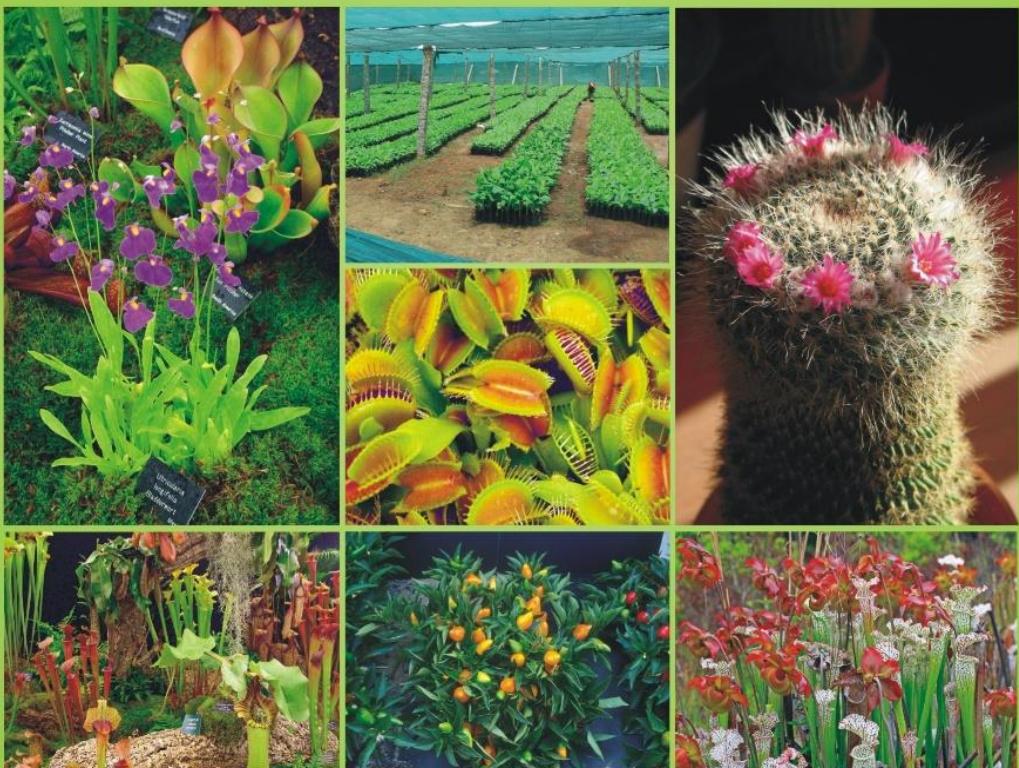




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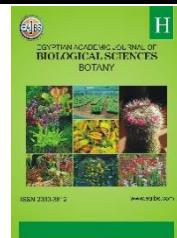
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Survey on Wound Healing Plants Traditionally Used by The Bambenga Pygmy Indigenous Peoples of Dongo Sector (South Ubangi Province) In the Democratic Republic of The Congo

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ABSTRACT

Background: Humans have used plants as a primary source of care in medicine since ancient times. Currently, about 80% of the population in southern Africa uses traditional medicine to meet their primary healthcare needs. This research was conducted with the aim of surveying ethnobotanical healing plants used by the Bambenga indigenous people of Dongo, the Democratic Republic of Congo.

Methodology: The study was conducted from May to June 2022. Semi-structured questionnaires were used to conduct the survey. Data collected included local names of plants, parts used, plant life forms, methods of preparation, and administration of plant remedies. Descriptive statistics were used to present the data in tabular and graphical forms. **Results:** Overall, 21 medicinal plant species belonging to 8 plant families were recorded to be used by Bambenga indigenous people to heal their wounds. Trees (38%), and shrubs (28%) were the most used life forms, while the leaves (48%) and bark (38%) were the most exploited parts of the plant. Incision (38%) and local application (95%) were the main method of drug preparation and administration used for the herbal recipes, respectively.

Conclusion: Herbal remedies were an important source of treatment for human ailments Dongo. Future research should explore the appropriate methods of drug preservation, preparation, and dosage of herbal remedies in order to obtain the best benefits from them.

INTRODUCTION

The use of plants for their benefits dates back to prehistoric times (Ali, 2017). Plants have always been an essential source of medicine. Even today, the majority of the world's population, especially in developing countries, relies solely on traditional plant-based remedies. Modern pharmaceutical industries themselves still rely heavily on the diversity of secondary plant metabolites to find new molecules with biological properties. This source seems inexhaustible as only a small fraction of the nearly 400,000 known plant species have been investigated phytochemical and pharmacologically, and each species may contain up to several media of different constituents (Seguen, 2014).

According to Rachel *et al.* (1997), the earliest technique used to list medicinal plants helped to identify the nature and degree of effectiveness of their actions, depending on whether they have sedative, antiseptic, or even diuretic properties. Indeed, strategies to search for natural substances or active secondary metabolisms from plants have often been based on ethnobotanical approaches, highlighting the use of these plants in traditional medicine by local people (Ali, 2017). According to the World Health Organization (WHO), more than 80% of the population in Africa uses traditional medicine to solve local health problems. The use of medicinal plants for various health problems is not only a choice but is also reportedly motivated by poverty and the high costs of modern medicines (WHO, 2002, Ngoboua *et al.*, 2011). In addition, for animals, maintaining their health is a primary concern. They use plants directly or indirectly not only for food and medicine (Mohamed, 2008). The Democratic Republic of Congo (DRC), with its cultural diversity, richness, and diversity of flora, is one of the world's reservoirs of biodiversity (Asimonyio *et al.*, 2015; Kambale *et al.* 2016; Katemo *et al.*, 2012; Omatoko *et al.*, 2012). In the field of herbal medicine, there is no data in the literature on medicinal plants used by Bambenga pygmies (Dibong *et al.*, 2011). In addition, the accelerated destruction of natural areas makes it increasingly difficult to conserve these plant genetic resources with medicinal properties. In traditional medicine, there is the concept of chronic wounds that traditional health practitioners find quite difficult to heal. These chronically infected wounds are in most cases quite debilitating and are common in rural areas where the majority of the population has access only to traditional medicine as a source of health care (CP-SRP/Equateur/Mbandaka, 2005). In order to maintain the essential functions of the skin in animals, it is very important to repair it when such an event occurs. The aim of this research is to gather information on the medicinal plants used by Bambenga pygmies to traditionally treat various wounds.

MATERIALS AND METHODS

Description of The Area:

The Indigenous People, Pygmies locally called Bambenga, who provided information on healing plants, according to their endogenous knowledge, are found in the villages Kake, Ngona, and Likpangbala. All of them are from the Groupement Lobala-Poko, Dongo Sector, Territory of Kungu, Province of South Ubangi, DRC (Fig. 1). These villages are bounded by the Ubangi River from North to South-West; the Monzombo Groupement on the river bank; and the Tando-Kombe, Motuba, Baenga, and Lobala - Sud Groupements from North to South-West.

The villages surveyed are generally included in the AW3 climate type, i.e. a climate that is half tropical in nature, characterized by the presence of a long rainy season lasting 9 months and a dry season for the rest of the year (Djolu *et al.*, 2021).

Methodology:

The survey was carried out among the Bambenga Indigenous Pygmy Traditional People, and through focus groups and individual interviews using a questionnaire, based on

the free consent of the respondents. The fieldwork was carried out between May and June 2022 (preliminary information: from 5 to 30 February 2021 and the final survey took place from 2 May to 14 June 2022). The survey was carried out according to the principles of the Helsinki Declaration. The ethnobotanical data collected from the survey forms were then completed with information on the morphological type: tree, herb, liana, etc.

The identification of the plants was carried out at the Herbarium of the Laboratory of Systematic Botany and Plant Ecology of the Biology Department of the University of Kinshasa.

Ethical Considerations:

The research protocol for this study was approved by the Ethics Committee of the Department of Life Sciences of the University of Kinshasa. The study respected the principles of the Declaration of Helsinki (free consent of respondents, etc.). All rules of confidentiality and ethics as well as the rules of access and benefit sharing (ABS) related to the use of plant genetic resources in force in the DRC were respected in this study. Respondents were informed that participation in the survey is voluntary and not subject to any coercion. They were informed that the results of this study will be returned to them in the form of open-access articles for dissemination by local leaders and their photos will be published.

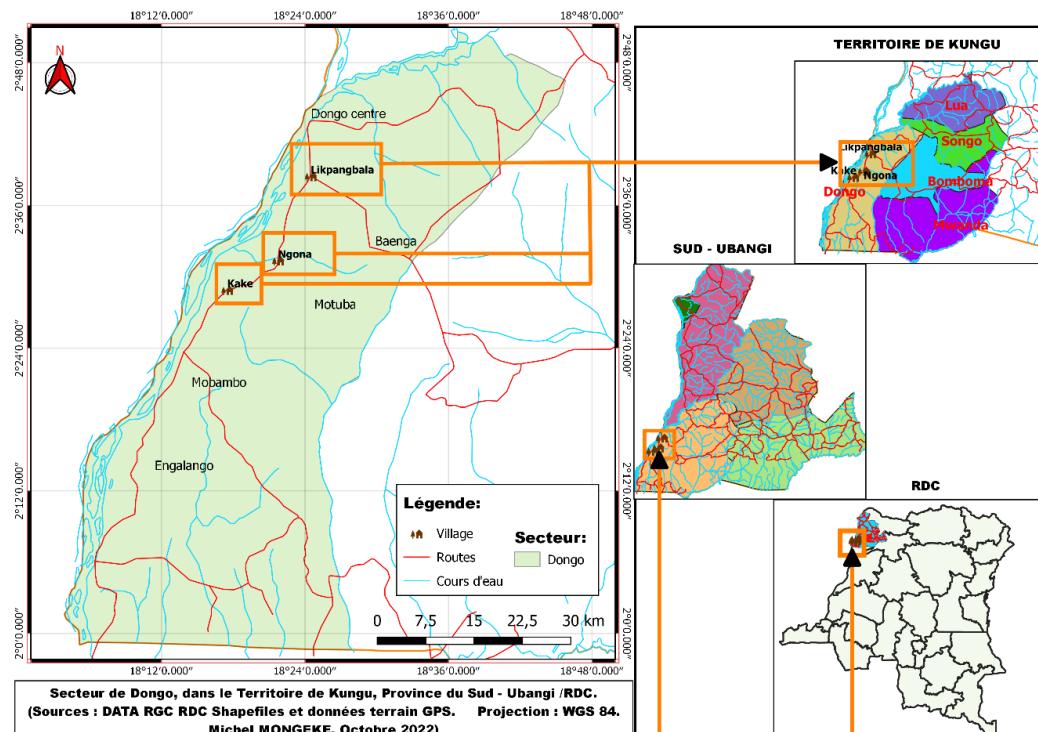


Fig. 1: Location map of Bambenga Pygmies surveyed in the three villages of Dongo Sector.

RESULTS AND DISCUSSION

Sociodemographic Data:

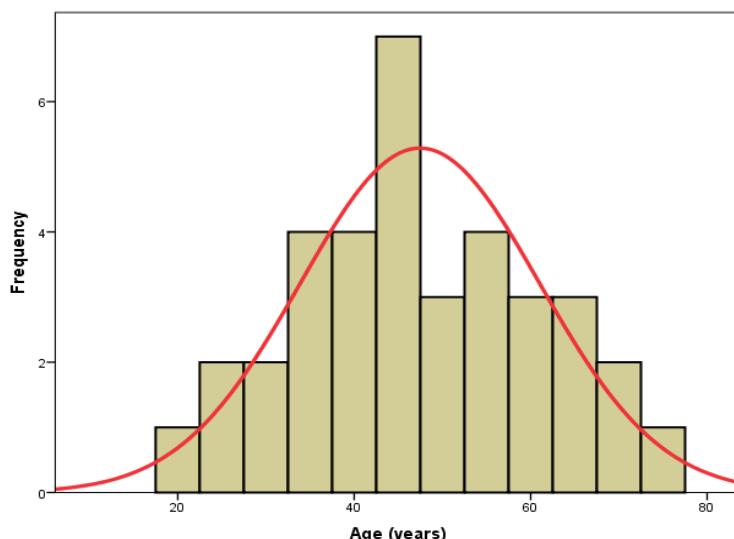
The data recorded in this survey (Table 1) reveal that men (55.6%) outnumber women (44.4%). This result may be related to the patrilineal nature of the Bambenga pygmy society in northern DRC.

The majority (38.9%) of informants were in the 31-50 age group, followed by those over 50 (33.3%) and 18-30 (27.8%) years old. Besides, the majority of informants were from Likpangbala village (38.9%), followed by Ngona (33.3%), and Kake (27.8%).

Table 1: Sociodemographic data of respondents

Variables		Frequency	Percentage
Villages	Kake	10	27,8
	Likpangbala	14	38,9
	Ngona	12	33,3
	Total	36	100,0
Age group	18 - 30 years	10	27,8
	31 - 50 years	14	38,9
	> 50 years	12	33,3
	Total	36	100,0
Gender	Female	16	44,4
	Male	20	55,6
	Total	36	100,0

Figure 2 shows that for a sample size of 36 people, the minimum age was 20 years, the maximum age was 75 years and the mean age was 47.44 ± 13.582 years. Statistical analysis according to Kolmogorov-Smirnov [ddl (36) = 0.127; p=0.152] or Shapiro-Wilk [ddl (36) = 0.983, p=0.839] shows that the age distribution of the respondents follows a normal distribution ($p>0.05$) in the population of the surveyed area.

**Fig. 2:** Age distribution of informants in the study area

Floristic Distribution:

Table 2 lists the healing plants inventoried, indicating their scientific names and vernacular names in Imbenga, family, morphological type, partly used, method of preparation of recipe, and method of administration.

The ethnobotanical inventory cataloged 21 species and 8 botanical families. Only 10 species were completely identified and the other 11 species were not. In fact, 4 morphological types of these plants were found, with also 4 different parts used, 7 modes of preparation of the recipes, and two modes of administration commonly used by the indigenous Bambenga people.

Table 2: Ethnobotanical and ecological data of healing plants documented by Bambenga "Pygmies" in the Dongo area

Nº	Scientific name (Family)	Vernacular name (Imbenga)	Morphological types	Parts used	Preparation methods	Methods Of administration
01	<i>Oncoba welwitschii</i> Oliv. (Salicaceae)	Munzokonzoko	Shrub	Bark	Incision of bark	Local application
02	<i>Manniphyton fulvum</i> Müll.Arg (Euphorbiaceae)	Mokosa	Liana	Sap	Sap extraction	Local application
03	<i>Pteridium aquilinum</i> (L.) Kuhn. (Dennstaedtiaceae)	Ezemu	Herb	Leaf	Leaf piling	Local application
04	<i>Morinda morindoides</i> (Baker) Milne-Reddy (Rubiaceae)	Kongobololo	Shrub	Leaf	Leaf decoction	Local cleaning
05	<i>Ricinodendron heudelotii</i> (Baill.) Heckel (Euphorbiaceae)	Edjiongo	Tree	Bark	Incision of bark	Local application
06	<i>Pycnanthus angolensis</i> (Welw.) Warb. (Myristicaceae)	Kolo	Tree	Bark	Incision of bark	Local application
07	<i>Piptadeniastrum africanum</i> (Hook.f.) Brenan (Mimosaceae)	Bokungu	Tree	Bark	Incision of bark	Local application
08	<i>Aichornea cordifolia</i> (Schumach. & Thonn.) (Euphorbiaceae)	Mboonzi	Shrub	Leaf	Leaf piling + Salt	Local application
09	<i>Sida acuta</i> Burm.f. (Malvaceae)	Motoku	Shrub	Leaf	Leaf piling	Local application
10	<i>Carica papaya</i> L. (Caricaceae)	Payipayie	Herb	Root	Root pestle	Local application
11	Sp. No identified.1	Mungesa	Liana	Sap	Sap extraction	Local application
12	Sp. No identified.2	Mongai	Shrub	Leaf	Leaf piling	Local application
13	Sp. No identified.3	Mumbondongo	Tree	Bark	Incision of bark	Local application
14	Sp. No identified.4	Ediki	Tree	Bark	Incision of bark	Local application
15	Sp. No identified.5	Bundu	Tree	Leaf	Leaf piling + Salt	Local application
16	Sp. No identified.6	Lisako	Tree	Bark	Incision of bark	Local application
17	Sp. No identified.7	Mopoki	Tree	Bark	Incision of bark	Local application
18	Sp. No identified.8	Mosongolondo	Shrub	Leaf	Leaf piling	Local application
19	Sp. No identified.9	Bisa	Liana	Leaf	Leaf piling	Local application
20	Sp. No identified.10	Bakolokoso, Kutukola	Herb	Leaf	Leaf piling + Oil	Local application
21	Sp. No identified.11	Sumba	Shrub	Leaf	Leaf piling	Local application

Legend: Sp. No identified: species no identified).

Morphological Types of Plants:

Figure 3 shows the morphological types of healing plants cited by the Bambenga pygmies.

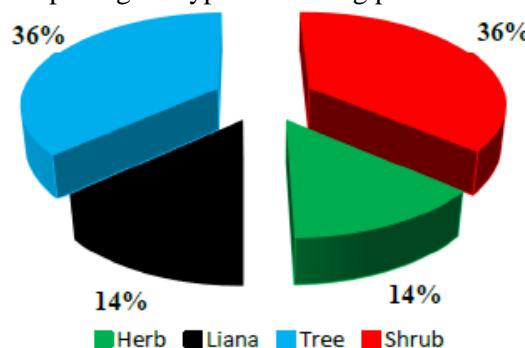


Fig. 3: Morphological types of healing plants cited by the Bambenga pygmies.

Figure 3 shows that out of twenty-one medicinal plants listed were trees (38%), shrubs (34%), herbs (14%) and lianas (14%).

However, the supremacy of tree species is very interesting, as they possess more developed anatomical and histological structures that through photosynthesis, allowing them to accumulate and synthesize more secondary metabolites responsible for their phytomedicinal properties (CP-SRP/Equateur/Mbandaka, 2005).

Healing Plant Organs:

Figure 4 illustrates information on the parts used for harvesting wound care recipes.

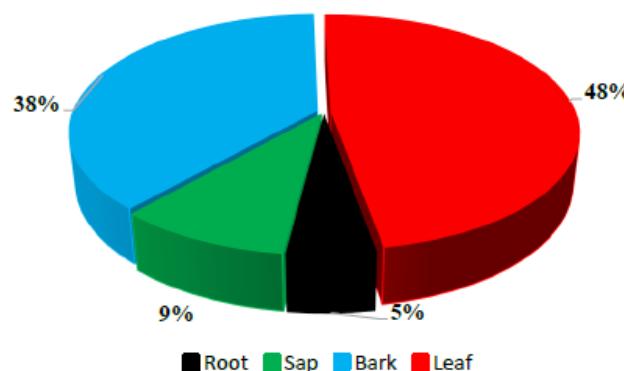


Fig. 4: Plant parts used in the preparation of therapeutic recipes (%).

Figure 4 shows that the most used plant organ is the leaf (48%), followed by the bark (38%), sap (9%), and root (5%) respectively. The use of leaves in therapeutic preparation is common in the world (Mawunu *et al.*, 2022; Lautenschläger *et al.*, 2018). The large-scale use of bark may contribute to the destruction of these plant resources (Ngbolua *et al.*, 2016).

Methods of Preparation and Administration:

Figure 5 shows the preparation methods of the plant recipes listed by Bambenga for wound healing.

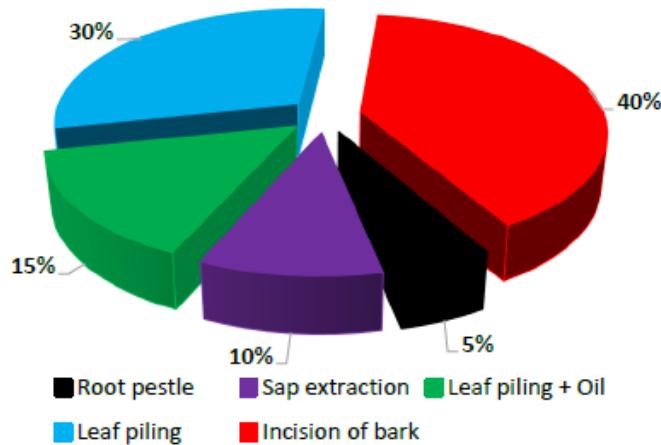


Fig. 5: Mode of preparation of the recipes for healing plants listed by Bambenga (%).

Figure 5 shows that in the 7 modes of preparation of the recipes cited by Bambenga for the healing medicinal plants listed, the most used users were the incision of the bark (38%), followed by the piling of the leaves (29%). On the other hand, sap extraction and leaf pestle + salt and sap extraction are the least used methods of recipe preparation (9%), followed by root pestle, leaf decoction, and leaf pestle + oil (5% overall).

Figure 6 shows the modes of administration of prepared recipes from the above-mentioned healing plants.

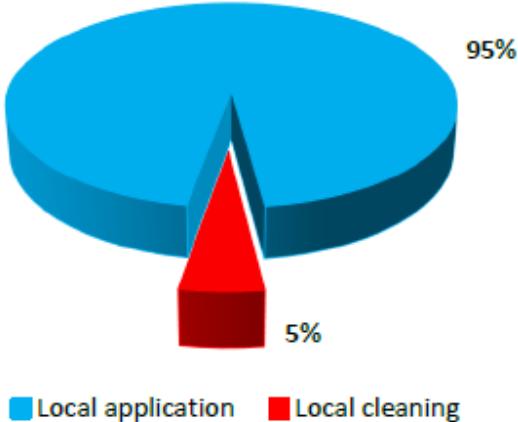


Fig. 6: Mode of recipe administration (%).

Figure 6 shows that 95% of the recipes prepared were applied locally, compared to 5% of those used for wound cleansing.

The endogenous knowledge of the indigenous Pygmy peoples on the medicinal plants used must be valued and taken into account to promote the development of this community.

In addition, tropical medicinal plants constitute natural plant resources for future generations (Dibong *et al.*, 2011). To this end, they must be incorporated into sustainable management for their rational use and exploitation, in order to improve the quality and effectiveness of their phyto and bio-therapeutic properties. Indeed, these plants can be exploited to extract secondary substances or metabolites that can be used by modern medicine as hits or for the manufacture of standardized phytomedicines that are less expensive and easily accessible to the population and indigenous pygmy peoples. As study strengths and weaknesses, the present research has inventoried a good number of value-added healing medicinal plant species and associated traditional knowledge necessary for the effective implementation of the Nagoya Protocol on access and benefit sharing in DRC. It should be noted, however, that the inventory of these plant resources concerns only a limited group of indigenous Pygmy peoples.

Frequency Of Citing Healing Plants by Respondents:

Table 3 presents the frequency of citing healing plants used by Bambenga pygmies. Table 3 shows that *Manniophyton fulvum* was the most cited plant by Bambenga pygmies (36 times), followed by *Morinda morindoides* (27 times), and *Piptadeniastrum africanum* (20 times).

Table 3: Frequency of citing healing plants used by Bambenga 'Pygmies of the Dongo sector.

Nº	TAXON (Family)	Vernacular names (Imbenga)	Citation Frequency
01	<i>Oncoba welwitschii</i> Oliv. (Salicaceae)	Munzokonzoko	12
02	<i>Manniophyton fulvum</i> Müll. Arg (Euphorbiaceae)	Mokosa	36
03	<i>Pteridium aquilinum</i> (L.) Kuhn. (Dennstaedtiaceae)	Ezemu	14
04	<i>Morinda morindoides</i> (Baker) Milne-Redh (Rubiaceae)	Kongobololo	27
05	<i>Ricinodendron heudelotii</i> (Baill.) Heckel (Euphorbiaceae)	Edjiongo	6
06	<i>Pycnanthus angolensis</i> (Welw.) Warb. (Myristicaceae)	Kolo	10
07	<i>Piptadeniastrum africanum</i> (Hook.f.) Brenan (Mimosaceae)	Bokungu	20
08	<i>Alchornea cordifolia</i> (Schumach. & Thonn) (Euphorbiaceae)	Mboonzi	7
09	<i>Sida acuta</i> Burm. f. (Malvaceae)	Motoku	4
10	<i>Carica papaya</i> L. (Caricaceae)	Payipayie	14
11	Sp.Inc.1	Mungesa	12
12	Sp.Inc.2	Mongai	10
13	Sp.Inc.3	Mumbondongo	15
14	Sp.Inc.4	Ediki	10
15	Sp.Inc.5	Bundu	8
16	Sp.Inc.6	Lisako	16
17	Sp.Inc.7	Mopoki	18
18	Sp.Inc.8	Mosongolondo	9
19	Sp.Inc.9	Bisa	7
20	Sp.Inc.10	Bakolokoso/Kutukola	7
21	Sp.Inc.11	Sumba	11

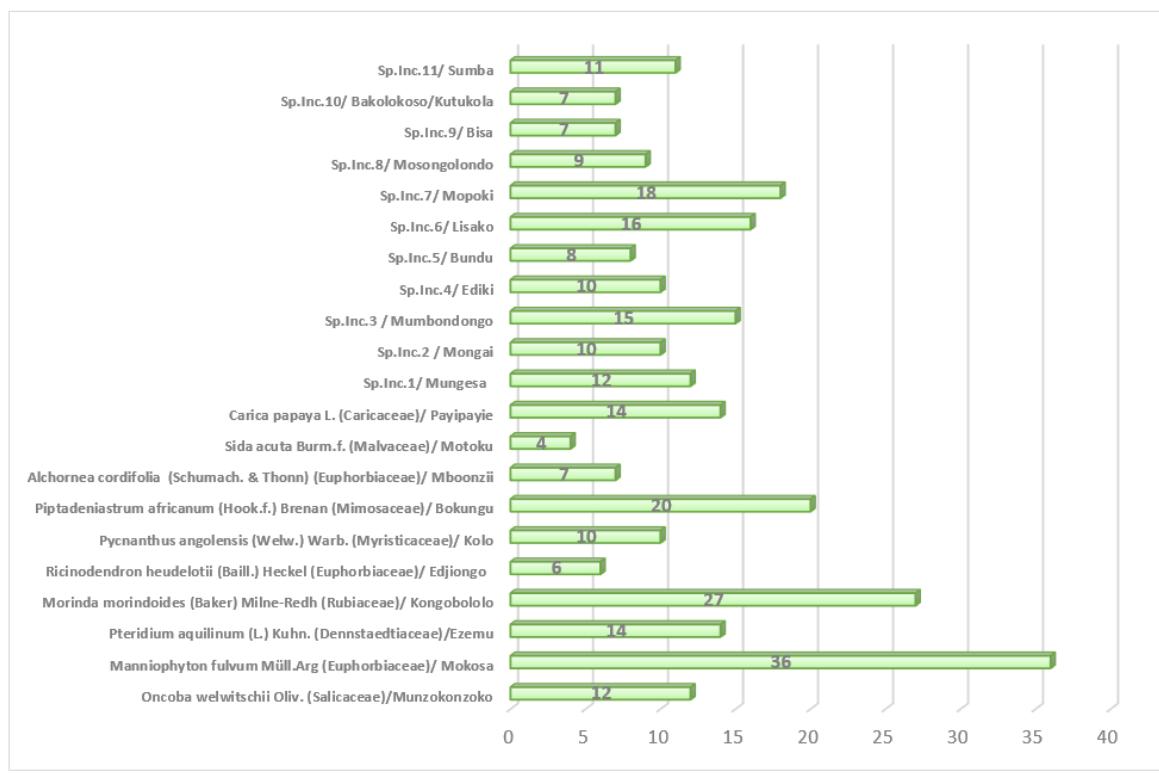


Fig.7: Frequency of citing listed healing plants used by Bambenga pygmies in the Dongo sector. *Manniophytum fulvum* was the plant most frequently cited by Bambenga pygmies (36 times), followed by *Morinda morindoides* (27 times) and *Piptadeniastrum africanum* (20 times).

Conclusions

The objective of this study was to inventory the healing plant species used in traditional medicine by the Bambenga pygmies, with a view to their approval for scientific use in future work. The study revealed that 21 species were inventoried, of which 10 belong to 8 families and 11 other species are unknown. However, *Manniophytum fulvum* was the plant most cited by the Bambenga pygmies (36 times), followed by *Morinda morindoides* (27 times) and *Piptadeniastrum africanum* (20 times). Of these plants; 38% were trees, 34% were shrubs, grasses and lianas constituted 14% respectively.

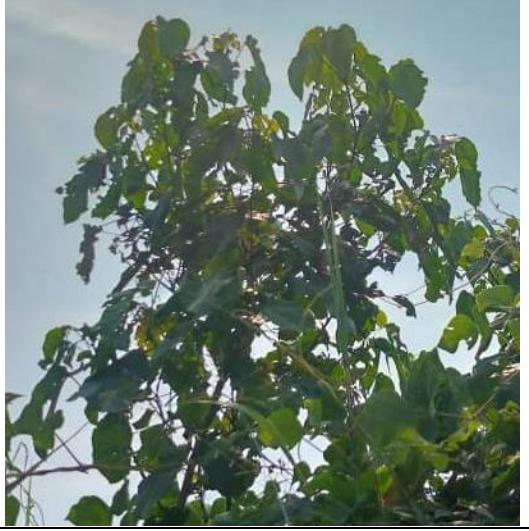
The leaf was the most used organ (48%), followed by the bark (38%), the sap (9%), and the root (5%). Grating the bark was considered the most used method of recipe preparation (38%), followed by pounding the leaves (29%). Indeed, 95% of the recipes prepared are applied locally on various wounds. This study has helped to strengthen knowledge of the traditional practices used by Bambenga pygmies for the treatment of various wounds in the Lobala - Poko group, Dongo Sector, Kungu Territory in South Ubangi. The richness of this knowledge is evident from the results obtained. However, it is desirable, on the one hand, to extend this investigation to other pygmies in the other provinces of the DRC and other tribes, in order to verify the inter-cultural transmission of this ethnomedical knowledge and know-how with a view to safeguarding it, and, on the other hand, to scientifically validate the validity of the use of these listed plants as remedies by means of in-depth in vitro studies. On the basis of this scientific evidence, it will be possible to set up rural development projects for the benefit of this Pygmy community, with a view to helping them to take charge of their own lives.

Acknowledgment

The authors thank the Bambenga pygmies for sharing their endogenous ethnomedical knowledge with scientists and humanity, as well as all those who contributed morally and financially to the success of the data collection.

Healing plants of the Bambenga indigenous people of Dongo.

	
1. Munzokonzoko	2. Mokosa
	
3. Ezemu	4. Kongobololo

	
5. Edjiongo	6. Kolo
	
7. Bokungu	8. Mboonzii
	
9. Motoku	10. Payipaye

	
11. Mungesa	12. Mongai
	
13. Mumbondongo	14. Ediki
	
15. Bundu	16. Lisako

	
17. Mopoki	18. Mosongbololo
	
19. Bisa	20. Bakolokoso/Kutukola
	
21 Sumba	

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