

Full Length Research Paper

Popular medicinal plants used by the Bantu people and Pygmies living in the administrative territories of Beni and Lubero (DRC)

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Received 4 June, 2014; Accepted 21 July, 2016

Medicinal plants occupy the most preponderant place in households in Democratic Republic of the Congo. Indeed, more than three quarters of its population depend on natural resources to survive financially and health wise, due to economic issue and inability of some modern medicines to cure some diseases. An ethno-botanical survey was conducted in Beni and Lubero territories, where Bantu people and Pygmies live. It was done to identify the plant species used by both groups (Bantu people and Pygmies) in traditional medicine. Sixty Bantu people and pygmies were interviewed about the plant species they used traditionally to treat different diseases. Sixty-three different diseases were identified among them. Recurrent diseases were: Malaria (15 species for treatment), diarrhoea (11), colic (7), internal candidiasis and yellow fever (12), migraine (3), and rheumatism (4). Ten plant species were cited mostly: *Allanblackia stanerana* (used against 18 diseases), *Dichrocephala integrifolia* (15), *R. communis* (15), *A. sativum* (14), *Achyranthes aspera* (13), *Bidens pilosa* (13), *Conyza sumatrensis* (13), *Canarium schweinfurthii* (12). The Wallis test ($\chi^2 = 10.9$; $df = 4$; $p\text{-value} = 0.028 < 0.05$) showed that the Bantu people and pygmies living in the same village in Beni and Lubero territories used different plant species as traditional medicines to treat the same diseases.

Key words: Plants, popular traditional medicine, Bantus, pygmies, Beni-Lubero.

INTRODUCTION

Medicinal plants occupy the most preponderant place in households in Democratic Republic of the Congo. This is due to the destruction of the economy of the nation,

which makes three-quarters of the population totally dependent on natural resources to survive, and the inability of some modern medicines to cure some specific

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diseases (Léonart et al., 2006; Kabangu, 1990). Congo people cannot buy modern drugs because of poverty and lack of medical structures/facilities in the villages (Olivier et al., 2002). Congo is well reputed for its richness in flora, although this is not well known in Central Africa (CIFOR, 2007).

This study took place in the administrative territories of Beni and Lubero, which are situated in the Northern part of the Province of North Kivu. This ethno-botanical study is centred on the use of plants for popular traditional medicines by the Bantu people and Pygmies living in the same villages. The two administrative territories have undergone strong demographic pressure and have known several armed conflicts, namely 'war of liberation' and 'War of aggression or occupation'. These armed conflicts have aggravated the vulnerability of the population and its dependence on the use of natural resources.

The two administrative territories are majorly occupied by the Nande ethnic group (Bantu). There are also other ethnic groups, but of less numeric importance, among which are the Piri and Pygmies (Mbuti) groups (Jongen, 1970; PNUD, 1998; Vyakuno, 2006). This co-habitation certainly permitted the exchange of knowledge of the use of medicinal plants. Thus, the study observations centre on the following question:

Do the Bantu people (Nande) and Pygmies (Mbuti) have the same level of knowledge of medicinal plants or herbal medicines, seeing that the former are generally farmers and sedentary settlers and the latter semi-nomads, hunters and fishers?

Since the Bantu people live in villages with ruderal plants and the Pygmies spend a good part of their lives in forest with so many medicinal plants, herbal medicine of the former would be different from the herbal medicine of the latter in the administrative territories of Beni and Lubero.

The aim of this study is therefore to study the common usage of herbal medicines between the Bantu people and Pygmies for treating similar ailments in their villages. It aims to discover whether there is some convergence in recourse to herbal medicine or whether each ethnic group has some kind of proper specialties.

It is worth noting that no specific research has been conducted on the issue of medicinal plants usage by the Bantu people and Pygmies living in Beni and Lubero administrative territories.¹ It is therefore paramount to investigate the convergences and divergences in the use of herbal medicine among the two tribes. Herbal medicine market is growing rapidly in Beni and Lubero administrative territories, and it generates substantial profits to the persons having knowledge of medicinal plants.

It is important to note that before colonization, most of

the farmers of the two ethnic groups used to resort to some traditional medicinal products to cure human or animals' ailments. There was easy access to these products because of their linkage to relations between members of the whole community. The service was usually paid for in kind (Mafikiri, 1998).

Nowadays, people with indigenous knowledge of herbal medicine usage have found some market in organising workshops on medicinal plant use. Trading on plants' parts (peels, roots, powder of leaves...) has become the generating activities of revenues in villages. The activity of trading in medicinal plants is seen as a relief to the population whose income is very low and does not have access to infrastructures and basic social services. Medicinal plants usage reduces medical costs, thereby making farmers to save their low incomes and only resort to modern medical centres or hospitals in case of emergency.

MATERIAL AND METHODS

Area of the study

Beni and Lubero are situated in the Eastern part of the Democratic Republic of the Congo. Among the villages in the two areas, there are six villages in which the Bantu people and Pygmies live together. These six villages were chosen because this study is an ethno-botanical investigation (Figures 1 and 2).

Lubero borders Edward Lake and is located between 28° and 30° longitude East, and 0°34' and 0°30' latitude South. Beni is located between 29° and 30° longitude East, 0°30' latitude South and 1° latitude North. This area is limited in the Northern part by Ituri District and in the Southern part by the Republic of Uganda (Kasay, 1988). According to Vyakuno (2006), the population density is high in Lubero, but very low in Beni area. The population of the two administrative territories consists predominantly of the Bantu people (Nande).

Ethno-botanical surveys

The ethno-botanical survey was conducted in six villages where the two ethnic groups, Bantu and Pygmies live together. Ethno-botanical survey is recognized at *Pharmacognostic* level as the most efficient method for collecting data, and is not financially demanding (Balick, 1990; King and Tempesta, 1994; Cotton, 1996; Betti and Lejoly, 2009). Data were collected with a standardized questionnaire containing list of traditional medicines and pharmacopoeia (PHARMEL data) (Adjanohoun et al., 1994).

The method utilised to collect data is essentially based on pre-established questionnaire. A sample of 120 persons, most of them heads of households in the two ethnic groups, was interviewed. The informants (males and females) were chosen at random, taking 60 from each ethnic group. Although all the informants are aged between 20 and 70, they were divided into four subgroups. The subgroup of the informants aged between 31 and 40 was the most cooperative of all the four. The data obtained from the different households were supplemented by information gleaned during group discussions. During the collection of data, the focus was on diseases treated in the traditional way, herbal plants used to cure them, the methods used in preparing the traditional medicines used, their mode of administration and pharmaceutical presentation.

Most of the plants included in the present study and referred to

¹ Hereinafter 'Beni and Lubero administrative territories' will be referred to as 'Beni and Lubero'.

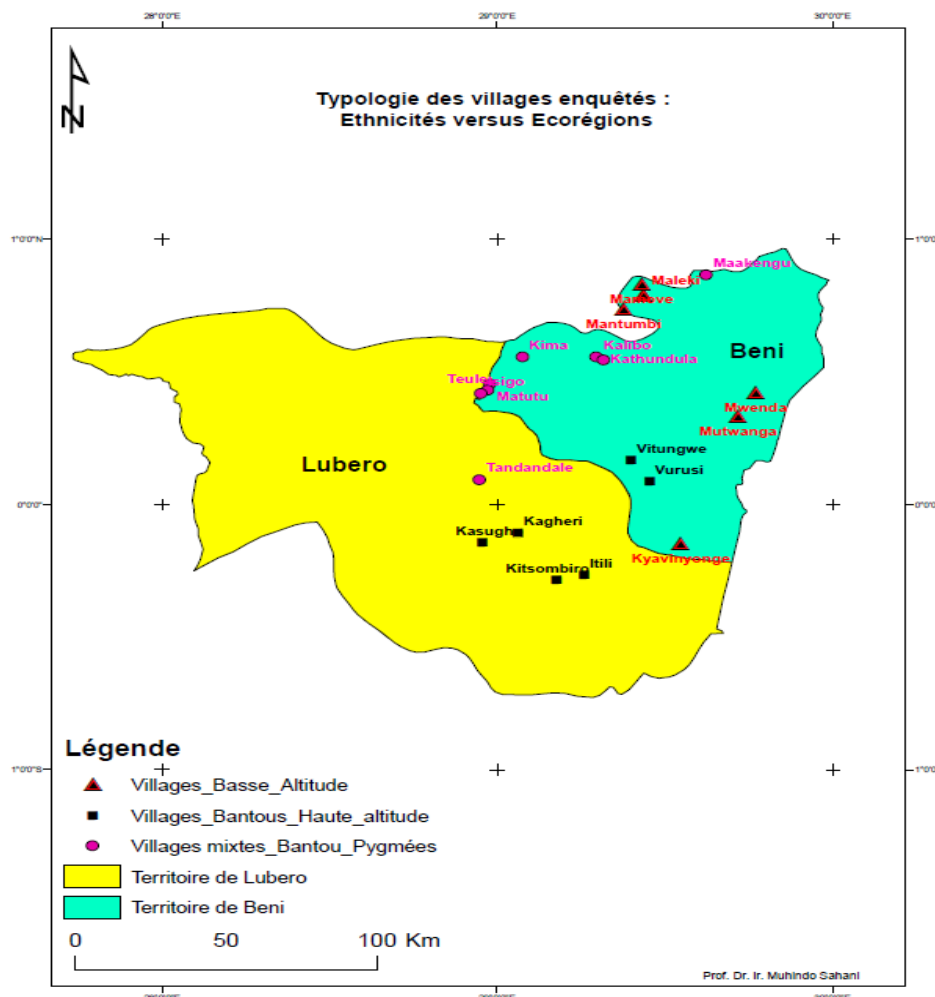


Figure 1. Map of the surveyed villages.

by respondents were recommended by Professor Kamabu Vasombolwa of the University of Kisangani. Those medicinal plant species not recognised by the professor were sent to the Botanical Laboratory of the University of Kisangani for them to be recommended by an expert, Mr Kombozi. Those specimens that were not recognised were not included in the present study; they are left available for further analysis. The result obtained from the respondents of the two ethnic groups was compared to that obtained by other African researchers' studies on similar therapeutic usage of plants.

RESULTS

Treated diseases

From the study, the Bantu people and Pygmies, using medicinal plants traditionally treated 63 diseases. Both members of the two ethnic groups mentioned used medicinal plants to treat forty-five of these diseases. The most recurrent diseases pointed to by at least 20% of the respondents for the two ethnic groups are: Malaria

(treated on average by 9 plant species by Bantu people and 6 by Pygmies), diarrhoea (5 plant species by Bantu people and 6 by Pygmies), gripes (5 plant species by Pygmies and 2 by the Bantu people), candida and yellow fever (6 plant species), migraine (3 plant species) and rheumatism (4 plant species).

The Jaccard similarity coefficient (or Jaccard Index), which is 72.58%, has shown that, popular traditional medicine of the Bantu people and Pygmies addresses diseases the same way and ethnic specificities are, in general, less remarkable. However, specific ways of treating specific diseases do exist. Thus, Pygmies are specialized in the treatment of hepatomegaly (liver enlargement), ovary cysts, toothaches and sterility.

Malaria is the disease mostly treated with medicinal plants, in Beni and Lubero area. Thus, a total number of 9 species of medicinal plants were used by the Bantu people and 7 by Pygmies to treat malaria. The two ethnic groups seem to use at least five (5) different herbal medicines to treat 18 different diseases, among which

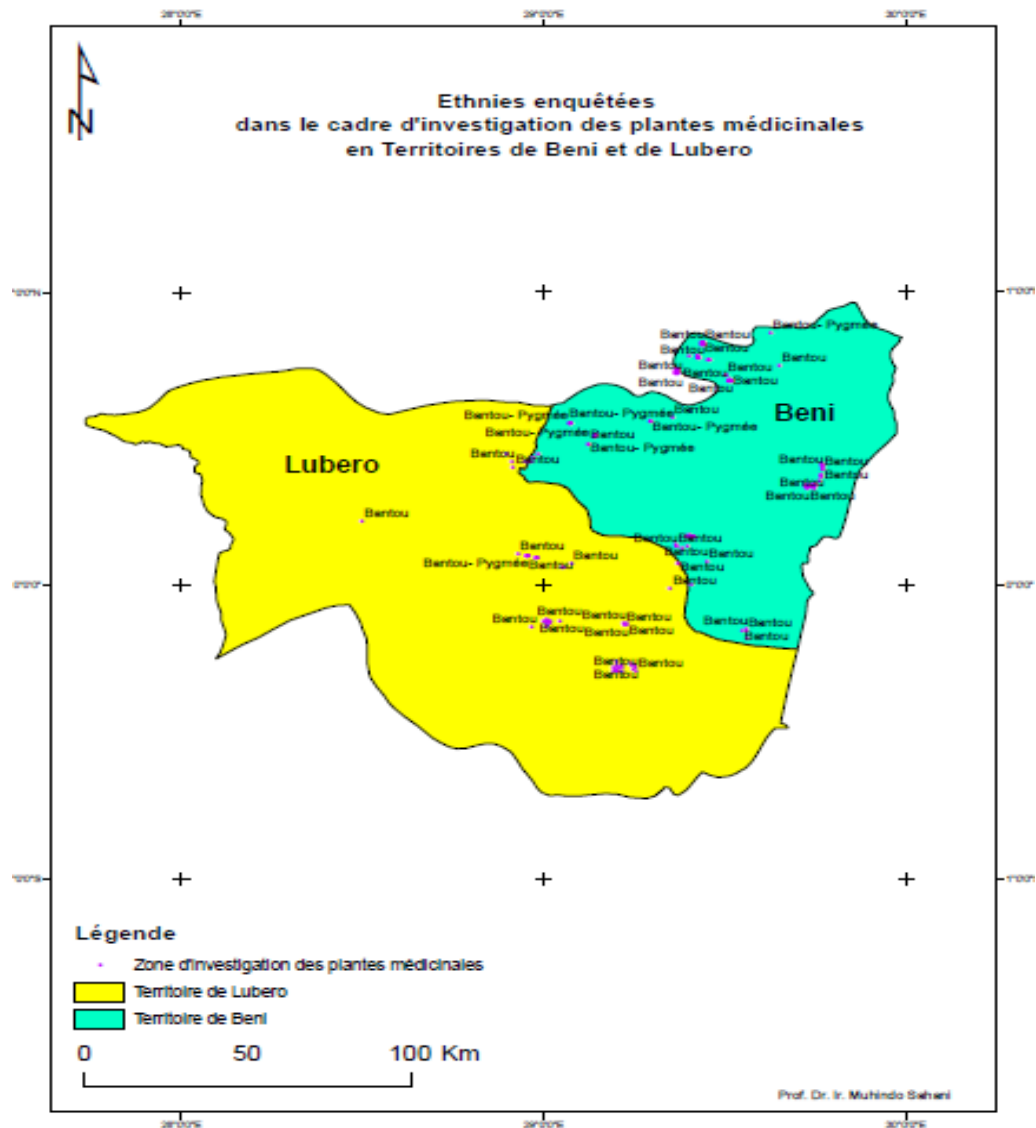


Figure 2. Map of distribution of the two ethnic groups in the surveyed villages.

one should mention epilepsy (5 recipes are used).

General characteristics of medicinal recipes

The Bantu people and Pygmies of the six villages resort to respectively 341 and 239 medicinal recipes among which 53 remain similar. In general, the two groups mentioned 15 preparations. In both groups, aqueous preparations predominate. Decoction is the medicine preparation mostly used by them, followed by trituration and extraction. Figure 3 shows variation in medicinal preparations between both groups. The two adjoined boxes of dispersion respectively represent the frequencies of every medicinal preparation methods for both groups.

The Wallis test ($\chi^2 = 99.9$, $df = 14$, $p\text{-value} = 4.863e-15$)

< 0.05) demonstrates that there must exist some meaningful differences between the methods of preparing medicines by the Bantu people and Pygmies, though they live in the same village. On the other hand, statistical analysis of frequencies of medicine preparation does not show any difference between the six investigated villages. Indeed, $P = 0.84$ value is superior to 0.05. Twenty-six pharmaceutical different presentations of herbal medicine were identified in the 6 villages (Figure 4). The choice of one or other pharmaceutical presentation depends on the patient's state, the emergency of the case and the organ involved. There is no certitude on how the different pharmaceutical presentations found in Beni and Lubero are shared between the Pygmy and Bantu people living together in the area. The analysis of the figure shows a meaningful

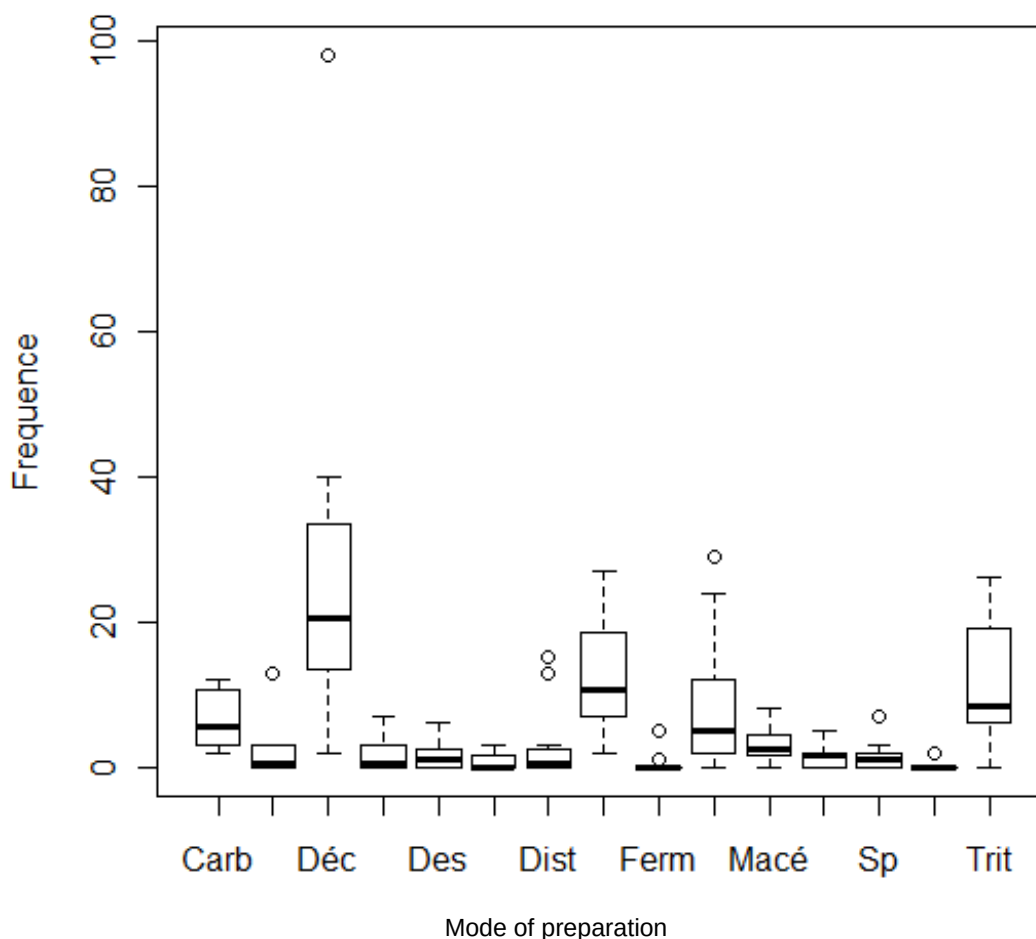


Figure 3. Variation in methods of medicine preparation between Bantus and Pygmies of the 6 villages where they live together (Legend: Carb = carbonization, Déc = Decoction, Des = Desiccation, Dist = Distillation, Ferm=Fermentation, Macé = Maceration, Trit = Trituration).

difference in pharmaceutical presentation between the two groups living in the same village. The P - value used for the frequency independence test ($2.2e-16$) is very low, 0.05. There are 17 ways of administering herbal medicine to patients. Oral ingestion is the most frequently used, with a rate of 53.45% among the Bantu people and 38.9% among the Pygmies. Figure 5 shows variations in ways of administering medicine to patients between the two groups living in the same villages.

The methods of administering medicine to patients vary considerably between the two communities. The analysis of χ^2 reveals 124.5, with $df=16$ and $P-V = 2.2e-16$. The value is very lower compared to the critical value of 0.05.

Floristic composition and convergences of plants' usage

Among 290 plant species whose medicinal virtues are recognized in traditional medicine of the two groups, 10

species are involved in the treatment of at least 10 different diseases in Beni and Lubero areas (Table 1). These most popular plants are: *Allanblackia stanerana* (18), *Dichrocephala integrifolia* (15), *Ricinus communis* (15) and *Allium sativum* (14). One specie, *Allanblackia stanerana*, is used by both groups alike in more than 5 villages, and two, *Conyza sumatrensis* and *Harungana madagascariensis*, in more than 3 villages. Ruderal plants were mostly used (40 %); forest plants, especially ligneous plants represent about 30% of species. The Pygmies who border forest area mostly use Forest species, whereas the Bantu people mostly use ruderal species.

Common therapeutic

The ethno-botanical investigations in the six villages where Bantus and Pygmies live together contributed to the identification of five disease groups treated using

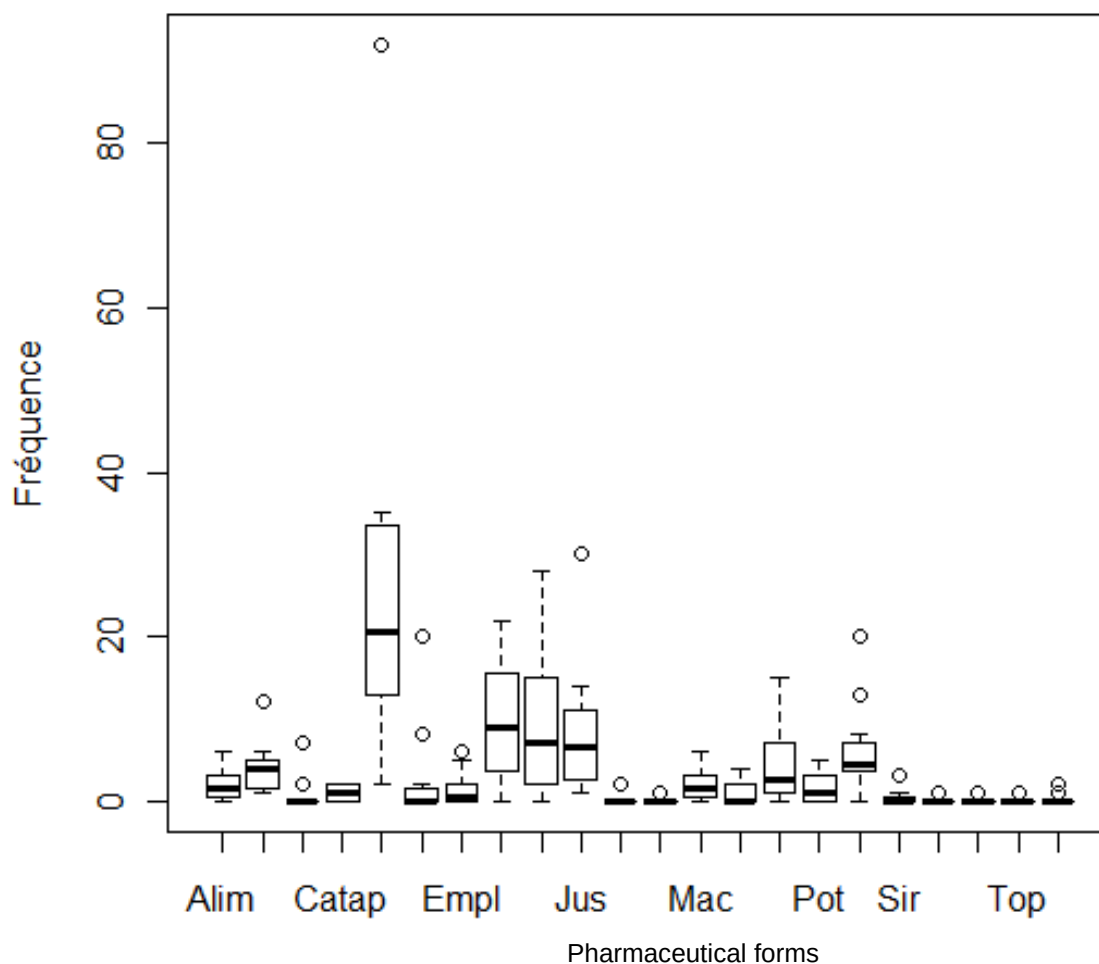


Figure 4. Variation of different pharmaceutical presentation frequencies (Legend: Alim = Food, Catap = Poultice, Empl = Plaster, Jus = Juice, Mac = Macerated, Pot = Potion, Sir = Syrup, Top = Topical).

herbal medicine or popular medicinal plants. Diseases are treated differently by both groups in the six villages (Table 2). The Jaccard similarity coefficients obtained in comparing villages are below 50% in five villages out of six taken into account. However, 57.69% was recorded in Tandandale village, situated in Lubero. This convergence is due to the sedentary life of the Pygmies living in the village who have the tendency to use ruderal species similar to those used by the Bantu people.

Infectious and parasitic diseases

The fact that infectious diseases spread over all the six villages and showed no differences from one village to another, it is important to test whether there are any convergences between the two groups in their struggle to control infections. Figure 6 visualizes such affinities. The factorial correspondence analysis (Figure 6) shows that the Pygmies from two villages (Kalibo and Isigo) and the

Bantu people from Isigo have similarities in the treatment of malaria and yellow fever. The Bantu people from the 4 villages (Maakangus, Kalibo, Tandandale and Kathundulas) have positive outcomes in the treatment of internal Candida. Six diseases, namely typhoid fever, shingles, amoebiasis, dysentery, tuberculosis and scabies are treated differently by members of the two ethnic groups.

Signs and states of non-defined morbidity, traumatic symptoms and poisoning

The first two axes show 61% of total inertia; in other words, 61% information contained in Figure 7 is summarized by the first two measurements. We will therefore only present in more details the interpretation of the results in relation to these two factorial axes. On one hand, the Pygmy people living in Kima and Maakengu villages, and the Bantu people of Kalibo village have

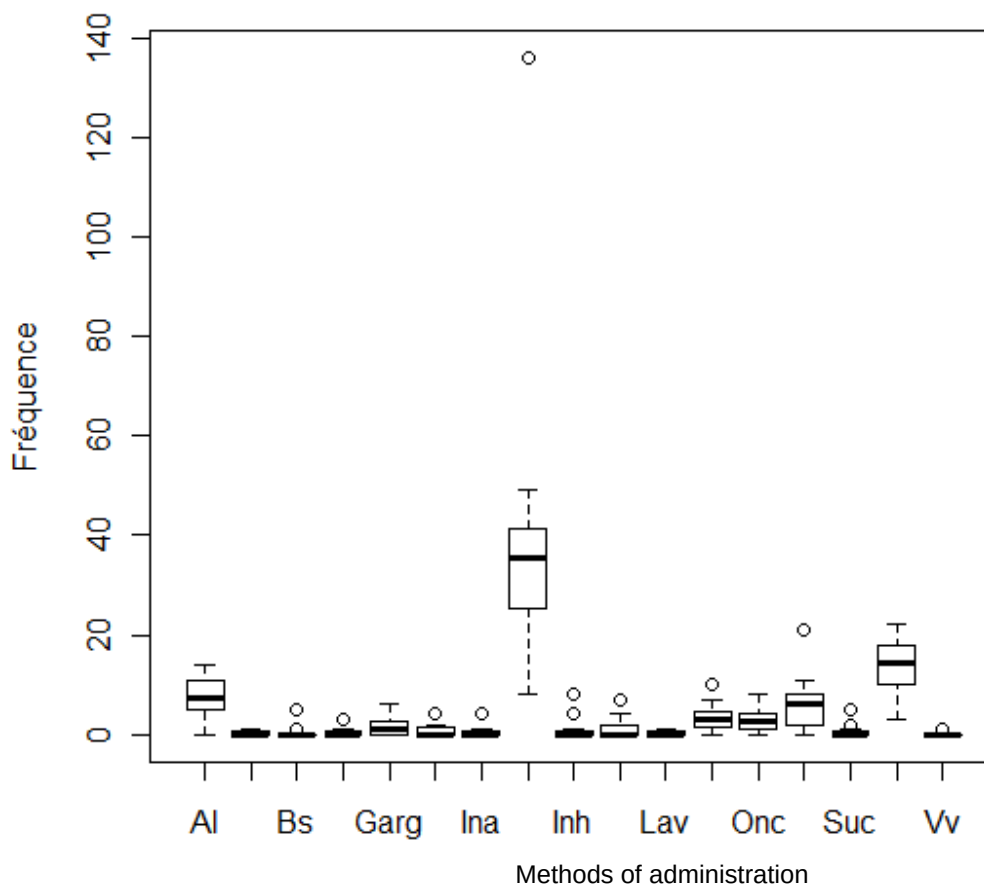


Figure 5. Ways of administering medicine to patients in investigated villages (Legend: Al = local Application, Bs = anal and buttocks bath, Garg = Gargle, Ina = nasal Instillation, Inh = inhalation, Lav= enema, Onc = Uction, Suc = suck, Vv = vaginal).

Table 1. Plant species involved in the treatment of at least 10 different diseases.

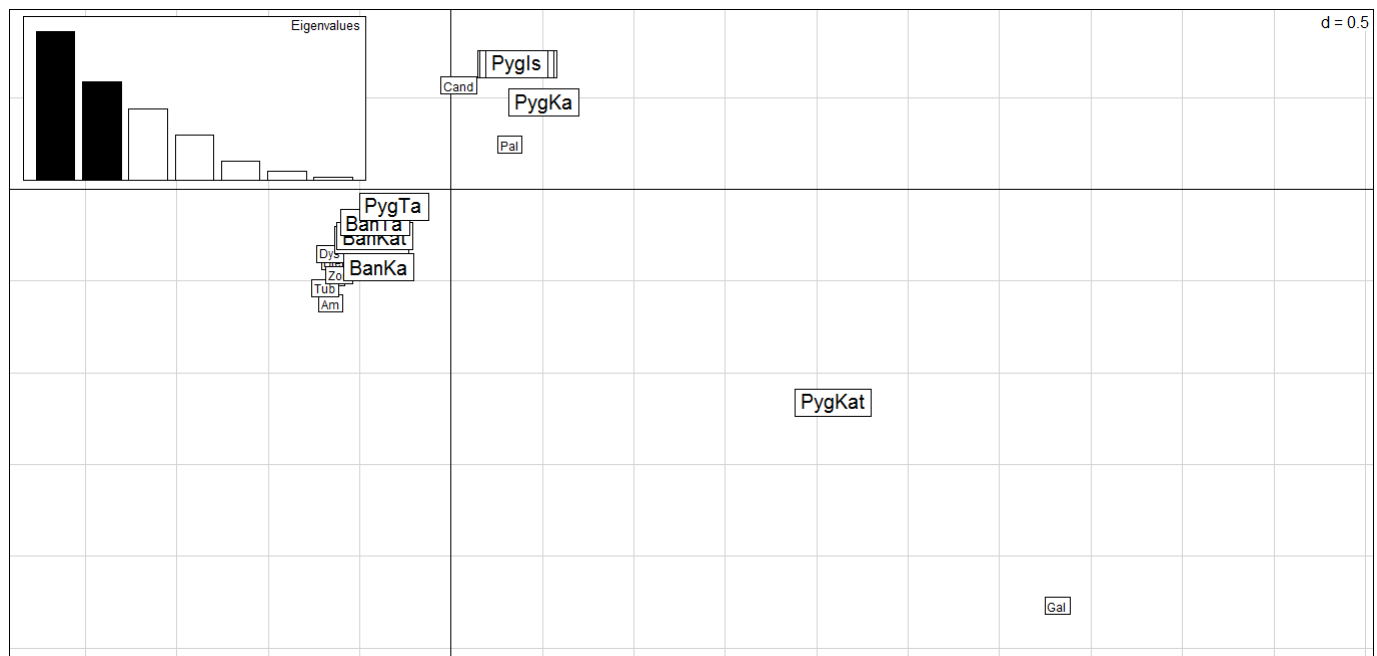
Specie	Flora family	Biotope	Number of villages	
			Bantu	Pygmy
<i>Achyranthes aspera</i>	Amaranthaceae	Fallow	1	1
<i>Allanblackia stanerana</i>	Clusiaceae	Secondary Forest	5	6
<i>Allium sativum</i>	Liliaceae	Garden	1	1
<i>Bidens pilosa</i>	Asteraceae	Fallow	1	1
<i>Canarium schweinfurthii</i>	Burseraceae	Secondary Forest	2	3
<i>Conyza sumatrensis</i>	Asteraceae	Fallow	6	4
<i>Dichrocephala integrifolia</i>	Asteraceae	Fallow	2	1
<i>Harungana m.</i>	Hypericaceae	Secondary Forest	4	3
<i>Psidium guajava</i>	Myrtaceae	Garden	2	0
<i>Ricinus communis</i>	Euphorbiaceae	Garden	0	1

some strong convergences in the treatment of HIV/AIDS related symptoms or ailments affinities, as well as in the treatment of diseases provoked by abortion. The two ethnic groups are very divergent in their treatment of poisonings and wounds. On the other hand, the Bantu

people living in Isigo and Kima villages do not treat snake bites, food allergies and fractures similarly. This finding shows that the Bantu people and Pygmies have similar ways of treating HIV / AIDS related ailments in Beni-Lubero villages where they live together. Any other non-

Table 2. Comparison of numbers of diseases treated in medicine of Bantus and pygmies in the 6 mixed villages.

Villages	Numbers of proper disease			
	Bantu	Pygmy	Common to 2 groups	Jaccard index
Isigo	30	22	4	19.04
Tandandale	25	16	15	57.69
Maakengu	31	24	16	41.02
kima	30	22	4	8.33
Kalibo	29	18	13	39.39
Kathundula	36	16	6	13.04

**Figure 6.** Representation of correspondences of infectious and parasitic illnesses across villages.

defined symptoms of ailments are treated differently in villages included in the present study.

Digestive system diseases

Figure 8 shows how digestive system diseases are treated throughout the villages of Beni and Lubero area. The analysis of the figure shows that ethnic groups living in the same village resort to different plants to treat digestive system diseases.

Diseases of the urogenital system

Figure 9 shows how the diseases of the urogenital system are treated throughout by the two ethnic groups (Bantu people and Pygmies) of Beni and Lubero villages. The analysis of the representation earlier

mentioned reveals a strong similarity between the Pygmies of the Tandandale and Kima villages in the treatment of urogenital diseases such as sexual impotence and miscarriages. The Bantu people living in Kathundula and Maakengu villages address dysmenorrhoea and metrorrhagia in the same way they treat other kinds of bleeding. It is therefore clear that there is a divergence in the treatment of urogenital diseases. This may be explained by the fact that the ethnic groups seem to have expertise in some specific urogenital diseases. Thus, Pygmies treat more efficiently sexual impotence, whereas the Bantu people address well any vaginal bleeding.

Skin and joints diseases

Figure 10 represents how different groups of the Bantu people from different villages address skin and joints

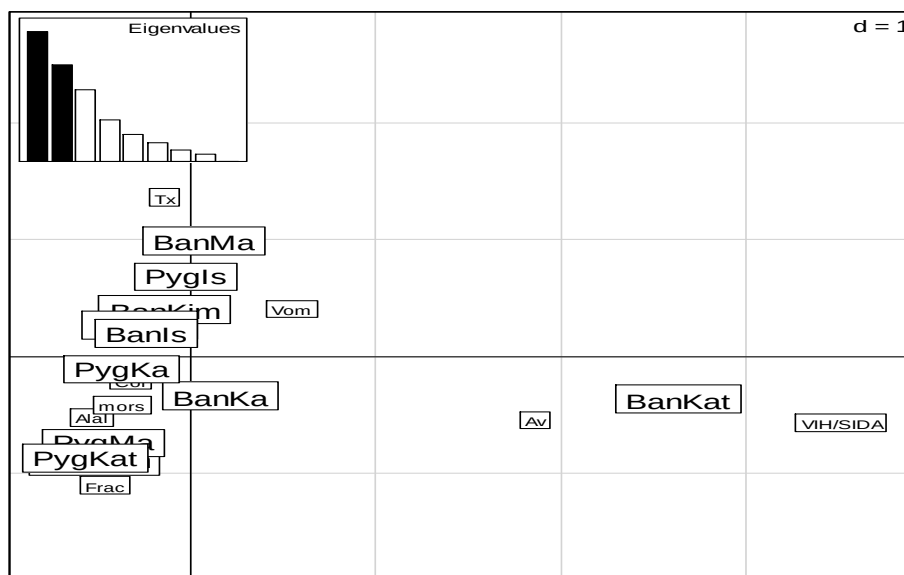


Figure 7. Representation of the correspondence analysis of morbidity signs and poisoning treated by Bantus and Pygmies.

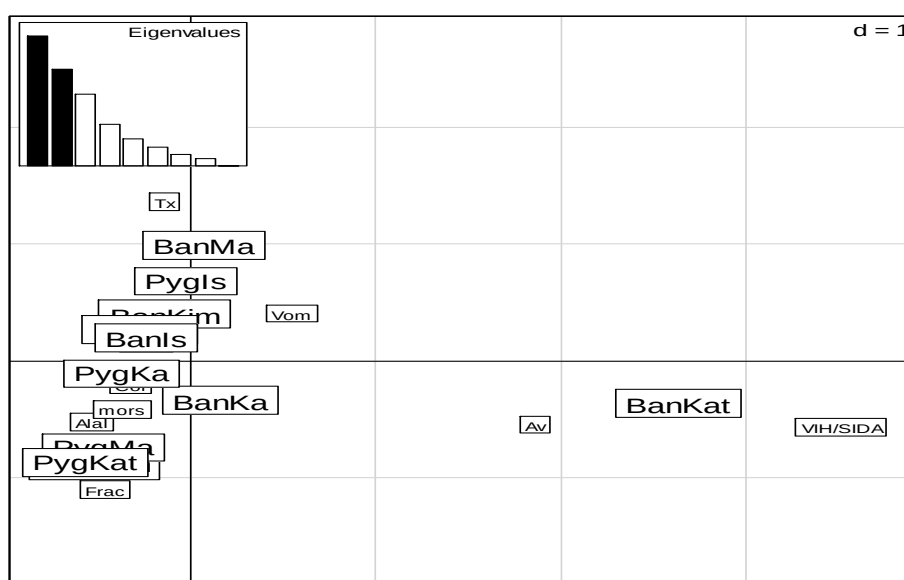


Figure 8. Representation of the Correspondence analysis of digestive system diseases treated by Pygmies and Bantus of Beni and Lubero areas

diseases.

From the figure above, one may conclude that the two ethnic groups throughout the villages differently treat abscesses. However, Lumbago and Whitlow remain a speciality of Pygmies; the Bantu ethnic group more frequently treats gout and myositis. The disease causing swollen joints (Gout) and that of muscle inflammation and soreness are considered to be caused by excessive consumption of red meat coupled with sedentary life of Bantu people and lack of physical exercise. Indeed,

Pygmies eat regularly red meat but as they actually move on feet and walk long distances a day, gout and myositis are rare among them.

Number of plants used by Bantu people and Pygmies living in the same village

Table 3 gives, from the Jaccard Index, the indication of similarity of plants used in different herbal medicines

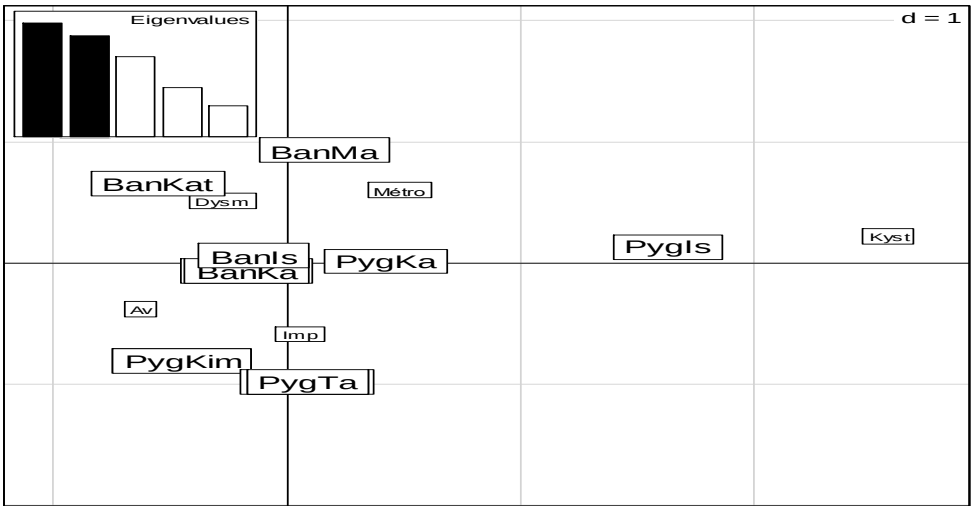


Figure 9. Representation of the AFC of the uro-genital system treated throughout the villages investigated.

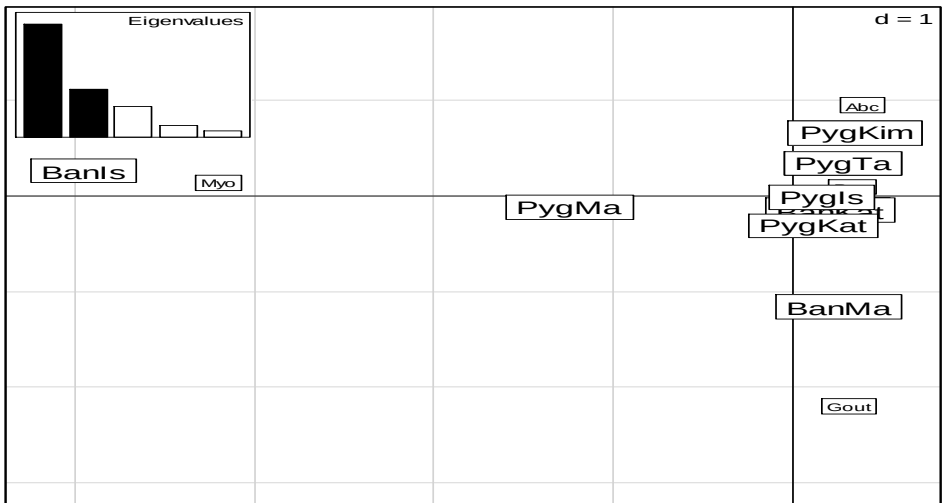


Figure 10. Representation of the AFC of skin and joints diseases treated throughout the villages.

used by the Bantu people and Pygmies living in the same villages. It is evident from the analysis of this table that the calculated values are below 50%. The authors therefore conclude that the Bantu people and Pygmies living in the same village do not use the same plants in their traditional medicine.

Number of therapeutic preparations used in the same village

Numerous therapeutic preparations have been identified in popular traditional medicine per village in Beni and Lubero administrative territories. The Bantu people have

resorted to 341 different therapeutic preparations, which are specific to this group alone, whereas 239 therapeutic preparations are specific to the Pygmy ethnic group. The two groups do use in common 53 therapeutic preparations. Since the Jaccard coefficients of similarity are very low (50%) (Table 4), the two groups do not have similar therapeutic preparations, despite the fact that they live in the same village.

Species of plants used against recurrent diseases

The analysis of the plant species against recurrent diseases in Figure 11 shows that *Harungana*

Table 3. Comparison of plants used in traditional medicine by Bantus and Pygmies per village.

Villages	Number plant species used by each ethnic group per village			
	Bantu	Pygmy	Common to both ethnic groups	Jaccard index
Isigo	60	21	17	17.34
Tandandale	47	19	7	9.58
Kima	69	34	22	17.6
Kalibo	44	25	12	14.81
Kathundula	63	41	12	10.34
Maakangu	38	33	32	31.06

Table 4. Comparison of therapeutic preparations used by Bantus and by pygmies of 6 villages.

Villages	Number of therapeutic preparation			
	Bantu	Pygmy	Common to the both ethnic groups	Cj
Isigo	54	43	8	0.76
Tandandale	38	28	11	0.14
Maakengu	50	48	11	0.1
Kima	61	45	10	0.08
Kalibo	50	31	7	0.07
Kathundula	88	44	6	0.04

madagascariensis, and *Allanblackia stanerana* are the herbs mostly used against malaria, whereas the plant species *Conyza sumatrensis*, *Allium sativum* and *Dichrocephala integrifolia* correlate negatively with the main axis and present lower values. They therefore intervene in the treatment of migraine and rheumatism. Colic and yellow fever are usually treated by *Conyza sumatrensis*, *Harungana madagascariensis* and *Allanblackia stanerana*. *Bidens pilosa*, *Allanblackia stanerana* and *Ricinus Communis* negatively correlate with the second axis and are used to treat diarrhoea. The plant species, *Allanblackia stanerana* is signalled everywhere for its efficiency against gripes. *Canarium schweinfurthii*, *Allium sativum*, *Dichrocephala integrifolia* and *Harungana madagascariensis* are mostly used against yellow fever, migraine and rheumatism. From the distribution of the plant species involved in 10 therapeutic preparations used for the ten different recurrent diseases, diarrhoea, yellow fever, rheumatism, and migraine are the most important.

Classification based on treatment of ailments or symptoms

The dendrogram (Figure12) regroups the data from a matrix of 33 lines of combinations of villages and plant species used in the treatment of recurrent diseases and of 6 columns of such recurrent diseases. The

hierarchical classification of resemblance, based on the method of Ward (Euclidian distance), the popular traditional medicine of the two groups in the six villages investigated reveals six classes of similarity at the level of terminal knots (100% of similarity). There are five (5) Bantus-Pygmies classes and one (1) Pygmy class. The highest level (97% similarity) in four (4) groups is identified: one group of Bantus, one of Pygmies, and two groups of both Bantu and Pygmies. At 90% of similarity, the diagram reveals 3 classes of Bantu-Pygmies together. At the highest level of the tree (85% of similarity), two (2) classes of Bantu - Pygmy are perceptible. The independence test based on ethnic groups and the treatment of recurrent diseases factors (Wallis test) result in: $\chi^2=16, 7$; $df= 9$, $P\text{-value} = 0.054 > 0.05$. It can be deduced from Wallis test that the difference in the treatments of recurrent diseases is not significant.

Classification based on species used in Bantu and pygmies traditional medicine

The dendrogram (Figure13), which shows intermediate groups according to the use of plant species, summarizes the matrix of 12 groups of maintenance and 10 plant species used in more than 10 different therapeutic preparations. The classification based on the square Euclidian distance, using the method of Ward, allows one

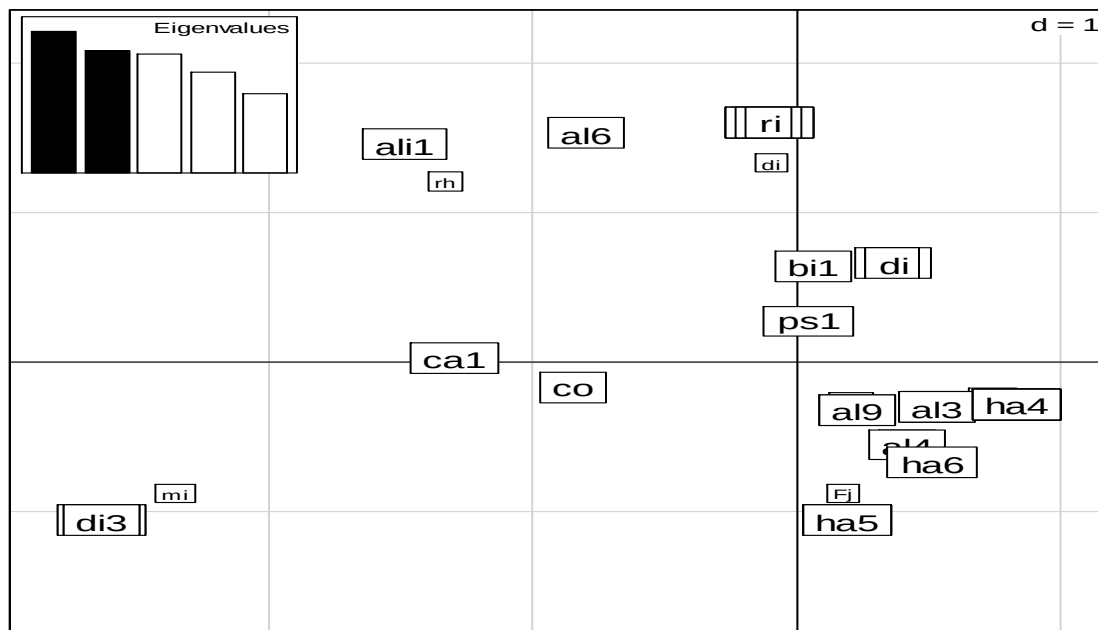


Figure 11. Representation of the AFC of species used against recurrent diseases in Bantu and Pygmy popular medicine.

Cluster Dendrogram for Solution HClust.2

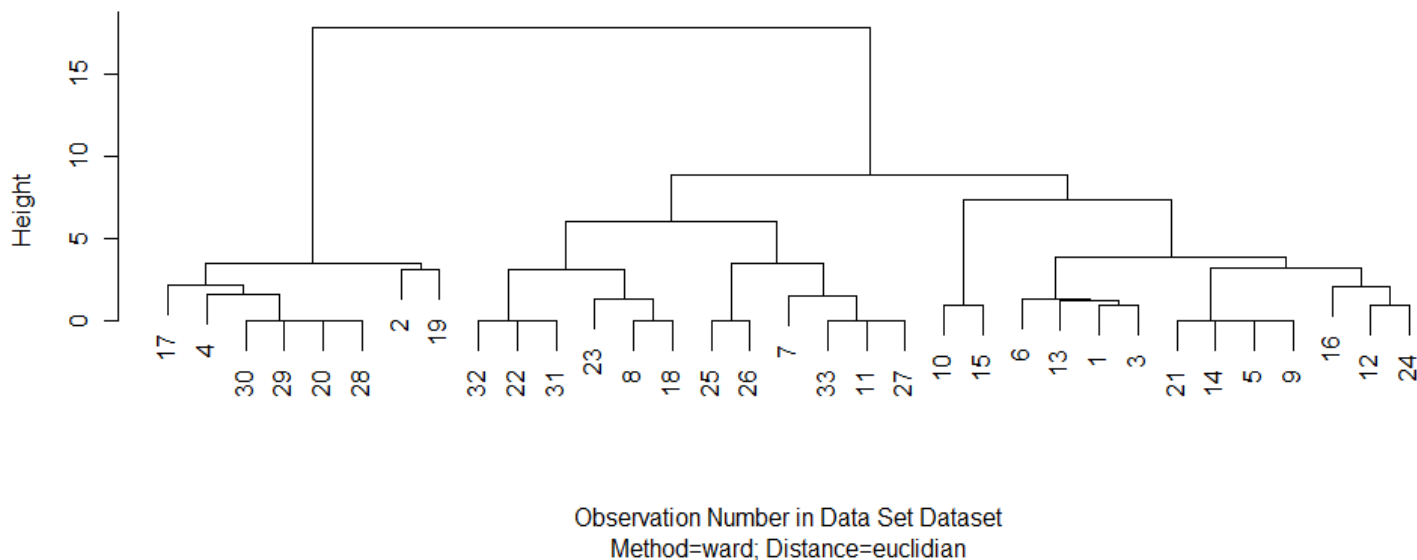


Figure12. Dendrogram of convergence use of plants against recurrent diseases. (Legend: Ban= Bantus; Pyg= Pygmies; Isi= Isigo (Village); Kim= Kima (Village); Kat= Katundula (Village); Ma= Maakengu (Village); Ta= Tandandale (Village); Ka= Kalibo (Village); 1= BanIsi, 2= BanIsi, 3=PygIsi, 4=BanKim, 5=PygKim, 6=PygKa, 7=BanKat, 8=PygKat, 9=BanMa, 10=PygTa, 11=BanKat, 12=BanIsi, 13=PygKa, 14=BanIsi, 15=PygKim, 16=PygTa, 17=BanIsi, 18=BanKim, 19=BanKa, 20=BanKat, 21=PygKat, 22=BanMa, 23=PygTan, 24=BanIsi, 25=PygMa, 26=PygTa, 27=BanKa, 28=PygKat, 29=BanMa, 30=PygMa, 31=BanKim, 32=BanKat, 33=PygKa).

to distinguish, at the level of the terminal knots (100% of similarity), 2 Pygmy groups, 1 Bantu group and 7 groups

of mixed Bantu and Pygmies. Above 80% of similarity, two classes of inter-groups (Bantu - Pygmies) emerge.

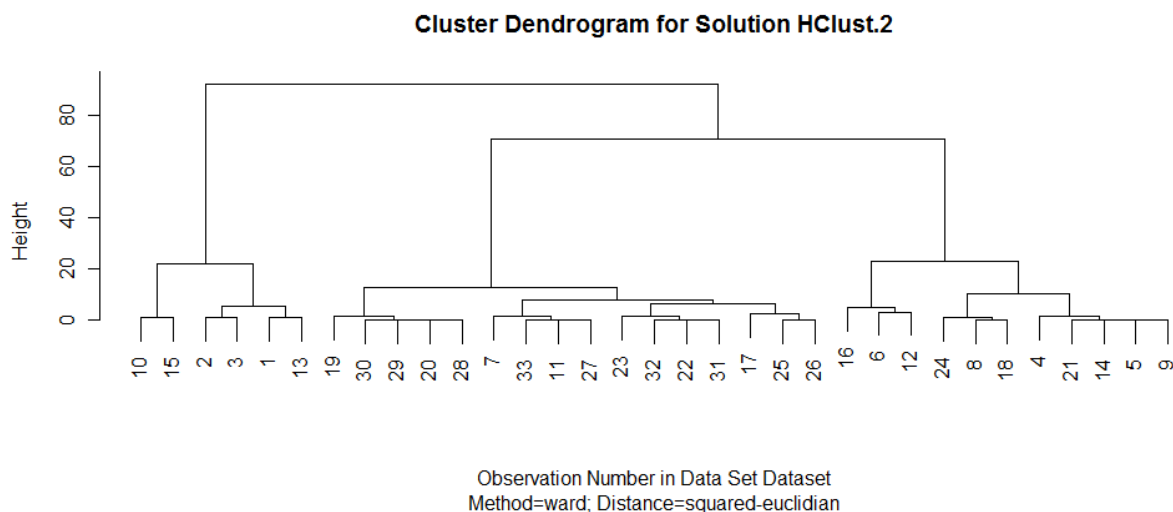


Figure 13. Dendrogram of similarities of the usage of species in the ethnic intergroup. (Legend: 1=*Achyranthes aspera*-BanIsi, 2=*Allanblackia stanerana* -BanIsi, 3=*Allanblackia stanerana*-PygIsi, 4=*Allanblackia stanerana*-BanKim, 5=*Allanblackia stanerana*-PygKim, 6=*Allanblackia stanerana*-PygKa, 7=*Allanblackia stanerana*-BanKat, 8=*Allanblackia stanerana*-PygKat, 9=*Allanblackia stanerana*-BanMa, 10=*Allanblackia stanerana*-PygTa, 11=*Allium sativum*-BanKat, 12=*Bidens pilosa*-BanIsi, 13=*Bidens pilosa*-PygKa, 14=*Canarium schweinfurthii*-BanIsi, 15=*Canarium schweinfurthii*-PygKim, 16=*Canarium schweinfurthii*-PygTa, 17=*Conyza sumatrensis*-BanIsi, 18=*Conyza sumatrensis*-BanKim, 19=*Conyza sumatrensis*-BanKa, 20=*Conyza sumatrensis*-BanKat, 21=*Conyza sumatrensis*-PygKat, 22=*Conyza sumatrensis*-BanMa, 23=*Conyza sumatrensis*-PygTan, 24=*Dichrocephala integrifolia*-BanIsi, 25=*Dichrocephala integrifolia*-PygMa, 26=*Dichrocephala integrifolia*-PygTa, 27=*Harungana madagascariensis*-BanKa, 28=*Harungana madagascariensis*-PygKat, 29=*Harungana madagascariensis*-BanMa, 30=*Harungana madagascariensis*-PygMa, 31=*Psidium guajava*-BanKim, 32=*Psidium guajava*-BanKat, 33=*Ricinus communis*-PygKa)

The analysis of plant species from the dendrogram above indicates that forest species such as *Allanblackia stanerana*, *Canarium schweinfurthii* and *Harungana madagascariensis* are mostly used by Pygmies, whereas ruderal plants such as *Achyranthes aspera*, *Allium sativum*, and *Psidium guajava* are a speciality of the Bantu people. It must be noted, however, that more than 50% of medicinal plants used by Pygmies are also used by the Bantu people.

The statistical analysis of the data relatively to plant species used by both groups revealed that there are some significant differences. Indeed, $\chi^2 = 10,9$; $df = 4$ and a p-value of $0.028 < 0,05$ make us to accept the nil hypothesis and to confirm that both groups living in the same administrative territories of Beni and Lubero use different plant species in their popular traditional medicines.

DISCUSSION

Seven recurrent diseases are treated by at least 20% of members of the Bantu and Pygmy ethnic groups. These 7 recurrent diseases include malaria, diarrhoea, colic, internal candida, yellow fever, migraine and rheumatism. Pygmies and Bantu people living in the same village make different therapeutic preparations from medicinal

plants. Bantu people resort often to humid types of herbal medicines (decoction, steeping, distillation), whereas Pygmies prefer trituration and direct chewing of medicines. The pharmaceutical preparations and means of administration of medicine vary considerably between the two groups. Whereas the former resort to oral ingestion, the latter prefer scarification.

Similar usages of plants have been proven in both groups. "Mbuti" and "Nande" use steeped *Allanblackia stanerana* peels to treat gripes and malaria. Triturated leaves of *Conyza sumatrensis* are used in the form of poultice on whitlows and its juice is used to treat colic and internal Candida. The decoction of *Harungana madagascariensis* peels (Lam.ex poir) is used to treat yellow fever. This also has same use in Congo (Bitsindou and Lejoly, 1992), and Cameroon (Betti and Lejoly, 2009).

Decoction of *Bidens pilosa* leaves is mostly used to treat diarrhoea. Decoction of *Harungana madagascariensis* peels is used for malaria treatment. These species have also been mentioned for the same use in Congo-Brazzaville (Adjanohoun et al., 1988; Trabi et al., 2008). The decoction of the leaves of *Bidens pilosa* and the peels of *Harungana madagascariensis* is used for malaria treatment in the City of Bukavu (Kasali et al., 2014). *Lantana camara* is a plant species used for treating some diseases, among which are typhoid fever,

Table 5. Use of medicinal plants by Mbuti pygmies and Nande Bantus and the similar usages in other countries of Africa.

Diseases	Plant	Families	Voucher number	Ethny	References
Gonorrhoea	<i>Desmodium adscendens</i> (SW)	Fabaceae	Erikas 98	Bantu and Pygmy	-
	<i>Fagara anaequalis</i>	Rubiaceae	Erikas 185	Bantu	-
	<i>Citrus limon</i> (L.) Burm	Rutaceae	Erikas 125	Bantu	-
	<i>Vernonia amygdalina</i> Del.	Asteraceae	Erikas 10	Bantu and Pygmy	-
	<i>Tabernaemontana johnstoni</i>	Apocynaceae	Erikas 59	Bantu	-
Colic	<i>Aframomum laurentii</i> (De Wild. & Th.)	Zingiberaceae	Erikas181	Bantou	-
Conjunctivitis	<i>Spathodea campanulata</i> P. Beauv.	Bignoniaceae	Erikas 148	Pygmy	-
	<i>Aframomum laurentii</i> (De Wild. & Th.)	Zingiberaceae	Erikas181	Pygmy	Balagizi et al. (2007)
	<i>Solanum aculeastrum</i>	Solanaceae	Erikas 116	Banty	-
	<i>Momordica foetida</i> Schumach.	Cucurbitaceae	Erikas 115	Pygmy	-
	<i>Aframomum laurentii</i> (De Wild. & Th.)	Zingiberaceae	Erikas181	Pygmy	Adjanohoun and Ake Assi. (1988)
Diabetes	<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae	Erikas 97	Bantu	Kabangu. (1990)
	<i>Momordica foetida</i>	Cucurbitaceae	Erikas 115	Bantu	Balagizi et al. (2007)
	<i>Alchornea cordifolia</i> (Sch.&Thonn.) Müll.Arg.	Euphorbiaceae	Erikas 27	Bantu	Schmelzer et al. (2008)
	<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae	Erikas 97	Bantu	Schmelzer et al. (2008)
Epilepsy	<i>Elaeis guineensis</i> Jacq.	Arecaceae	Erikas 171	Bantu	-
	<i>Sida acuta</i> Burm.	Malvaceae	Erikas 127	Bantu	-
	<i>Solanum aculeastrum</i>	Solanaceae	Erikas 116	Bantu	-
	<i>Kigelia africana</i> (Lam.) Benth	Bignoniaceae	Erikas 41	Pygmy	-
	<i>Cymbopogon citratus</i> (DC.) Stapf	Poaceae	Erikas 170	Pygmy	-
Typhoid fever	<i>Desmodium adscendens</i> (SW.)	Fabaceae	Erikas 98	Bantu	-
	<i>Eucalyptus maideni</i>	Myrtaceae	Erikas 157	Bantu	-
	<i>Lantana camara</i> L.	Verbenaceae	Erikas 182	Bantu	Nguegang et al. (2005)
	<i>Solanum nigrum</i> Auct.	Solanaceae	Erikas 150	Bantu	Schmelzer et al. (2008)
	<i>Citrus limon</i> (L.) Burm.	Rutaceae	Erikas 125	Bantu	-
	<i>Cymbopogon citratus</i> (DC.) Stapf	Poaceae	Erikas 170	Bantu	-
Haemorrhoid	<i>Piper capense</i>	Piperaceae	Erikas183	Bantu and Pygmy	Schmelzer et al. (2008)
	<i>Solanum aculeastrum</i>	Solanaceae	Erikas 116	Bantu	-
	<i>Eucalyptus maideni</i>	Myrtaceae	Erikas 157	Bantu	-
	<i>Solanum nigrum</i> Auct.	Solanaceae	Erikas 125	Bantu	-
	<i>Citrus limon</i> (L.) Burm.	Rutaceae	Erikas 125	Pygmy	-
	<i>Mangifera indica</i> L.	Anacardiaceae	Erikas 159	Bantou and Pygmy	Kalanda et al. (1993)
Hernia	<i>Citrus limon</i> (L.) Burm.	Rutaceae	Erikas 125	Pygmy and Pygmy	-
	<i>Kigelia africana</i> (Lam.) Benth.	Bignoniaceae	Erikas 41	Bantu	Adjanohoun and Ake Assi (1988)
	<i>Sida acuta</i> Burm.	Malvaceae	Erikas 127	Bantu and Pygmy	-
	<i>Rauvolfia vomitoria</i> Afzel.	Apocynaceae	Erikas 179	Bantu	-
	<i>Rumex bequaertii</i>	Polygonaceae	Erikas 130	Bantu	-
	<i>Tabernaemontana johnstoni</i>	Apocynaceae	Erikas 59	Pygmy	-
Hypotension	<i>Centella asiatica</i> (L.) Urb.	Apiaceae	Erikas 184	Bantu	-
Lombalgia	<i>Impatiens</i> sp	Balsaminaceae	Erikas 21	Pygmy	-
	<i>Alstonia boonei</i> De Wild.	Apocynaceae	Erikas 2	Pygmy	-
	<i>Fagara anaequalis</i>	Rubiaceae	Erikas 185	Pygmy	-
	<i>Tabernaemontana johnstoni</i>	Apocynaceae	Erikas 59	Bantu	-
	<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae	Erikas 97	Pygmy	Schmelzer et al. (2008)

Table 5. Contd

Sterility	<i>Centella asiatica</i> (L.) Urb.	Apiaceae	Erikas 184	Bantu	-
	<i>Piper guineense</i> Schum. & Thonn.	Piperaceae	Erikas 13	Bantu	Karhagomba et al. (2007)
	<i>Rumex bequaertii</i>	polygonaceae	Erikas 130	Bantu	-
	<i>Solanum aculeastrum</i>	Solanaceae	Erikas 116	Bantu	Schmelzer et al. (2008)
Tuberculosis	<i>Citrus limon</i> (L.) Burm.f.	Rutaceae	Erikas 125	Pygmy	-

especially in Cameroonian pharmacopoeia, in the zone of Ekozoa (Nguegang et al., 2005).

Roots of *Carica papaya* are commonly used in Bantus' herbal medicine to treat gonorrhoea. This plant is also known for the same usage in South Kivu Province (RDC) (Balagizi et al., 2007; Kasali et al., 2013); even in Congo-Brazzaville for treating urogenital infections (Adjanohoun et al., 1994). *Solanum aculeastrum* roots are used by the Bantu people to treat infertility; the decoction of these roots is also known in South Africa for the same use (Schmelzer et al., 2008).

Pygmies in Beni and Lubero use the leaves of *Piper capense*, softened on fire, as suppositories against internal parasitic worms. They also have the same usage in Congo-Brazzaville herbal medicine (Schmelzer et al., 2008).

The powder of dry fruits of *Piper guineense* is used in Beni and Lubero against sterility, the aqueous extract of dry fruits of the same plant has reproductive function in rats (Mbongue, 2005). The decoction of leaves of *Mangifera indica* was used for treating haemorrhoids in Beni and Lubero administrative territories. The same usage has been cited in traditional medicine of Twa Pygmies and Oto Bantus in Equator Province of RDC (Ilumbe et al., 2014; Kalanda and Ilumbe, 1993).

The Bantu and Pygmies use decoction of *Morinda morindoides* daily for malarial treatment. It also has the same usage in herbal medicine of Bantus and Twa (Pygmies) in Equator Province of RDC (Ilumbe, 2010).

Conclusion

The study lists some plant species commonly used in the traditional medicine of the Bantu people and Pygmies living in Beni and Lubero located in the Eastern part of the Democratic Republic of Congo. The result of this work shows that the choice of plant species depends on the ethnical group to which the traditional healer belongs. Similar usage of plant species presented with respect to other regions of Africa shows their medical virtue. Numerous species presented in Table 5, which have not been identified till now for the similar purpose in other regions, contribute to the originality of this work. The promising plants like *Allanblackia stanerana* and *Solanum aculeastrum* not yet marked worldwide should attract the

attention of scientists and pharmaceutical corporations to determine their chemical structure and therapeutic activity. Numerous works of this kind should attract the attention of scientists to palliate the lack of knowledge of plants usage of such a great multi-staged vegetation of the East of the DRC

Conflict of interests

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENT

This work was financed by the International Forest Research Center (CIFOR) through the "REFORCO project" supported by the Training and Forest Research at UNIKIS. The authors thank the General Director of CIFOR and Director of REFORCO, as well as all the co-ordination for logistic and financial means given to us for the realization of this work. We also thank the authority of Kisangani University represented by the Rector and those of the Faculty of sciences, in particular, for the support and hospitality offered to us. Their gratitude also goes to the co-ordinator of PREPYG, as well as all the team of technicians for facilitating field visits. Finally, we sincerely thank professor KALWAHALI Charles and senior lecturer KIVIKWAMO Norbert for the English translation improvements brought to this work.

REFERENCES

- Adjanohoun E, Ahyi MRA, Ake AL, Chibo P, Cusset G, Doulou V, Enzanza A, Goudote E, Keita A, Mbemba C, Mollet J, Moutsambote JM, Sita P (1988). Contribution aux études ethnobotaniques et floristiques au Congo. ACCT, Paris. 605p.
- Adjanohoun E, Cusset G, Issalo KA, Le Bras M, Lejoly J (1994). Banque de données de Médecine et pharmacopée (Pharmel). Notice pour la collecte et l'entrée des données, Seconde édition. A.C.C.T., Paris.
- Balagizi I, Kambale F, Ratti E (2007). Les plantes médicinales du Bushi. Genova: Auslieferungsstelle des Buches Emiliani-Rapallo. P 315.
- Balick MJ (1990). Ethnobotany and the identification of therapeutic agents from the rainforest in Chadwick DJ, Marsh J (Eds.), bioactive compounds from plants (Cibe foundation Symposium N°154). Wiley, Chichester. pp. 22-32.
- Betti JL, Lejoly J (2009). Contribution to the Knowledge of medicinal plants of the Dja Biosphere Reserve, Cameroon: plants used for

- treating jaundice. *J. Med. Plant Res.* 3(12):1057-1065.
- Bitsindou M, Lejoly J (1992). Contribution à la connaissance des plantes médicinales de la périphérie Sud du parc national d'Odzala(Congo). 15p.
- CIFOR (2007). Forests in post-conflict, Democratic Republic of Congo, Analysis of a priority agenda, Center for International Forestry Research.
- Cotton CM (1996). *Ethnobotany. Principles and applications*. Ed. Wiley 424p.
- Ilumbe BG, Van Damme P, Lukoki LF, Joiris V, Visser M, Lejoly J (2014). Contribution à l'étude des plantes médicinales dans le traitement des hémorroïdes par les pygmées Twa et leur voisin Oto de Bikoro, en RDC. *Congo Sci.* 2(1):46-54.
- Ilumbe G (2010). Utilisation des plantes en médecine traditionnelle par les Pygmées (Ba-Twa) et les Bantus (Ba- Oto) du Territoire de Bikoro, Province de l'Equateur en République Démocratique du Congo. Thèse de Doctorat Université Libre de Bruxelles.
- Jongen P (1970). Carte des sols et de la végétation du Congo, du Rwanda et du Burundi: 26 Nord-Kivu et région du Lac Edouard. A. Notice explicative de la carte des sols. Bruxelles: INEAC. 78p.
- Kabangu K. (1990). Apport des plantes médicinales africaines à la thérapeutique moderne. Centre de recherches pédagogiques. p. 138.
- Kalanda K, Ilumbe G (1993). Contribution à la connaissance des plantes médicinales du Haut-Zaïre. *Plantes Anti hémorroïdaires de Kisangani. Rev. Méd. et Pharma. Afric. A.C.C.T.* 9(1):51-58.
- Kasali FM, Mahano AO, Nyakabwa DS, Kadima NJ, Misakabu FM, Tshibangu DST, Ngbolua KN, Mpiana PT (2014). Ethnopharmacological survey of medicinal plants used against malaria in Bukavu city (DR Congo). *Eur. J. Med. Plants* 4(1):29.
- Kasali MF, Mahano AO, Bwironde FM, Amani AC, Mangambu JD, Nyakabwa DS, Wimba LK, Tshibangu DST, Ngbolua KN, Kambale JK, Mpiana PT (2013). Ethnopharmacological survey of plants used against diabetes in Bukavu city (DR Congo). *J. Ethnobiol. Trad. Med.* 119:538-546.
- Kasay LL (1988). Dynamique démo-géographique, mise en valeur de l'espace en milieu équatorial d'altitude (cas des pays Nande au Kivu septentrional), Zaïre: Thèse de doctorat Université de Lubumbashi.
- Kasika EL, Vasombolwa VK, Lejoly J (2015). Contribution to the knowledge of plants used by Bantu and Pygmy healers in Beni and Lubero territories (Democratic Republic of Congo). *J. Plant Stud.* 4(2):157.
- King SR, Tempsta MS (1994). From shaman to human clinical trials: The role of industry in ethno botany, conservation and community. In Chadwick DJ& Marsh J (eds) *Ethno botany and the search for New Drugs* (Ciba Foundation Symposium N° 185). Wiley, Chicester. pp. 197-206.
- Léonart S, Angers P, Gosselin A, Ramputh AL, John T, Arnason ET, Martine D (2006). Lacueillette sauvage et conservation des plantes médicinales. *Horticultural* (sd).
- Mafikiri AT (1998). Aspects économiques du médicament traditionnel et du médicament occidental en Afrique. N'Dama 1Mbongue FG, Kamtchouing P, Essame OJ, Yewah PM, Dimo T, Lontsi D (2005). Effect of the aqueous extract of dry fruits of *Piper guineense* on the reproductive function of adult male rats. *Indian J. Pharmacol.* 37(1):30.
- Nguegang P, Nicole M, Guedje, Lejoly J (2005). Exploitation de la floriculture urbaine médicinale dans le bas- fond d'Ekozoa (Yaoundé. Cameroun). In: van der Burgt X, van der Maesen J, Onana J.-M. (Eds.). *Royal Botanic Garden* (13):397-405.
- Olivier M, Sanou L, Flahaut E, Olicard C, Sanou B (2002). Traditional medicine and pharmacopoeia in South West Burkina Faso: medicinal plants from fallow areas: study, management and promotion. pp. 345-347.
- PNUD (1998). Monographie de la province du Nord-Kivu. Kinshasa: Ministère de l'Agriculture et de l'Elevage, du Plan, de l'Education nationale, de l'Environnement, Conservation de la nature, Forêts et Pêche. 306p
- Schmelzer GH, Gurib-Fakim A, Lemmens RHMJ, Oyen ICM, Siemonsma JS (2008). *Plantes médicinales 1.PROTA/ Backhuys Publishers, Leiden/CTA, Wageningen, Pays- bas, 869p.*
- Trabi FH, Irie GM, N'gaman KCC, Mohou CHB (2008). Etudes de quelques plantes thérapeutiques utilisées dans le traitement de l'hypertension artérielle et du Diabète : deux maladies émergentes en Côte d'Ivoire. *Sci. Nat.* 5(1):39-48
- Vyakuno E (2006). Pression Anthropique et Aménagement rationnelle des hautes terres de Lubero en R.D.C. Rapport entre société et Milieu physique dans une montagne équatoriale. Thèse de Doctorat Université Toulouse II.