



***Garcinia lucida* Vesque (Clusiaceae): from traditional uses to pharmacopeic monograph for an emerging local plant-based drug development**

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ABSTRACT

Objectives: This paper seeks to assess information on the identity, traditional uses, safety and efficacy of *Garcinia lucida* Vesque (Essok in Boulou and Ewondo local language), in order to highlight its potential as a species to be registered in medicinal plant list and formularies needed for the development of monographs leading to local production of phytomedicines.

Methodology and Results: Ethnobotanical survey was carried in the Bipindi-Akom II region (South Cameroon) with the help of interviews based on standardised questionnaires addressed to key-informants. Bark and seeds were the major parts used, highly appreciated due to its properties in preventing consumers from poison, diarrhoea and headaches. The most important therapeutic indications were additive to palm wine, antidote to poisoning, gastritis and snake bite. Other uses in treating included gynaecological pains and infections, sexual diseases and cancers. The bark was also believed by local people to act on the stability of chemical antibiotic drugs in pharmacy, while leaves were used as insect repellent against mosquitoes and cockroaches.

Conclusions and application of findings: As an additive in palm wine processing, poisoning antidote, aphrodisiac and medicines, bark and seeds are widely used in the Bipindi-Lolodorf-Akom II area, in the Centre and South regions of Cameroon, in Gabon and Equatorial Guinea, in Central Africa and West Africa. This similarity of use across many regions is considered as an important biological activity marker tool guiding plant parts or species selection in drug discovery and development using ethnopharmacological approach. Through the ethnobotanical and biological tests, accurate information is provided to substantiate safety and efficacy of *G. lucida* and to satisfy the requirements of official compendia such as pharmacopoeia. Further studies are needed to understand the effects of bark and seeds as additive to palm wine, as well as the interaction between bark and chemical antibiotic drugs.

Keywords: *Garcinia lucida*, traditional uses, medicinal plant list, monograph, pharmacopoeia, phytomedicine production.

INTRODUCTION

Health systems around the world are experiencing increased levels of chronic illness and for millions of people in developing countries, herbal medicines, traditional treatments, and traditional practitioners are the main source of health care, and sometimes the only source of care (WHO, 2013). The affordability of most traditional medicines makes them more attractive at a time of soaring health-care costs and nearly universal austerity. According to Cordell (2011), it is the obligation of most of these countries to weigh the public health and economic issues of whether it will be more effective to develop local resources for the production of selected synthetic medicinal agents, to rely on imported drugs, or to establish research and possibly discovery programs, based on indigenous resources, to explore traditional medicines as health care resources. Moreover, the global resurgence of interest in herbal medicines has created a large market for plant-derived remedies that developing countries could exploit to their advantage, provided they could be produced with acceptable quality and safety specifications (Kasilo *et al.*, 2010). To provide phytomedicines with these quality and safety specifications, a standardized mode of production, which meets modern pharmaceutical manufacturing standards, must be developed. Indeed, the development of such plant factories requires approval by the government of the respective developing country states, the existence of institutional and legal frameworks, as well as that of evidence-based information on the safety, efficacy and quality assurance of plant species or products of widely used medicinal plants according to WHO guidelines (2004a, b). Within the WHO African Region, progress have been made in policy development and country regulatory frameworks, including various instruments such as the code of ethics and the legal framework for traditional practitioners (WHO, 2011a; 2013). However, in most of these African countries, the herbal medicine consumption and market are poorly developed and regulated, and herbal products are often neither registered nor controlled. Only twelve countries issued marketing authorizations for traditional or phytomedicines, ranging from three products in

Cameroon and Congo to over 1000 in Mali, Ghana and Nigeria (WHO, 2005; 2013). To obtain registration or marketing authorization, a dossier of information on the remedy's safety and efficacy must be submitted to the national regulatory authorities. Depending on the particular country and existing legislation, herbal products are usually regulated as drugs or as "dietary supplement". To be registered these products need to be tested to prove their safety and clinical efficacy. However, few programs have been established to study the safety and efficacy of herbal medicines as proposed by the WHO Guidelines for the assessment of herbal medicines through clinical trials (Calixto, 2000; WHO, 2007; 2011b). Fortunately, the requirements for the dossier within the WHO African Region vary according to the four categories distinguished by the classification of traditional medicines (OAPI/OMS, 2004). Most improved traditional medicines are of category 1 or 2, made of crude traditional preparations, for which clinical trials are not an absolute requirement, but rather that evidence of traditional use, according to WHO guidelines (1998; 2004a,b; 2007; 2011b). Indeed, the general tendency in the processes of regulation and registration is to combine scientific studies and traditional knowledge well documented in monographs which are important tools needed to establish official compendia and appropriate guidelines for drug registration and regulation (Calixto, 2000; Wilcox *et al.*, 2012; WHO, 2007; 2011b; 2013). Unfortunately, very few or no countries or jurisdictions in the region have reported promoting or establishing these official compendia such as pharmacopoeias, formularies or legislative documents. Therefore, in order to effectively implement the "WHO *Strategic plan for local production of traditional medicines*" and ensure that traditional medicines of acceptable quality could be made available, pharmacopoeias need to be elaborated or enriched, at the national or regional levels such as the volume 1 of the African pharmacopoeia (OAU, 1985). The development of monographs on selected medicinal plants, as well as the establishment of formularies or medicinal plant list is few of the important prerequisites to this

achievement. According to WHO (2010), monographs are valuable tools serving as source of information for regulation or registration system for medicinal plants or herbal medicines as therapeutic agents or active ingredients in the country of production. As part of efforts to the effective implementation of a local production of

phytomedicines across Africa, this paper seeks to assess information on the identity, uses, safety and efficacy of *Garcinia lucida* Vesque, in order to highlight its potential as medicinal species to be registered in medicinal plant list or formularies needed for the development of monographs and establishment of official pharmacopoeia.

MATERIALS AND METHODS

Field surveying to assess the traditional uses and the botanical characteristics of *G. lucida* species was carried in the Bipindi – Lolodorf - Akom II region (South Cameroon). The research was carried out in and around two *G. lucida* collection sites, named Minwo'o and Akok (Fig. 1). The selected villages were Meka'a II, Nyangong and Mefak located near the Nyangong site (2856.040N, 10849.620E), and Ebom and Nkouékouk, near the site of Minwo'o (3806.040N, 10846.280E). The fieldwork included ethnobotanical survey and literature search.

Information on the utilisation and traditional processing of *G. lucida* bark and seeds was collected with the help of interviews with key-informants based on questionnaires. In total, twenty key-informants (4 women, 8 young men and 8 elderly men) were selected, regarding of their past or present activities related to the exploitation of bark and seeds for additive to palm wine production and for medicinal uses. In addition, a total of 35 bark gatherers and/or traders (8 women and 27 men) provided information by filling in standardised questionnaires.

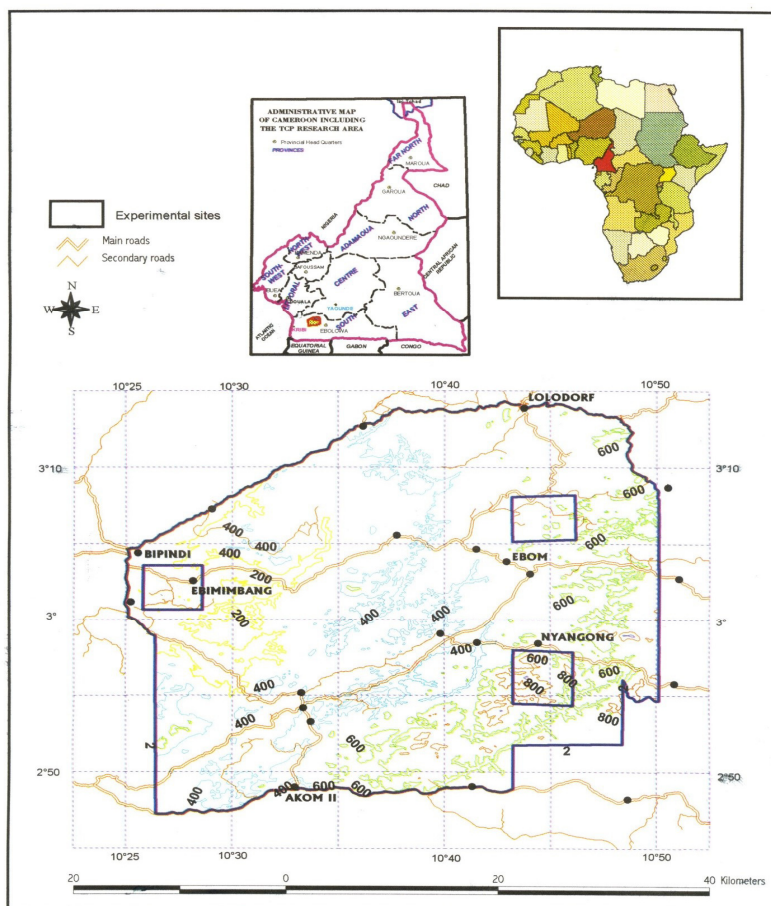


Fig. 1: Location of the Bipindi – Akom II – Lolodorf region in Cameroon

The identification of the species was confirmed with the help of Dr Xander (botanist at the Herbarium of Wageningen) and voucher specimens (WAG0021844) were selected and kept at the National Herbarium of Cameroon and at the Wageningen Herbarium (Fig. 2A). The therapeutic judgements were made based on specific disease, symptom or physiological effect, grouped according to the classification proposed by the World Health Organisation (WHO) and adapted by the Organisation of the African Unity (OAU) for the

Cameroonian traditional pharmacopoeia (Adjahoun et al., 1994; 1996). The importance of each specific disease, symptom or physiological effect was evaluated based on the number of citations made by the informants. A literature review was performed via electronic search (using PubMed, SciFinderScholar, TPL (www.theplantlist.org), Google Scholar, Bing and Web of Science). The search words were *Garcinia lucida* coupled with biological activity, as well as isolated compounds. These data were compiled on an excel sheet and analysed.

RESULTS

Botanical characteristics and distribution: *G. lucida* species is a small understory dioecious tree, standing sometimes on stilt roots, reaching 25 - 30 cm in diameter at breast height (dbh) and 12–15 m in height. Trees are of variable aspect, well-branched (Fig. 2B, 2C) and evergreen. The stem exhibits yellow and resinous exudates after the dark brown bark is cut or removed. The underside of the lanceolated leaf is of a shining golden colour. The buds are green and the flowers white (Fig. 2C). The green fruits (Fig. 2D), classified as a berry, are medium-size (13 cm x 11 cm), ellipsoidal or globular in form and green to green-golden in colour, and contain 1 to 3, sometimes 4 seeds, wrapped with a thin and white

yellowish pulp. Seeds are medium-size (4 cm x 3 cm x 2 cm to 8 cm x 6 cm x 4 cm), reddish-purple in colour and of semi-ellipsoidal form (Fig. 2E). When ripe, these seeds drop from the fruit or with the fruit on the ground beneath the parent tree. The natural habitat of *G. lucida* is the Atlantic “primary” humid forests. The species is usually found in hilly moist forest sides, up to 600 – 800 m above sea level, with some hills or mountains exceeding 1400 m, with a yearly rainfall of about 2000 mm, and with an average annual temperature of around 25°C. *G. lucida* tree grows in high-density stands covering few hectares with an abundance varying from 348 young matures (5 - 10 cm dbh) to 5 large trees (> 20 cm dbh) per hectare.

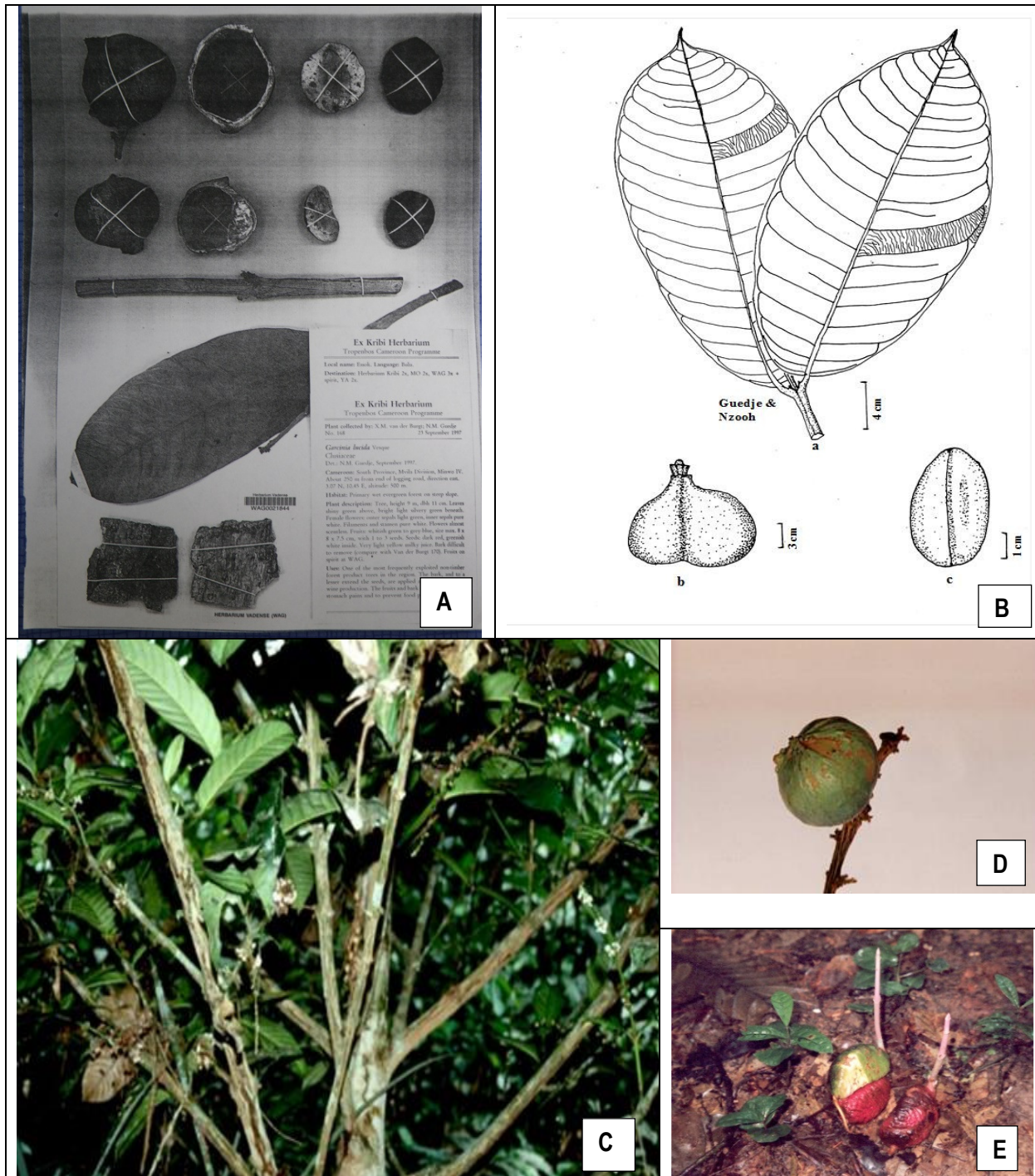


Fig. 2: *Garcinia lucida* Vesque (Clusiaceae) photographs selected for compendia. A = voucher specimens kept at the Wageningen Herbarium, B = freehand drawing of leaves, fruit and seed, C = Flowering branches, D = green fruit, E = purple seeds.

Traditional uses: *G. lucida* species is widely used in the Bipindi-Lolodorf-Akom II region for its medicinal properties and physiological effects. Table 1 summarises the

different therapeutic indications of *G. lucida*, classified by physiological effect, diseases or symptom according to systems.

Table 1: Therapeutic indications of *G. lucida* in the Bipindi-Lolodorf-Akom II area, classified by specific disease, symptom or physiological effect according to systems.

Effects, diseases and condition Groups	Effects, diseases or symptoms	Plant parts used	Number of Citation
Digestive system	Diarrhoea (A09)	Bark	7
	Abdominal distending or Flatulence (R14); Indigestion or Constipation (K59.0)	Seeds	5
		Roots	2
	Gastralgia (R10.1)	Bark	5
		Seeds	3
	Abdominal pains (R10.4)	Bark	5
		Seeds	3
	Gastritis (K29.7), gastric ulcer	Seeds	20
		Bark	18
		Fruits	3
Peptic ulcer	Bark	2	
	Seeds	2	
Directions for medico-magic use	against evil spirits; Chase away ghosts	Leaves	6
Effects on parasite or pathogenic organisms	Insect repellent, merely against mosquitoes and cockroaches	Leaves	4
Effects on reproductive system, in relation with glandular systems	Aphrodisiac / stimulant	Fruits	5
		Seeds	5
Female genital system: obstetrics and gynaecology	Gynaecological pains and infections (unspecified)	Seeds	7
Infectious diseases	Sexual transmittable diseases (unspecified)	Seeds	2
	Measles (B05.9)	Seeds	5
		Bark	5
Miscellaneous or sundry usages	Additive	Bark	35
		Root bark	2
		Seeds	25
Specific diseases and conditions (miscellaneous)	Cancer (unspecified) (D48.9)	Bark	2
		Seeds	2
		Roots	2
	Antidote / Poisoning (T65.9)	Bark	30
		Fruits	4
		Seeds	30
		Roots	2
	Snake bite (T63.0)	Seeds	25
Specific symptoms	Generalised pain (R52.9)	Bark	2
Total number of citations			275

Almost every part of *G. lucida* trees is useful in traditional medicine, ranging from the seeds (49% of citations or indications) to its root-bark (1%). However, seeds and bark are the parts mostly used for the different effects, diseases and conditions (Fig. 3). These seeds and bark, dried or fresh, are often used to treat various diseases, including diarrhoea, abdominal pains, flatulence, constipation, gastralgia, gastritis or stomach ulcers, and

mostly, snakebites and food poisoning. The bark and seeds are also used in the treatment of gynaecological pains and infections, sexual transmittable diseases, generalised pain and cancers. The use of leaves against evil spirits or to chase away ghosts and as insect repellent, merely against mosquitoes and cockroaches, was mentioned only by elderly key-informants. Furthermore, local people in the Bipindi-Akom II region

strongly advice people against to enter in a pharmacy with a piece of *G. lucida* bark, which is believe to

deactivate pharmaceutical antibiotics.

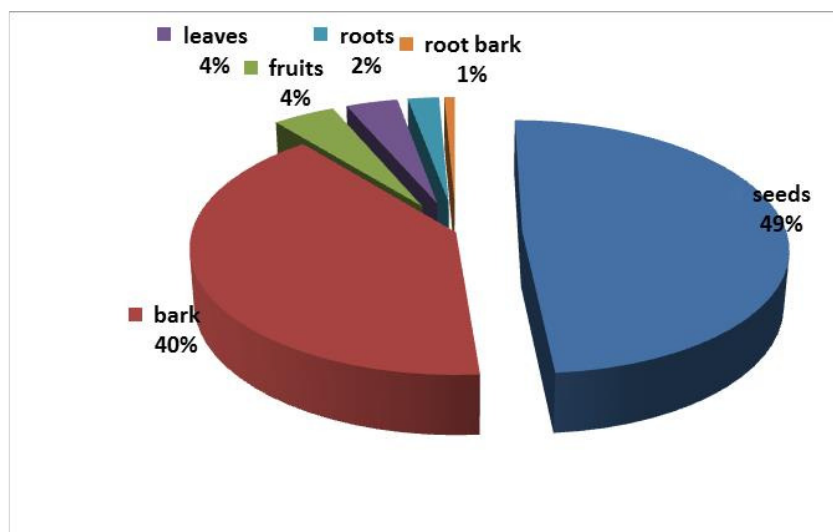


Fig. 3: Relative importance of *Garcinia lucida* plant parts used in the Bipindi-Lolodorf-Akom II region.

G. lucida bark, as an additive or flavour in palm wine production and in palm wine distilled to obtain traditional liquor named "Mkpwet" (fermented wine) and "Odonto" (distilled wine) is widely used in the Bipindi-Lolodorf-Akom II area. The seeds and the bark of the root are sometimes used for this purpose; however, the bark is the most popular plant part used. During the survey, almost all the informants indicated that *G. lucida* bark was widely and highly appreciated due to its properties preventing palm wine consumers from diarrhoea, headaches occurring after getting drunk, and the most important, from wine poison.

Relative importance of therapeutic indications: The relative importance of the different physiological effects, diseases and symptoms recorded for *G. lucida* species is illustrated in Fig. 4a, with additive (24% of the citations), antidote to poisoning (22%), gastritis (15%) and Snakebite (9%) as the most important therapeutic indications. Specific diseases and conditions (33%), digestive system (27%) and miscellaneous usages (24%) are in this order, the most important therapeutic indication groups treated with *G. lucida* plant parts (Fig. 4b).

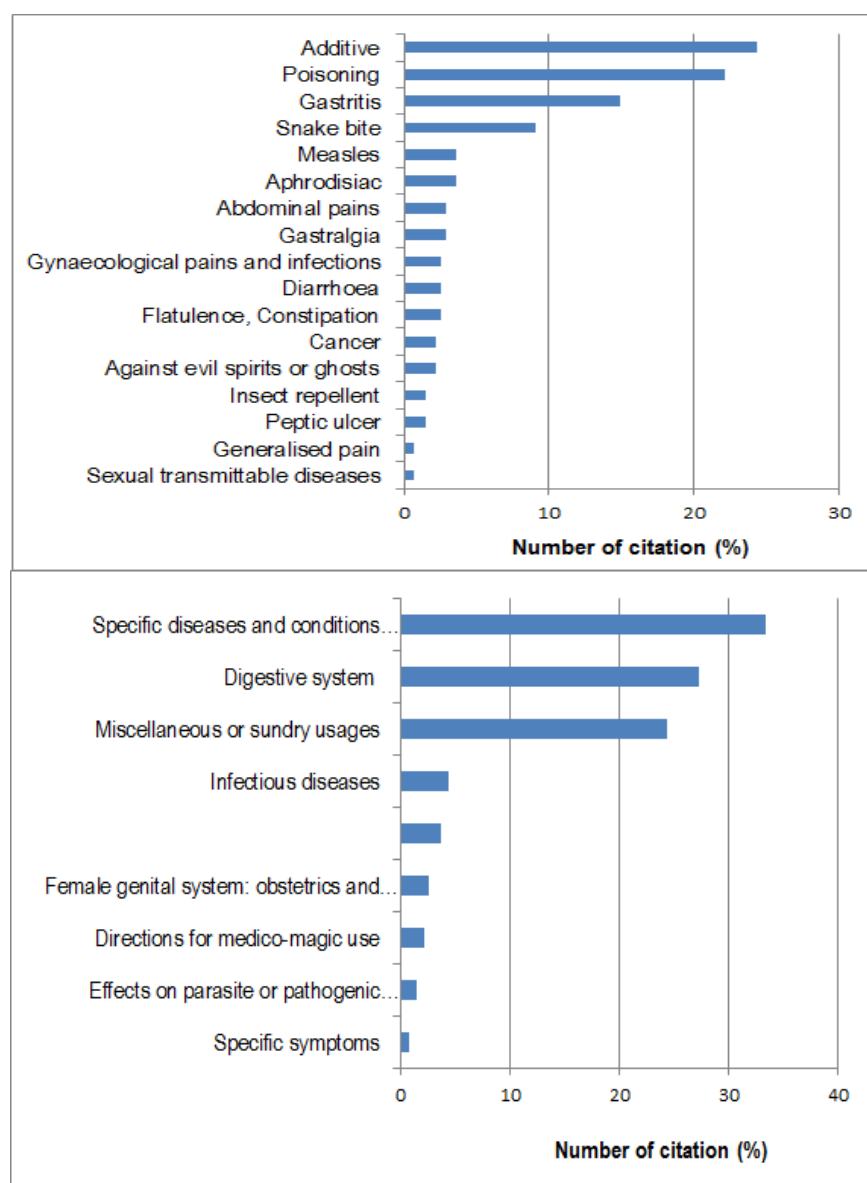


Fig. 4: Relative importance of therapeutic indications of *G. lucida* in the Bipindi-Lolodorf-Akom II area, classified by physiological effect, diseases or symptom according to systems. A = Relative importance of physiological effects, diseases or symptoms recorded, B = relative importance of therapeutic indication groups treated with different plant parts.

DISCUSSION

Definition and taxonomy of *Garcinia lucida* Vesque (Clusiaceae): According to WHO (2003; 2010), some reported adverse events following the use of certain herbal medicines have been associated with a variety of possible explanations, including the inadvertent use of the wrong plant species. Therefore, as stated by Brigham *et al.* (2004) and WHO (2003; 2004b; 2007), an accurate and adequately identification of medicinal plant species, with voucher specimens from the collection site, represents one of the key elements of the development of

pharmaceutical industries based on high quality and safety specifications; as it allow each batch of goods to be traced back to the area where it was collected or produced. The present paper has been supplemented with *G. lucida* specimen voucher, freehand drawing and typical photographs (Fig. 2), in order to facilitate the species identification and to avoid confusion with other species at it has been noted during literature search where, some works assessing biological activity or phytochemical components have been published with

pictures not corresponding to those of *G. lucida* species accurately identified by trained botanists. According to the Linear Angiosperm Phylogeny Group III (LAPG III), *G. lucida* Vesque is scientifically classified as follows (Haston *et al.* 2009): Kingdom: Plantae; Division: Magnoliophyta; Class: Magnoliids or Magnoliopsida; Sub-Class: "Eudicots" or "Eudicotyledons"; Order: Malpighiales Juss. ex Bercht. & J.Presl (1820) or Theales; Family: Clusiaceae Lindl. (1836) or Guttiferae; Genus: *Garcinia*. Therefore, in each pharmacopoeia summary, the definition section providing the Latin binomial pharmacopoeia name is the most important criterion in quality assurance, according to WHO (2010). The detailed botanical description is also intended for quality assurance at the stages of production and collection, whereas the detailed description of the plant part used or drug material is for the same purpose at the manufacturing and commerce stages. The geographical distribution information is included to provide additional quality assurance information. According to Bamps (1970), the geographical distribution of *G. lucida* is limited to parts of Cameroon, Equatorial Guinea and Gabon; however, the species was indicated to be used as additive to palm wine in Central and West Africa by Irvine (1961), Bouquet (1969) Bouquet and Debray (1974). In Cameroon, Vivien and Faure (1996) indicated that the species can be found in the following regions : Yaoundé, Akom II, Akonolinga, Bijoka, Bipindi, Ebolowa, Edip (Kupe-Muanenguba), Korup National Park, Lolodorf, Matomb, Mbam Minkom, Mbanga (81Km Kribi-Ebolowa road), Mfou, Ndikinimeki and Nta Ali (25km SE Mamfe). **Convergence or similarity of use:** The importance of *G. lucida* is derived from its therapeutic indications. As an additive or flavour (Miscellaneous usages) in palm wine production and distilled, bark and seeds are widely used in the Bipindi-Lolodorf-Akom II area, in the Centre and South regions of Cameroon (Noumi, 1984; Ndoye, 1995; van Dijk, 1999; Ndoye *et al.*, 2001), Gabon and Equatorial Guinea (Ndoye *et al.*, 1999; 2000; Sunderland and Obama, 1999), Central Africa and West Africa (Irvine, 1961; Bouquet, 1969; Bouquet and Debray, 1974). Noumi (1984) has listed many plant products used in the production of palm wine in Cameroon. In the Bipindi - Akom II region *Garcinia kola*, *Phyllanthus muellerianus*, *Sacoglottis gabonensis*, *Alstonia boonei*, *Pentaclethra macrophylla*, *Piper guineense*, *Ceiba pentandra* and *Carapa procera* were mentioned also to be used in palm wine production (van Dijk 1999). Informants indicated that the bark of all those species was rarely used, although it was frequently used in the past. However, *G. lucida* bark was widely and mostly appreciated due to its properties

against wine poison, diarrhoea and headaches. As medicine, in rural communities, where villagers have hardly access to health centres, the use of bark and seeds to treat diarrhoea, abdominal pains, flatulence, constipation, gastralgia, gastritis or stomach ulcers (digestive system) was also reported throughout the Centre and South regions of Cameroon (Nyemba *et al.*, 1990; Kuete *et al.*, 2011), at Douala in the Littoral region (Dibong *et al.*, 2013; Ngene *et al.* 2015) and at Bangangte in the West region (Noumi & Dibakto, 2000). The bark and seeds enjoy a folk reputation as antidote to poisoning and snake bites (Specific diseases and conditions - miscellaneous), and as aphrodisiac or stimulant (Effects on reproductive system, in relation with glandular systems) not only in the Bipindi-Akom II region, but also in Douala (Dibong *et al.*, 2013; Ngene *et al.*, 2015), Yaoundé, Kribi (Adjanohoun *et al.*, 1996), and throughout Cameroon, especially in the South and Central regions (Kamanyi *et al.*, 1990; Nyemba *et al.* 1990; Vivien & Faure, 1996; Ndoye *et al.* 1999; Sunderland *et al.*, 1999; Kuete *et al.*, 2011). The use of leaves against evil spirits or to chase away ghosts (Directions for medico-magic use) and as insect repellent (Physiological effects on parasite or pathogenic organisms), mentioned by elderly key-informants of the Bipindi-Akom II region, suggests that this type of ethnobotanical use was applied in the past. Such usage, not yet mentioned in the literature, suggests that further studies are needed to fully understand its insecticide or repellent mechanisms and how it could best be utilized for this purpose. As additive, poisoning antidote, aphrodisiac and medicines for therapeutic indication groups (such as digestive system, specific diseases and conditions, specific symptoms), a remarkable convergence or similarity of bark and seed uses is observed between Bipindi-Lolodorf-Akom II region and others regions throughout Cameroon (Akak, Bagangté, Binyenyale, Douala, Yaoundé, Kribi, the Center and South regions of Cameroon in general), Central and West Africa (Gabon, Equatorial Guinea, Congo, Ivory Coast, Ghana, Nigeria). From the perspectives of drug discovery and development using ethnopharmacological approach or method, the notion of convergence of use, considered as biological activity markers according to Fleurentin *et al.* (2011), is a key concept to validate the source of information (Edwards *et al.*, 2005; Heinrich *et al.*, 2009) and therefore constituted one of the most useful approaches guiding the selection of plant species and/or plant parts for further pharmacological studies, ethnopharmacological experimental or clinical investigations. The ethnopharmacological method is particularly useful when

searching for compounds, which are effective in treating specific health conditions. This approach may be strengthened by comparing the plants used by different ethnic groups who live in the same region. It may be that species used in a similar way by a majority of local peoples are more likely to contain a physiologically active substance than species, which are used by only one ethnic group or in a single community (Martin, 1995). An illustrative example is the garden spurge, for which a study highlighting the importance of certain taxa to treat skin conditions in Brisbane, Australia allowed the identification and development of the second most commonly mentioned species, *Euphorbia peplus*, as an interesting lead, now in Phase II clinical trials (Andrade-Cetto & Heinrich, 2011).

Constituents and biological activities warranting traditional uses: From the literature survey, *G. lucida* was found to have several compounds isolated from different plant parts (Annex 1). Chemical tests carried out have permit to isolate from seeds, leaves and bark of *G. lucida*, bioflavonoids, anthocyanins, saponins, carbohydrates, triterpenes and derivatives of cycloartane (Etounou, 1991). Furthermore, phytochemical studies conducted by Nyemba *et al.* (1990) led to the isolation from the bark of three cycloartanes: 30-hydroxycycloartenol, 31-norcycloartenol and 24, 25-epoxy-31-norcycloartenol (mixture of epimers). Cycloartenol is known as an intermediate in the biosynthesis of phytosterols. Investigations conducted by Fotié *et al.* (2007) have led to the isolation of trypanocidal and antileishmanial dihydrochelerythrine derivatives in addition with five known others products isolated: stigmaterol, betulinic acid, *D*-glucopyranoside of sitosterol, sesamin and *trans*-fagaramide. According to Momo *et al.* (2011), Dichloromethane sub-fraction from the methanol crude extract of the stem bark of *G. lucida* afforded eleven compounds namely putranjivic acid **1**, methyl putranjivate **3**, their intermediary lactone **2**, friedeline **4**, cycloartenol **5**, 1,2-dihydroxy- xanthone **6**, 1-hydroxy-2-methoxyxanthone **7**, betulinic acid **8**, oleanolic acid **9**, β -sitosterol **10** and stigmaterol **11**. Most of the isolated metabolites from the *G. lucida* are alkaloids, flavonoids, phenols and polyphenols, tannins, anthraquinones, steroids, saponins, glycosides (Lacmata *et al.*, 2012; Ntie-Kang *et al.*, 2013; Djabou *et al.*, 2014). At the Medical Institute of Medicinal Plants of Cameroon (IMPM, 1987), cycloartane derivatives and triterpene pentacyclane, anti-inflammatory and anti-acids active component were isolated from the leaves and bark of *G. lucida*. Antibacterial activity was also detected in extracts of bark and seeds of *G. lucida* at the Centre for the Study

of Medicinal Plants of Cameroon (CEPM) of the IMPM institute. The presence of these anti-inflammatory and anti-acid compounds might explain and validate its uses in traditional medicine against gastrointestinal disorders (abdominal pains, gastralgia, gastric ulcer, peptic ulcer, diarrhoea, constipation) in the Bipindi-Lolodorf-Akom II region and other areas. An inhibitory effect of extracts of *G. lucida* seeds on curare have been proved by Kamanyi *et al.* (1990). Curare, administered by intra-péritonienne injection has no effect on mice that have ingested seven hours earlier, *G. lucida* seed extracts. According to these authors, the action of these extracts seems to be more effective in prophylactic action than in curative treatment. The results of this work, which also shown that these extracts were non-toxic, justify why local populations preferentially use the bark of *G. lucida* to produce and spread their palm wine and think that they are guard against possible poisoning. These probably also explain its reported aphrodisiac properties. In their efforts to find new bioactive β -lactamase inhibitors, Gangoué-Piéboji *et al.* (2007; 2009) investigated 16 Cameroonian plants and found that, extracts from *G. lucida*, together with other species, presented interesting *in vitro* β -lactamase inhibition. The isolation and the structural elucidation of the active constituents of *G. lucida* could provide useful leads in the development of β -lactamase inhibitors. Furthermore, the extracts of *G. lucida* leaves have demonstrated broad spectrum activity against all tested Gram-negative bacilli with inhibition zones in the range of 9-23 mm, good activity on non-fermenter Gram-negative bacilli (*P. aeruginosa* and *A. baumannii*), high potency on beta-lactam-resistant Gram-positive cocci (*Enterococcus* sp P054 and *S. aureus* U127). Moreover, *G. lucida* extracts showed good antifungal activities on filamentous fungi. The antibacterial activities of twelve methanol extracts of medicinal plants were evaluated using broth microdilution by Lacmata *et al.* (2012). The results of their test showed that extracts from *G. lucida* with the minimal inhibitory concentrations (MIC) varying from 128 to 512 $\mu\text{g/mL}$ were one of the most active on all the 29 studied bacteria including MDR (multi drug resistance) phenotypes. The results of this study suggested that the tested plant extracts and mostly those from *Picalima nitida*, *G. lucida* and *G. kola* could be used alone or in association with common antibiotics in the fight of bacterial infections involving MDR strains. These different results support the traditional antimicrobial use of this species in digestive system, gynaecological and infectious diseases. Djabou *et al.* (2014) have found a high antiradical activity in *G. lucida* bark and fruit extracts, measured by the ability to scavenge DPPH free radicals.

The extracts have potent nitric oxide scavenging activity. The species can be useful for the management of diseases in which radical nitrite is directly involved. Extracts of *Acalypha racemosa*, *G. lucida* and *Hymenocardia lyrata* have higher total phenol content and antioxidant activity. Concerning the safety of the plant, people in the Bipindi-Lolodorf-Akom II region agreed on the non-toxicity of *G. lucida* seeds and bark since many years of uses. No side or adverse effects, as well as no contraindications were reported. Gangou'e-Pi'eboji *et al.* (2007) have demonstrated that *G. lucida* has little toxicity to vero cells and the host cells; they concluded that this species could be source of compounds, which might be useful in managing beta-lactam resistant bacteria and extended spectrum beta-lactamase-producing enterobacteria. Kamanyi *et al.* (1990) have also highlighted that *G. lucida* seed extracts were non-toxic; indicating therefore that *G. lucida* is safe consumed with or without other foods. These various phytochemical and biological tests show that many active compounds are found in *G. lucida* bark, seeds and leaves, with bioactivities such as intermediate phytosterols biosynthesis intermediary, antibacterial, antimicrobial, anti-inflammatories, antacids, antiradical, curare antidote or inhibitory effect, β -lactamase inhibition, antibacterial involving MDR strains. This thereby conferring to the species, a great therapeutic value and potential in drug innovation and development, as well as strengthening the link between the traditional knowledge and modern science.

Traditional uses and pharmacopeic monographs: As stated by Wilcox *et al.* (2012), one of the most important advantages of "improved phytomedicines" is that they can be developed much faster and more inexpensively than new modern drugs. This is because their use, preparation and safety are already understood in traditional knowledge systems, and so preclinical development can be greatly accelerated. According to WHO (1998) guidelines, no requirement for preclinical toxicity testing, but rather that evidence of traditional use or recent clinical experience is sufficient. In addition,

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WHO (2007) specifications for pharmaceutical preparations highlight the fact that if the product has been traditionally used without demonstrated harm, no specific restrictive regulatory action should be undertaken unless new evidence demands a revised risk-benefit assessment. Therefore, the remarkable convergence of bark and seed usages observed between Bipindi-Lolodorf-Akom II region and others regions throughout Cameroon, Central and West Africa highlights the potential of *G. lucida* to be compiled or registered in the list of medicinal plants that helped the establishment of national specifications for the most widely used medicinal species and simple preparations. Furthermore, through the ethnobotanical and biological tests analyzed in this paper, accurate and sufficient scientific information and data have been provided to substantiate safety and efficacy of *G. lucida* species and to satisfy the requirements of the various sections in the development process of monographs and consequently the establishment of official compendia such as pharmacopoeia, formularies or legislative documents. As complete monographs of medicinal plant species listed in official compendia are one of the important elements of the brochure or dossier for requesting a marketing authorization for phytomedicine, this report has direct bearing on attempts to facilitate the establishment of quality specifications and standards by national drug regulatory authorities, as well as quality assurance and control measures leading to massive phytomedicine production across Africa, meeting modern pharmaceutical manufacturing standards. Further studies are needed to fully understand the physiological effects of bark and seeds as additive to palm wine, as well as the interaction between the bark and the stability of chemical antibiotic drugs in pharmacy. Furthermore, no pharmacological evidence was found to support the aphrodisiac or stimulant properties, as well as the antidote to snake bite and several others utilizations, indicating that *G. lucida* is still a good candidate for further biological research leading to drug discovery and innovation.

Wageningen. It is author's sincere hope that information of this paper will be useful to pharmacist students and to all who are expected to valorise the vast resources of African medicinal plants and care about health in African regions. We also thank the anonymous reviewers for their precious comments.

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Annex 1. Phytochemical composition and Bioactivities of *Garcinia lucida* crude extract.

Plant Parts studied	Components	Bioactivities of crude extract	References
Seeds, leaves, bark	bioflavonoids, anthocyanins, saponins, carbohydrates, triterpenes and derivatives of cycloartane Three cycloartanes: 30-hydroxycycloartenol, 31-norcycloartenol and 24,25-epoxy-31-norcycloartenol (mixture of epimers)	Intermediate in the biosynthesis of phytosterols	Nyemba <i>et al.</i> (1990) Etounou (1991)
Bark, leaves, seeds	Cycloartane derivatives and triterpene pentacyclane	Anti-inflammatory; anti-acids; antibacterial	IMPM (1987)
Seeds		Inhibitory effect on curare	Kamanyi <i>et al.</i> (1990)
Bark, seeds, roots	Dihydrochelerithrine, 6-ac'etonyldihydrochelerithrine, and lucidamine [24]	Antimicrobial, β -lactamase inhibitor; cytotoxicity of fruits crude methanol extract; weak activity on leukemia CCRF-CEM and CEM/ADR5000 cells; pancreatic MiaPaCa-2 cell lines	Fotié <i>et al.</i> (2007) Gangou'e-Pi'eboji (2007) Kuede <i>et al.</i> (2011)
Seeds and stembark		Broad spectrum activity against all tested Gram-negative bacilli; Good activity on non-fermenter Gram-negative bacilli; High potency on beta-lactam-resistant	Gangoué-Piéboji <i>et al.</i> (2009)
Stem bark	Putranjivic acid 1, methyl putranjivate 3, their intermediary lactone 2,	Antimicrobial activity with good inhibitory potential against <i>Escherichia coli</i> ,	Momo <i>et al.</i> (2011)

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	friedeline 4, cycloartenol 5, 1,2-dihydroxy- xanthone 6, 1-hydroxy-2-methoxyxanthone 7, betulinic acid 8, oleanolic acid 9, β -sitosterol 10 and stigmasterol 11	<i>Pseudomonas aeruginosa</i> and <i>Candida albicans</i>	
Seeds	Alkaloids, Flavonoids, Phenols, Tannins, Anthraquinones	Antibacterial activities alone and in combination with PA β N on a panel of Gram-negative bacteria	Lacmata <i>et al.</i> (2012)
Bark, fruits	Polyphenols, Steroids, Saponins, Tannin, Flavonoids, Alkaloids, Glycosides	High Antiradical activity of the extract; nitric and hydroxyl radical scavenging activity; potent nitric oxide scavenging activity; management of diseases in which radical nitrite is directly involved; antioxidant activity; cytotoxicity activity, antimicrobial property and inhibitory effect of β -lactamase	Djacbou <i>et al.</i> (2014)