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Ethnobotanical survey and antibacterial activity of some plants used in Guinean traditional medicine

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Abstract

A total of 418 healers have been interviewed in Guinea, a coastal country of West Africa, ranging between 7°30 and 12°30 of northern latitude and 8° and 15° of western longitude. Plant species used by the local inhabitants to treat infectious diseases were identified using ethnobotanical, ethnographic and taxonomic methods. During these investigations, 218 plants were registered, of which the following were the most frequently used: *Erythrina senegalensis*, *Bridelia ferruginea*, *Crossopteryx febrifuga*, *Ximenia americana*, *Annona senegalensis*, *Cochlospermum tinctorium*, *Cochlospermum planchonii*, *Lantana camara*, *Costus afer*, *Psidium guajava*, *Terminalia glaucescens*, *Uapaca somon* and *Swartzia madagascariensis*. Most plants, and especially the leaves, were essentially used as a decoction. In order to assess antibacterial activity, 190 recipes were prepared and biologically tested, among which six showed activity (minimal inhibitory concentration < 125 μg/ml) against *Bacillus cereus*, *Mycobacterium fortuitum*, *Staphylococcus aureus*, or *Candida albicans*, i.e., *Entada africana*, *Chlorophora regia*, *Erythrina senegalensis*, *Harrisonia abyssinica*, *Uvaria tomentosa*, and a mixture of six plants consisting of *Swartzia madagascariensis*, *Isoberlinia doka*, *Annona senegalensis*, *Gardenia ternifolia*, *Terminalia glaucescens* and *Erythrina senegalensis*.

Keywords: Guinea; Traditional medicine; Antimicrobial activity; Antifungal activity; Infectious diseases; Ethnic groups

1. Introduction

Since a long time, mankind has been developing throughout the world a traditional medicine based on the knowledge of medicinal plants. This knowledge got enriched over numerous generations due to experimentation but also through observations of animal behaviour. Most of the time, this information is only orally inherited and is therefore in danger of being lost in favour of modern medicine. However, it represents for the local population a possibility of simple and cheap treatment. In addition, it is a source of potentially important new pharmaceutical substances (Diehl et al., 2004). The interest and urgency of ethnobotanical research is thus obvious (Hammond et al., 1997; Schillhorn van Veen, 1997).

Many plant extracts and essential oils isolated from plants have been shown to exert biological activity in vitro and in vivo, which justified research on traditional medicine was focused on the characterization of antimicrobial activity of these plants (Martinez et al., 1996).

African traditional medicine abounds in medicinal plants, and the tribal people, wherever they exist, still rely chiefly on herbal medicines. In many parts of Africa, herbal medicine still plays a vital role in health care delivery systems especially in remote places where clinics and hospitals are sparsely located. In these communities, traditional herbalists operate closer to the people, taking advantage of the biodiversity of plant species in such areas to cure various diseases and aliments (Gelfand et al., 1985; Ndubani and Hojer, 1999). Although herbal medicine is well

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established in many cultures and traditions of Africans, and is still a way of life of almost 80% of the people in Africa (Cotton, 1996; Jager et al., 1996), unfortunately however, not much information has been documented in scientific literature. Information on herbal medicine in this part of the world has been dominated by oral tradition (Van Wyk et al., 1997).

The flora of Guinea is rich and various. It counts about 3000 vegetal species of which 2960 are identified (Lisowski, in press). In Guinea, in addition to herbalists who enjoy great prestige as the "real" practitioners of traditional medicine, divine healers and witch doctors also employ medicinal plants that are supposed to have either special spiritual or exorcizing powers.

This paper presents the results of ethnobotanical survey and biological investigations on plants used by traditional healers in Guinea. We have performed an ethnobotanical survey to collect traditionally used plants among six ethnic groups of Guinea (Soussou, Peuhl, Malinké, Guerzé, Manon and Konon) located in Low Guinea, Middle Guinea, Upper Guinea and Forest Guinea, and we have evaluated the in vitro antimicrobial activity of some of them. The results of this study may play a role in conservation of traditional medicine knowledge of plants and in stimulating further phytochemical studies.

2. Materials and methods

2.1. Study site

Guinea is a coastal country of West Africa, ranging between 7°30 and 12°30 of northern latitude, 8° and 15° of Western longitude. It covers a surface of 245.857 km^2. Limited to the West by the Atlantic Ocean, to the North-West by Guinea Bissau, to the North by Senegal, to the North-East by Mali, to the East by the Ivory Coast, and to the South by Liberia and the Sierra Leone, it has Conakry as the capital. It sets out in four distinct natural areas: Low Guinea, area of littoral plains; Middle Guinea, with mountainous solid masses and lateritic high plateaus; Upper Guinea, a vast plateau; Forest Guinea, a true chain of mountains. The population was estimated at 8,259,000 inhabitants in 2004, with an average density of 37.61 inhabitants per km^2. It is characterized by a diversity of ethnic groups, languages and religions with a variety of habits. The main ethnic groups are Soussous (Low Guinea), Peuhls (Middle Guinea), Malinkés (Upper Guinea), Kissis, Tomas and Guerzés (Forest Guinea). The principal occupation of the population is agriculture. The climate is of the tropical type, and is subject to the influence of local factors: The maritime tropical climate (known as subguinean) in Low Guinea, has rather constant average temperatures (between 23 and 25 °C) and a significant rainfall ranging between 2100 and 5000 mm. In the tropical mountain climate (known as foutanien) of Middle Guinea, there are two seasons of almost equal duration and rainfall varies from 1600 to 2000 mm; the dry tropical climate of Upper Guinea (known as sub-soudanien) is characterized by a smaller quantity of rains (from 1100 to 1500 mm) and high temperatures on average 28 °C; the subequatorial climate of Forest Guinea is characterized by a long rainy season from 8 to 10 months (1600–2800 mm) and high temperatures 25 °C on average. The vegetation is dependent on the type of climate and the nature of the soil: mangrove in the littoral areas, savanna in the major part of the country, and forest in Forest Guinea. Guinea is well sprinkled by rivers, of which the Niger, Senegal and Gambia are among the most significant of the African continent.

2.2. Selection of plants

The plant materials were collected from February 2002 to December 2005. A total of 418 traditional healers in four of the ecological zones of Guinea (Low, Middle, Upper and Forest Guinea). The traditional healers were sensibilized through social, political and religious leaders to meet the investigators. The healers had to be convinced that their cooperation was of great benefit to the country and, at the same time that the revelation of their knowledge of medicinal plants to the members of the expedition would not in any way interfere with the continued practice of their art. Then, with respect to the local custom, *viz.* a presentation of "cola", the nut of *Cola nitida* (Sterculiaceae) or equivalent, the consented interested healers were contacted individually and confidentially for an interview which was conducted on the basis of a standardized inquiry file. Among the main questions were the experience, knowledge acquisition, diagnostic methods, causes of the disease, treatment, preparation of pharmaceutical forms and dosage. The inquiries were focused on infectious diseases in a broad sense. An agreement was signed between any interested healer with the Research and Valorisation Center on Medicinal Plants of Dubreka (RVCMP) for a long-term collaboration, in order to share any benefit from any eventual valorisation of their recipes. All plants (if available in nearby fields) were collected with the help of the informant. Voucher specimens were authenticated by the Department of Botany of RVCMP and deposited in the herbarium of this Center. Among the species mentioned by the informants, samples were taken for analysis. Nevertheless some of plants could not yet be identified; in Table 1 only identified plants are included.

2.3. Plant extraction

Leaves, stem barks and roots were dried at room temperature after collection and then pounded by mill. Crude plant extracts were prepared for in vitro screening by extracting 10 g of powdered plant material with 50 ml of methanol, with mechanical stirring, during 24 h at room temperature (25 °C). Methanol was completely evaporated at 40 °C. The extract was dried and stored at room temperature until use.

2.4. Antibacterial screening

The biological assays were carried out on 190 plant extracts or recipes. The following strains of bacteria or fungi were used: *Bacillus cereus* ATCC 14579, *Escherichia coli* ATCC 8739, *Klebsiella pneumoniae* ATCC 13883, *Mycobacterium fortuitum* ATCC 6841, *Proteus vulgaris* ATCC 13315, *Pseudomonas aeruginosa* ATCC 15442, *Salmonella typhimurium* ATCC 13311, *Staphylococcus aureus* ATCC 6538, *Streptococcus pyogenes* ATCC 12344 and *Candida albicans* ATCC 10231.

Table 1
Plants used in Guinean traditional medicine to treat infectious diseases, including sexually transmitted diseases

Family	Species	Specimen number	Local name	Used part	Manner of use	Route of administration	Total mention
Ampelidiaceae	*Cissus aralioides* (Hochst.) Baill.	MG-ca840	Fafaru	Root	Decoction	Oral	3
Anacardiaceae	*Lannea nigritana* (Cs. Elliot) Keay	HG-ln182	Budigi	Stem bark	Decoction	Oral	1
	Mangifera indica L.	BG-mi378	Mango	Leaves	Decoction	Oral	6
	Sorindeia juglandifolia (A. Rich.) Planch	BG-sj678	Kanke bomba	Leaves	Decoction	Oral	2
	Spondias mombin L.	BG-sm679	Lukhure sinè	Stem bark	Decoction	Oral	6
Annonaceae	*Adenium obesum* (Forsk) Roem. Sc.	MG-ao261	Dyindyi	Leaves	Decoction	Oral	6
	Annona senegalensis Pers.	HG-as27	Sunsuningbè	Root bark	Decoction	Oral	43
	Funtumia elastica	GF-fe300	Hëghëlë	stem Bark	Powder	Local application	2
	Holarrhena floribunda (G. Don) Dur et Schinz	GF-ha123	Mèhèn	Leaves	Decoction	Oral	7
	Landolphia dulcis (R. Br. Ex Sabine) Pichon var dulcis	GF-ld167	Hologbömö	Stem bark	Decoction	Oral	6
	Landolphia heudoletii A. DC.	HG-lh181	Tambanin	Root bark	Decoction	Oral	1
	Saba senegalensis (A. DC.) Pichon	BG-ss530	Pore laare	Leaves	Decoction	Oral	6
	Thevetia nerifolia Juss	BG-tn701	Bane	Leaves	Decoction	Oral	6
	Uvaria tomentosa P. Beau	HG-uc735	Firinyan	Leaves	Decoction	Oral	6
	Xylopia aethiopica (Dunal) A. Rich	GF-xa729	Hëbhë	Fruit	Decoction	Oral	
Arecaceae	*Eleais guineensis* Jacq	GF-eg247	Towu	Stem + Pith	Decoction	Oral	1
Asclepiadaceae	*Leptadenia hastata* (Pers.) Deene	MG-lh188	Safatè	Leaves	Decoction	Oral	3
Asteraceae	*Vernonia colorata* (Willd.) Drake	BG-vc762	Khönökhönönyi	Leaves	Decoction	Oral	7
Bignoniaceae	*Markhamia tomantosa* (Benth.) K. Schum.	BG-mt382	Kaafa waandu	Leaves	Decoction	Oral	2
	Newbouldia laevis (P. Beauv.) Seemann ex Bureau	GF-nl437	Tölö tölö	Root bark	Powder	Local application	3
	Spathodea campanulata P. Beauv	GF-sc780	Puwalowulu	Stem bark	Pounded	Local application	3
Bixaceae	*Bixa orellana* L.	HG-bo790	Djaboran	Leaves	Decoction	Oral	4
Bombacaceae	*Adansonia digitata* L.	HG-ad25	Sida	Stem bark	Decoction	Oral	2
	Bombax costatum (Pellegs et Will)	HG-bc7	Bumbun	Root bark	Decoction	Oral	2
	Ceiba pentandra L	HG-cp40	Bandan	Stem bark	Decoction	Oral	2
Borraginaceae	*Heliotropium indicum* Linn.	GF-hi106	Hoghonhwan	Leaves	Decoction	Oral	2
Bromelliaceae	*Ananas comosus* Linn.	GF-ac125	Kwito	Fruit	Steep	Oral	1
Caesalpiniaceae	*Afzelia africana* Sm. ex Pers.	HG-aa2	Lènkè	Stem bark	Decoction	Oral	1
	Bauhinia thonningui K. Schum.	HG-pt480	Nyaman	Leaves	Decoction	Oral	6
	Bussea occidentalis Hook	GF-bo26	Kpayelen	Fruit	Powder	Oral	1
	Cassia alata DC.	HG-ca35	Kötambalen kèman	Fruit	Decoction	Oral	4
	Cathormium altissima Hook et H. Dyandyi	MG-ca38	Nete tyangol	Root bark	Steep	Oral	5
	Daniela oliveri (Rolfe) Hutch. Et Dalz.	BG-do227	Wulunyi	Stem bark	Decoction	Oral	1
	Detarium microcarpum G., Perr.	HG-dm233	Tombo börö	Root bark	Steep	Oral	1
	Dialium guineense Willd.	HG-dg873	Köfina	Leaves	Decoction	Oral	4
	Disthemantus bentamieanus	GF-db245	Kwalatalan	Stem bark	Decoction	Oral	3
	Erythrophleum micrantum Harms	HG-em255	Tali	Stem bark	Decoction	Oral	2
	Mezoneurum benthamianum (Bail.)	BG-mb402	Bembelensi S	Leaves	Decoction	Oral	1
	Senna podocarpa Guill. Et Perr.	BG-sp518	Wongele	Leaves	Decoction	Oral	1
	Swartzia madagascariensis Desv.	HG-sm623	Samakada	Root bark	Decoction	Oral	38
	Tamarindus indica L.	BG-ti632	Tömbinyi	Fruit	Steep	Oral	3
Cannaceae	*Canna indica* Ruiz et Pav	GF-ci31	Mèmèn	Flower	Powder	Oral	1
Caricaceae	*Carica papaya* L.	HG-cp33	Yiridye	Root bark	Steep	Oral	2
Chrysobalanaceae	*Parinarium benna*	MG-pb455	Sigon	Fruit	Decoction	Oral	1

Cochlospermaceae	*Cochlospermum planchonii*	HG-cp211	Tourouban musoman	Root bark	Decoction	Oral	22
	Cochlospermum tinctorium A. Rich.	HG-ct213	Tourouban kèman	Stem bark	Decoction	Oral	30
Combretaceae	*Anogeissus leiocarpus* (DC.) Guill. Et Perr.	HG-al265	Gbèrè gbèrè	Stem bark	Decoction	Oral	1
	Guiera senegalensis G. F. Gmel.	MG-gs185	Fafarou	Root bark	Steep	Oral	3
	Terminalia biglobosa Sc. Elliot	MG-tb898	Booribillèl	Leaves	Decoction	Oral	9
	Terminalia glaucescens	HG-tg675	Hörö	Root bark	Steep	Oral	28
	Terminalia ivoirensis A. Chev.	HG-ti529	Walisa	Root bark	Steep	Oral	2
Commelinaceae	*Palisota hirsuta* K. Schum	HG-ph450	Tolo tolo	Leaves	Decoction	Oral	3
Composaceae	*Ageratum conizoides*	HG-ac34	Baafida	Leaves	Decoction	Oral	1
	Aspilia latifolia	HG-al268	Frufruni kunbgè	Leaves	Steep	Oral	2
	Bidens spilosa (L.)	BG-bs58	Nyömunifida	Leaves	Decoction	Oral	2
	Microglosa pyrifolia (Lam.) Katze.	GF-ma450	Kpalahauna	Leaves	Decoction	Oral	3
	Mikania scandens Willd (L.)	GF-ms410	Hwemakpölö	Leaves	Pounded + clay	Local application	2
Crassulaceae	*Briophyllum pinnatum*	HG-bp830	Tolo tintirin	Leaves	Decoction	Oral	2
Cucurbitaceae	*Curcurbita pepo* L	BG-cp222	Nalinyi	Fruit	Decoction	Oral	2
Cypericaceae	*Cyperus* sp.	GF-ln170	Lèlè nwun	Stem bark	Decoction	Oral	3
	Rhynchospora corymbosa Britt	BG-rc560	Waaka	Leaves	Decoction	Oral	3
	Scleria cyneria	GF-sc498	Lèelè	Root	Powder + clay	Local application	1
Dilleniaceae	*Tetracera alnifolia* Willd.	BG-ta526	Bogise	Leaves	Decoction	Oral	1
	Tetracera obtusa Planch, ex Oliv.	BG-to530	Ninte	Leaves	Decoction	Oral	2
	Tetracera potetoria Azel. ex G. Don	GF-tp710	Gban	Root bark	Decoction	Oral	3
Ebenaceae	*Diospyros mespiliformis* Hochst. Ex A. DC.	HG-dm241	Dabakala sunsun	Root bark	Decoction	Oral	2
Euphorbiaceae	*Alchornea cordifolia* (Schum., Thonn.)	BG-ac89	Bölönta S	Leaves	Decoction	Oral	5
	Anthostema senegalensis	HG-as649	Woani	Sap	Decoction	Oral	2
	Bridelia ferruginea	HG-bf17	Dafin sagba	Root bark	Decoction	Oral	66
	Euphorbia bateri N.E. Brown	HG-eb877	Baganifin	Sap	Sap	Local application	3
	Euphorbia hirta Linn.	GF-eh257	Nhalengwulöbono	Entire plant	Decoction	Oral	6
	Hymenocardia acida Tul.	HG-ha127	Tanyön yiri	Leaves	Decoction	Oral	2
	Jatropha curcas (L.)	BG-jc135	Bakhanè	Stem bark	Steep	Oral	3
	Macaranga heterophylla (Müll. Arg) Müll. Arg.	GF-ms340	Kuulebhe	Leaves	Decoction	Oral	2
	Maesobotrya parviflora	GF-mp370	Tonya	Stem bark	Steep	Oral	3
	Maniophytum fulvum	BG-mf380	Sanè	Leaves	Decoction	Oral	1
	Margaritaria discoideus	GF-mh400	Mëhë	Leaves	Decoction	Oral	1
	Phyllanthus discoïdes (Baill Müllarg)	MG-pd476	Kêri	Root bark	Decoction	Oral	3
Fabaceae	*Afrormosia laxiflora* (Benth.) Harmo	MG-al256	Koulo koulo	Root bark	Steep	Oral	2
	Erythrina senegalensis DC.	MG-es254	Mbhötyöla	Leaves	Decoction	Oral	65
	Pterocarpus erinaceus Poir	HG-pe542	Gbèn	Root bark	Steep	Oral	2
Flacourtiaceae	*Caloncoba echinata*	HG-ce29	Köbadani	Leaves	Steep	Oral	2
Guttiferaceae	*Garcinia kola* Heckel	GF-gc158	Petit cola	Fruit	Steep	Oral	4
Hypericaceae	*Harungana madagascariensis* Lam. Ex Poir	GF-hm104	Lolo	Leaves	Decoction	Oral	1
	Vismia guineensis	BG-vg763	Latörè	Stem bark	Steep	Oral	5
	Vismia leonensis L	BG-vl922	Wobe sina	Stem bark	Decoction	Oral	3

Table 1 (*Continued*)

Family	Species	Specimen number	Local name	Used part	Manner of use	Route of administration	Total mention
Labiaceae	*Ocimum gratissimum* (L.)	BG-og509	Kunfere S	Leaves	Decoction	Oral	
	Ocimum viridae Willd	GF-ov505	kunyulu	Leaves	Powder + clay	Local application	2
Lauraceae	*Belschimedia manii*	BG-bm781	Töla	Fruit	Decoction	Oral	1
	Persea americana Mill.	HG-pa872	Piya	Leaves	Decoction	Oral	7
Liliaceae	*Asparagus africanus* Lam	MG-ac72	Rabbel fohdu	Root	Decoction	Oral	6
Loganiaceae	*Antocleista nobilis* G. Don	HG-an289	Faritani	Stem bark	Steep	Oral	3
	Strychnos spinosa Lam.	HG-ss670	Kunde kunde	Root bark	Decoction	Oral	2
Lythracea	*Lawsonia inermis* L.	HG-li598	Sadya	Leaves	Decoction	Oral	1
Malvaceae	*Gossypium herbaceum* (L.)	BG-gh181	Gèsè	Leaves	Decoction	Oral	1
	Hibiscus asper Hook	GF-ha107	Pan nènyan	Leaves	Steep	Oral	1
	Hibiscus sabdarifa L	BG-hs119	Santii	Leaves	Steep	Oral	3
	Sida stipulosa Cav	GF-ss578	Kèikè tèntèn	Leaves	Decoction	Oral	3
Meliaceae	*Carapa procera* DC.	HG-cp684	Kora	Stem bark	Steep	Oral	2
	Khaya senegalensis (Ders) Dan	GF-ks155	Gbitili	Stem bark	Decoction	Oral	2
	Melia azadiractha L.	BG-ma966	Kassia kunkhuri	Leaves	Decoction	Oral	3
Menispermaceae	*Dioscoreaphyllum cuminsii*	HG-dc989	Fendabola	Fruit	Eat	Oral	1
Mimosaceae	*Albizya sassa* Mac. Bride (de FWTA)	GF-as820	Gbanhan	Stem bark	Decoction	Oral	4
	Albizzia adianthifolia Schum	MG-aa321	Seinyègèl	Leaves	Decoction	Oral	3
	Albizzia zigya Much	GF-az24	Gbanhan	Stem bark	Decoction	Oral	2
	Dichrostachys cinerea Wight et Arn.	GF-dc238	Lanaa	Leaves	Decoction	Oral	5
	Entada africana Guill. Et Perr.	HG-ea251	Dyalankamba	Root bark	Steep	Oral	2
	Parkia biglobosa (Jacq) Benth.	HG-pb813	Nèdè	Stem bark	Steep	Oral	1
	Pentaclethra macrophylla Benth.	GF-pm473	kobhëla	Stem bark	Decoction	Oral	1
	Piptadeniastrum africanum	GF-pa482	Löwè	Stem bark	Steep	Oral	1
	Prosopis africana Guill et Perr. Tanb	HG-pa490	Gbelen	Stem bark	Steep	Oral	2
	Vitellaria paradoxa Gaertn.	HG-vp765	See	Stem bark	Steep	Oral	1
Moraceae	*Chlorophora regia*	HG-cr200	Silin M	Root bark	Decoction	Oral	1
	Ficus exasperarta Vahl	BG-fm280	Nyönyi	Leaves	Decoction	Oral	1
	Ficus capensis Thunb	BG-fc277	khörè	Leaves	Decoction	Oral	2
	Ficus gnaphalocarpa (Miq) Steud	BG-fg288	Urthè	Leaves	Decoction	Oral	1
	Ficus vallis Choudea Del.	MG-fv878	Yhibbè myeninka	Root	Decoction	Oral	3
Musaceae	*Musa* spp. Linn.	GF-ms421	Nagwi	Sap	Sap + clay	Local application	3
Myrtaceae	*Psidium guajava* L.	BG-pg541	Köbè	Leaves	Decoction	Oral	16
	Syzygium guineense (Will) DC.	MG-sg912	Kaadyö	Leaves	Decoction	Oral	2
Nympheaceae	*Nymphea* spp.	GF-ns448	Yaakwala weli	Leaves	Decoction	Local application	2
Ochnaceae	*Lophira lanceolata* Van Tiegh.	HG-ll310	Mana	Stem bark	Decoction	Oral	6
Olacaceae	*Ximenia americana* L.	HG-xa726	Gbani	Leaves	Decoction	Oral	13
Palmaceae	*Borassus flabellifer* L.	BG-bf10	khankè	Root	Decoction	Oral	1
	Phoenix reclinata	GF-pr475	Gnamoukpala këlë wulu	Leaves	Decoction	Oral	2
Papillionaceae	*Dalbergia saxatilis* Hoock	BG-ds224	Konyökhui	Leaves	decoction	Oral	6
	Mucuna pruriens (Linn) DC	GF-mp420	Yolokpölö	Leaves	Steep	Oral	2
	Tephrosia vogelii Hook. f.	HG-tv915	Dyambani kuna	Leaves	Steep	Oral	1

Passifloraceae	*Adenia lobata* (Jacq. Eng.)	BG-al26	Lakhasè förè	Stem bark	Steep	Oral	3
Piperaceae	*Piper guineensis* Schum. et Thonn.	HG-pg481	Nyamakun	Root Bark	Decoction	Oral	6
Poaceae	*Pennisetum pedicelllatum* Trin.	HG-pp890	Sadyusu	Leaves	Decoction	Oral	1
Polygalaceae	*Securidaga longepedunculata* Fres	HG-sl497	Dyoro	Root bark	Decoction	Local washing	2
Rosaceae	*Parinari excelsa* Sabine	HG-pe452	Kora	Stem bark	Steep	Oral	6
Rubiaceae	*Borerria verticillata* (L.) G. F. W. Mey.	HG-bv11	Daa si daa dala	Stem bark	Decoction	Oral	2
	Canthium vulgare Bullock	MG-cv30	Ndakalin	Root bark	Decoction	Oral	3
	Craterispermum laurinum Benth.	GF-cl216	Gbèghèe	Stem bark	Decoction	Oral	3
	Crossopteryx febrifuga (Afzel. Ex G. Don) Benth.	MG-cf217	Belendê	Stem bark	Decoction	Oral	18
	Gardenia ternifolia Schum. Et Thonn.	HG-gt167	Buren	Root bark	Decoction	Oral	5
	Mitragyna stipulosa O. Kuntz	MG-ms411	Pöpö	Stem bark	Decoction	Oral	4
	Morinda geminata DC.	GF-mg741	Dyologban	Leaves	Decoction	Oral	2
	Nauclea latifolia Sm	HG-nl440	Badi	Stem bark	Steep	Oral	1
	Nauclea pobeguinii (Pob. ex. Pell) Petit	MG-np880	Doundoukhè Tyangol	Stem bark	Decoction	Oral	2
	Pavetta crassipes K. Schum	HG-pc456	Kumufida	Stem bark	Steep	Local washing	1
	Pavetta owariensis	GF-po470	kpeliwulu	Leaves	Decoction	Oral	1
Rutaceae	*Citrus limonum* L	HG-cl202	Lemunukumun	Leaves	Decoction	Oral	2
	Fagara zanthoxyloides (G.P.)	HG-fz278	Woo	Stem bark	Steep	Oral	1
Sapindaceae	*Allophylus africanus* (P. Beauv.)	BG-aa90	Futètè S	Leaves	Decoction	Oral	2
	Paullinia pinnata L.	HG-pp881	Bolokoyinin lolu	Leaves	Decoction	Oral	2
Simaroubaceae	*Harrisonia abyssinica*	GF-ha102	Nyiale dowo	Stem bark	Decoction	Oral	1
Similacacea	*Similax kraussiana* Meissn.	GF-sk524	Bhonumunyanha	Rhizome	Decoction	Oral	2
Solanaceae	*Lycopersicum esculatum*	GF-le328	Welikonèe	Leaves	Steep	Oral	1
	Schwenckia americana L.	BG-sa538	Sèrèrè	Entire plant	Decoction	Oral	1
	Solanum macrocarpum Schum. et Thonn	HG-sm910	Gbusun	Leaves	Decoction	Oral	2
Sterculiaceae	*Sterculia tragacantha* (Lindl.)	BG-st688	Förkè	Stem bark	Decoction	Oral	1
Tiliaceae	*Grewia vilosa* Willd.	BG-gp183	Dangunè	Stem bark	Decoction	Oral	2
Uapacacea	*Uapaca somon* L.	HG-us722	Sömö	Leaves	Decoction	Oral	26
Ulmaceae	*Trema guineensis* (Schum. Et Thonn.) Ficalho	HG-tg708	Sangban yiri fölö	Leaves	Steep	Oral	1
Uricaceae	*Urema lobata* L.	GF-ul920	Hëbhë hilë hilë	Flower	Steep	Oral	3
Verbenaceae	*Clerodendron scandens* P. Beauv.	GF-cs210	Kaalenwana	Leaves	Decoction	Oral	
	Lantana camara L	BG-lc190	Tagani	Leaves	Decoction	Oral	40
	Premna hispida Benth.	MG-ph875	kunsöösö	Leaves	Decoction	Oral	1
	Vitex doniana Sweet	HG-vd768	Kodo	Root bark	Steep	Oral	2
Zingiberacaea	*Aframomum latifolium* K. Schum	HF-al86	Yaya	Leaves	Decoction	Oral	1
	Costus afer Ker	GF-ca214	Tonwa	Pith	Powder + clay	Local application	19

Estimation of the minimal inhibitory concentration (MIC) was carried out by the broth dilution method. About 100 μl of a bacterial or yeast suspension was brought into a 96-well plates and subsequently 100 μl of a twofold plant extract dilution was added. A control for the normal microbial growth was added. Culture broths used were tryptic soy broth (TSB) for bacteria and sabouraud (SAB) for fungi. The wells were inoculated with a microbial suspension of 10^5 CFU/ml and then incubated for 24 h. The inhibition of bacterial or yeast growth was evaluated by comparing with normal microbial growth in the control wells without plant extracts. The minimal inhibitory concentration (MIC) was determined as the lowest concentration that completely inhibited macroscopic growth of bacteria or yeasts. Samples with a MIC value of <125 μg/ml were considered active. To determine the minimal bactericidal concentration (MBC), the wells where there was no microbial growth were plated out on a nutrient agar and incubated for 24 h at 37 °C. Ampicilline (Fluka), rifampicine (Fluka), flucytosine (Sigma) and doxycycline hyclate (Sigma) were used as positive controls.

3. Results

A total of 37 expeditions were made from February 2002 to January 2005 and 385 villages from 27 prefectures through the country were surveyed. During these expeditions 418 traditional healers were interviewed and 218 plants were collected. It was not possible to obtain plant material from all healers. The number of plants given by each healer varied from one to six. The interviews showed that the healers knew more plants than the ones we were able to collect. Several reasons account for the relatively low number of plants obtained from each healer. Not all the plants that the healer knew were available at the time of the year when the interviews were performed. Some healers lived far from the village where the interview was performed and were not able to find all the plants they used within a reasonable distance from this place. Moreover, the time during which the expedition could stay in one village was limited.

The ethnobotanical results are presented in Tables 1 and 2. From the collected 218 species, 164 belonging to 64 different families have been identified, and the identification of the remaining is in progress. Most plants (72.0%) were used as a decoction; the essential route of administration (94%) was oral. Most used plant parts were leaves (40.8%) and stem bark (30.7%). It is very important to note the clay use in the traditional medicine of Forest Guinea.

One hundred and ninety recipes representing 190 extracts were tested for biological activity. From these, only seven showed a modest to significant activity against the following bacteria and fungi: *Staphylococcus aureus*, *Mycobacterium fortuitum*, *Bacillus cereus* and *Candida albicans* (Table 3).

4. Discussion

Of all the informants, 40.4% were female and 59.6% were male. In general, in Guinea, many males practice traditional medicine as a professional occupation. For this reason, men play an important role in the health care of our country.

According to our investigations, younger informants were more numerous than old ones: 28–37 years old (24.6%), 38–47 (23%), 48–57 (19.6%), 58–67 (18.4%) and 68–77 (14.4%). This constitutes a menace for our traditional medicine because of the disappearance of ancestral knowledge if it is not transmitted in time from older to younger people. It was observed that informants between 58 and 77 years old mentioned have more species than younger informants: 58–67 years old: about 9 per informant; 48–57: about 7; 38–47: about 5; and 28–37: 3 quoted plants. This can obviously be explained by the larger experience of these individuals. These results also agree with previous studies of Boster (1986) and Garo (1986) who state that a person's amount of knowledge is determined by the role he or she fulfils in his or her society (sex, age, professional occupation, individual experience, etc.). Most informants received their knowledge from father (19%), apprenticeship (16.9%), grandfather (15.8%), grand-mother (15.0%), mother (14.8%), former patients (10.7%) and dream (7.7%). Hereditary transmission of heal art has been found important.

Among 218 studied plant species, 13 were widely used and have been quoted by at least two ethnic groups. The following plants mentioned show the highest frequency: *Bridelia ferruginea*, *Erythrina senegalensis* and *Annona senegalensis* (Table 2).

Table 2
Inter-ethnic quotation of widely used plants

No.	Plant name	Soussous	Peulh	Malinké	Forester group[a]
1	*Bridelia ferruginea*	+	−	+	+
2	*Erythrina senegalensis*	−	+	+	+
3	*Crossopteryx febrifuga*	−	+	+	−
4	*Ximenia americana*	−	−	+	+
5	*Annona senegalensis*	−	−	+	+
6	*Cochlospermum tinctorium*	+	+	−	−
7	*Cochlospermum planchonii*	+	+	−	−
8	*Lantana camara*	+	−	+	+
9	*Costus afer*	+	−	−	+
10	*Psidium guajava*	+	−	−	+
11	*Terminalia glaucescens*	−	−	+	+
12	*Uapaca somon*	+	+	−	−
13	*Swartzia madagascariensis*	−	−	+	+

[a] Forester group includes Guerzé, Konon and Manon, which have been concerned by our study.

Table 3
Antibacterial activity of active recipes (MIC and MBC in μg/ml) and positive controls

Recipes	Sa[a]		Mf[a]		Ca[a]		Bc[a]	
	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC
Entada africana	> 1000	> 1000	> 1000	> 1000	> 1000	> 1000	**125**	> 1000
Chlorophora regia	**62.5**	> 1000	> 1000	> 1000	> 1000	> 1000	> 1000	> 1000
Erythrina senegalensis	**125**	> 1000	> 1000	> 1000	**125**	> 1000	> 1000	> 1000
Harrisonia abyssinica	**125**	> 1000	> 1000	> 1000	> 1000	> 1000	> 1000	> 1000
Lantana camara	**250**	> 1000	> 1000	> 1000	> 1000	> 1000	> 1000	> 1000
Alchornea cordifolia *Mezoneurum benthamianum* *Sorideia juglandifolia*	**250**	>1000	>1000	>1000	>1000	>1000	>1000	>1000
Swartzia madagascariensis *Isoberlinia doka* *Annona senegalensis* *Gardenia ternifolia* *Terminalia glaucescens* *Erythrina senegalensis*	**62.5**	>1000	>1000	>1000	**250**	>1000	>1000	>1000
Uvaria tomentosa	**15**	**250**	**31.3**	**125**	> 1000	> 1000	> 1000	> 1000
Ampicilline (μM)							2	
Flucytosine (μM)					0.5			
Rifampicine (μM)	0.1							
Doxycycline hyclate (μM)			0.5					

[a] Sa, *Staphylococcus aureus*; Mf, *Mycobacterium fortuitum*; Ca, *Candida albicans*; Bc, *Bacillus cereus*.

These results are in agreement with the statements of healers on the traditional use of the plants species quoted. The most frequently mentioned plants in Guinea in this study were: *Erythrina senegalensis*, *Bridelia ferruginea*, *Crossopteryx febrifuga*, *Ximenia americana*, *Annona senegalensis*, *Cochlospermum tinctorium*, *Cochlospermum planchonii*, *Lantana camara*, *Costus afer*, *Psidium guajava*, *Terminalia glaucescens*, *Uapaca somon* and *Swartzia madagascariensis*. These plants were quoted in at least two natural regions (Table 2).

The fact that we obtained some amount of duplication, that the same plants were shown to us by several healers, and that most of the plants collected have been reported in the literature to be used as medicinal plants, indicated that the healers could be trusted for the information they imparted about the plants they use. It could be observed that quite often plants showing antiparasitic properties exert antimicrobial effect. For example, in West Africa, pulverized stem bark and root of *Ximenia americana* are applied on refractory wounds, in Zimbabwe, a decoction of leaves is used as laxative and to treat cough, fruits as well as leaves are consumed as anthelmintic; in Senegal, a macerate of root is used to treat leprosy (Kerharo and Adam, 1973; Sofowora, 1986); in Ivory Coast, the root is used against diarrhoea and cough (Mamidou et al., 2005); fruit, root and stem bark were active against worms and diarrhoea (Diehl et al., 2004); roots are indicated to treat mouth wounds, rheumatism and diarrhoea (Koné et al., 2004); in Sudan, the aqueous extract of the root exhibited a high antimicrobial activity (Omer and Elnima, 2003); pulverized roots in association with *Guiera senegalensis* are used against syphilis (Kerharo and Adam, 1973).

Several previous studies showed the antibacterial activity of *Psidium guajava*: dry leaf extract showed interesting activity against *Staphylococcus aureus*, *Streptococcus pyogenes* and *Staphylococcus epidermidis* (Gnan and Demello, 1999). However, in the present study we have not been able to confirm this activity. A leaf extract possessed antidiarrhoeal and antimicrobial activities (Lutterdot, 1989; Ghosh et al., 1993; Tona et al., 1999), and showed anticough (Jaiarj et al., 1999), antiamoebic and antispasmodic properties (Lozoya et al., 1994; Tona et al., 1999). Several chemical compounds isolated from *Psidium guajava* leaves possessed antibacterial activities against different strains of Gram negative bacteria (Caceres et al., 1990) as well as Gram positive bacteria (Jaiarj et al., 1999). Bark extracts showed a significant antibacterial activity (Abdelrahim et al., 2002). An extract of the leaves inhibited growth of both reference standard strains (*Staphylococcus aureus* ATCC 25923 and β-streptococcus group A 1000s type 28), and strains isolated from patients (Praneee et al., 1999); extract leaves exhibited antibacterial activity (Narayan, 1994). The methanolic extract of leaves showed significant inhibitory activities against the growth of *Salmonella* spp., *Shigella* spp. and enteropathogenic *Escherichia coli* (Lin et al., 2002).

Bridelia ferruginea is widely used in traditional medicine; for example in Ivory Coast, leaves and roots extracts are used against helminthiasis, malaria and trypanosomes (Okpekon et al., 2004; Mamidou et al., 2005). The aqueous extract of stem bark has been found to be active against inflammatorions which are sometimes associated with sexually transmitted diseases (Olumayokun et al., 2003). Extracted tannins showed antibacterial activity (Narayan, 1994).

Lantana camara has antibacterial activity against *Bacillus subtilis* and *Staphylococcus aureus* (Ioset et al., 2000; Misra and Laastsch, 2000). The essential oil of this plant showed a wide spectrum of antibacterial and antifungal activities (Deena

and Thoppil, 2000); aerial parts of *Lantana camara* are used against diarrhoea (Hernandez et al., 2003).

The extracts rich in alkaloids of *Crossopteryx febrifuga* demonstrated the antimalaria activity (Sanon et al., 2003). Ethanolic extracts of the aerial part of this plant have been found to be active against malaria (Elufioye and Agbedahunsi, 2004). Leaves extracts are used in traditional medicine to treat diarrhoea and helminthiasis (Mamidou et al., 2005).

In external application, roots of *Costus afer* are used to treat ulcers (Kerharo and Adam, 1973). *Alchornea cordifolia* showed antiplasmodial activity (Mustofa et al., 2000); leaves of *Alchornea cordifolia* are recommended by Ivory Coast traditional practitioners to treat dysenteric syndrome, malaria and helminthiasis (Okpekon et al., 2004); stem bark and leaves extracts showed strong antiplasmodial activities (Mustofa et al., 2000). *Erythrina senegalensis* is quoted in Ivory Coast traditional medicine to treat different infectious diseases (Koné et al., 2004).); stem bark and root extracts are indicated in dry cough, gonorrhoea and stomach ache (Mamidou et al., 2005). Stem bark of *Entada africana* is used in Ivory Coast traditional medicine against intestinal worms and diarrhoea (Mamidou et al., 2005); root extract is recommended in respiratory diseases (Mamidou et al., 2005). Leaves, roots and trunk barks of *Terminalia glaucescens* are used to treat malaria (Mustofa et al., 2000; Okpekon et al., 2004). Dried stem bark of *Annona senegalensis* appears to posses some anthelmintic properties (Alawa et al., 2003). Decoction of roots are drunk against pneumonia and venereal sores; a decoction mixed with coconut oil is drunk to treat diarrhoea and gonorrhoea (Chhabra et al., 1987); stem bark, fruit, leaf and stem root extracts are used against worm and diarrhoea (Diehl et al., 2004); leaves and roots are considered as possessing properties against gonorrhoea and dermatitis. Mixed with other recipes, it is used against syphilis in traditional medicine in Senegal (Kerharo and Adam, 1973). Root extracts of *Holarrhena africana* are prescribed to treat helminthiasis, gonorrhoea and dysentery (Kerharo and Adam, 1973). It was observed that bark decoction of *Harrisonia abyssinica* could be taken against dysentery (Sofowora, 1986).

Of the 190 extracts from 218 plant species subjected to antibacterial screening, six demonstrated an inhibitory effect on one or more bacterial strains (Table 3). Leaf extracts *Entada africana* (Mimosaceae) showed antibacterial activity against *Bacillus cereus* and leaf extracts of *Erythrina senegalensis* (Fabaceae) were active against *Staphylococcus aureus* and *Candida albicans*. MIC values of 250 μg/ml, as for *Lantana camara* (Verbenaceae), are included in the table, but are considered as inactive. Root bark and bark extracts of *Chlorophora regia* (Moraceae) and *Harrisonia abyssinica* (Simaroubaceae), and a mixture of the root extracts of six plants, consisting of *Swartzia madagascariensis*, *Isoberlinia doka*, *Annona senegalensis*, *Gardenia ternifolia*, *Terminalia glaucescens* and *Erythrina senegalensis*, were active against *Stapylococcus aureus*. Of the six active extracts, five demonstrated an antibacterial effect against *Staphylococcus aureus*. The *Uvaria tomentosa* (Annonaceae) leaf extract showed the best antibacterial activity with a minimal bactericidal concentration (MBC) of 125 and 250 μg/ml on *Mycobacterium fortuitum* and *Staphylococcus aureus*, respectively.

The antibacterial activity of members of the Annonaceae has well been studied. A phytochemical screening of eight Brazilian Annonaceae showed the presence of Annonaceous acetogenins in some active extracts (Takahashi et al., 2006). The antibacterial activity of *Uvaria hookeri* and *Uvaria narum* have been reported by Padmaja et al. (1993); apart from some triterpenes, acetogenins including the uvariamycins I, II and III were identified in this plant (Hisham et al., 1990). Stem bark of *Uvaria chamae* has been found to show antimicrobial effects (Ebi et al., 1999); also in this plant Annonaceous acetogenins were identified (Fall et al., 2006). In addition, the dihydrochalcones uvaretin and diuvaretin were shown to contribute, at least in part, to the antibacterial and cytotoxic effects of a series of *Uvaria* extracts (Nkunya et al., 1991).

However, a plant extract showing no antibacterial activity should not necessarily be considered as being completely inactive. Activities resulting of mixtures of different plant species or from a special preparation procedure of the plant can be absent in isolated extracts. The extraction method using 95% methanol does not guarantee a complete extraction of potentially active molecules.

5. Conclusion

Many plants are used in Guinean traditional medicine to treat infectious diseases, including sexually transmitted diseases by the healers. Our study demonstrated that a few showed an antibacterial effect in vitro, and justified at least in part of their use in traditional medicine by traditional healers or herbalists. These results encourage further investigations to extract and identify the active chemical compounds responsible for the antibacterial effect observed.

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