

Contribution to the Knowledge of Plants Used by Bantu and Pygmy Healers in Beni and Lubero Territories (Democratic Republic of Congo)

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Abstract

Traditional medicine is largely used in Benin and Lubero Territories (D R Congo) as costs for conventional drugs increase and become unaffordable to many people, particularly living in rural areas. The aim of this work is to unlock convergences of plant species used in Bantu and Pygmy herbal medicine. An ethno botanical survey was conducted from 2010 to 2012 in Beni and Lubero Territories. Thirty- six healers, well known in villages where Nande Bantus and Mbuti Pygmy live together were interviewed concerning the plant species used in traditional medicine. One hundred and ninety seven recipes from 182 plant species were identified in Bantu ethnic group and 78 recipes from 83 plant species in pygmy ethnic group. Decoction and Carbonization have been the main modes of preparation by Bantus healers, whereas pygmy healers have mostly used triturating. Ruderal plant species were mostly used among which the Asteraceae family is preponderant (23%). Frequencies comparison with Khi squared method has shown that Bantu herbal medicine is different from pygmies' traditional medicine.

Keywords: medicinal plants, healers, bantus, pygmies, beni, lubero

1. Introduction

The picking-up of medicinal and “magic” plants as well as in Africa and elsewhere in the world has always been considered as very important and determinant. Seeing that the traditional medicine takes in consideration the human being in its somatic and extra-material integrity, the operation of picking-up medical matters and the making of medicines is always accompanied with mysteries and rites (Amakoué, 1995; Léonardt et al., 2006).

According to Balagizi et al. (2007), developing countries are conscientious that their health systems are based on imported technologies and modern medicines, which are costly. If this state of dependence persists, the health expenses will increase and will affect the state's finances. It could be better to promote medicine by the exploitation and rational use of local knowledge found in natural local resources, particularly medicinal plants.

The WHO (2003) gives 53000 to 72000 the estimation of species of medicinal plants used through the World by different types of traditional medicine; several of the plants have medicinal properties. The same organization estimates up to 80%, the African population that uses traditional pharmacopoeia for their health care.

The DRC has at least fifty thousand vegetative species among which 10% have medicinal properties (Hans, 2006). Despite this enormous and rich flora, the vegetation of DRC is among the less known in Central Africa (CIFOR, 2007 in Ilumbe, 2010).

The use of traditional medicine to treat recurrent diseases is an indigenous practice in Africa (Hans, 2006). In fact, according to the World Health Organization (HWO, 1996) estimation of ratio noticed more than 2000 and 4000 of inhabitants per Tradi-practitioner in Uganda country. Whereas the statistics of the public health Ministry

of Burkina Faso estimates this ratio to 1/500 in Burkina Faso (Zerbo et al., 2008). In D R Congo, two third of patients do not refer their cares need to the modern system, either because they have not financial means to get access to it, or because the health services are not available. For these, medicinal plants are the key product for Congolese population. Both urban and rural populations depend on medicinal plants for their health care deed (RD Congo, 2006; Ngbolua et al., 2011). This is the case for Beni and Lubero territories.

Despite the abusive use of traditional medicine does not only advantages, but also intoxication and adulteration remains the major problems in the therapeutic management of patients. Brigham and Cocksedge (2004) attach many cases of bad identification, of adulteration of health products used wildly on belief that Tradi practitioners or healers bring to the practice of cares by plants and to the oral character, which does not allow a good transfer of knowledge of generation-to-generation.

In order to frame our study, we have considered in this study the definition of Rwangabo (1993) who describes a Tradi-practitioner or traditional healer as a person who is recognized by the chieftaincy in which one lives, as being competent to give health cares thanks to the employment of vegetative animal or mineral substances. In addition, he knows other methods also based on the socio- cultural religious basis than on the knowledge of mental and social behaviors as well as etiology of diseases prevalent in the collectivity.

Very often, healers use the same recipes to treat the same diseases, whereas each has a specialty for which the other members of the community come to consult. The aim of the present study is to check affinities concerning plant use and recipes in traditional medicine of “Nande” Bantus and “Mbuti” Pygmies healers in Beni and Lubero territories. We started from the hypothesis that the Bantus’ herbal medicine could be different from the Pygmy’s specialized medicine.

2. Study Area

The ethno botanical investigations were conducted in Beni and Lubero Territories. This area is located in the Northern part of Democratic Republic of the Congo. 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 (Kasay, 1988)

The two territories cover an area of 25,580 sq Km, from which 18,096 sq Km for Lubero and 7484 sq Km for Beni (Kujirakwija, 2006). The population is irregularly divided in the two territories, at one side, population density is high in the mountain zone of Lubero territory , sometimes it can reach 105 inhabitants/ sq Km (Mafikiri, 1994), on the other side, very low density in Beni area .

Beni and Lubero are located in a humid tropical climate with temperature situated between 24 to 25°C for the low lands which contain a large rain forest (2183 mm), whereas in the high lands where the average altitude is situated between 2000 and 3100m. The temperature is regulated by the equator line and altitude (15 to 17 °C) with precipitations, which varies to 1110, and 1330 mm (Vyakuno, 2007).

According to Mafikiri (1994), the “Nande” people is the main ethnic group in the two territories, and it is mixed to other peaples Piri, Pakombe, Batalinga, Walese and Mbuti “Pygmies”.

3. Materials and Method

The ethno botanical investigations were conducted in Beni and Lubero territories from 2010 to 2012 in six villages where Bantus and Pygmies live together. The criteria for choosing the surveyed villages were; the distance which separates two villages (at least 80 Km), the presence of “Nande” Bantus and “Mbuti” Pygmies in the same village.

The method used is essentially based on asking questions directly to respondents, using a semi-structured questionnaire previously established according to the guide of the database of traditional Medicine and Pharmacopeia “PHARMEL 2” (Adjanohoun et al., 1994). Thirty- six healers from the two ethnic groups were interviewed. The collected data during the ethno botanical surveys were focused on the identification of traditional healers (his ethnic group and specialty), the used plants (Vernacular and Scientific name, used parts), and the characteristics of recipes (methods of preparation, administration and pharmaceutics form) the indications on diseases and symptom (Kasali et al., 2014).

The specialists, like Professor Kamabu of Kisangani University, identified most of collected plants. Several documents have facilitated the correction and adaptation of specific names (Troupin & Bridso, 1982; Schnell, 1979; Lejoly et al., 1988; Tailfer, 1989)

The species that were not identified have been deposed and compared to the specimens of Herbarium of the Faculty of Sciences at Kisangani University.

The convergences of employment of recipes were foreseen in two ways: by comparison of lists of treated diseases and the characteristics of medicinal recipes used by the two communities, on the one part. The Jaccard index, which measures the report of double presences “a” divided on the sum of b, c, and a, were calculated using the following formula:

$$C_j = \frac{a}{a+b+c}$$

In this formula, (a) represents the number of species or recipes commonly used by the two communities, (b), the number of species or recipes proper to Bantus healers and (c) the number of species or recipes proper to Pygmies healers). On the other part in the most analytical manner, the information citing the same plant or recipe for the same disease by members of two ethnic groups was been considered as convergence of employment. The treated data being binary and any environmental variable was not been measured; we have referred to a method of non-parametric classification because any estimation of parameter is not necessary. The Chi-squared test which globally allows to see the links between two characters (ethnic groups- mode of preparation of recipe for example), and to compare the observed proportions to a theoretical value fixed by the method permitting to test the hypothesis. We have then referred to Chi squared of Wallis and Freidman (Cornillon et al., 2008; Husson et al., 2009). All data were analyzed using R 2.10.0 software; the cluster analysis using the Euclidian distance and the correspondence analysis were expressed to perform affinities for plants and recipes using in traditional medicine of the two ethnic groups.

4. Results

4.1 Number of Species

The results of the number of species used in traditional medicine of Bantu and Pygmy Tradi-practitioners living in the same village are summarized in Table 1.

Table 1. Comparison of list number of plant species used by Bantu and Pygmy healers of six surveyed villages in Beni and Lubero territories

Village	Number of species			
	Bantu	Pygmy	Common	Cj
Isigo	36	17	1	1.85
Kima	39	22	8	11.59
Tandandale	18	9	1	3.57
Kalibo	29	10	2	4.87
Kathundula	27	11	2	5
Maakengu	33	14	1	2.08

The coefficients of similarity drawn from the recipe following Jaccard method were inferior to 50%. This difference shows that there is not yet significant exchange between these two groups, which are claimed to possess each the secret of medicinal virtues of plants. The reticence of Tradi-practitioners of the two ethnic groups brings to a loss of much information. These ones have used medicinal plants as a profitable activity, attracting more and more people in villages for the training in the use of plants for traditional medicine.

4.2 Number of Recipes at the Level of the Same Village

Bantu and Pygmy Tradi-practitioners use several recipes in specialized traditional medicine. In general, 196 and 78 recipes have been listed respectively at the Bantu and Pygmy Tradi-practitioners; they are shared in disproportional manner trough the village as shown in Table 2.

Table 2. Comparison of recipes used in traditional medicine of Bantu and pygmy healers of six surveyed villages.

Village	Number of recipes	
	Bantu	Pygmy
Isigo	78	18
Kima	36	23
Maakengu	20	11
Tandandale	15	8
Kalibo	16	8
Kathundula	31	10
Total	196	78

Bantu Tradi-practitioners have acquired much knowledge in the use of medicinal plants thanks to many exchanges during the trainings organized by associations or NGOs that are willing to promote the traditional medicine in several areas of the North Kivu Province. Thus, the number of recipes is more diversified in Bantu areas where people know how to read and write. By this, they are capable of acquiring experiences of other regions of Africa and elsewhere. Pygmies, however, refer to recipes known for years and transmit them from generation to generation without considerable addition.

In order to make it more perceptible, the affinities, which could exist, between Tradi-practitioners of the two ethnic groups, the cluster analysis model of hierarchical classification in simple link based on the recipes used by the two ethnic groups through the surveyed villages was done. We listed the illnesses according their category and based our analysis to the recurrent illnesses treated by at least 20 % of Tradi-practitioners. Among these diseases, which were evaluated to 14, three affections that the charge taking is remarkable in the two ethnic groups such as Hemorrhoid, Malaria and sexual impotence have been submitted to the cluster analysis.

4.2.1 Classification Based on “Recipes Used against Hemorrhoid- Bantu and Pygmy healers-Villages Investigated”

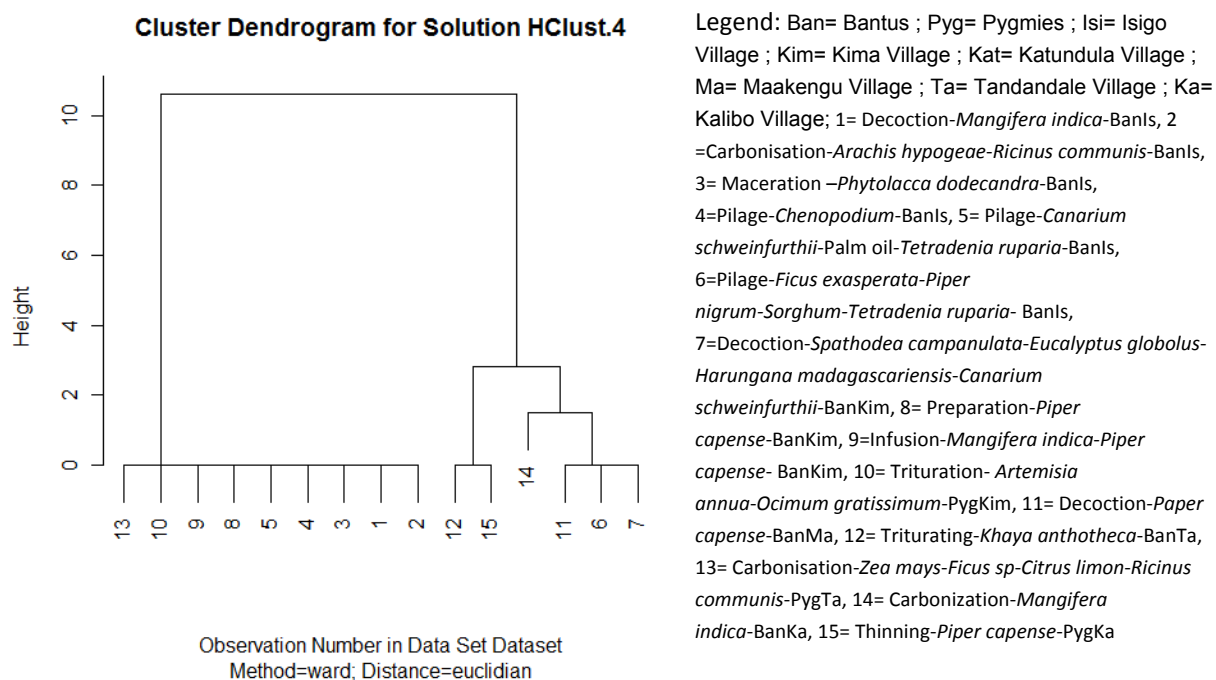


Figure 1. Classification of Bantu and Pygmy specialists according to the recipes used against Hemorrhoid in Beni and Lubero Territories

At the low level of cluster, or at 100% of similarity, ten classes among the 13 listed are visible. Few of convergences of recipes use against Haemorrhoids are visible at this level and constitute only 20% of found groups, whereas the classes exclusively Bantus predominate in reason of 80 % the individualized classes. This has brought us to conclude that the Haemorrhoids are more treated by the Bantu tradi-practitioners. The two cases of inter-ethnic similarity fixed at the lowest level concern the triturating of leaves of *Artimisia annua* and *Ocimum gratissimum* on the one hand and the mixture of *Piper capense* on the other hand.

At 97% of similarity, three classes of similarity exclusively formed by Bantus are visible, these concern; The carbonization of leaves of *Mangifera indica*, the decoction of leaves of *Piper nigrum*- grains of Sorghum- leaves of *Tetradenia ruparia* and then the decoction of skins of *Spathodea campanulata*- leaves of *Eucalyptus globolus*-skins of *Harungana madagascariensis* and *Canarium schweinfurthii*. At 85% of similarity, two classes are visible, one class exclusively Bantu and a mixed class. The observation of cluster shows a little representation of interclass's, consequently the tradi-practitioners of the two ethnic groups have different recipes to calm Hemorrhoids through the surveyed villages.

4.2.2 Classification Based on "Recipes Used against Sexual Impotence-Bantu and Pygmy Healers- Villages Investigated"

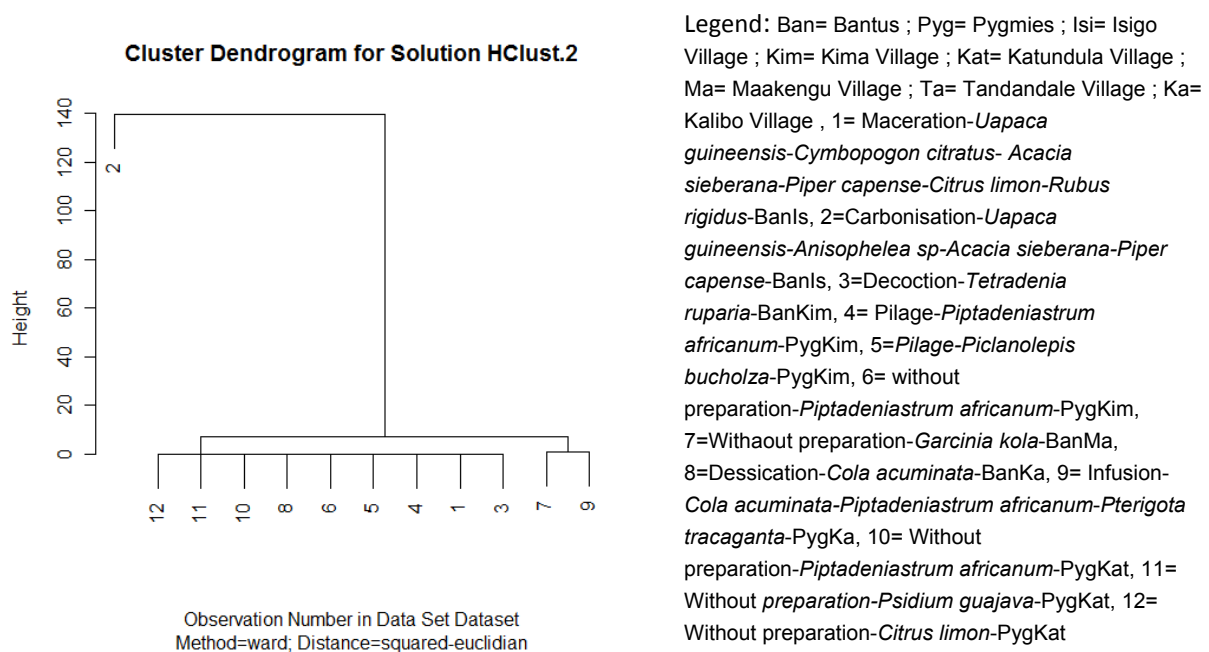
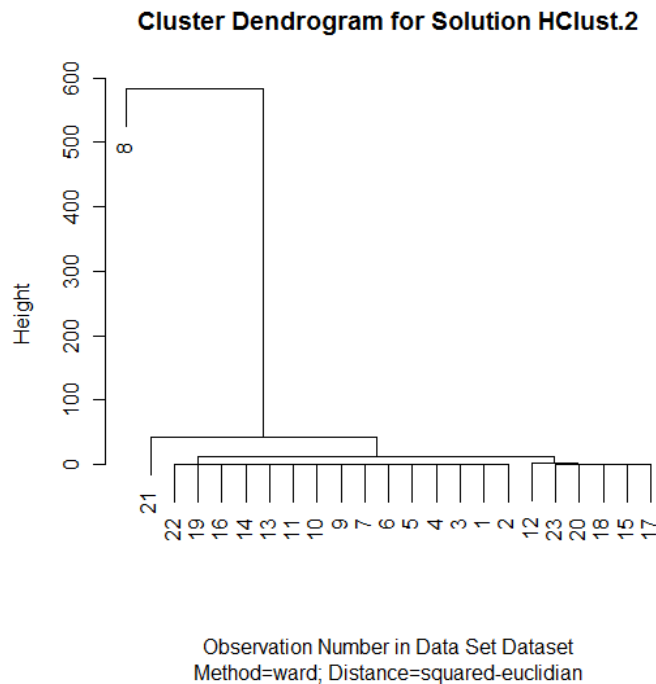


Figure 2. Classification of Bantu and Pygmy specialists according to the recipes used against Sexual impotence in Beni and Lubero Territories

The classification based on recipes used to treat sexual impotence clears on eleven classes of similarity. At the lowest level of Cluster Dendrogram, or at 100% of similarity, five classes are visible, among them, 2 classes, or 40% of individual classes. The recipes conjointly used by the two ethnic groups concern; the desiccation of *Cola acuminata* and the consumption of roots of *Piptadeniastrum africanum*; the consumption of *Garcinia kola* and the infusion of *Cola acuminata*-*Piptadeniastrum africanum* and *Pterigota tracagantha*. At 97% of similarity 2 mixed Bantu-Pygmy classes are drawn. At the highest level of hierarchical classification one class exclusively, Bantu forms a marginal group and concerns: the carbonization of leaves of *Uapaca guineensis*- *Cymbopogon citratus* -*Acacia sieberana*-*Piper capense*-*Citrus limon* and *Rubus rigidus*. The recipes used to treat sexual impotence are in 50% similar for the two ethnic groups, whereas the Pygmy Tradi- practioners keep knowledge relatively superior to the one of Bantus for the charge taking of sexual impotence.

4.2.3 Classification on the Base “Recipes Used against Malaria - Bantu and Pygmy Healers – Villages Investigated”



Legend: Ban= Bantus ; Pyg= Pygmies ; Isi= Isigo Village ; Kim= Kima Village ; Kat= Katundula Village ; Ma= Maakengu Village ; Ta= Tandandale Village ; Ka= Village Kalibo , 1= Infusion- *Aidia micrantha*-*Allanblackia stanerana*-*Dichrocephala integrifolia*-Banls, 2=Distillation-*Cynodon dactylo*-*Carica papaya*- *Drymaria cordata*-*Achyranthes aspera*-Banls, 3=Infusion-*Pigium africanum*-*Rauvolfia vomitoria*-*Ageratum conyzoides*-*Sida acuta*-Banls, 4= food-*Rumex bequaertii*- *Drymaria cordata*-*Allanblackia stanerana*-Banls, 5= Decoction-*Spilanthes mauricianum*-*Cynodon dactyl*-*Pennisetum purpureum*-*Ageratum conyzoides*-Banls, 6=Decoction-*Cynodon dactylo*- *Piper guineensis*-*Carica papaya*-Banls, 7= Decoction-*Acacia sieberena*- *Piper guineensis*- *Anisophelea sp*-Banls, 8=Maceration-*Acacia sieberena*-*Piper guineensis*- *Anisophelea sp*-Banls 9= Extraction-*Fagara macrophylla*-Pygls, 10=Decoction- *Carica papaya*-*Ageratum conyzoides*-*Bidens pilosa*-BanKim, 11=Decoction-*Carica papaya*-*Allium sativum*-BanKim, 12= Carbonisation-*Fagara macrophylla*-*Carica papaya*-BanKim, 13=Infusion-*Morinda morindooides*-BanKim, 14=Infusion-*Morinda morindooides*-PygKat, 15= Decoction-*Khaya anotheca*-BanMa, 16= Decoction- *Khaya anotheca*-PygKa, 17= Decoction-*Carica papaya*-*Allium sativum*-BanTa, 18= Decoction-*Alstonia boonei*-*Fagara macrophylla*-PygTa,19= Decoction- *Carica papaya*-BanKa, 20=*Carica papaya*- BanKat, 21= Decoction- *Cymbopogon citratus*-Camomille- *Dichrocephala integrifolia*-*Ageratum conyzoides*-*Bidens pilosa*- *Conyza sumatrensis*-BanKa, 22= Decoction-*Achyrenthes aspera*-BanKat, 23= Decoction-*Alstonia boonei*-*Fagara macrophylla*-PygKat

Figure 3. Classification of Bantu and Pygmy specialists according to the recipes used against Malaria in Beni and Lubero Territories

Eleven classes of similarity are visible at the level of 100% of similarity, among these, the exclusive Bantus classes predominates in reason of 7 classes, or 63.6%, whereas only one pygmy class or 9% of cases is visible. This one concerns, the infusion of leaves of *Morinda morindooides* and the decoction of skins of *Khaya anotheca*. The trained intergroup at this level represent 27.2%, or three classes on the eleven listed. These affinities concern the extraction of skins of *Fagara macrophylla*, decoction of flowers of *Carica papaya*-leaves of *Ageratum conyzoides* and leaves of *Bidens pilosa*. As well as, the carbonization of skins of *Fagara macrophylla*- flowers of *Carica papaya* and the decoction of leaves of *Alstonia boonei*- skins of *Fagara macrophylla*, then, the decoction of flowers of *Carica papaya* and the decoction of skins of *Alstonia boonei*-skins of *Fagara macrophylla*.

At the highest level of Cluster Dendrogram, two groups are visible, on the one hand, a mono-ethno pharmacological Bantu group that concerns special recipes obtained from maceration of leaves of *Acacia sieberana*-fruits of *Piper guineensis* and the *Anisophelea sp* and on the other hand, the class formed of the rest of

listed recipes. These observations show that the recipes used to treat Malaria are very different for the healers of two ethnic groups.

4.3 Characteristics of Recipes

In general, the recipes used by Bantus and Pygmies healers in the six villages were submitted to different modes of preparation that clears to several pharmaceuticals forms. As well as, the mode of administration of medicines, vary sensitively between the two groups.

4.3.1 Mode of Preparation of Recipes

Bantus and Pygmy Tradi-practitioners through the surveyed villages in Beni and Lubero territories prepare the recipes differently. The raised variations between the two ethnic groups living in the same villages are summarized on Figure 4.

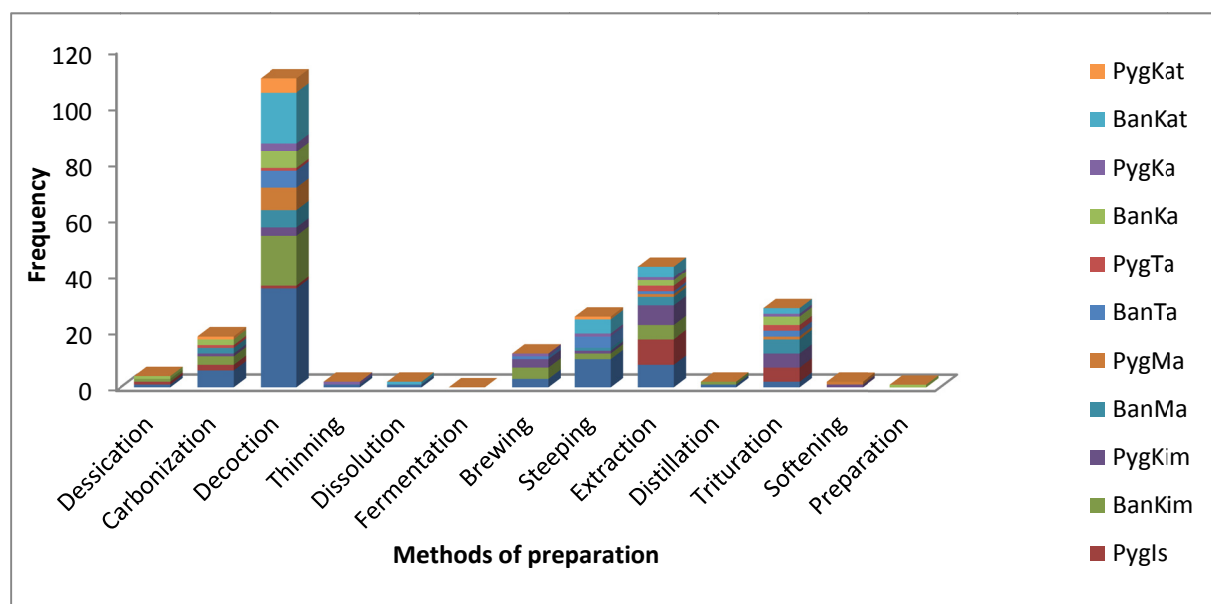


Figure 4. Variation in methods of medicine preparation between Bantus and Pygmies healers of the six villages where they live together in Beni and Lubero territories

The analysis of variations of preparation modes of the medicine shows a great divergence between the Bantu and pygmy specialists. The tendency of specialists does not differ from that of popular medicine. Bantus use mostly carbonization and decoction, whereas Pygmies roast on fire the parts of plants to be used. The Chi squared test of Wallis gives the values ($\chi^2= 75.26$, $df = 11$ and $p\text{-value}= 1.206e^{-11}$); the net inferiority of P-value based on the critical value which is 0.05 lets us conclude that Bantu and Pygmy Tradi-practitioners prepare very differently their medicines.

4.3.2 Pharmaceutical Form

Pharmaceutical forms of drugs used in traditional medicine of Bantu and Pygmy healers depend on their ethnics' appurtenance. The Figure 5 summarizes evidence variations of pharmaceutical forms of medicines between the two groups.

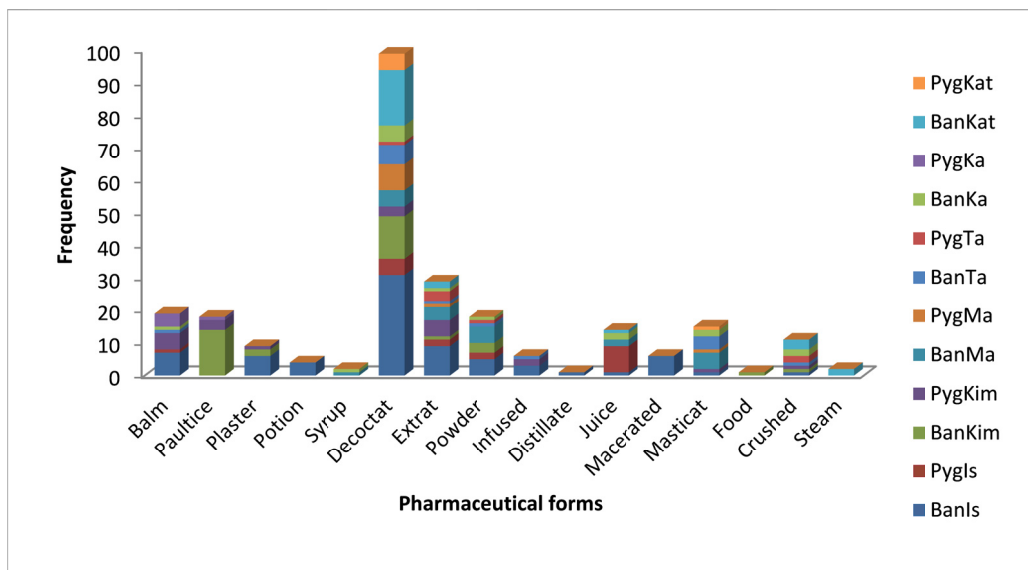


Figure 5. Variation of frequencies of pharmaceutical forms used in traditional medicine of Bantu and Pygmy healers of Beni and Lubero

Pharmaceutical forms of medicines used by Bantu specialists are very different from those preferred by Pygmy Tradi-practitioners in the same villages. Pygmies have strong values for the products used as food and cataplasm, whereas Bantu specialists prefer the extract of plants. The test of chi squared shows a highly significant difference between the two ethnic groups ($\chi^2 = 66.2997$, $dl = 15$, $p\text{-value} = 2.02e^{-08} < 0.05$).

4.3.3 Mode of Administration of Medicines

The mode of administration goes in pair with the mode of preparation of medicines in the specialized traditional medicine in Beni and Lubero territories. The Figure 6 summarizes the differences, which exist between the two ethnic groups.

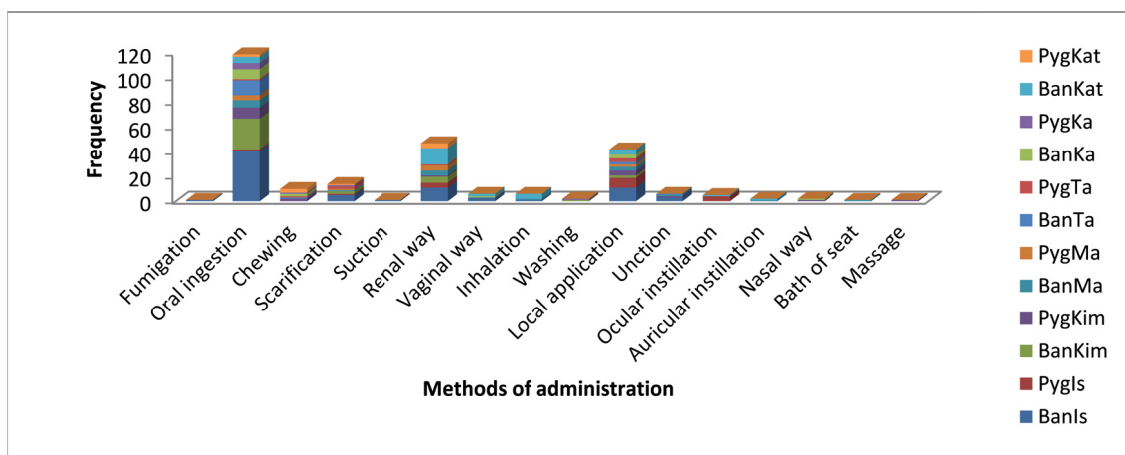


Figure 6. Ways of administering medicine to patients in investigated villages

Three modes of administration, oral ingestion and rectal way of medicines are mostly used. The oral ingestion is the most modes used by Bantu Tradi-practitioners, whereas Pygmies prefer more the products used in cataplasm and scarification. The Chi squared test of Bartlett applied on frequencies raised in the two ethnic groups has shown a difference highly significant between the two ethnic groups ($\chi^2 = 479.2165$, $dl = 15$, $p\text{-value} = 2.2e^{-16} < 0.05$). This could be in part due to the mode of life of each group. Pygmies seem to be different because of their instability, whereas Bantu prepare well their recipes by the frequency rate of patients.

4.4 Number of Diseases

Bantu and Pygmy Tradi-practitioners take in charge in total 72 affections, particularly 47 affections for Bantus and 7 for pygmies. The two groups take in charge in common 18 diseases, the Jaccard index taken from these (0.25) is below 50%, and this brings us to conclude that Bantu and Pygmy Tradi-practitioners treat very different diseases in Beni and Lubero Territories. In order to fear the similarities or differences in the charge taking of diseases, we listed illnesses according to the WHO classification and the following categories have been raised:

4.4.1 Diseases of Nervous System

The principal axes around which the Tradi-practitioners of two ethnic groups are regrouped in the correspondence analysis contribute to more than 70% to total inertia, so we can interpret valuably the affinities between the members of the two ethnic groups through the surveyed villages. The Figure 7 summarizes the affinity that exists between the two ethnic groups.

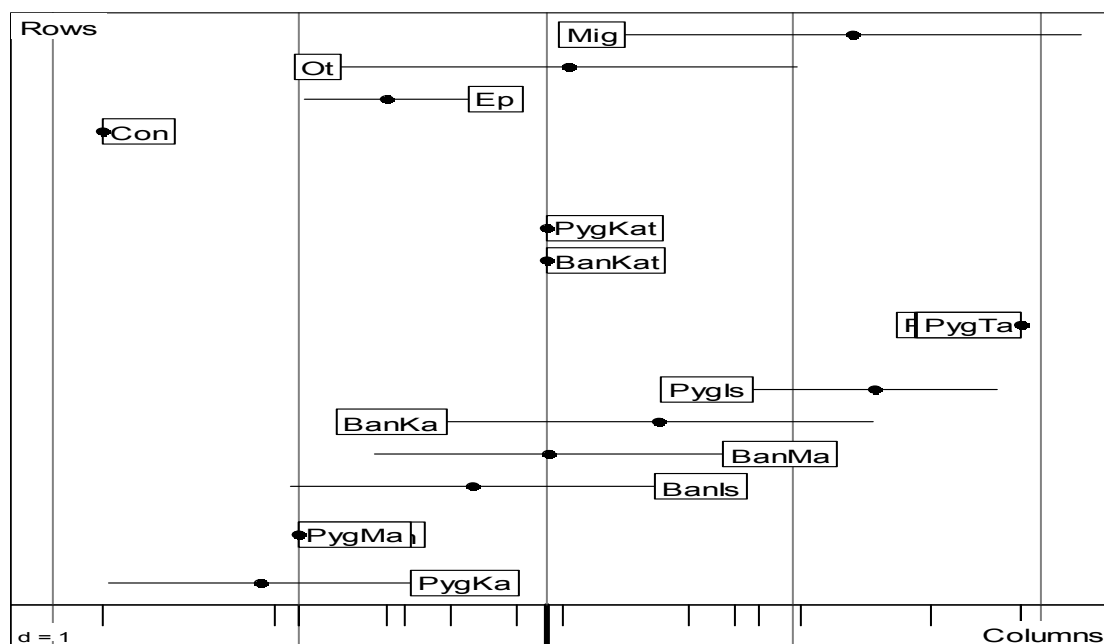


Figure 7. Representation of correspondence analysis of nervous and sense organs treated by Bantus and Pygmies healers

The correspondence analysis of charge-taking of diseases of the nervous system and sense organs shows that Bantu practitioners are more specialized in taking care of Conjunctivitis and Otitis, whereas the Pygmies Tradi-practitioners are reproached to migraine against which they apply a series of species of wild plants by scarification. Epilepsy, which obliges a skilful competence from the healer, is treated conjointly by Bantu and Pygmy practitioners. The Chi squared from Friedman test, or ($\chi^2 = 12.8$, $df = 11$, $P\text{-value} = 0.3062 > 0.05$) has not raised significant differences in the charge-taking of the diseases of nervous system and sense organs by the Tradi-practitioners of the two studied ethnic groups.

4.4.2 Signs and States of Badly Defined Morbidity Traumatic Lesions and Poisoning

The interpretation of convergences of charge taking of signs of badly defined diseases has been based on the two axes of correspondence analysis, which represent more than 60% of the total inertia.

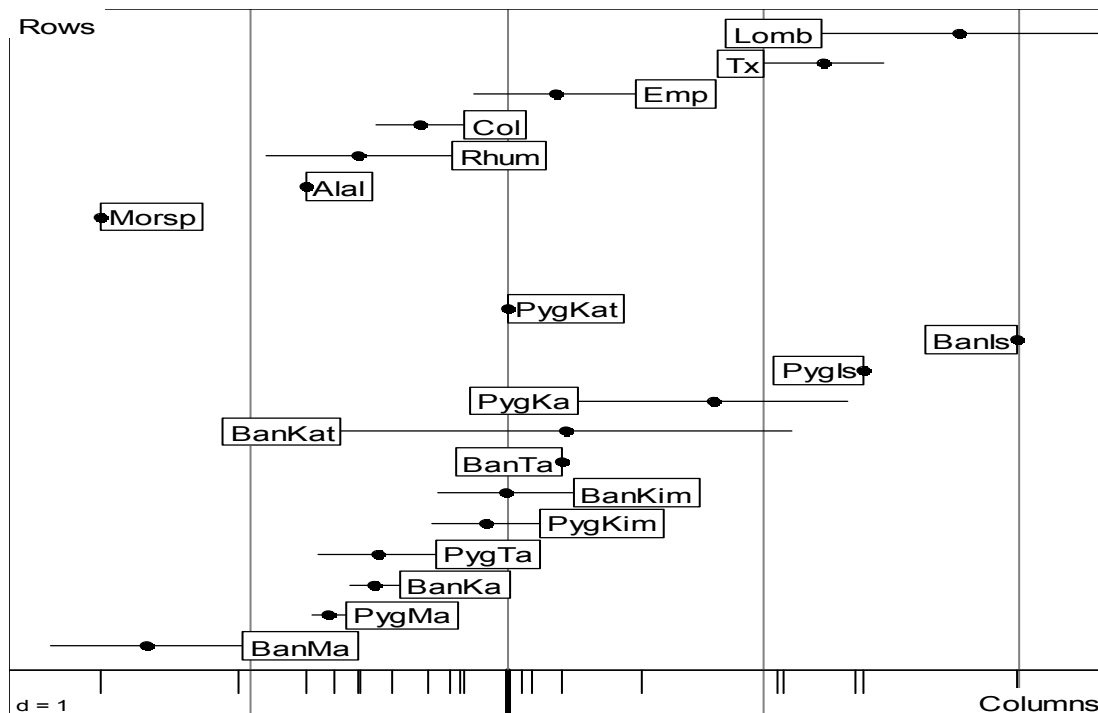


Figure 8. Representation of the correspondence analysis of morbidity signs treated by Bantus and Pygmies healers

Several badly defined signs are taken in charge in specialized medicine of Bantus and Pygmies through the surveyed villages.

The results of the correspondences analysis (Figure 8) show that Bantu and Pygmy healers present strong convergence in the charge-taking of Rheumatism, poisoning, food allergic and colic. However, pygmies specialize in the charge taking of coughing and lombalgia, yet Bantus master more the snake biting. The snake biting is rare in the pygmies' camps because of the prevention of this by scarification in young age of all member of the community.

4.4.3 Infectious and Parasitic Diseases

The two principal axes of the correspondence analysis (Figure 9) contribute in more than 70% to the total inertia and then keep the maximum of necessary information for the interpretation of convergences between the two studied ethnic groups.

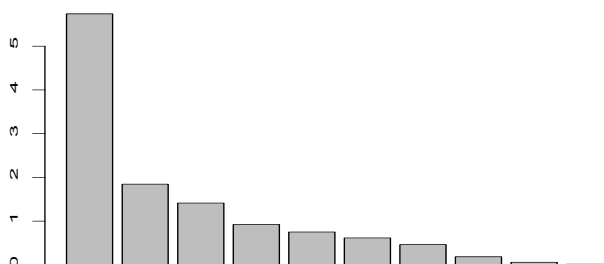


Figure 9. Value of dimensions linked to correspondence analysis of charge taking of infectious and parasitic diseases

The infections and parasitic diseases are very perceptible in the villages inhabited by Bantus and Pygmies in Beni and Lubero territories. The sharing of these diseases often linked to the state of dirtiness varies sensitively in the area inhabited by the two ethnic groups. The analysis of affinities in the charge-taking of these two groups

shows that pygmies master more the treatment of internal Candida, tuberculosis, coetaneous scabies and infectious diarrhea (Figure 10).

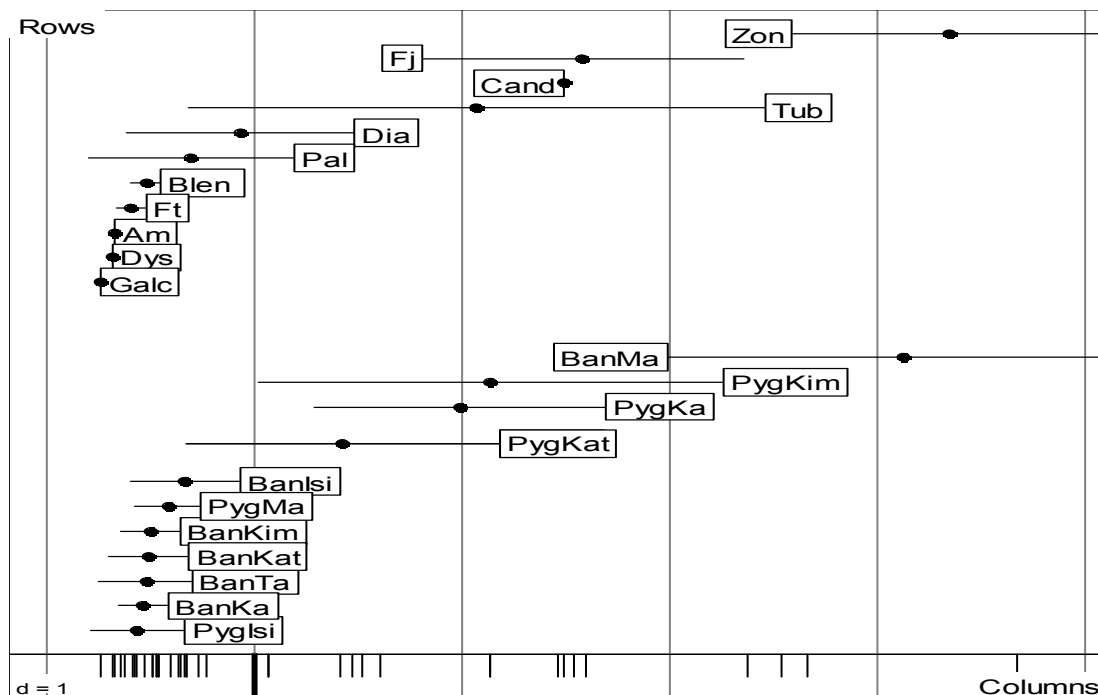


Figure 10. Representation of correspondences of infectious and parasitic illnesses across villages

The Bantus healers of Tandandale, Isigo, Kalibo, Katundula, Kima villages which represent more than 83% of the group have links with Pygmy healers of Isigo, Maakengu and Kathundula or (50%) for the charge taking of 63% of infectious and Parasitic affections. Two marginal groups are observed and concerning pygmy healers of two villages; Kima and Kalibo (33%) for the charge-taking of Internal Candidiasis, Yellow fever, and Tuberculosis (27% of infectious and parasitic diseases). The other marginal group is formed by Bantu Tradi-practitioners of Maakengu village (16%) for the charge taking of Zone or (9% infectious and parasitic affections). The proportion of convergences between the healers of two ethnic groups which comes over 50% for more than 60% of infectious and parasitic diseases shows that they conjointly treat the infectious and parasitic affections, this shows that the exchanges of experiences are possible between the two ethnic groups despite the hidden characteristic of the traditional medicine.

4.4.4 Diseases of the Digestive System

The interpretation on convergences of charge taking of the diseases of the digestive system by Bantu and pygmy healers has been based on the two axes of correspondence analysis which participate to more than 70% of the total inertia (Figure 11).

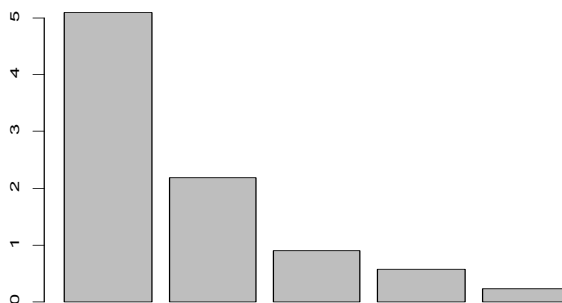


Figure 11. Value of dimensions linked to Correspondence of charge taking of diseases of the digestive system

A net duality of two categories of Pygmy and Bantu specialized traditional medicine seems to be drawn through the villages. The figure shows the correspondences, which exist between the two groups for the charge taking of diseases of the digestive system (Figure 12).

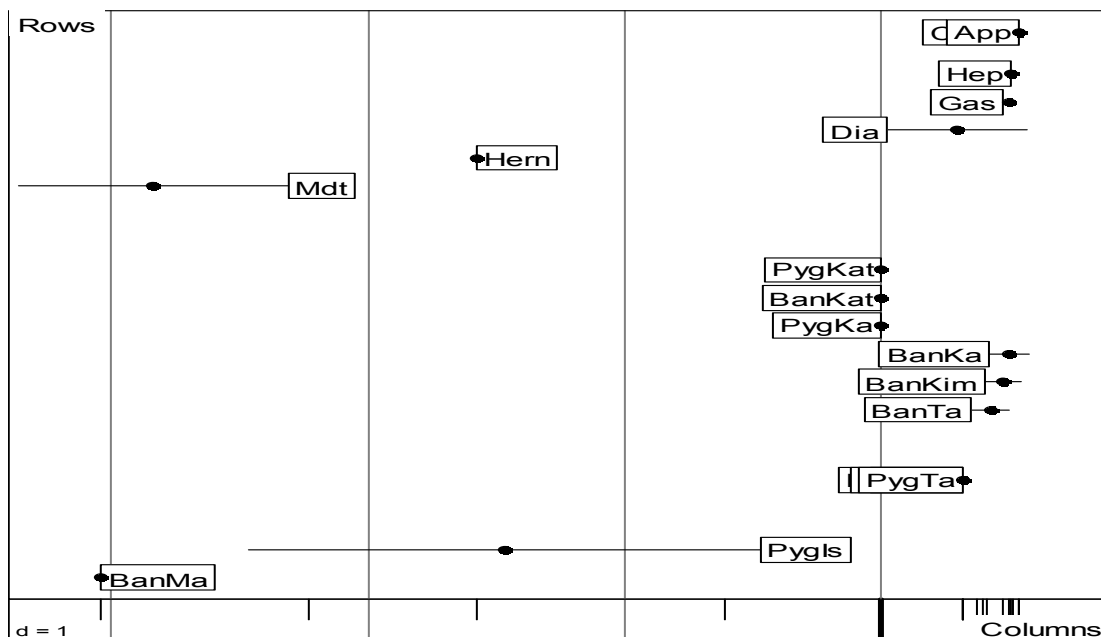


Figure 12. Representation of the Correspondence analysis of digestive system diseases treated by Pygmies and Bantus healers of Beni and Lubero areas

On the one part, Bantu healers of 3 villages; Tandandale, kima and kalibo, or (50% of Bantu healers) have strong convergences in the charge taking of; Constipation, Hepatitis, Appendicitis (57% of digestive system diseases). On the other part, Pygmy healers of three villages; Isigo, Kima and Maakengu are very linked around the charge-taking of Diarrhea (14% of the diseases of digestive system listed). Two marginal cases are observed and trained by Bantu tradi-practitioners of Isigo village who have particular practices of charge taking of hernia, whereas Bantu healers of Maakengu village have exclusivities for teeth aches. The proportions of affections taken in charge separately by healers of each ethnic group that represent 70% relatively to those conjointly treated by the two groups (more or less 30%) shows that the charge taking of digestive system diseases depend to ethnic appurtenance .

4.4.5 Diseases of Uro-Genital System

The diseases of Uro-genital system are differently tidy in the traditional medicine of Bantu and Pygmy healers (Figure 13).

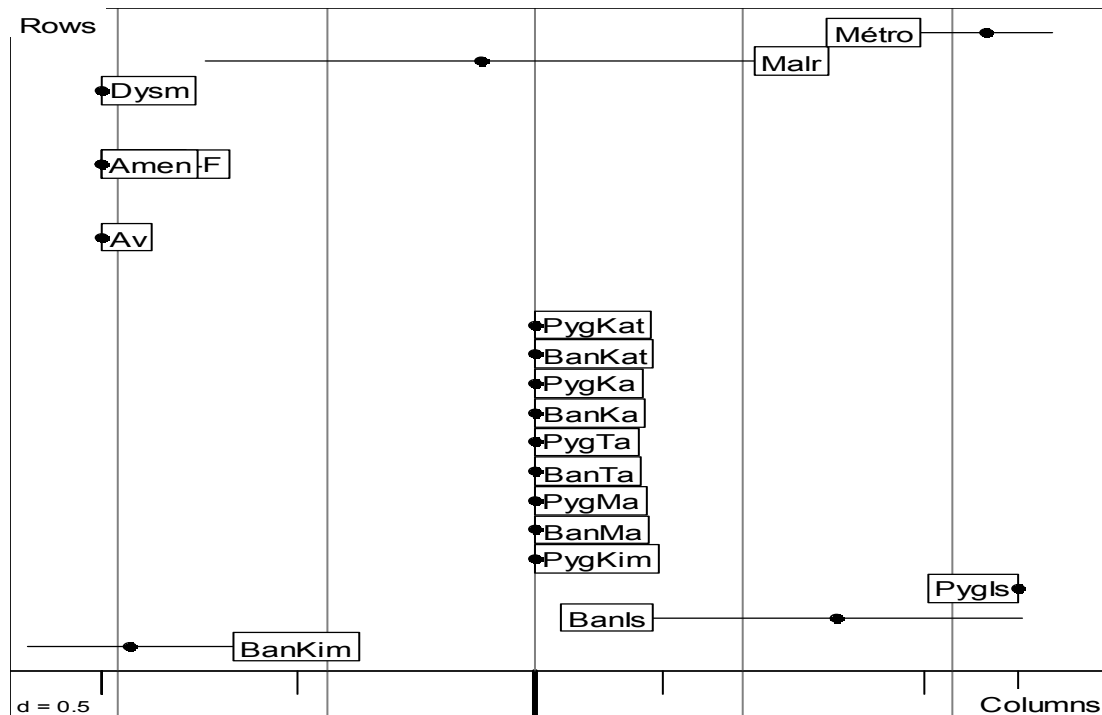


Figure 13. Representation of the Correspondence analysis of the diseases of the uro-genital system treated throughout the villages investigated

The correspondence analysis shows near nesses between pygmy healers of Katundula, Kalibo, Tandandale, Maakengu and Kima villages, or (66% of surveyed pygmy healers), on the other part Bantus healers of ; katundula Kalibo, Tandandale and Maakengu villages , who also represent 66% present strong affinities for Metrorage. Hawever individualities are visible on the one part for the tradi-practioners of Kima village (16% of surveyed Bantu healers) for charge-taking of 4 affections, Dysmenorrhea, Amenorrhea, abortions, Myomes, these ones represent 66% of affections of this category. On the other side, Pygmies of Isigo village have particular know ledges for the care of Metrorrhagy. This brings to the proportion of affections of this category taken in charge exclusively by the members of the two studied ethnic groups to more than 70%, which brings us to conclude that the two groups keep very different know ledges of recipes to treat the Uro-genital affections. Another remarkable fact is that Pygmy young girls are initiated in use of plants against the affections of this category. This increases the family self-charge –taking without referring to a specialist.

4.5 Floristic Composition

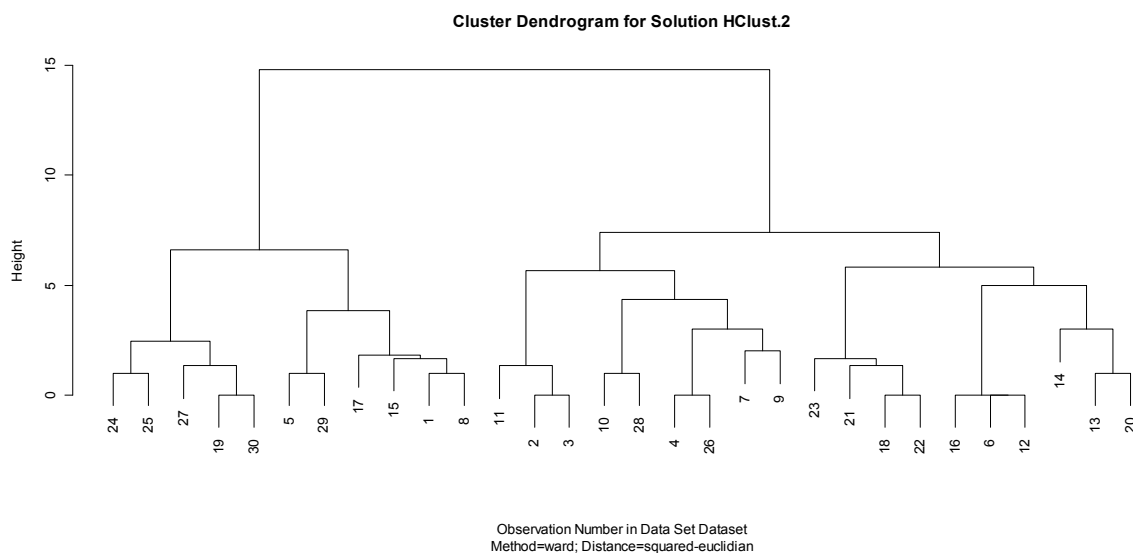
Two hundred and eighty plant species are used by Bantu and Pygmy traditional healers through the surveyed villages. One hundred and eighty two species are exclusively used by Bantus and 83 species by pygmies. The two ethnic groups use in common 15 plant species; among the used species through the survey villages, 12 enter in the preparation of at least 5 different recipes (Table 3).

Table 3. Plant species mostly cited in Bantu and pygmy specialized traditional medicine

Species	Family	Biotope	Number of village where the plant has been cited	
			Bantu	Pygmy
<i>Allanblackia stanerana</i>	Clusiaceae	Secondary forest	1	1
<i>Bidens pilosa</i>	Asteraceae	Fallow	3	0
<i>Carica papaya</i>	Caricaceae	Fallow	2	0
<i>Citrus limon</i>	Rutaceae	Garden	3	0
<i>Conyza sumatrensis</i>	Asteraceae	Garden	2	1
<i>Dichrocephala integrifolia</i>	Asteraceae	Fallow	1	0
<i>Khaya anthotheca</i>	Meliaceae	Secondary forest	2	0
<i>Phytolacca dodecandra</i>	Phytolacaceae	Fallow	2	1
<i>Piper capense</i>	Piperaceae	Secondary forest	3	3
<i>Rauvolfia vomitoria</i>	Apocynaceae	Secodary forest	1	0
<i>Sida acuta</i>	Malvaceae	Fallow	1	1
<i>Solanum aculeastrum</i>	Solanaceae	Fallow	3	1

From the results of the Table 3, the healers of the two ethnic groups refer more to ruderal species to prepare recipes. The ones represent 50% of species the most cited. The progressive farness of the forest and the extinction of the species the most converted for their medicinal virtues explain the substitution by the species in great dispersion found in fallows. Plants of the family of Asteraceae are preponderant with 3 representatives or (30%) of plant species the most cited in specialized medicine. Three plant species, like: *Bidens pilosa*, *Citrus limon*, *Solanum aculeastrum* have been cited in 3 villages uniquely by Bantus, yet only one species (*Piper capense*) has been cited simultaneously in 3 bantu and Pygmy villages.

The hierarchical classification of plant species use by the healers of Bantu and Pygmy ethnic groups in Beni and Lubero territories by the method of Word has given the classes of similarity (Figure 14).



Legend: 1 = BanIs -*Allanblackia stanerana*; 2 = BanIs-*Allanblackia stanerana*; 3= PygIs- *Allanblackia stanerana*; 4= BanIs-*Bidens pilosa*; 5= BanKim-*Bidens pilosa*; 6= BanKa- *Bidens pilosa*; 7= BanIs-*Carica papaya*; 8= BanTa- *Carica papaya*; 9= BanIs- *Citrus limon*; 10= BanKim-*Citrus limon*; 11= BanTa-*Citrus limon*; 12= BanIs- *Conyza sumatrensis*; 13= BanKim-*Conyza sumatrensis*;14 = PygKim- *Conyza sumatrensis*;15 = BanIs- *Dichrocephala integrifolia*; 16= BanKim- *Khaya anthotheca*; 17 = BanIs- *Khaya anthotheca*; 18= PygMa-*Phytolacca dodecandra*; 19= BanKat- *Phytolacca dodecandra*; 20= BanIs-*Piper capense*; 21= PygKim- *Piper capense*; 22= BanMa- *Piper capense*; 23= PygTa- *Piper capense*; 24= BanIs- *Rauvolfia vomitoria*; 25= BanIs- *Sida acuta*; 26= PygTa- *Sida acuta*; 27= BanIs -*Solanum aculeastrum*; 28= BanKim- *Solanum aculeastrum*; 29= BanKa- *Solanum aculeastrum*; 30= PygMa- *Solanum aculeastrum*

Figure 14. Dendrogram of similarities of the usage of species in the ethnic intergroup

At the level of 100 % of similarity of use of specialized medicine 5 Bantu and pygmy mixed classes have been raised, among which, 4 mixed classes and one class exclusively bantu. At the level of 97% of similarity, five classes from which 4 exclusively Bantu and one class Bantu-Pygmy was raised. The highest level of the hierarchical tree , or 90% of similarity of use of plant species in specialized medicine, two classes are shown, one class formed by the Bantu sub-class and the other mixed sub-class of Bantu-Pygmy. It is shown that the analysis of the hierarchical tree that the mixed groups formed of Bantu and Pygmy healers predominate in reason of 60%, yet the groups exclusively, Bantus represent 40% of the whole. Any class formed exclusively by pygmies was not raised.

The predominance of Bantu classes in the hierarchical tree can explain itself by stability of Bantu healers who take in charge their patients in the pharmacy of traditional medicine and harvest most of plants used in fallows and recued forests. Concerning their colleague's pygmies, it is visible that the semi-nomad characteristic makes them instable, which does not allow homogeneous classes for the use of recipes in this ethnic group. Pygmy healers keep an experience of their own. They harvest sometimes plants very far in the forest at the same time they are hunting animals. In order to confirm these results, the test of Friedman based on the sums of rows of frequencies was used. Thus the expressed Chi-squared gave $\chi^2 = 39.3$ at $df = 13$ and P-V (0.00017), very inferior value to 0.05 (Critical value). This has allowed us to conclude that Bantu and Pygmy specialists use very differently the plant species to treat diseases despite the higher exchanges between the two ethnic groups.

4.5.1 Convergence of Use of Species for Treating Recurrent Diseases

The analysis of the floral composition of the lists of species used by Bantu and Pygmy specialists in the surveyed villages has shown the predominance of 12 species such as *Allanblackia stanerana*, *Bidens pilosa*, *Carica papaya*, *Citrus limon*, *Conyza sumatrensis*, *Dichrocephala integrifolia*, *Khaya anthotheca*, *Piper capense*, *Sida acuta* and *Solanum aculeastrum*. The comprehension of the distribution of species frequently used in specialized traditional medicine of Bantus and Pygmies for the control of this or other recurrent disease requires a correspondence analysis (Figure 15).

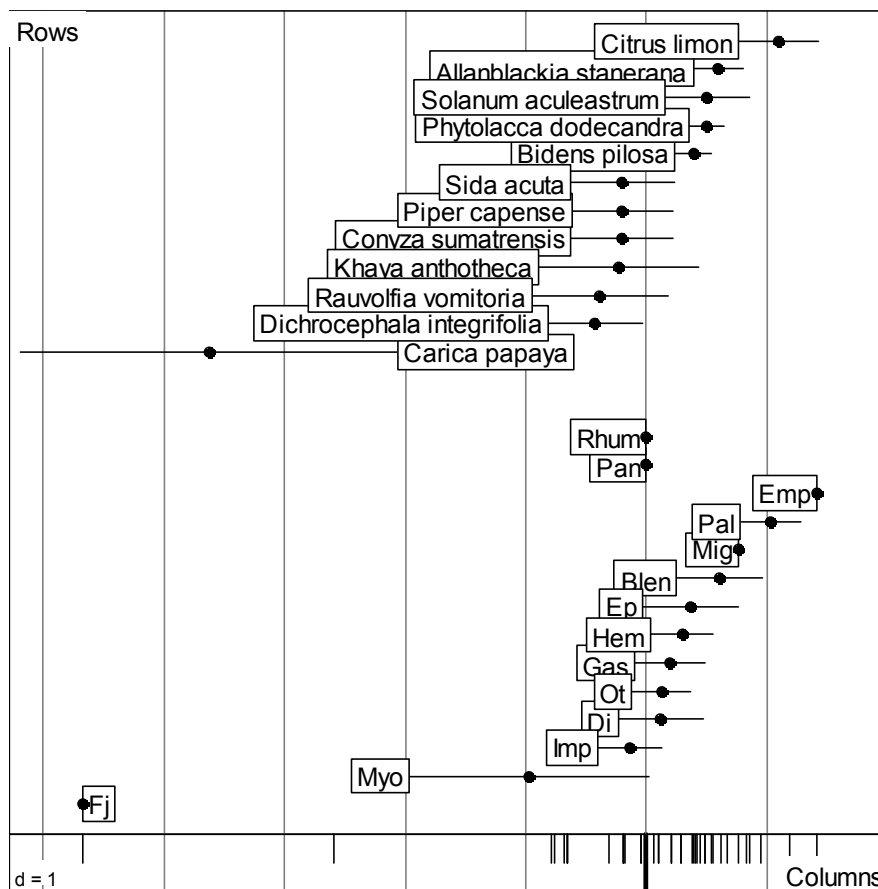


Figure 15. Representation of the Correspondence analysis of species used against recurrent diseases in Bantu and Pygmy specialized medicine

The two axes of correspondence analysis on which we have based our interpretation contribute more than 90% to the total inertia and include the necessary information for this analysis (Figure 16).

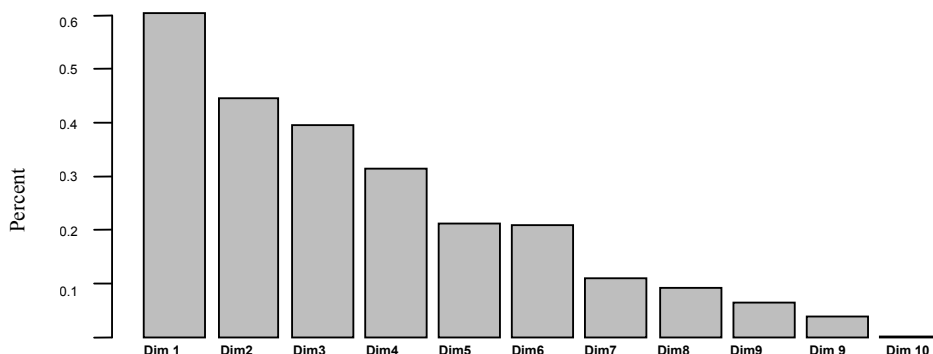
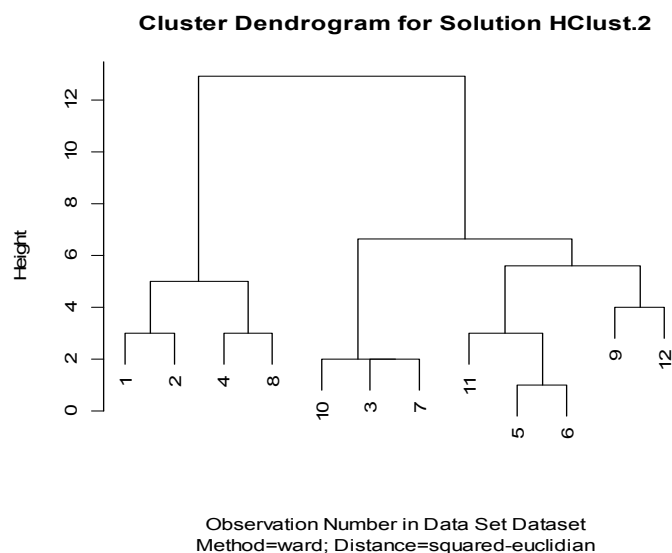


Figure 16. Proper values linked to the dimensions of Correspondence analysis of the convergence of species frequently used for the control of recurrent diseases

The analysis shows that most species frequently in Bantus and Pygmies specialized in traditional medicine in Beni and Lubero territories have strong similitude of employment against recurrent diseases; there are strong correlations between the species *K. anthotheca*, *R. vomitoria*, *D. integrifolia*, *C. sumatrensis*, *P. capense*, *S. acuta*, *C. papaya*, *B. pilosa*, *S. aculeastrum*, for treating malaria, gonorrhoea, otitis, panaris, migraine, sexual impotence, epilepsy, diarrhea and hemorrhage. The species of *Citrus limon* is mostly used in treating rheumatism, whereas *C. papaya* is used in the control of gastritis. Bantu and Pygmy herbalists independently treat yellow fever and poisoning.

4.5.2 Classification of Species Used in Treating Recurrent Diseases in Specialized Traditional Medicine

In order to raise the convergence of use of species against recurrent diseases, a hierarchical classification is seen as important. This will give an idea on the close species in charge of a given infection and those which are the closest. Figure 17 shows the classes which exist in the two types of specialized traditional medicine.



Legend: 1=*Allanblackia stanerana*; 2= *Bedens pilosa*, 3= *Carica papaya*; 4= *Citrus limon*; 5= *Conyza sumatrensis*; 6= *Dichrocephala integrifolia*; 7= *Khaya anthotheca*, 8= *Phytolacca dodecandra*; 9= *Piper capense*; 10= *Rauvolfia vomitoria*; 11= *Sida acuta*; 12= *Solanum aculeastrum*

Figure 17. Dendrogram of convergence use of plants against recurrent diseases

At the lowest level of the dendrogram or at 95% of similarity, a class regroups the species of *C. sumatrensis* and *D. integrifolia* against diarrhea, myositis and malaria. At 90% affinity of species use, a class of *P. dodecandra*, *C. papaya* and *K. anthotheca* for treating gonorrhoea and malaria was raised. Notice that in these classes, two sub-classes, which are the closest, should be remarked, especially one sub-class made up of *P. dodecandra* and *K. anthotheca* against gonorrhoea and *C. papaya* and *K. anthotheca* against malaria. The progressive ascension in the hierarchical tree at the level of 85% of similarity brings 3 classes from which a class regroups *Allanblackia stanerana* and *bidens pilosa* against gonorrhoea, diarrhea and epilepsy. The second class is made up of *C. limon* and *P. dodecandra* against gonorrhoea and epilepsy, whereas the third class regroups the species *S. acuta* and *C. sumatrensis* against epilepsy, myositis and malaria and the species *C. sumatrensis* and *D. integrifolia* for the control of diarrhea and malaria.

A class of affinity of using two species, *P. capense* and *S. aculeastrum* for treating epilepsy, migraine and myositis is repeated at the level of 80% of similarity; whereas, at 75%, a class of *A. stanerana*, *B. pilosa*, *C. limon*, *P. dodecandra* is used against gonorrhoea and epilepsy. At the highest level of the tree, or at 70% of similarity of employment of species which is the most cited against the recurrent diseases, two classes are formed. The first is composed of *R. vomitoria*, *C. papaya* and *K. anthotheca* against malaria. The second class is subdivided into 4 sub-classes which are *S. acuta* and *C. sumatrensis* against epilepsy and myositis. *D. integrifolia* and *C. sumatrensis* were used against diarrhea and malaria, *P. capense* and *D. integrifolia* against malaria and myositis. The second sub-class is composed of *P. capense* and *S. aculeastrum* against migraine and myositis.

The Cluster analysis of use of twelve species, which are the most cited against fourteen recurrent diseases, shows that Bantus and Pygmies in Beni and Lubero territories commonly use the most diverse combinations of twelve species in nine formed classes.

5. Discussion

The medicine of traditional healers is very spread in cities as well as in several villages of Beni and Lubero territories. The obtained results of the surveys done in the mixed villages where Bantus “Nande” and Pygmies “Mbuti” live together have shown that Bantu and Pygmy tradi-practitioners use different vegetative species for the charge taking of diseases. The classification of specialists of the two ethnic-groups has given a dendrogram in which Bantu-Pygmy classes predominate in reason of 60%, which tells about experience exchanges between the specialists of the two ethnic-groups. The similar exchanges have been signaled at Bantu and Pygmy specialists of Bikoro in Equator province (Ilumbe, 2010). However, a very high rate of classes exclusively formed of Bantu specialists or (40%) shows that there are again great secrets that the specialists of the two ethnic groups hide. Bantu specialists easily exchange the secrets among them and obtain experiences of homologue pygmies paying portions. Pygmies on the other hand do not exchange so experiences among them and great disparities are noted in their camps. This appears different from the statement of Ilumbe, op cit., who has shown the exchanges both at Bantu Tradi-practitioners of Bikoro in Equator province in the DR Congo. The situation of the exclusivity of same practices used in traditional medicine of Bantus of Beni and Lubero meets the statement of many authors in other regions of Africa, such as Pfeiffer and Butz (2005) cited by Zerbo et al. (2008). Deleke koko et al. (2009) who stipulate that the geographical origin, the local culture and sex can influence the transmission of know ledges.

Great differences are observed in the number of recipes, Bantu healers use more diversified recipes because of many exchanges that they do with other specialists, whereas pygmy healers are limited to the acquired knowledges from their ancestors without much evaluation. The characteristics of recipes differ between the two ethnic groups. Bantus healers mostly refer to carbonization and decoction, whereas Pygmies prefer to soften the parts of the plants, as well as the triturating. Additionally Pygmies administer their recipes mostly by cataplasm and scarification, whereas Bantus prefer the oral ingestion. Considering the specialty of charge taking of affections between the two groups, the affinities are very numerous; however, differences should be raised for same affections. Bantus healers are specialized more in the charge taking of diseases of digestive system and the affections of Uro-genital system, less frequent in the pygmies' camps. The pygmies on their side have more experience in the charge taking of sexual impotence.

The similarities of use of same vegetative species between Bantu and Pygmy specialists of Beni and Lubero territories are in most of cases signaled in the phytotherapy of others regions of Africa. Here are some cases of similarity that we have raised:

The *Piper capense* whose all the parts are used in different manners for the charge taking of several diseases such as; Hemorrhoids, malaria, Myositis, Migraine, Epilepsy and sexual impotence have been cited in Cameroun

in the charge taking of Epilepsy in Madagascar fresh or cooked roots are consumed as aphrodisiac tonic. These roots might contain especially α -pipene, β -pipene, Camphene, and sabinene, also extract of roots has shown a significant antibacterian activity against *Staphylococcus aureus*, *Staphylococcus pyogenes* and *Corynebacterium sclerosis* in vitro (Schmetzer et al., 2008). However, special oils extracted from fruits could be composed majoritarily of monoterpenes hydro carbonated (58%) followed by sesquiterpenes hydrocarbonated (23,2%) which have insecticide properties vis-à-vis weevils "*Callosobruchus maculates*" (Woguem, 2012). *Rauvolfia vomitoria* currently used in maceration of leaves in Bantu and Pygmy specialized medicines of Beni and Lubero for the control of Epilepsy and Malaria was cited for the similar uses in other regions of Africa. In Cameroun, the decoction of sprayed roots is taken to treat diabetes and Malaria (Schmelzer et al., 2008), in South Kivu (DR Congo) the product in basis of roots are taken currently to treat hypertension and to calm the Epilepsies, Psychotics (Balagizi et al., 2007). The chemical composition of *Rauvolfia vomitoria* includes numerous alkaloids was tenor in total alkaloids varies from 7 to 10 %, numerous chemotypes seem to exist with reserpine of antihypertensors and neuroleptic (sedative); ajmaline with antiarrhythmic properties neighboring to those of Quinidine, isolated alkaloid of Quinquina (Kabangu, 1990; Didier & Micha, 1995). *Carica papaya* species of which the decoction of flowers and roots are used in specialized medicine in Beni and Lubero territories for the control of gonorrhoea and Malaria was signaled in South-Kivu province in the DR Congo and in Congo Brazzaville for Uro-genital diseases (Balagizi et al., 2007; Adjanohoun et al., 1988). The ripe fruit of *Carica papaya* is regularly prescribed to patients who have problems of gastritis containing papaine indicated in pharmacy as in the treatment of digestive insufficiencies in internal use, whereas decoction of leaves enters in the therapy of malaria; the same usages have been cited in south-Kivu province (Defour, 1995).

Triturated leaves of *Conyza sumatrensis* is frequently used against Mycosis and several skin diseases, even in plaster against panaris, the same usages were cited for the similar ways in Congo Brazzaville (Bitsindu & Lejoly, 1992). The leaves of *Conyza sumatrensis* and *Dichrocephalla integrifolia* grinded and applied in ocular instillation against Migraine in South-Kivu province (Balagizi, op cit.) are also remarkable in the specialized medicine of the two territories. Leaves of *Bidens pilosa* used in decoction against Diarrhea in Congo Brazzaville and Ivery coast (Adjanohoun et al., 1988; TaBi et al., 2008); were cited in the traditional medicine of healers in Beni and Lubero territories. Maceration of leaves of the same plant is used for the charge taking of gonorrhoea and Epilepsy; the similar usages were cited in South-Kivu Province (DRC) (Defour, 1995).

The therapeutic virtues of *Bidens pilosa* just been mentioned in several literatures, its medicinal properties could be due to Phenylheptatriene, and other derived of Thiophene, which is antimicrobial repeated (Fotso et al., 2002).

However, the results of qualitative photochemical analysis of aqueous extract of leaves of *Bidens pilosa* have come to the identification of Flavonoids, Polyphenols, Terpenes (Kouakou et al., 2008).

The skins of *Harungana madagascariensis* used in decoction sometimes in maceration then administered by anal voice or again by seat bath against Haemorrhoids have been one of important in the surveyed villages.

The same plant is used against Haemorrhoid in Kisangani (Kalanda et al., 1993) and Equator province of the Democratic Republic of Congo (Ilumbe et al., 2014)

6. Conclusion

Great differences are observed in the number of recipes used in traditional medicine of Bantus and Pygmies healers living in the same villages. Bantu healers are more informative because of several exchanges that they have with other specialists, whereas Pygmy healers limit themselves to the knowledge acquired from their ancestors without much evolution. The characteristics of formulas and the modes of administration of formulas differ between the two groups. Bantus healers mostly prefer carbonization and decoction, whereas Pygmies prefer to destroy the parts of the plants, as well as triturating. In the same way, Pygmies administer their recipes mostly by cataplasm and scarification, whereas Bantus prefer oral and rectal way. Considering the specialties of treating infections between the two groups, affinities are very numerous; however, differences are noticed for some infections. Bantus healers are mostly specialized in treating diseases of the digestive system and the infections of Uro-genital system, which are less frequent in the Pygmy camps. Pygmies on their own side have more experience in treating sexual impotencies'. Most methods used by specialists of two ethnic groups in traditional medicine are not lasting, this could attract the attention of researchers and other actors of development worked in the area to integrate the traditional medicine in lasting management of the ecosystems to preserve the species more coveted.

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