho; Ganvie 37.04%).

Antimalarial drugs are purchased from street vendors at the rate of 38.46% of the respondents of Aguegues-Daho against 25.92% for Ganvie. Among the drugs used by the lakeside population of southern Benin to treat malaria we have: bactrim, boska, amoxicilline, fordine iron, which are illegal products dumped on the Beninese market via Nigeria; nivaquine and chloroquine despite the presence of Plasmodium strains resistant to chloroquine in Benin[5]. The plants are used for most in the form of decocted (69.23% Aguegues-Daho; 66.67% Ganvie) administered per os (84.62% Aguegues-Daho; Ganvie 66.67%). These results are in agreement with those of Denou *et al.*, [6] and Yetein *et al.*, [7] who found that the decoction occupies the first place in the mode of preparation of antimalarial recipes and are administered in the majority of cases orally.

Plants identified by family

Figure 5 shows the frequency of botanical families of identified plants.

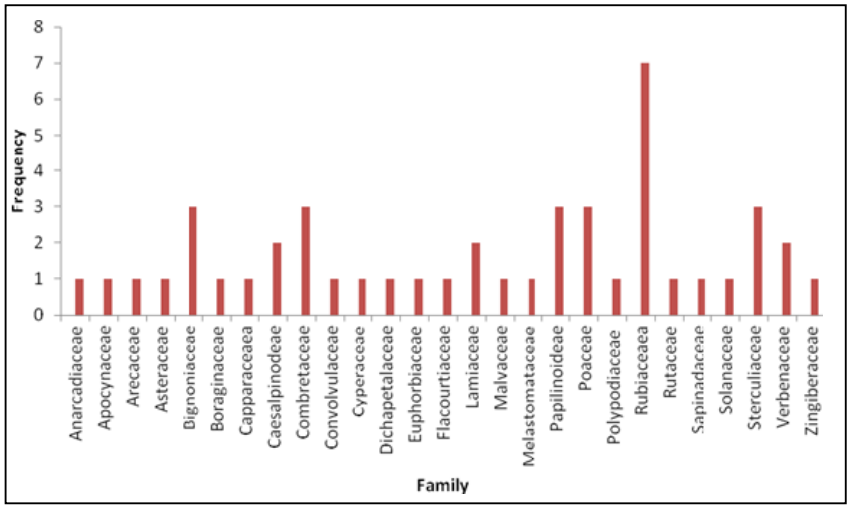

Fig 5: Frequency of botanical families

After ethnobotanical investigation, we identified 47 plants belonging to 27 botanical families used by the lakeside population of southern Benin in the treatment of malaria. The Rubiaceae are the most represented with six genus (Morinda, Psychotria, *Pavetta*, Pauridiantha, Rytigymia, Diodia) followed by the Bignoniaceae (Kigelia, Newbouldia, Spathodea); Papilinoideae (Cajanus, Alysicarpus, Desmodium) and Sterculiaceae (Walteria, Cola, Sterculia) who have all three genus. Yetein *et al.* [7] well as Koudouvo *et al.*, [8] following investigations carried out respectively in the town of Allada, Benin and Togo the maritime region found that the majority of plants used to treat malaria belongs to the family Rubiaceae. The use of plant species belonging to this family to treat malaria today not date and for proof quinine,

first anti-malarial molecule was extracted from the bark of different species of Cinchona and ipecac, a emetic, produced by *Psychotria ipecacuanha*. In traditional medicine sub-Saharan Africa, we find a certain number of species of Rubiaceae used to treat more than 70 medical indications such as malaria, hepatitis, dermatitis, edema and hypertension [9]. *Cymbopogon citratus* (Poaceae) and *Dissotis rotundifolia* (Melastomataceae) are the most cited species with a frequency of 41.66% each. The team of Tchoumbougnang in 2005 sought antiplasmodial activity of essential oil *Cymbopogon citratus* and has concluded that it has good activity with an IC_{50} antiplasmodial 6 to 9.5 µg/mL [10].

In Table below presents the 47 plants belonging to 27 botanical families were identified.

Table 2: plants identified

Family	Species	Local name	Organs	CF (%)
Combretaceae	*Pteleopsis suberosa*	kuilikuiligoto	Bark of the trunk	08.33
	Combretum indicum	Akinkonman	Aerial part	16.66
	Combretum paniculatum	Aloviaton	Aerial part	08.33
Rubiaceae	*Morinda lucida*	Xwèsin	Root	25.00
	Psychotria vogeliana	Démlango	Aerial part	16.66
	Pavetta crassipes	parakouman	Aerial part	16.66
	Pavetta corymbosa	Lohou	Aerial part	16.66
	Pauridiantha hirtella	Aduwé, Towé	Aerial part	16.66
	Rytigynia umbellulata	Gbadéman	Aerial part	08.33
	Diodia sarmentosa	sêzo	Aerial part	16.66
Poaceae	*Cymbopogon citratus*	Timan	Aerial part	41.66
	Cymbopogon giganteus	GbezƐn	Aerial part	08.33
	Sorghum caudatum	Fan	Leaf sheath	08.33
Capparaceae	*Crateva adansonii*	Ontozunzin	Aerial part	08.33
Malvaceae	*Hibiscus surattensis*	Kpofin	Aerial part	33.33
Apocynaceae	*Pleiocarpa pycnantha*	Dan man	Aerial part	16.66
Melastomataceae	*Dissotis rotundifolia*	Hêhêman	Aerial part	41.66
Papilinoideae	*Cajanus cajan*	Klwékounman	Aerial part	16.66
	Alysicarpus zeyheri	Azinman	Aerial part	25.00
	Desmodium ramosissimum	Zêdali	Aerial part	08.33
Caesalpinioideae	*Dialium guineense*	Assouinsouin	Aerial part	08.33
	Cassia siamea	Cassia	Aerial part	33.33
Euphorbiaceae	*Croton zambesicus*	Ajèkfolé,	Aerial part	08.33
	Sebastiania chamaelea	Ahéhéma	Aerial part	08.33
Lamiaceae	*Hyptis suaveolens*	Hwéflu	Aerial part	25.00
	Ocimum canum	Kesu kesu	Aerial part	08.33
Sterculiaceae	*Waltheria indica*	Adasunsunman	Aerial part	08.33
	Cola millenii	Aloviaton	Aerial part	16.66
	Sterculia setigera	Azilokwê	Aerial part	08.33
Verbenaceae	*Lippia multiflora*	Aglala	Aerial part	16.66
	Lantana camara	Hlachiayo	Aerial part	08.33
Sapindaceae	*Paullinia pinnata*	Adacloman	Aerial part	08.33
Arecaceae	*Cocos nucifera*	Agonkêtin	Root	08.33
Bignoniaceae	*Kigelia africana*	Gnanblikpotin	Bark of the trunk	08.33
	Newbouldia laevis	Désréguéman	Aerial part	08.33
	Spathodea campanulata	Adadaman	Aerial part	08.33
Zingiberaceae	*Costus afer*	Trétrégougou	Aerial part	08.33
Convolvulaceae	*Calycobolus africanus*	Ajindé	Aerial part	08.33
Dichapetalaceae	*Dichapetalum madagascariensis*	Gbaglo	Aerial part	16.66
Rutaceae	*Citrus aurantifolia*	Klétin	Trunk	08.33
Boraginaceae	*Ehretia cymosa*	Zozoman	Aerial part	16.66
Asteraceae	*Acanthospermum hispidum*	Ahouanglon	Aerial part	08.33
Cyperaceae	*Remirea maritima*	Adukin	Aerial part	08.33
Flacourtiaceae	*Flacourtia indica*	Gbohoucadje	Aerial part	08.33
Anarcadiaceae	*Lannea barteri*	Koraru	Bark of the trunk	08.33
Solanaceae	*Schwenkia americana*	Amankuikui	Aerial part	16.66
Polypodiaceae	*Phymatodes scolopendria*	Dégoman	Aerial part	08.33

Our results are similar to those of Stangeland *et al*., [11] well as Idowu *et al*., [12] which respectively recorded 56 plants grouped in 47 genus and 23 families used to treat malaria in Uganda and 38 species to 24 families in Nigeria. As against the number of plants identified during this investigation does not reach the size of the sample of Yetein *et al.,* [7] have identified 82 plant species belonging to 43 families used by the population of the Allada plateau and the team of Hermans [13] who identified in the south of Benin close to 30 vendors of medicinal plants 85 species of antimalarial plants.The difference between our results and those of the literature could be related to the degree of specialization in the sale of certain species, the diversity of plant sources, to experience the sales and season (seasonal availability of plants) in which the survey was conducted by Adomou *et al*., [14]. The Table 3 presents the plants grouped according to receipts.

Table 3: Plants grouped according to receipts

Adult

R1	
Species	**Family**
Crataeva adansonii	capparaceae
*Morinda lucida****	Rubiaceae
Psychotria vogeliana	Rubiaceae
*Cymbopogon citratus****	Poaceae
*Hibiscus surattensis***	Malvaceae
Pleiocarpa pycnantha	apocynaceae
*Dissotis rotundifolia***	Melastoma-taceae
Cajanus cajan	Fabaceae
Pavetta crassipes	Rubiaceae

R2	
Species	**Family**
Morinda lucida	Rubiaceae
Cymbopogon citratus	Poaceae
Dissotis rotundifolia	Melastomataceae
*Cassia siamea****	Caesalpinoides
*Alysicarpus zeyheri***	Papilinoideae
Dialium guineense	Caesalpinoides

R3	
Species	**Family**
Cassia siamea	Caesalpinoides
Alysicarpus zeyheri	Papilinoideae
Cola millenii	Sterculiaceae
Hibiscus surattensis	Malvaceae
Lannea barteri	Anarcadiaceae
Kigelia africana	*Bignoniaceae*

R4	
Species	**Family**
Morinda lucida	Rubiaceae
Cassia siamea	Caesalpinoides
Cymbopogon citratus	Poaceae
Rytigymia umbellulata	Rubiaceae
Flacourtia indica	Flacourtiaceae
Pavetta corymbosa	Rubiaceae
Croton zambesicus	Euphorbiaceae
Cocos nucifera	Arecaceae

The number of plants by recipe varies from 6 to 9. *Morinda lucida*, *Cymbopogon citratus* and *Cassia siamea* are the most cited species. They are found in 3 out of 4 receipts. The antiplasmodial activity of its three plants has been already proved by many teams including that Sittie in 1999 [15] which attributes the antiplasmodial activity of the root of *Morinda lucida* to anthraquinones who are present. As for the *Cymbopogon citratus* of antiplasmodial activity and the *Cassia siamea* we have team Tchoumbougnang respectively (2005) [10] who proved the essential oil of *Cymbopogon citratus* antiplasmodial activity and Morita team (2007) [16] which has indexed aromatic alkaloids (Cassiarin a 0.005µg/mL and B 6.9 µg/mL) as responsible for the antiplasmodial activity of *Cassia siamea*.

Pregnant woman

R1	
Species	**Family**
*Hibiscus surrattensis***	Malvaceae
Pavetta crassipes	Rubiaceae
Cajanus cajan	Papilinoideae
*Dissotis rotundifolia***	Melastoma-taceae
*Cymbopogon citratus***	Poaceae
Pleiocarpa pycnantha	Apocynaceae
Spathodea campanulata	*Bignoniaceae*
Cymbopogon giganteus	Poaceae
Phymatodes scolopendria	Polypodiaceae
*Dichapetalum madagascariensis***	*Dichapetalaceae*
Newbouldia laevis	*Bignoniaceae*

R2	
Species	**Family**
Cymbopogon citratus	Poaceae
Costus afer	*Zingiberaceae*
Dissotis rotundifolia	Melastomataceae
Calycobolus africanus	*Convolvulaceae*
Cassia siamea	Caesalpinoides
Sterculia setigera	Sterculiaceae

R3	
Species	**Family**
Hibiscus surrattensis	Malvaceae
Cola millenii	Sterculiaceae
Schwenkia americana	Solanacae
Lannea barteri	Anarcadiaceae

R4	
Species	**Family**
Alysicarpus zeyheri	Papilinoideae
Desmodium ramosissimum	Papilinoideae
Dichapetalum madagascariensis	*Dichapetalaceae*
Pavetta corymbosa	Rubiaceae
Diodia scandens	Rubiaceae
Schwenkia americana	Solanaceae

The recipe 1 is composed of 11 plants whereas the recipe 3 contains only 4. The most encountered species are *Hibiscus surattensis*, *Dissotis rotundifolia*, *Cymbopogon citratus* and *Dichapetalum madagascariensis*. Besides the essential oil of *Cymbopogon citratus* whose antiplasmodial activity has been identified by the team of Tchobougnang (2005) [10], literature does not the case antiplasmodial activity of other plants.

Child

R1	
Species	**Family**
Citrus aurantifolia	*Rutaceae*
*Ehretia cymosa **	*Boraginaceae*
*Pauridiantha hirtella***	Rubiaceae
*Hyptis suaveolens****	Lamiaceae
Diodia sarmentosa	Rubiaceae
*Combretum indicum***	Combretaceae

R2	
Species	**Family**
Ocimum canum	Lamiaceae
Sorghum caudatum	Poaceae
Hyptis suaveolens	Lamiaceae
Pauridiantha hirtella	Rubiaceae
Dissotis rotundifolia	Melastoma-taceae
*Lippia multiflora***	Verbenaceae
Acanthospermum hispidum	*Asteraceae*
R3	
Species	**Family**
Pteleopsis suberosa	Combretaceae
Waltheria indica	Sterculiaceae
Lippia multiflora	Verbenaceae
Combretum indicum	Combretaceae
Ehretia cymosa	*Boraginaceae*
Hyptis suaveolens	Lamiaceae

3 recipes (R1, R3, R4) on 4 are composed of 6 plants whereas the recipe 2 contains 7. *Hyptis suaveolens* was found in 3 out of 4 receipts. This plant is endowed with antiplasmodial activity from the work carried out by team of Dossa (2015) [17] in Benin (IC_{50} <6.25 µg/mL) and the Chukwujekwu (2005) [18] in Nigeria (IC_{50}: 2 µg / mL).

R4	
Species	**Family**
Remirea maritima	*Cyperaceae*
Sebastiania chamaelea	Euphorbiaceae
Lantana camara	*Verbenaceae*
Paullinia pinnata	Sapindaceae
Psychotria vogeliana	Rubiaceae
Combretum paniculatum	Combretaceae

Plants identified during previous investigation by other authors

Table 3 shows among the plants identified in this study those that have been identified in previous investigations in Benin, Togo and Mali.

Table 4: Plants simultaneous identified in this study and in previous investigations

Plants	Diseases	References
Pavetta corymbosa, Cymbopogon citratus *Cajanus cajan, Cassia siamea, Newbouldia laevis*	Fever Malaria	ALLABI *et al.*, 2011 [19]
Acanthospermum hispidum DC, Newbouldia laevis, Kigelia africana (Lam.) Benth, Ehretia cymosa, Senna siamea, Dialium guineense WiIld., Crateva adansonii DC. ssp. Adansonii, Dichapetalum madagascariense Poir Cajanus cajan, Desmodium ramosissimum Flacourtia indica, Hibiscus surattensis L., Cymbopogon citrates, Rytigynia umbellulata, Morinda lucida Benth. Pavetta corymbosa (DC.) F.N. Williams, Paullinia pinnata L., Cola millenii K, Lantana camara L, Costus afer Ker	Malaria	YETEIN *et al.*, 2013 [7],
Pavetta corymbosa **(**R**),** *Pavetta crassipes* *Senna siamea, Acanthospermum, Hispidum* *Cola millenii, Costus afer, Dialium guineense* *Dichapetalum Madagascariense, Ehretia cymosa* *Flacourtia indica, Hibiscus surrattensis* *Pavetta corymbosa, Pavetta crassipes, Rytigynia umbellulata, Senna siamea*	Malaria Fever	ADOMOU *et al.,* 2012 [14],
Acanthospermum hispidum (DC), *Cajanus cajan* Millsp, *Citrus aurantifolia* (Christm. & Panzer) Swingle, *Cocos nucifera* Linn, Cymbopogon citrates, Dialium guineense, Dichapetalum madasgascirensis, *Hibiscus surattensis* Linn, *Hyptis sauveolens* Poit, *Kigelia africana* (Lam.)Benth, *Lippia multiflora* Moldenke, *Morinda lucida* Linn, *Newbouldia laevis* Seem, *Ocimum canum* Sams, *Paullinia pinnata* Linn, *Pavetta corymbosa* (DC) F.N. Will., *Pteleopsis suberosa* Engl. et Diels, *Senna siamea* (Lam.) H.S. Irwin & Barneby, *Sorghum caudatum* Linn. var. *caulorans, Spathodea campanulata* P. Beauv, *Waltheria indica* Linn.	Malaria	DENOU *et al.*, 2011 [6] Togo Mali
Citrus aurantifolia (Christm. & Panzer) Swingle *Paullinia pinnata* Linn, *Pteleopsis suberosa* Engl. & Diels, *Senna siamea* (Lam.) H.S. Irwin & Barneby		

Conclusion

This work carried out in the lake cities of South Benin has identified 47 antimalarial plants used to treat the disease in children, pregnant women and adults. 12 recipes were collected from four vendors of medicinal plants in two markets. These plants belong to 44 genera and 27 families. The most common are from the familly of Rubiaceae, Papilinoideae, Sterculiaceae and Bignoniaceae. Among the identified plants *Cymbopogon citratus* (DC) Stapf, *Hibiscus surrattensis* Linn., *Dichapetalum madagascariense* (DC) Keay, *Pavetta corymbosa* (DC) FN Will., *Morinda lucida*, *Cassia siamea*, *Dissotis rotundifolia*, *Alysicarpus zeyheri*, *Pauriandiantha hirtella*, *Combretum indicum*, *Ehretia cymosa* and *Lippia multiflora* were found in many recipes.The recipes are mostly prepared by decoction and administered by the oral route.

References

1. Tabuti JRS, Lye KA, Dhillion SS. Traditional herbal drugs of Bulamogi, Uganda: plants, use and administration. J. Ethnopharmacology, 2003; 88:19-44.
2. Sangare D. Étude de la prise en charge du paludisme par les thérapeutes traditionnels dans les aires de Kendié (Bandiagara) et de Finkolo (Sikasso). Thèse Doct., Univ. Bamako, 115. http:// www.keneya.net/fmpos/theses/2004/pharma/04P27/
3. Lewison G, Srivastava D. Malaria research, 1980-2004, and the burden of disease. Acta Trop, 2008; 106:96-103.
4. Organisation Mondiale de la Santé (OMS). Paludisme aide-mémoire, 2014 ; N°94
5. WHO. World Malaria Report 2012. Geneva: WHO Press, 2012.
6. Denou A. Etude des propriétés analgésiques des plantes antipaludiques du Togo et du Mali sélectionnées par

enquêtes ethnobotaniques. Université de Lomé, Diplôme d'Etudes Approfondies en biologie de développement, 2011.
7. Yetein MH, Houessou LG, Lougbégnon TO, Teka O, Tente B. Ethnobotanical study of medicinal plants used for the treatment of malaria in plateau of Allada, Benin (West Africa). Journal of Ethnopharmacology, 2013; 146:154-163.
8. Koudouvo K, Karou DS, Kokou K, Essien K, Aklikokou K, Glitho IA, Simpore J *et al*. An ethnobotanical study of antimalarial plants in Togo Maritime Region. Journal of Ethnopharmacology, 2011; 134:183-190.
9. Karou SD, Tchacondo T, Ilboudo DP, Simpore J. Sub-Saharan Rubiaceae: A Review of Their Traditional Uses, Phytochemistry and Biological Activities. Pak. J. Biol. Sci. 2011; 14(3):149-169.
10. Tchoumbougnang F, Zollo PH, Dagne E, Mekonnen Y. *In Vivo* Antimalarial Activity of Essential Oils from *Cymbopogon citratus* and *Ocimum gratissimum* on Mice Infected with *Plasmodium berghei*. Planta Medica, 2005; 71:20-3. [PubMed]
11. Stangeland T, Alele PE, Katuurac E, Lye KA. Plants used to treat malaria in Nyakayojo sub-county, western Uganda. Journal of Ethnopharmacology, 2011; 137:154-166
12. Idowu OA, Soniran OT, Ajana O, Aworinde DO. Ethnobotanical survey of antimalarial plants used in Ogun State, Southwest Nigeria. African Journal of Pharmacy and Pharmacology, 2010; 4(2):055-060.
13. Hermans M, Akoègninou A, Vander Maesen LJG. Medicinal plants used to treat malaria in southern Benin. Economic Botany, 2004; 58:S239-S252.
14. Adomou AC, Yedomonha H, Djossa B, Legba SI, Oumorou M, Akoègninou A. Etude Ethnobotanique des plantes médicinales vendues dans le marché d'Abomey-Calavi au Bénin. Int. J Biol Chem Sci. 2012; 6(2):745-772.
15. Sittie AA, Lemmich E, Hviid L, Kharazmi A, Nkrumah FK, Christensen SB. Structure - activity studies *in vitro* of antileishmanial and antimalarial activities of anthraquinones from Morinda lucida. Planta Medica, 1999; 65:259-261.
16. Morita H, Oshimi S, Hirasawa Y, Koyama K, Honda T, Ekasari W *et al*. Novel Antiplasmodial Alkaloids from *Cassia siamea*. Organic letters. 2007; 9(N°18):3691-3693.
17. Medoatinsa SE, Agbangnan Dossa CP, Viwami F, Bogninou-Agbidinoukoun GSR, Noudogbessi JP, Lagnika L *et al*. *In vitro* antiplasmodial and antioxidant activities of ethanolic and hydroethanolic extracts of *Hyptis suaveolens*. World Journal of Pharmacy and Pharmaceutical Sciences, 2015; 4(08).
18. Chukwujekwu JC, Van Steden J, Smith P. Antiplasmodial diterpenoid from the leaves of Hyptis suaveolens. South African Journal of Botany, 2005; 71:316-325.
19. Allabi AC, Busia K, Ekanmian V, Bakiono F. The use of medicinal plants in self-care in the Agonlin region of Benin. Journal of Ethnopharmacology. 2011; 133:234-243.