

# Ethnobotanical survey, antimicrobial and anticomplement activities of Guinean medicinal plants traditionally used in the treatment of inflammatory diseases in Conakry and Dubreka

A. M. Baldé<sup>1,2,\*</sup>, M. S. Traoré<sup>1,2,5</sup>, M. S. T. Diallo<sup>1,2</sup>, E. S. Baldé<sup>1,2</sup>, Y. Huang<sup>2</sup>, Z. Liu<sup>2</sup>, K. Oularé<sup>3</sup>, M. S. Barry<sup>3</sup>, M. A. Baldé<sup>1,5</sup>, A. Camara<sup>1,5</sup>, D. Vanden Berghe<sup>4</sup>, A. Vlietinck<sup>4</sup>, L. Pieters<sup>4</sup>

<sup>1</sup>Centre de Recherche et de Valorisation des Plantes Médicinales de Dubréka, Dubréka, Guinée

<sup>2</sup>Département de Pharmacie, Faculté de Médecine-Pharmacie-Odontostomatologie, Université de Conakry, Conakry, Guinée

<sup>3</sup>Département de Biologie, Faculté des Sciences, Université de Kankan, Kankan, Guinée

<sup>4</sup>Department of Pharmaceutical Sciences, University of Antwerp (U.I.A.), Antwerpen, Belgium

<sup>5</sup>AMB-PHARMA, Laboratoire Pharmaceutique sarl, Dubreka, Guinée

## Email address:

bmalieu2002@yahoo.fr (A. M. Baldé), sahartra1@yahoo.fr (M. S. Traoré)

## To cite this article:

A. M. Baldé, M. S. Traoré, M. S. T. Diallo, E. S. Baldé, Y. Huang, Z. Liu, K. Oularé, M. S. Barry, M. A. Baldé, A. Camara, D. Vanden Berghe, A. Vlietinck, L. Pieter. Ethnobotanical Survey, Antimicrobial and Anticomplement Activities of Guinean Medicinal Plants Traditionally Used in the Treatment of Inflammatory Diseases in Conakry and Dubreka. *Journal of Plant Sciences*. Special Issue: Ethnopharmacological Investigation of Medicinal Plants. Vol. 3, No. 1-2, 2015, pp. 11-19. doi: 10.11648/j.jps.s.2015030102.13

**Abstract:** Based on an ethnobotanical survey related to inflammatory diseases, 67 Guinean plant species belonging to 35 botanical families were inventoried. Some plant species frequently used in the treatment of rheumatism, skin diseases and microbial infections were selected and submitted to a biological investigation including antimicrobial and anticomplement activities. At a concentration of 1mg/ml, all the tested extracts were devoid of any activity against the tested fungi viz *Candida albicans*, *Aspergillus niger*, and *Trichophyton rubrum* and showed a cytotoxicity varying from 0.25 to 500 µg/ml which prevented the evaluation of possible antiviral effects against *herpes simplexvirus type 1*, *Coxsackie-B2*, *Measle Edmondston A*, *Poliomyelitis virus type 1*, *Semliki forest L10* and *Vesicular stomatitis virus* for viruses. At 1mg/ml, only the extracts of *Ageratum conyzoides*, *Alchornea cordifolia*, *Acanthospermum hispidum*, *Erythrina senegalensis*, *Harungana madagascariensis*, *Hymenocardia acida*, and *Lophira alata* showed an antibacterial effect against *Bacillus cereus* and/or *Staphylococcus aureus*. All the tested extracts exhibited an inhibitory effect on the Alternative Complement Pathway complement except for *Bambusa vulgaris*. Only the extracts of *Ageratum conyzoides* and *Hymenocardia acida* interfered with both activation pathways of the complement system. The results of the present work support the anti-inflammatory traditional use of some selected plant species which could be explained, at least partly, by their anticomplement properties.

**Keywords:** Guinea, Ethnobotanical Survey, Anti-Inflammatory, Antimicrobial, Anticomplement

## 1. Introduction

Inflammatory diseases are major worldwide problem characterized by a complex biological response of vascular tissue to harmful stimuli, pathogens, irritants and indicated by redness, warmth, pain and swelling [1]. Aiming to treat these classical signs, a series of natural remedies have been proposed in the different traditional medicinal systems around the world. Indeed, for many Guinean people, particularly the rural populations, traditional medicine continues to be the first

and most important source of medical solace when illness strike health, particularly in the management of many inflammatory diseases such as rheumatism, arthritis, allergy etc. From the traditional remedies, medicinal plants remain the most used and marketed, particularly in reducing the swelling and pain of inflammation.

Since the long term use of expensive anti-inflammatory drugs like Non Steroidal Anti-inflammatory Drugs (NSAIDs)

cause adverse side effects and damage human biological systems such as the liver, gastrointestinal tract, etc, plant-derived materials have received increased attention as bioactive agents against inflammatory diseases[2]. Consequently, many medicinal plants have been studied and shown to exhibit a potential anti-inflammation activity in using various models [3].

Extracts and compounds from medicinal plants could be as effective as NSAIDs. Previous investigations indicated that some herbal drugs are a good source of natural inflammatory agents. These herbal drugs are also considered as good sources for some kinds of regulators of the complement system [; 4] which is an important host-defense mechanism against foreign invasive organisms such as bacteria, fungi, and viruses. [5; 6]. This paper describes the ethnobotanical investigation of Guinean antiinflammatory plant species as well as the antimicrobial and anti-complementary activities of some selected plants species.

## 2. Material and Methods

### 2.1. Methodology

#### 2.1.1. Ethnomedical and Ethnobotanical Investigations

Frequent ethnomedical and ethnobotanical investigations were conducted from June 2008 to December 2009 in Conakry and Dubréka. The traditional health actors were contacted, interviewed and recorded through a questionnaire. The selection of the interviewees was done on the basis of their assent, their presence in the place and at the time of the investigation, their fixed domiciliation in the area of the investigation, their professional recognition by the local community. The questionnaire and oral interviews were based on the standardised model which was made by the “Centre de Recherche et de Valorisation des Plantes Médicinales (CRVPM)—Dubreka” which is an open free listing mainly focused on demographic data (age, sex, educational level), knowledge and management of the targeted disease. Consent was obtained from the respondents to divulge information.

#### 2.1.2. Plant Material

The plants were collected in the districts of Conakry and Dubreka. Voucher specimen were deposited at the herbariums of the Department of Pharmacy – University of Conakry (Guinea) and the “Centre de Recherche et de Valorisation des Plantes Médicinales de Dubréka”. Their botanical identification was done first by the traditional healer or the herbalist to give the local name, then, by the botanists from the “CRVPM–Dubreka”, and the Environmental Study and Research Center–Conakry.

#### 2.1.3. Preparation of Extracts

The air-dried plant material (50 g) was ground and extracted with 400 ml MeOH by maceration at room temperature for 24 h. The macerated plant suspension was concentrated *in vacuo* below 40°C to dryness. The tested concentrations were 1mg/ml and in dilution of 0.5 mg/ml for bacteria and fungi, 100 µg/ml and in dilutions 50, 25, 10 and 1 µg/ml for viruses.

#### 2.1.4. Microorganisms and Culture Medium

The following micro-organisms were used : *Staphylococcus aureus* ATCC6538, *Escherichia coli* ATCC8739, *Pseudomonas aeruginosa* ATCC 15442 and *Bacillus cereus* ATCC 14579 for the bacteria, *Candida albicans* ATCC10231, *Aspergillus niger* ATCC16404, *Trichophyton rubrum* ATCC10218 for fungi, *herpes simplexvirus type 1*, *Coxsackie-B2*, *Measle Edmondston A*, *Poliomyelitis virus type 1*, *Semliki forest L10* and *Vesicular stomatitis virus* for viruses.

Antibacterial and antifungal testing: microtiter plates dilution method [7].

Antiviral assay: endpoint titration technique [7].

Anticomplementary activity: Classical and Alternative pathway complement activities (procedure described by Mayer [1971][8] and Platts-Mills [1974],[9] respectively.

## 3. Results and Discussion

### 3.1. Ethnobotanical Survey

#### 3.1.1. Socio-Demographic Characteristics

42traditional health actors were included in the study: 25 (60%) in Conakry and17 (40%) in Dubreka. Among these, 28 (19 male and 9 female, 67%) were traditional healers and 14(10 male and 4 female, 33%) were herbalists. With 31% (13/42), the participation of females was quite modest. Moreover, they were poorly represented as traditional healers (9/28, 32%) or herbalist (4/14, 29%). It should be noted that female traditional healers are progressively entering the arena of traditional medication, which usually was closed for them since the traditions excluded women from all inheritances, whether material or moral. Such situation could be related at least partly to the fact that the main economic charge of the family is globally assumed by female. On the other hand, the female’s diseases related to menstruations are mostly treated by females.

The age of the traditional healers and herbalists ranged from 24 to 79 years old. The majority of the recorded traditional health practioners are below of 60 years old (6/28 traditional healers; 4/14 herbalist) indicating a relative marked interest by young people. Nowadays, the decreasing number of old and true practitioners is a challenge in the countries where the traditional medicine remain the only available and accessible health service for the majority of the populations. These old practioners usually live and practice in their villages.

The educational levels of the interviewees were low to quite modest: only 2/14 (14%) for the herbalists and 9/28 (32%) for the traditional practioners have attended a higher education institution or traditional Coranic schools. It is interesting to note that more and more educated people are involved in the management of traditional medicine. Partly, this is due to the unemployment of the young although highly educated. But, most of these get their knowledge from the literature data.

All the contacted traditional healers claimed to have treated pain diseases such as rheumatism, arthritis for up to 5 years. Due to their evident symptoms, the diseases mainly linked with

pain, fever, or inflammation are easily identified and usually treated with either animal or vegetal recipes in the Guinean traditional medicine. The vegetal remedies consisted mostly of one plant species. But combinations of two or three plant species were also usual. This is the case of the following associations: *Acanthospermum hispidum/Strophantus sarmentosus*; *Afromosia laxiflora/Harungana madagascariensis*; *Solanum incanum/Spondias mombin*; *Hymenocardia acida/Alchornea cordifolia*; *Erythrina senegalensis/Hymenocardia acida*; *Jatropha curcas/Ageratum conyzoides*; *Lophira alata/Bambusa vulgaris* or *Maytenus senegalensis/Alchornea cordifolia/Ocimum viride*; *Hymenocardia acida/Zanthoxylum leprieurii/Costus afer*; *Mitragyna inermis/Sarcocephalus esculantus/Bambusa vulgaris*; *Ageratum conyzoides/Piliostigma thonningii/Cassia sieberiana*; *Acanthospermum hispidum/Harungana madagascariensis/Lophira alata*; *Anthocleista nobilis/Erythrina senegalensis/Alchornea cordifolia*.

The oral transmission of knowledge on traditional medicine was done by parental inheritance for (13/28, %), training (10/28, %) or by revelation (5/28, %). The parental inheritance tradition was significantly evident in the district of Dubreka with 9/12 practitioners. Concerning the herbalists, they all evolve in the public market. They are supplied of plant species either directly in the vicinity of their place of dwelling or near salesmen wholesalers. They sell the different dried plant organs in the form of bunch or packed in a plastic bag.

### 3.1.2. Inventory of Plant Species

As shown in Table 1, the collected traditional remedies were composed of 67 plant species belonging to 35 families. Of these, the Caesalpiniaceae, Euphorbiaceae, Meliaceae and Rubiaceae were the most represented with 5 species recorded in each family followed by the Apocynaceae, Fabaceae, or

Rutaceae with 4 plant species in each. 3 plant species were found in the Moraceae and only 1 to 2 species were recorded for the other families.

The most frequently cited plant species by the traditional healers and herbalists were in decreasing order *Alchornea cordifolia* (6 times), *Harungana madagascariensis* (6), *Acanthospermum hispidum* (5), *Jatropha curcas* (5), *Piliostigma thonningii* (5), *Anthocleista nobilis* (4), *Hymenocardia acida* (4), *Ageratum conyzoides* (4), *Bambusa vulgaris* (3), *Erythrina senegalensis* (3), *Lophira alata* (3). These eleven plant species corresponded to nine botanical families viz Asteraceae, Caesalpiniaceae, Euphorbiaceae, Fabaceae, Hymenocardiaceae, Hypericaceae, Loganiaceae, Ochnaceae, and Poaceae. Most of these plants have been described in "Plantes Medicinales de Guinee" [10].

There is much convergence in the traditional use of most of these eleven plant species as anti-inflammatory throughout tropical Africa or ayurvedic system: *A. cordifolia* is used as topical anti-inflammatory [11]. *H. acida* is traditionally used in Nigeria for the treatment of inflammation, including arthritis, rheumatic pain and toothache [12]. Extracts of *A. conyzoides* have been used in many traditional medicines as remedies against wounds and burn, microbial infections, arthrosis, headache, inflammation dyspnea, pain, asthma, spasms, gynaecological diseases, leprosy and other skin diseases [13], fever, rheumatism, malaria, and colics [14]. In Ayurvedic system, *Bambusa* is used for various ailments like ulcer and anti inflammatory, fever, asthma [15], wound healing, emmenagogue etc. [16]. *Piliostigma thonningii* (Schum.) Milne-Redhead (Caesalpiniaceae) is used to treat a variety of infections, fever and inflammatory conditions such as gingivitis, wounds etc [17].

Table 1. Socio-demographic characteristics of the traditional health actors.

District	Sex	Traditional healers			Herbalists			
		Number	Educated people	Age >60	Oral transmission	Number	Educated people	Age >60
Conakry	Male	14	8	2	3	8	2	4
	Female	2	0	0	1	1	0	0
Dubreka	Male	5	1	1	3	2	0	0
	Female	7	0	3	6	3	0	0
Total		28	9	6	13	14	2	4

### 3.1.3. Preparation and Administration

The most frequently used plant parts by the traditional healers and the herbalists were the leaves (28 citations) followed by the stem-bark (19), the root (15), fruits (6), and whole plant (3). The aerial, branch, seed and petiole parts were less frequent. Apparently, all the cited plant parts were harvested from the spontaneous flora without any control by both traditional healers and herbalists. Intensive, anarchistic and not regulated harvests could in the long term threaten the existence of the overexploited species mainly if this targets the roots.

All the herbalists hand out prescriptions at the request of the patient and often they gave limited advices. None of the interviewees reported any toxicity associated with their

medications.

### 3.1.4. Biological Activities

In view to promote their scientific support, the eleven most cited plant species widely used in the treatment of pain, fever, skin diseases and microbial infections were submitted to a biological investigation including antimicrobial and anticomplement activities.

### 3.1.5. Antimicrobial Properties

The plant extracts were biologically investigated. At a concentration of 1mg/ml, all the extracts were devoid of any activity against the tested fungi. Similar inactivity against *Candida albicans* and *Aspergillus niger* were also recorded by Le Grand *et al.* (1988) [18], Vlietinck *et al.* (1995) [19], Nwodo

(1989)[20] for *Anthocleista djalensis* (stem-bark), *Bambusa vulgaris*, *Ageratum conyzoides*, *Harungana madagascariensis* (stem-bark). In contrast, the methanol extract of the leaves of *Alchornea cordifolia* has shown antifungal activities against *C. albicans*, *A. niger* and *Microsporum gypseum* with a minimum inhibitory concentration (MIC, in µg/ml) corresponding to 62.5, 250, and 250 respectively [21]. On the other hand, the ethanol extract of the leaves of *H. madagascariensis* was described by Madubunyi *et al.* (1995)[22] as fungistatic for *Aspergillus flavus* and *C. albicans*.

All the tested extracts have shown a cytotoxicity varying from 0.25 to 500 µg/ml which prevented the evaluation of possible antiviral effects. The highest (0.25-0.5 µg/ml) and the lowest (>100µg/ml) cytotoxicity were recorded for *B. thonningii* and *J. curcas*, respectively. According to Tih *et al.* (1992)[23], the crude extract of *L. alata* inhibited Epstein-Barr virus activated by tumor promoters.

As indicated in the table 1, at a concentration less than 1mg/ml, the extracts of *H. acida* has shown an antibacterial effect against *B. cereus* and *S. aureus*, with the minimal inhibited concentration (MIC) of 0.03mg/ml and the minimal bactericidal concentration (MBC) of 0.03 mg/ml for *B. cereus* and the MIC of 0.06mg/ml and the MBC of 0.5mg/ml for *S. aureus*.

Previous studies have also shown the antibacterial activity of the ethanol leave extract of *A. cordifolia* against *Micrococcus luteus*, *Pseudomonas aeruginosa*, *S. aureus*, *Escherichia coli*, *Shigella dysenteriae* and *Salmonella typhi* [24], the ethanolic extract of the leaves of *H. madagascariensis* against *S. typhi*, *S. dysenteriae*, *P. aeruginosa*, *S. aureus* [22, 25], the stem-bark of *H. madagascariensis* and *L. alata* against *Sarcinea lutea* and *S. aureus* [26], the aqueous methanol extract of the stem-bark of *H. madagascariensis* against *S. aureus*, *B. cereus*, *P. aeruginosa*; *E. coli*, *Proteus morganii* and *Klebsiella pneumonia* [20], the young leaves of *A. cordifolia*, the bark of *E. senegalensis* against *Bacillus subtilis* and *S. aureus* [18], the methanol extracts of the leaves of *A. cordifolia* against *K. pneumonia*, *S. aureus* and *Streptococcus mutans*, the methanol extracts of the leaves, stem bark or root bark of *H. acida* against *K. pneumoniae* and *S. aureus*, the two last extracts being more active while the leave extract was the

only one to be active against *S. mutans* (21).

Reports on antimicrobial activities of *A. djalensis* [27-29], *A. cordifolia* (against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*) [30], *A. hispidum* (against *S. aureus* ATCC 6538 P and *Enterococcus faecalis* ATCC 39212 and methicillin-resistant *S. aureus*, MRSA ; one of the main microorganisms involved in human chronic infection.) [31] have been published

### 3.1.6. Anticomplement Activities

The complement system is an important host-defense mechanism against foreign invasive organisms such as bacteria, fungi, and viruses. However, excessive or inappropriate activation of complement can contribute to the pathogenesis of acute and chronic disorders as diverse as inflammatory and degenerative diseases like various hemolytic anemias, rheumatoid arthritis, gout, microbial infections. [5,6]. As part of the search for anticomplementary active components from natural products, the anticomplementary properties of methanolic extracts from the most frequently cited eleven plant species have been investigated.

The different extracts of the selected eleven plant species were tested for their anticomplement-inhibiting properties. Table 2 showed the lowest concentration of each extract giving rise to 50% inhibition. The results implied that the strongest inhibition of the alternative pathway (AP) complement activity is associated with the extract of *A. hispidum* which showed an IC<sub>50</sub> value corresponding to 38.19 µg/ml. When compared with the known inhibitor of the complement system [32], the reference rosmarinic acid (IC<sub>50</sub>: 160.71 µg/ml), all the tested extracts exhibited an inhibitory effect on the AP complement except that of *B. vulgaris* (IC<sub>50</sub>> 933.3 µg/ml). In decreasing order of activity, an inhibition was recorded for the extracts of *H. acida* (IC<sub>50</sub>: 60.34 µg/ml), *B. thonningii* (IC<sub>50</sub>: 63.17 µg/ml), *J. curcas* (IC<sub>50</sub>: 74.61 µg/ml), *A. conyzoides* (IC<sub>50</sub>: 91.49 µg/ml), *A. nobilis* (IC<sub>50</sub>: 91.57 µg/ml), *L. alata* (IC<sub>50</sub>: 92.55 µg/ml). The extracts of *A. cordifolia* and *H. madagascariensis* were moderately active on the AP complement (IC<sub>50</sub>: 113.94 and 140.26 µg/ml, respectively).

Table 2. Antiinflammatory Guinean plant species.

	Family	Plant species	Voucher specimen number	Plant part	Galenical form	Other uses
1	Apocynaceae	<i>Alstonia boonei</i> De Wild. Syn.: <i>A. congensis</i> selon A. Chevalier et Schnell, non Engl.)	8HK69	Root	Ointment (palm oil) ; massage	Antipyretic ; antiparasitic
		<i>Rauwolfia vomitoria</i> Afz.	8HK70	Leave and Root	Infusion	Antiparasitic ; analgesic
		<i>Strophanthus hispidus</i> DC.	8HK71	Root	Pastry	Analgesic ; Treatment of sexual diseases
		<i>Strophanthus sarmentosus</i> DC.	8HK72	Stem-bark (extremities)	Decoction	Antiseptic ; rheumatism
2	Asteraceae	<i>Acanthospermum hispidum</i> DC	13HK179	Whole plant	Decoction	antimalarial ; antiviral ; anthelmintic Arthritis, rheumatism [Carière, 1994]

	Family	Plant species	Voucher specimen number	Plant part	Galenical form	Other uses
		<i>Ageratum conyzoides</i> L.	13HK180	Whole plant	Decoction	Antipyretic ; antioedema
3	Bignoniaceae	<i>Newbouldia laevis</i> (P. Beauv.) Seem.	18HK209	Root	Powder (local application)	Analgesic ; antiparasitic
4	Bombacaceae	<i>Bombax brevisuspe</i> Sprague	20HK59	Root	Pastry (per-os)	Antimicrobial ; analgesic
5	Burseraceae	<i>Boswellia dalzielii</i> Hutch.		Stem-bark	Decoction	Antimicrobial ; antipyretic
6	Caesalpiniaceae	<i>Cassia sieberiana</i> DC	27HK435	Leave	Decoction	Pain and fever
		<i>Detarium senegalense</i> J.F.Gmel.	27HK436	Fruit	Massage	Tonic ; antipyretic
		<i>Dialium dinklagei</i> Harms	27HK437	Stem-bark	Pastry with palm oil	analgesic
		<i>Erythrophleum guineense</i> G. Don. Syn.: <i>E. suaveolens</i> Guill. & Perr.) Brenan	27HK438	Stem-bark	Decoction (external uses only)	Inflammatory diseases
		<i>Piliostigma thonningii</i> (Schumach.) Milne-Readhead	27HK439	Leave	Decoction ; Lotion	Antirheumatism ; treatment of toothache (Bailevskai, 1969)
7	Capparidaceae	<i>Maeria angolensis</i> DC	30HK3	Leave	Decoction (per-os, local application)	Pain
8	Caryophyllaceae	<i>Drymaria cordata</i> (L.) Willd. ex Roem.& Schult.	32HK2	Leave	Decoction (bath)	Analgesic
9	Celastraceae	<i>Maytenus senegalensis</i> (Lam.) Exell	34HK13	Leave	Decocotion	Pain
10	Combretaceae	<i>Guiera senegalensis</i> Lam.	38HK470	Leave	infusion	Diuretic ; skin diseases ; appetite stimulant
		<i>Terminalia avicennoides</i> Guill. & Perr.	38HK471	Leave	Ointment (ashes in oil)	Oedema ; skin diseases ; antipyretic
11	Commelinaceae	<i>Commelina nudiflora</i> L.	144HK2	Leave	Decoction	stomachache
12	Dilleniaceae	<i>Tetracera alnifolia</i> Willd.	44HK472	Stem-bark	Ointment	Analgesic
13	Euphorbiaceae	<i>Alchornea cordifolia</i> (Schumach. & Thonn.) Müll. Arg.	52HK498	Leave	Decoction ; infusion (bath)	Analgesic ; antipyretic ; purgative
		<i>Bridelia ferruginea</i> Benth.	52 HK499	Stem-bark and leave	Infusion (per-os ; bath)	Analgesic (headache) ; antipyretic ;
		<i>Euphorbia hirta</i> L.	52HK500	Aerial part ; leave	Infusion	analgesic
		<i>Mareya micrantha</i> (Benth.) Müll.Arg. Syn.: <i>M. spicata</i> Baill.	52HK501	Leave	Pastry (local application)	Analgesic ; antibacterial ; tonic
		<i>Jatropha curcas</i> L.	52HK502	Leave	Infusion (per-os)	Antiparasitic ; antipyretic ; anti-citric
14	Fabaceae	<i>Abrus precatorius</i> L.	53HK 522	Root	Decoction	Diuretic ; antimicrobial
		<i>Afrormosia laxiflora</i> (Benth. ex Bak.) Harms Syn. : <i>Pericopsis laxiflora</i> (Benth. ex Bak.) van Meeuwen	53HK523	Leave	Decoction (per os ; local application)	Analgesic ; antiparasitic ; diuretic ; antibacterial
		<i>Erythrina senegalensis</i> DC.	53HK 524	Stem-bark	Decoction (per-os)	Antipyretic ; antirheumatismal (Bailevskai, 1969)
		<i>Physostigma venenosum</i> Balf.	53HK525	Seed	Local application	Skin diseases ; antiparasitic
15	Hymenocardiaceae	<i>Hymenocardia acida</i> Tul.	62HK533	Leave	Decoction (per-os)	Antipyretic ; analgesic ; antimalarial
16	Hypericaceae	<i>Harungana madagascariensis</i> Hook f.	63HK561	Stem-bark	Decoction (per-os)	Analgesic ; treatment of toothache
17	Lamiaceae	<i>Ocimum viride</i> Willd. Syn.: <i>O. gratissimum</i> L.	67HK105	Whole plant	Ointment	Antipyretic ; mosquito repellent
18	Lauraceae	<i>Beilschmiedia mannii</i> (Meisn.) Benth.& Hook.f.	68HK565	Fruit	Juice (per-os)	Antitussive ; bronchitis treatment
19	Leeaceae	<i>Leea guineensis</i> G. Don	70HK2	Leave	Pulp (massage)	Analgesic
20	Loganiaceae	<i>Anthocleista nobilis</i> G.Don.	74HK572	Root	Decoction (per-os)	Analgesic ; antiparastic
21	Meliaceae	<i>Azadirachta indica</i> A. Juss	82HK581	Leave	Decoction	Fever ; pain
		<i>Carapa procera</i> DC	82HK582	Fruit (oil)	ointment	Anti-inflammatory ; anthelmintic ; purgative
		<i>Khaya ivorensis</i> A. Chev.	82HK583	Stem-bark	Decoction (per-os ; bath)	Antitussive ; stomach diseases
		<i>Pseudocedrella kotschy</i> (Schweinf) Harms.	82HK584	Stem-bark	infusion	Stomachache treatment
		<i>Trichilia emetica</i> Vahl.	82HK585	Leave	Decoction	Pain ; fever
22	Mimosaceae	<i>Albizia sassa</i> Macbride	86HK606	Stem-bark	Decoction (external use)	Pain ; skin diseases

	Family	Plant species	Voucher specimen number	Plant part	Galenical form	Other uses
23	Moraceae	<i>Cathormion altissimum</i> (Hook.f.) Hutch.& Dandy Syn.: <i>Pithecolobium altissimum</i> Oliv. ; <i>Arthrosamanea altissima</i> (Hook.f.) Gilbert	86HK607	Leave	Pastry (local use)	Anti-inflammatory ; antiseptic
		<i>Ficus exasperate</i> Vahl.	88HK623	Leave	Decoction	Analgesic
		<i>Morus mesozygia</i> Stapf	88HK624	Stem-bark ; Root	Decoction (per-os ; bath ; ointment	Analgesic
24	Myrtaceae	<i>Tetrapleura tetraptera</i> Taub	88HK625	Fruit	Ointment	Antimalarial ; antipyretic
		<i>Syzigium rowlandii</i> Sprague. Syn.: <i>S. abidjanense</i> Aubrév. &Pellegr.	93HK627	Stem-bark	Ointment	Analgesic
25	Ochnaceae	<i>Lophira alata</i> Banks ex Gaertn.	96HK631	Root	Decoction (per-os)	Analgesic ; treatment of toothache ; antimalarial ; antiparasitic
26	Piperaceae	<i>Piper umbellatum</i> L.	108HK3	Root	Alcoholic extract	Antipyretic
27	Poaceae	<i>Bambusa vulgaris</i> Schrad	112HK642	Leaves	Decoction (per-os)	Antipyretic ; analgesic
28	Polygalaceae	<i>Securidaca longepedunculata</i> Fresen.	113HK8	Root	Ointment	Analgesic ; antiparasitic ; antibacterial
29	Rhamnaceae	<i>Gouania longipetala</i> Hemsl.	119HK7	Leave	Decoction (vapor bath)	Analgesic (headache ; antipyretic ; antibacterial
30	Rubiaceae	<i>Gardenia ternifolia</i> Schumach. & Thonn.	121HK80	Root	Powder (external use)	antirheumatismal
		<i>Geophila obvallata</i> (Schumach.) F. Didr. Subsp. <i>Obvallata</i>	121HK81	Leave	Pastry in palm oil	Anti-inflammatory
		<i>Mitragyna inermis</i> (Willd.) O. Ktze.	121HK82	Leave	Decoction (external use)	Antiseptic ; antipyretic
		<i>Sarcocephalus esculantus</i> Afzel	121HK83	Stem-bark	Decoction	Antipyretic
		<i>Oxyanthus tubiflorus</i> DC	121HK84	Leave and Stem-bark	Decoction	Analgesic
31	Rutaceae	<i>Clausena anisata</i> (Wild.) Hook.f.	122HK685	Root	Pastry in kaolin (massage)	Analgesic (headache ; toothache) ; antipyretic
		<i>Zanthoxylum leprieurii</i> Guill. & Perr.	122HK686	Stem-bark	Powder (external use)	Antibacterial
		<i>Zanthoxylum viride</i> (A. Chev.) Waterman	122HK687	Root	Pastry (massage)	Antibacterial
32	Sapindaceae	<i>Zanthoxylum zanthoxyloides</i> (Lam.) Zepernick & TImber	122HK688	Stem-bark and Root	Pastry (massage)	Analgesic (toothache) ; antipyretic
		<i>Paullinia pinnata</i> L.	125HK689	Stem-bark	Decoction	analgesic
33	Solanaceae	<i>Capsicum frutescens</i> L.	129HK131	Fruit	Pastry (massage)	arthritis
34	Verbenaceae	<i>Solanum incanum</i> L.	129HK132	Leave	Pastry (association with <i>Spondias monbin</i> L. leaves)	antirheumatismal
		<i>Clerodendrum buchholzii</i> Gürke Syn.: <i>C. silvaticum</i> Henriques var. <i>buchholzii</i> (Gürke) Verdc.	138HK709	Leave	Pastry (external use)	Antipyretic
		<i>C. splendens</i> G. Don.	138HK710	Leave	Decoction (per-os ; bath)	Inflammatory diseases
35	Zinziberaceae	<i>Costus afer</i> Ker-Gawl	141HK718 67	Leave and stem-bark	Decoction (external use)	Inflammatory diseases

On the classical pathway (CP), the only inhibiting properties were recorded for the extracts of *A. conyzoides* and *H. acida* (IC<sub>50</sub>: 9.68 and 13.32 µg/ml, respectively). These activities were more pronounced than that of rosmarinic acid (IC<sub>50</sub>: 24.50µg/ml). From all the tested samples, only the extracts of *A. conyzoides* and *H. acida* interfered with both activation pathways of the complement system. Their inhibiting effects were more pronounced on the classical (IC<sub>50</sub>: 9.68 and 13.32 µg/ml for *A. conyzoides* and *H. acida* respectively) than on the alternative pathway (IC<sub>50</sub>: 91.49 and 60.34 µg/ml for *A. conyzoides* and *H. acida*, respectively).

Previous studies depicted the biological property of most of these plant species. Moreover, the potential anti-inflammatory and antinociceptive activities of the aqueous leaf extract of *H.*

*acida* were confirmed in animal models [12]. *H. acida* present also antioxidant and anti-inflammatory activities and contains lupeol, β-sitosterol, friedelin (analgesic) while *H. ulmoides* (bark and leaf) displayed an analgesic potential similar to the Acetyl Salicylic Acid (ASA) [33]. The stem bark extract of *E. senegalensis* exhibited only slight antiplasmodial activity while significant ( $P < 0.05$ ) analgesic and anti-inflammatory effects were observed [34]. The methanol extract of the stem bark of *H. madagascariensis* inhibited significantly carrageenan-edema and reduced the activity of the prostaglandin synthetase [20]; some antioxidant and antiinflammatory effects of the plant have been described [35]. The wound healing effect of *A. nobilis* could partly be attributed to their antibacterial and antioxidant properties as

evidenced in their ability to inhibit bacteria growth and protect human fibroblast cells against oxidant injury [36]. The leave methanol extract of *B. vulgaris* exhibited a marked anti-inflammatory activity [16]. The analgesic and anti-inflammatory effects of the methanolic extract of the leaves of *Jatropha curcas* were demonstrated in mice and rats respectively, while the anti-inflammatory activity of topical application of *J. curcas* root powder in paste form in TPA-induced ear inflammation was confirmed in albino mice [37,38].

The local and systemic anti-inflammatory properties of various extracts from *Alchornea cordifolia* have been validated in recent pharmacological studies [11]; the MeOH and hexane extracts of leaves were shown to possess a very high anti-inflammatory activity [39] and the MeOH extracts of *A. cordifolia* leaves showed strong dose-dependent anti-inflammatory activity after topical application. This activity may be explained at least partially by unidentified lipophilic compounds and by flavonoids (e.g. hyperoside and quercitrin) [40].

Although the diversity of molecular structures in crude plant extracts poses a widely unpredictable situation in the initial screening phase, it is admitted that crude extracts represent however the most logical starting point for an anti-complement initial screening studies [41]. The tested plants may be considered as good sources for the isolation of complement-inhibiting compounds. Plant-derived complement inhibitors or activators can be found in the classes of low (phenolics and terpenoids) and high molecular (polysaccharides) weight compounds. However, many compounds interact with the complement system *in vitro* while a few do so efficiently *in vivo*. Aside from toxicity, most active drugs fail to reach sufficiently persistent concentrations *in vivo* [42].

Phytochemical screening of *A. cordifolia* extracts revealed the presence of tannins, flavonoids (quercetin, hyperin, guaijaverin), an alkaloid (triisopentenylguanidine), glycosides, resins, and carbohydrates [11]. The anti-inflammatory activity of the extracts was related even partly (at least in part) with the presence of the active daucosterol, acely-aleutorilic acid, diethylhexyl-phtalate, N1, N2- diisopentenyl guanidine, N1, N2, N3-triisopentenyl guanidine [43]. The crude extract of the leaves inhibited the prostaglandin synthesis and fractionation of this extract led to the isolation of the active flavonoids (quercetine derivatives) from which 6-C-methylquercetin 3,7,3'-trimethyl ether was about 200 times more potent than aspirin [17]. From *Lophira alata*, two chalcone tetramers isolated showed potent inhibitory activities against teleocidin B-4-induced inflammation on mouse ear and were inhibitors of Epstein-Barr virus (EBV)-activation induced by a tumor promoter, teleocidin B-4 [44].

Because the activation of the system may contribute to or evoke pathologic reactions in a variety of inflammatory and degenerative diseases such as dermatological diseases or microbial infections [5], the *in vitro* anticomplementary activities of some of the tested plants can support their traditional uses. *Hymenocardia acida*, *Ageratum conyzoides*

and *Acanthospermum hispidum* are good sources of natural inflammatory agents. These preliminary results gave evidence of the presence of interesting biological constituents in the active extracts. The detection and isolation of the active components are in progress. In view of the potential usefulness of these plant species in anti-inflammatory therapy, there is a need to provide evidence for their toxicity and efficacy through clinical trials.

**Table 3.** Antibacterial active methanol extracts from eleven guinean plants.

Sample	<i>B. cereus</i>		<i>S. aureus</i>	
	MIC	MBC	MIC	MBC
<i>Ageratum conyzoides</i>	0.5	0.5	>1	>1
<i>Alchornea cordifolia</i>	0.5	0.5	0.5	>1
<i>Acanthospermum hispidum</i>	0.5	0.5	>1	>1
<i>Erythrina senegalensis</i>	0.06	0.125	0.125	>1
<i>Harungana madagascariensis</i>	0.125	0.125	0.125	1
<i>Hymenocardia acida</i>	0.03	0.03	0.06	0.5
<i>Lophira alata</i>	0.06	0.5	N	>1

MIC: minimal inhibition concentration (mg/ml); MBC: minimal bactericidal concentration (mg/ml); N: precipitation

**Table 4.** Inhibition potency of the plant extracts on the Classical and Alternative Pathway (CP and AP) of Complement System.

Plant extract	IC <sub>50</sub> (µg/ml)	
	AP	CP
<i>Lophira alata</i>	92.55	>333.3
<i>Anthocleista nobilis</i>	91.57	>333.3
<i>Jatropha curcas</i>	74.61	>333.3
<i>Alchornea cordifolia</i>	113.94	>333.3
<i>Ageratum conyzoides</i>	91.49	9.68
<i>Bambusa vulgaris</i>	>933.3	>333.3
<i>Hymenocardia acida</i>	60.34	13.32
<i>Harungana madagascariensis</i>	140.26	>333.3
<i>Acanthospermum hispidum</i>	38.19	>333.3
<i>Piliostigma thonningii</i>	63.17	>333.3
Rosmarinic acid	160.71	24.5

## References

- [1] Praveen K. D. and Suchita M. (2013): Anti-inflammatory agents of herbal origin: An overview. *Int. J. Res. Pharm. Sci.*, 4 (2), 295-302
- [2] Ill-Min Chung, Eun-Hye Kim, Jong-Jin Kim<sup>2</sup> and Hyung-In Moon (2010) : Inhibition effects of the classical pathway complement of isolated compounds from *Quercus glauca*. *Human and Experimental Toxicology* ; 30(9) 1415–1419.
- [3] Deepa M. and Renuka D. (2014): Potential anti-inflammatory medicinal plants – A Review. *Int J Pharm Pharm Sci*, 6 (4), 43-49
- [4] Labadie RP, van der Nat JM, Simons JM, Kroes BH, Kosasi S, van den Berg AJ, t' Hart LA, van der Sluis WG, Abeysekera A, Bamunuarachchi A, et al. (1989): An ethnopharmacognostic approach to the search for immunomodulators of plant origin. *Planta Med.* 55(4):339-48.
- [5] Cimanga K, De Bruyne T, Iasura A, Van Poel B, Pieters L, Vanden Bergh D, Vlietinck A. (1995) : *In vitro* anticomplement activity of constituents from *Morinda morindoides*. *J. Nat. Prod.*, 58 (3) , P372 - 378

- [6] Fraser D.A., Harris C.L., Smith R.A.G. and Morgan B.P. (2002): Bacterial expression and membrane targeting of the rat complement regulator Crry: A new model anticomplement therapeutic. *Protein Sci* ; 11; 2512-2521.
- [7] Vanden Bergh, D.A., Vlietinck, A.J. (1991): in: Dey, P.M., Harborne, J.B. (Eds), *Methods in Plant Biochemistry: Screening Methods for Antibacterial and Antiviral Agents from Higher Plants*. Academic Press, London, 47-69.
- [8] Mayer M.M. (1971): in "Experimental immunochemistry". Ed. By Kabat E. and Mayer.M, 2nd Ed., Charles C. Thomas, Springfield, IL., Ch. 4, pp. 133-240
- [9] Platts-Mills T.A.E. and Ishizaka K. (1974) : *J. Immunol.*, 113, 348
- [10] Basilevskaia,V.(1969): *Plantes Medicinales de Guinée. République de Guinée*, 127,184.
- [11] Kouakou K, Schepetkin I.A., Yapi A., Kirpotina L.N., Jutila M.A., Quinn M.T.(2013) :Immunomodulatory activity of polysaccharides isolated from *Alchornea cordifolia* J *Ethnopharmacol* 146, 232-242
- [12] Basilevskaia,V.(1969): *Plantes Medicinales de Guinée. République de Guinée* ,127,184.
- [13] Kamboj A, Saluja AK. (2008): *Ageratum conyzoides* L: a review on its phytochemical and pharmacological profile. *Int J Green Pharm*; 2: 59-68
- [14] Oladejo OW, Imosemi IO, Osuagwu FC, Oyedele OO, Oluwadara OO, Ekpo OE, et al. (2003): A comparative study of the wound healing properties of honey and *Ageratum conyzoides*. *Afr J Med Sci*; 32(2): 193-6.
- [15] Sravanprasad M., Manoranjan S., Sharadanalla, Venkateshwarlu.G, Rajeshwari E. (2012): Evaluation of anti-Microbial activity of *Bambusa vulgaris* leaves. *International Journal of Phytotherapy Research*, 2 (2) ; 36-39
- [16] Carey WM, Dasi JM, Rao NV, Gottumukkala KM.(2009): Anti-inflammatory activity of methanolic extract of *Bambusa vulgaris* leaves. *Int J Green Pharm*;3:234-8
- [17] Ibewuiké J.C., Ogungbamila,F.O., Ogundaini A.O., Okeke I.N., and Bohlin L.(1997) :Antiinflammatory and Antibacterial Activities of C-methylflavonols from *Piliostigma thonningii*. *Phytother. Res.* 11, 281–284.
- [18] Le Grand, A., Wondergem, P.A., Verpoorte, R. and Pousset, J.L.(1988): Anti-infectious Phytotherapies of the Tree-Savannah of Senegal (West-Africa) II. Antimicrobial Activity of 33 Species. *J. Ethnopharmacol.*, 22, 25-31.
- [19] Vlietinck A.J., Van Hoof L., Totte J., Lasure A., Berghe D., Rwangbo P.C., Mvukiyumwani J. (1995): Screening of hundred Rwandese medicinal plants for antimalarial properties. *J. Ethnopharmacol.* 46, 31-47
- [20] Nwodo, O.F.C. (1989): Antibiotic and anti-inflammatory analgesic activities of *Harungana madagascariensis* stem bark. *Int. J. Crude Drug Res.*, 27, 3, 137-140.
- [21] Muanza, D.N., Kim, B.W., Euler, K.L. and Williams, L. (1994): Antibacterial and antifungal activities of nine plants from Zaire. *Int. J. Pharmacog.*, 32, 4, 337-345.
- [22] Madubunyi, I.I., Obi, S.K.C., Nwebube, N.I. and Chime, A.B. (1995): Antihepatotoxic and antimicrobial activities of *Harungana madagascariensis* leaf extracts. *International Journal of Pharmacology*, 33, 2, 129-134.
- [23] Tih, A., Martin, M., Tih, R. G., Vuidepot, I., Sondengam, B. and Bodo, B. (1992): Lophirolivans B and C, tetraflavanoids of *Lophira alata*. *Phytochemistry*, 31, 10, 3595-3599.
- [24] Ajao, A.O. , Shonuka, O. and Femi-Onadeko, B. (1985): Antibacterial effect of aqueous and alcohol extracts of *Spondia monbin* and *Alchornea cordifolia* – Two local antimicrobial remedies. *Int. J. Crude Drug Res.* 23, 2, 67-72
- [25] Maïkere-Faniyo,R., Van Puyvelde, L., Mutwewingabo, A. and Habiyaemye, F.X. (1989): Study of Rwandese medicinal Plants Used in the Treatment of Diarrhoea. *Journal of Ethnopharmacology*, 26, 101-109.
- [26] Malcolm, S.A. and Sofowora, E.A. (1969): Antimicrobial activity of selected nigerian folk remedies and their constituent plants. *Lloydia*, 32, 4, 512-517.
- [27] Antia BS, Okokon JE, Etim EI, Umoh UF, Bassey EO.(2009): Evaluation of the in vivo antimalarial activity of ethanolic leaf and stem bark extracts of *Anthocleista djalonensis*. *Indian J Pharmacol*; 41(6): 258-261.
- [28] Chah KF, Eze CA, Emuelosi CE, Esimone CO.(2006): Antibacterial and wound healing properties of methanolic extracts of some Nigerian medicinal plants. *J Ethnopharmacol*; 104: 164-167.
- [29] Nweze NE, Ngongeh LA.(2007): In vitro anthelmintic activity of *Anthocleista djalonensis*. *Nigerian Vet J*; 28(1): 9-13.
- [30] Ajali U. (2000) : Antibacterial activity of *Alchornea cordifolia* stem bark. *Fitoterapia* 71 ; 436-438
- [31] Mario E. Arena, Elena Cartagena, Nadia Gobbato, Mario Baigori, Juan C. Valdez and Alicia Bardon (2011) : In Vivo and In Vitro Antibacterial Activity of Acanthospermal B, a Sesquiterpene Lactone Isolated from *Acanthospermum hispidum*. *Phytother. Res.* 25: 597–602
- [32] Lasure, A., Van Poel, B., Pieters, L., Claeys, M., Gupta, M., Vanden Berghe, D. and Vietinck, A.J. (1994) : Complement inhibiting properties of *Apeiba tibourbou*. *Planta Medica*, 60, 276-277.
- [33] Makambila-Koubemba MC., Mbatchi B., ArdidD., Gelot A., Henrion C., Janisson R., Abena AA., Banzouzi JT. (2011) : Pharmacological studies of ten medicinal plants used for analgesic purposes in Congo Brazzaville. *Int. J. of Pharmacology*; 7 (5) 608-615
- [34] Saidu K., Onah J., Orisadipe A., Olusola A., Wambebe C., Gamaniel K. (2000): Antiplasmodial, analgesic, and anti-inflammatory activities of the aqueous extract of the stem bark of *Erythrina senegalensis*. *Journal of Ethnopharmacology*. 71; 275–280.
- [35] Ezekiel. Olugbenga Iwalewa, Isaac O Adewale, Bamigboye J Taiwo, Tope Arogundade, Ade Osinowo, Oluwatoyin M Daniyan, Gbade E Adetogun (2008) : Effects of *Harungana madagascariensis* Stem Bark Extract on the Antioxidant Markers in Alloxan Induced Diabetic and Carrageenan Induced Inflammatory Disorders in Rats. *Journal of Complementary and Integrative Medicine*. Volume 5, Issue 1, ISSN (Online) 1553-3840, DOI: 10.2202/1553-3840.1088, February 2008
- [36] Annan K. and Dickson R. (2008): Evaluation of wound healing actions of *Hoslundia opposita* Vahl, *Anthocleista nobilis* G Don and *Balanites aegyptiaca* L. *Journal of Science and Technology* 28 (2): 26-35.



- [37] Uche, F I., Aprioku, J.S. (2008): The Phytochemical Constituents, Analgesic and Anti-inflammatory effects of methanol extract of *Jatropha curcas* leaves in Mice and Wister albino rats. *J. Appl. Sci. Environ. Manage.* 12(4) ; 99 - 102
- [38] Mujumdar AM, Misar AV. (2004): Anti-inflammatory activity of *Jatropha curcas* roots in mice and rats. *J Ethnopharmacol.*; 90(1) : 11-5.
- [39] Mavar-Manga H, Brkic D, Marie DEP, Quetin-Leclercq J (2004) : In vivo anti-inflammatory activity of *Alchornea cordifolia* (Schumach & Thonn.) Müll.(Euphorbiaceae). *Journal of Ethnopharmacology*, 92, 209-214.
- [40] Osadebe, P.O., Okoye, F.B.C., (2003):. Anti-inflammatory effects of crude methanolic extract and fractions of *Alchornea cordifolia* leaves. *Journal of Ethnopharmacology* 89, 19–24.
- [41] Labadie, R.P. (1993): Immunomodulatory compounds. In *Bioactive Natural Products*. Colegate, S.M. and Molyneux, R.J., CRC Press, 280-317
- [42] Wagner, H. and Jurcic, K. (1991): Assays for immunomodulation and effects on mediators of inflammation, In *Methods in Plant Biochemistry*, Vol.6, 195-217, Dey, P.M. and Harborne, J.B. series eds, Academic press, London
- [43] Mavar-Manga H, Haddad M, Pieters L, Baccelli C, Penge A, Quetin-Leclercq J (2008): Anti-inflammatory compounds from leaves and root-bark of *Alchornea cordifolia* (Schumach & Thonn.) Müll. Arg. *Journal of Ethnopharmacology*, 115, 25-29.
- [44] Murakami A., Tanaka S., Ohigashi H., Hirota M, Irie R, Takeda N, Tatematsu A & Koshimizu K. (1992) : Chalcone Tetramers, Lophirachalcone and Alatachalcone, from *Lophira alata* as Possible Anti-tumor Promoters. *Bioscience, Biotechnology, and Biochemistry*. 56, 5, 769 – 772