



## **In situ Inventory of Medicinal Plant Species in Democratic Republic of the Congo: A case study of two Community-Based Forests of the Ubangi Eco-Region**

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### **ABSTRACT**

A forest inventory was conducted in two community-based forests in the Oubanguian eco-region from November 2016 to May 2017 to identify therapeutically valuable phylogenetic resources and traditional knowledge associated with their use. 269 medicinal plants belonging to 24 families and 26 species have been identified. *Morinda morindoides* (13.01%), *Ricinodendron heudelotii* (12.26%) and *Triplochiton scleroxylon* (10.40%) are the most common species *in situ*. However, species such as: *Urena lobata* (0.37%), *Monodora myristica* (0.37%) and *Elaeophorbia drupifera* (0.37%) are unfortunately becoming rare in the forest. Leaves (51.73%), bark (41.22%) and stems (0.74%) are the most commonly used. Anemia (22, 66%), sexual impotence (15.60%) and malaria as well as hemorrhoid (11.87 %) are the most treated diseases. In order to protect plant biodiversity from human pressures, it is suggested the creation of a protected reserve to prevent species erosion and regulate access to these genetic resources in this eco-region for a sustainable development of community-based people.

**Keyword:** Indigenous knowledge, medicinal plants, ecosystem protection, sustainable development, Nord-Ubangi.

### **INTRODUCTION**

Since immemorial times, humans have been using plants as sources of food, cosmetics and medicines. They are part of forest genetic resources and their use is made possible through the traditional knowledge associated with them [1-5]. The Convention on Biological Diversity (CBD) was ratified in 1992 in order to stop the rate of biodiversity loss. Three key objectives have been identified, namely: biodiversity conservation, sustainable use of biodiversity components and benefit sharing [6].

The Ubangi forest massif is a biome having an area of about 40 335 km<sup>2</sup> i.e. 64.7% of the total area of Nord Ubangi Province and more than 3.15% of the Democratic Republic of Congo (DRC) total forest [7], which is rich in both plant and animal biodiversity, including the emblematic *Okapia johnstoni* [8-12]. It has been reported in the literature that nearly a third of vascular plants would be threatened to extinction if no action is taken to protect them. Tropical forest ecosystems are particularly vulnerable to anthropogenic pressures as it is the case of DRC which is a biogeographic region referred to as having mega-biodiversity, and more than 60% of its national territory is consisted of forests [13].

In addition to the eco-systemic services they provide (carbon sequestration, soil stabilization against degradation, etc.), they are also sources of bio-products used as raw materials for the food, cosmetics and pharmaceutical industries [14]. In the particular case of Nord Ubangi forest massif, the artisanal exploitation of slash-and-burn agriculture is factors which reduce the potential of this forest. Henceforth, the need to initiate studies which inventory and identify medicinal plants in the aim of their *in situ* conservation. In fact, in the particular case of the forest block of Nord Ubangi province, artisanal logging and slash-and-

burn agriculture are factors that reduce the potential of this forest. Thus justifying the need to initiate studies to inventory and identify medicinal plants for *in situ* conservation. Indeed, antimalarial drugs such as Artemisinin and Quinine as well as Taxol which is an anti-cancer drug, are chemical compounds isolated from medicinal plants [15-17].

### **MATERIAL AND METHODS**

The survey was carried out in Wambe (Molegbe) and Mangundu (Gbado-Lite) forests respectively, both located in Nord Ubangi province, DRC between November 2016 and May 2017. The forest inventory method according to DIAF [18] was used with rectangular inventory plots, centered on tracks, and contiguous between them by setting the sampling rate at 1% for a forest massif of less or equal to 50.000 ha [19]. It is questioned of a survey made in strips of 25 m wide and 200 m long or 20 m wide and 250 m long. The surveys focused on the abundance of indicator species. The field team consisted of a layering group and a group responsible for counting and additional readings. The counting operation following immediately the layering operation in the field consisted in the identification of plant species having therapeutic virtues based on the local name indicated by guides/traditional practitioners as well as botanic indicators. For each plant species with a therapeutic virtue, the following were recorded: the family of the inventoried species, its scientific name, its local name, its used organ, its mode of use and the disease treated.

### **RESULTS AND DISCUSSION**

The plant species with therapeutic virtues inventoried in Wambe and Mangundu forests in Gbado-Lite (table 1).

Table 1: List of plant species inventoried in the Gbado-Lite forest (Nord Ubangi)

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Family	Plant species			Number	Frequency Index (%)	Used part	Treated diseases
	Scientific name	Local Name (language)	Biological type				
Malvaceae	<i>Cola nitida</i> Vent.	Colatier (Français)	Tree	9	3.34	Fruits	Sexual Impotence
Gnetaceae	<i>Gnetum africanum</i> Welw.	Fumbwa (Lingala)	Liana	30	11.15	Leaves	Hemorrhoid
Fabaceae	<i>Swartzia fistuloides</i> Kalala.	Mibalisambo (Lingala)	Tree	3	1.11	Roots	Sexual Impotence
Malvaceae	<i>Ceiba pentandra</i> (L.) Gaertner	Nduru (Ngbandi)	Tree	30	11.15	Bark	-Backache - Sexual Impotence
Strombosiaceae	<i>Strombosi opsistetrandra</i> Louis & J. Léonard	Ngbanda (Ngbandi)	Shrub	3	1.11	Leaves	-Snake bite -Rheumatism
Caricaceae	<i>Carica papaya</i> L.	Payipayi (Lingala)	Shrub	3	1.11	Roots, Leaves	-Tooth decay -Worms
Urticaceae	<i>Myrianthus arboreus</i> P. Beauv.	Ngbolo (Ngbandi)	Tree	15	5.57	Seeds Leaves	-Stomachache -Angina
Moraceae	<i>Trema orientalis</i> (L.) Blume	Peesu (Ngbandi)	Shrub	2	0.74	Barks Leaves	-Hemorrhoid -High blood pressure
Rubiaceae	<i>Morinda morindoides</i> (Baker) Milne-Redh	Ngonzo konga (Ngbandi)	Liana	35	13.01	Leaves	Malaria
Apocynaceae	<i>Alstonia boonei</i> De Wild.	Gugia (Ngbandi)	Tree	6	2.23	Bark	-Amoeba dysentery -Genital Infection
Annonaceae	<i>Anonidium mannii</i> (Oliver) Engler & Diels	Mopombi (Lingala)	Tree	15	5.57	Bark	-Measles - Genital Infection
Marantaceae	<i>Palisota hirsuta</i> (Thunb.) K. Schum.	Matete (Lingala)	Herbe	23	8.55	Leaves	Amenorrhoea
Lecythidaceae	<i>Petersianthus macrocarpus</i> (P. Beauv.) Liben	Bombinzo	Tree	2	0.74	Bark	Cyst and Appendicitis
Combretaceae	<i>Terminalia superba</i> Engler & Diels	Limba	Tree	5	1.85	Bark	-Genital Infection - Parasitic infection
	<i>Terminalia catappa</i> L.	Damier	Tree	1	0.37	Leaves	High blood pressure
Meliaceae	<i>Entandrophragma cylindricum</i> (Sprague) Sprague	Sapelli/Mboyoy	Tree	9	3.34	Bark	Hepatitis
Fabaceae.	<i>Scorodophloeus zenkeri</i> Harms	Fuse (Ngbandi)	Tree	3	1.11	Leaves	-Edema ; - Stomachaches
Annonaceae	<i>Monodora myristica</i> (Gaertner) Dunal	Pomanzingo (Ngbandi)	Tree	1	0.37	Bark	- Malaria - Backache
Piperaceae	<i>Piper nigrum</i> L.	Ketsu (Lingala)	Liana	+++		Leaves	Asthma
Burseraceae	<i>Canarium schweinfurthii</i> (D. Don) H.J. Lam.	Bé (Ngbandi)	Tree	3	1.11	Leaves	Asthma
Euphorbiaceae	<i>Elaeophorbia drupifera</i> (Thonn.) Stapf	Dumé (Lingala)	Tree	1	0.37	Latex	Cataract/conjunctivitis
Rutaceae	<i>Zanthoxylum gillettii</i> (De Wild.) P.G. Waterman	Bolongo (Ngbandi)	Tree	10	3.71	Bark	Tooth decay
Urticaceae	<i>Musanga cecropioides</i> R. Br.	Vonvo (Ngbandi)	Tree	13	4.83	Leaves	Malaria
Euphorbiaceae	<i>Ricinodendron heudelotii</i> (Baillon) Pierre ex Heckel	Ngbu (Ngbandi)	Tree	33	12.26	Bark	Anemia
Malvaceae	<i>Triplochiton scleroxylon</i> K. Schum.	Gbau (Ngbandi)	Tree	28	10.40	Leaves	Anemia

As shown above, 269 plant species belonging to 24 families and 26 species as forest plant species with therapeutic virtues were identified in this study. These plant species are commonly used by the local community for the management of common diseases. The figure 1 presents the list of the most used species having therapeutic virtues used by the community of Gbado-Lite.

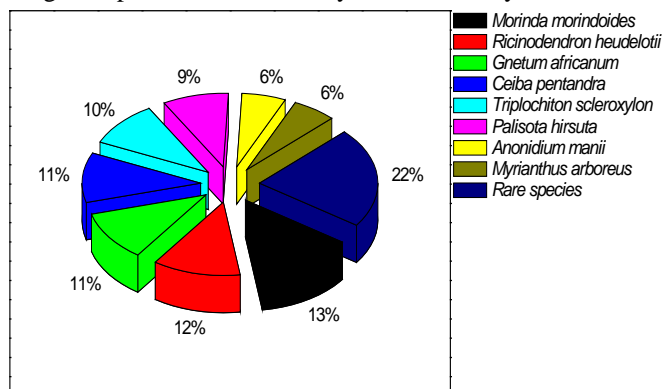


Figure 1. Frequency of the most used plant species in the Nord Ubangi Forest Massif

*Morinda morindoides* (Kongo bololo) was the most frequent virtuous species in the forests of Gbadolite (13%) followed by *Ricinodendron heudelotii* (12%), *Gnetum africanum* and *Ceiba pentandra* (both 11%), *Palisota hirsuta* (9%), *Anonidium mannii* and *Myrianthus arboreus* with 6% respectively and *Triplochiton scleroxylon* (10%). Other medicinal species used in Gbadolite phytotherapy such as *Urena lobate*, *Monodora myristica* and *Elaeophorbia drupifera* were unfortunately rare in their biotopes. Different biological types found in this forest are presented in the figure 2.

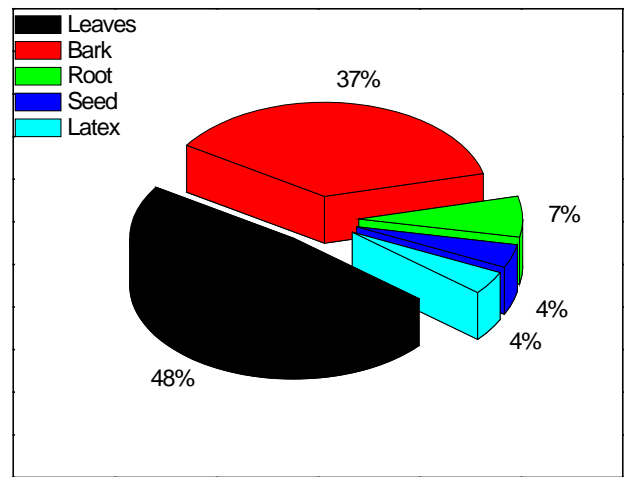
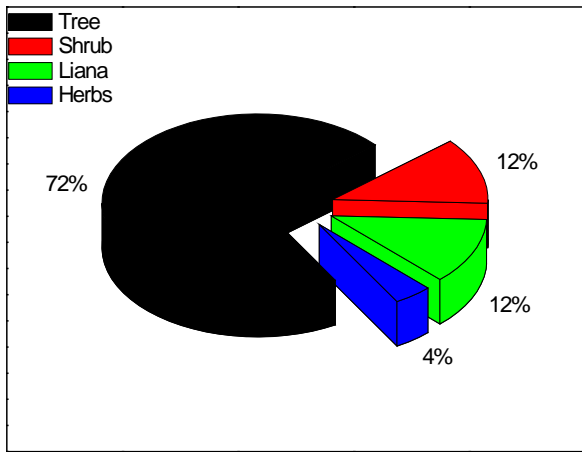


Figure 2. Biological types of plant species inventoried *in situ*  
 Regarding biological types, it can be observed from the above figure that trees (72%) are by far the most frequent biological types followed by shrubs and liana (12%) respectively and herbs (4%).  
 The different used parts of plants for therapeutic purposes are presented in the figure 3.

Figure 3. Distribution of forest species with phytochemical resources per organs used  
 As to different organs used in phytotherapy, it was observed that leaves were the most used part of different plant species (48%), followed by barks (38%), roots (7%) while Latex and Seeds represent 4% respectively.  
 In addition, it should be noted that the 26 listed species *in situ* are used in traditional medicine to treat 22 different diseases among which the following were common malaria, anaemia and sexual impotence. These results show the importance of the forest for this riverside population.  
 Figure 4 gives some medicinal plants from the Nord Ubangi forest massif.



*Ceiba pentandra*



*Ricinodendron heudelotii*



*Petersianthus macrocarpus*



*Bidens pilosa*



*Morinda morindoides*



*Trema orientalis*



*Myrianthus arboreus*



*Carica papaya*



*Zanthoxylum gillettii*



*Strombosiopsis tetrandra*



*Palisota hirsuta*



*Cola nitida*

Figure 4. Some medicinal plants from the Nord Ubangi forest massif

The plants listed in this study are also quoted in other regions of DRC and the World as having remarkable pharmaco-biological properties [20]. Plants such as *Gnetum africanum*, *Ceiba pentandra*, *Trema orientalis*, *Canarium schweinfurthii* and *Zanthoxylum gillettii* has been experimentally demonstrated for their antisickling activity *in vitro* [21-25] and they are also traditionally used to treat different diseases in Nord Ubangi province.

According to the World Health Organization (WHO), more than 80% of the African population uses traditional medicine for their primary health care [26]. Therefore, it is urgent that the process of access and benefit sharing arising from the use of phylogenetic resources and the traditional knowledge associated with their use be promoted at the community level in order to empower the local population in the management of their ecosystem.

### CONCLUSION AND SUGGESTIONS

The goal of this study was to inventory *in situ* medicinal plants of Nord Ubangi forest massif. 269 specimens belonging to 24 families and 26 species were identified. These plants treat 22 diseases among which the following diseases malaria, anaemia and sexual impotence were common. Leaves and bark are the most commonly used organs, while 22% of inventoried species became increasingly rare *in situ*. In order to protect plant biodiversity from human pressures, we suggest the creation of a protected reserve to prevent species erosion and regulate access to these biological resources in this eco-region for a sustainable development of community-based people.

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### REFERENCES

1. Ngbolua KN, Inkoto LC, Mongo LN, Masengo AC, Masens Da-Musa YB, Mpiana PT. Etudes ethnobotanique et

1. floristique de quelques plantes médicinales commercialisées à Kinshasa, République Démocratique du Congo. Rev. Mar. Sci. Agr. Vet. 2019 ; 9(1) : (Sous presse).
2. Inkoto LC, Bongo NG, Kapepula MP, Masengo AC, Gbolo ZB, Tshiana C, Ngombe KN, Iteku BJ, Mbemba FT, Mpiana PT, Ngbolua NK. Microscopic features and chromatographic fingerprints of selected congolese medicinal plants: *Aframomum alboviolaceum* (Ridley) K. Schum, *Annona senegalensis* Pers. and *Mondia whitei* (Hook.f.) Skeels. Emergent Life Sciences Research. 2018 ; 4(1):1-10.
3. Mongeke MM, Ngbolua KN, Bakola DR, Inkoto LC, Elikandani NP, Camille Y., Mouli YC. Enquête sur les plantes utilisées en Médecine Traditionnelle par les Bambenga: Pygmées du Secteur de Dongo (Territoire de Kungu, Province du Sud-Ubangi) en République démocratique du Congo. Revue Marocaine des Sciences Agronomiques et Vétérinaires. 2018 ; 6(4) : (sous presse).
4. Ngbolua KN, Mpiana PT, Mudogo V, Ngombe NK, Tshibangu DST, Ekutsu EG, Kabena ON, Gbolo BZ, Muanyishay L. Ethno-pharmacological survey and Floristical study of some Medicinal Plants traditionally used to treat infectious and parasitic pathologies in the Democratic Republic of Congo. International Journal of Medicinal Plants. 2014; 106: 454-467.
5. Ngbolua KN, Benamambote BM, Mpiana PT, Muanda DM, Ekutsu EG, Tshibangu DST, Gbolo BZ, Muanyishay CL, Basosila NB, Bongo GN, Robijaona B. Ethno-botanical survey and Ecological Study of some Medicinal Plants species traditionally used in the District of Bas-Fleuve (Bas-Congo Province, Democratic Republic of Congo). Research Journal of Chemistry. 2013; 01(02): 01-10.
6. COMIFAC. Le Protocole de Nagoya et les ressources génétiques. Cameroun, 2017.

7. PARAP. Evaluation des nécessités de création d'une aire protégée dans le massif forestier du Nord-Ubangi. Rapport de lieu, Gbado-Lite, République démocratique du Congo, 2014.
8. Ngbolua KN, Yabuda KH, Abia M, Bongo NG, Mabe K, Nzamonga GA, Masengo AC, Djolu DR, Likolo BJ, Ngemale GN, Molongo MM, Mangbukudua M, Kamienge KM, Gbatea KA, Bosanza Z, Mongeke M, Muanza LM. Preliminary ecological study of plant species of Lokame Natural Forest (Nord Ubangi Province, Democratic Republic of the Congo): A special emphasis on Non-timber Forest Products. *J. of Advanced Botany and Zoology*. 2017; 5(2): 1-6.
9. Ngbolua KN, Ambayi BS, Bongo NG, Masengo AC, Djolu DR, Likolo BJ, Gbolo ZB, Ngunde-te-Ngunde S, Iteku BJ, Mpiana PT. Ethno-botanical survey and floristic study of medicinal plant taxa used by Traditional Healers in Gbadolite city (Province of Nord-Ubangi, Congo-Kinshasa). *Journal of Modern Drug Discovery and Drug Delivery Research*. 2017; 5(2): 1-7. doi: 10.5281/zenodo/1116857.
10. Ngbolua KN, Ambayi BS, Bongo NG, Djolu DR, Nzamonga GA, Masengo AC, Koyagialo J-L, Gbatea KA, Ndaba MM, Kowozogono KR. Preliminary survey on the bushmeat sector in Nord-Ubangi Province (DR Congo): Case of Gbado-Lite city and its surroundings. *J. Advanced Botany and Zoology* 2017 ; 5(3): 1-7. doi: 10.5281/zenodo.1024570.
11. Ngbolua KN, Ngemale GM, Konzi NF, Masengo CA, Gbolo ZB, Bangata BM, Yangba TS, Gbiangbada N. Utilisation de produits forestiers non ligneux à Gbadolite (District du Nord-Ubangi, Province de l'Equateur, R.D. Congo): Cas de *Cola acuminata* (P. Beauv.) Schott & Endl. (Malvaceae) et de *Piper guineense* Schumach. & Thonn. (Piperaceae). *Congo Sciences* ; 2014 ; 2(2): 61-66.
12. Ngbolua KN, Mafoto A, Molongo M, Magbukudua JP, Ngemale GM, Masengo MC, Kondo P, Yabuda H, Zama J, Veke F. Evidence of new geographic localization of *Okapia johnstoni* (Giraffidae) in Republic Democratic of the Congo: The rainforest of "Nord Ubangi" district. *Journal of Advanced Botany & Zoology*. 2014; V2I1. DOI: 10.15297/JABZ.V2I1.02.
13. Debroux L, Hart T, Kaimowitz D, Karsenty A, Topa G. Forests in Post-Conflict, Democratic Republic of Congo: Analysis of a Priority Agenda. Center for International Forestry Research: Jakarta, 2007.
14. FAO. Contribution des ressources génétiques à la sécurité alimentaire et à la nutrition. Dernières nouvelles, Rome, 2018.
15. Ngbolua KN, Rafatro H, Rakotoarimanana H, Ratsimamanga US, Mudogo V, Mpiana PT, Tshibangu DST. Pharmacological screening of some traditionally-used antimalarial plants from the Democratic Republic of Congo compared to its ecological taxonomic equivalence in Madagascar. *Int. J. Biol. Chem. Sci.* 2011; 5 (5): 1797-1804.
16. Ngbolua KN, Rakotoarimanana H, Rafatro H, Ratsimamanga US, Mudogo V, Mpiana PT, Tshibangu DST. Comparative antimalarial and cytotoxic activities of two *Vernonia* species: *V. amygdalina* from the Democratic Republic of Congo and *V. cinerea subsp vialis* endemic to Madagascar. *Int. J. Biol. Chem. Sci.* 2011; 5 (1): 345-353.
17. Ngbolua KN, Tshibangu DST, Mpiana PT, Mudogo V, Tshilanda DD, Masengo AC, Selvaraj D, Muthiah R, Govindarajan S. Medicinal Plants from Democratic Republic of the Congo as Sources of Anticancer Drugs. *J. of Advanced Botany and Zoology*. 2018; V6I1.01. doi: 10.5281/zenodo.1162973.
18. DIAF. Normes d'inventaire forestier. Guide opérationnel. MECNT, République démocratique du Congo, 2007.
19. MEDD. Plan opérationnel d'inventaire forestier. Module de formation. Direction d'Inventaire d'Aménagement Forestier (DIAF), RDC, 2017.
20. Neuwinger HD. African Traditional Medicine. Mepharm Scientific Publisher, Stuttgart, 2000.
21. Ngbolua KN, Mpiana PT, Akoundze BJ, Mwanza BF, Tshibangu DST, Masengo CA, Liesse JM, Takaisi K6. Anti-sickling and bacterial inhibitory effects of two medicinal foods from the Congo River basin: *Gnetum africanum* Welw. (Gnetaceae) and *Grewia coriacea* Mast. (Malvaceae). *Current Traditional Medicine*. 2016; 2(1): 34-41.
22. Mpiana PT, Mudogo V, Tshibangu DST, Kitwa EK, Kanangila AB, Lumbu JBS, Ngbolua KN, Atibu EK, Kakule MK. Antisickling Activity of Anthocyanins from *Bombax pentadrum*, *Ficus capensis*, *Zizyphus mucronata*: Photo degradation effect. *J. Ethnopharmacol.* 2008;120: 413-418.
23. Mpiana PT, Ngbolua KN, Mudogo V, Tshibangu DST, Atibu EK, Tshilanda DD, Misengabu NM. Antisickle erythrocytes haemolysis properties and inhibitory effect of anthocyanins extracts of *Trema orientalis* (ULMACEAE) on the aggregation of human deoxyhemoglobin S *in vitro*. *Journal of Medical Sciences*. 2011; 11 (3): 129-137.
24. Tshibangu DST, Ngbolua KN, Lengbiye EM, Tshilanda DD, Mvingu KB, Iteku BJ, Mbala MB, Mudogo V, Mpiana PT. Chemical composition and bioactivity of *Canarium schweinfurthii* stem bark extracts from DR Congo against Sick cell disease and associated bacteria. *Journal of Pharmacognosy and Phytochemistry* 2016; 5(4): 181-187.
25. Adesina SK. The Nigerian *Zanthoxylum*: chemical and biological values. *Afr.J.Trad. Compl. Altern. Med.* 2005; 2(3): 285-301.
26. World Health Organization, 2002. Traditional medicine strategy 2002-2005..

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