Heliyon 5 (2019) e02007

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.heliyon.com

Ethnobotanical and phytotherapeutic study from Kouni community of the sub-prefecture of Kayes (Bouenza – Congo)

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ARTICLE INFO

Keywords:
Public health
Ethnotherapy
Traditional pharmacopoeia
Phytodiversity
Socio-cultural value
Congo

ABSTRACT

The ethnobotanical and phytotherapeutic study conducted in Mvouandzi (4°10′00″ S, 13°25′00″ E), sub-prefecture of Kayes (Bouenza - Congo), is based on the floristic inventory, the personalized interviews and focus groups. The target population, aged between 15 to 70 years or more, is divided into 3 age groups, and consists of 46 informants (12 men and 34 women) who possess the plant secrets. The floristic inventory lists 60 useful species, corresponding to 53 genera and 35 families. The medicinal cohort is associated with 109 recipes and 57 diseases and symptoms. Classified as a sphere of diseases and symptoms, infectious and parasitic diseases predominate (27.11%) and retain 30.27% of recipes. All organs (vegetative and generative) intervene in the daily satisfaction of the needs of the populations. Ethno-sociological analysis reveals that the level of endogenous knowledge is proportional to the subjects' age and in this matter, women by virtue of their role as manager and guardian of morals, excel in the exploitation of empirical knowledge. Data on the value of ethnobotanical use, the informant consensus factor and the level of fidelity show that these plants are strongly involved in the primary care of this society. Notwithstanding the inseparable link between man and his environment, the value associated with this biodiversity, the socio-cultural foundation of the Kouni ethnic-linguistic community, is inevitably eroded. The reasons for this are the rural exodus, the main corollary of which is the ageing of the population, and the effects inherent in the construction of physical communication infrastructures.

1. Introduction

Humans, since the colonization of the planet earth, derives their existence from the components of their environment, for the daily satisfaction of their needs. Among all needs, feeding themselves was the very first and healing themselves being the second need which was indirect before being direct (Wezel, 2002; Dupuis, 2011). In spite of pet therapy and lithotherapy, phytodiversity is the main source of acquisition of medicinal substances. Since the colonization of the planet earth, man has derived his existence from the components of his environment, for the daily satisfaction of his needs. Among all needs, feeding oneself was the very first and with it healing oneself, which was secondarily indirect before being direct (Wezel, 2002; Dupuis, 2011). Despite animal and lithotherapy, phytodiversity is the main source of acquisition of medicinal substances.

Humanity increasingly interest in the environment and its components over the past decades has led humans to take initiatives that support the conservation of biodiversity. Indeed, as the work of Bergonzini (2004), Riera and Alexandre (2004) and, Bergonzini and Lanly (2000), shows the three levels of biodiversity (α, β, γ) are threatened with extinction as a result of human activities. This situation is all the more worrying because it brings not only scientists but also human societies to invest in the sustainable development of phytodiversity, the basis of endogenous and even intrinsic knowledge and sociocultural added value. The future of rural communities whose life and the sustainability of the socio-cultural base are closely dependent on the state of conservation of the surrounding ecosystems is at stake. The human - environment relationship is the driving force behind the perpetuation and transmission of knowledge; empirical and secular practices on the natural virtues of flora. Currently, traditional knowledge is disappearing for several reasons (lack of writing, the rural exodus, and the disappearance of the elderly ...). The increasingly influential influence of worldly habits are factors favoring the decline of the endogenous knowledge of various traditional societies on the use of biodiversity (Kimpouni et al., 2017, 2018). Thus, in Africa

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https://doi.org/10.1016/j.heliyon.2019.e02007
Received 15 January 2019; Received in revised form 1 April 2019; Accepted 24 June 2019

"An old man who dies, it is a whole library which burns".

Since antiquity, man, in his quest to satisfy his daily needs, has always drawn intelligence from the surrounding nature (Raponda-Walker and Sillans, 1961; Kimpouni et al., 2014). Among the knowledge developed, food and phytotherapeutic anthropology, and handicrafts (in all these forms) have been the most sophisticated and well-groomed (Kimpouni et al., 2011). For a long time put on the back burner and supplanted by manufactured products and modern medicine, this empirical knowledge showed a regressive decadence, despite numerous associated molecules (Farsworth et al., 1986; Baker et al., 1995; Verpoorte, 1999; Sanogo, 2006). Around the world, the poverty of members of different ethno-linguistic communities and the prohibitive charges of drugs coupled with quality health care, are the main reasons for the revaluation of phytotherapy and the use of endogenous knowledge.

In Africa in general, and particularly in Congo, several ethnobotanical studies have been conducted on useful plants and concern various aspects (Profizi et al., 1993; Kimpouni and Nguembo, 2018). Based on the whole national territory, these works do not often express the ethnico-cultural specificities of the peoples surveyed. But they remain very general because they are based on the whole country (Bouquet, 1969; Adjanohoun et al., 1988). Hence the tendency to hover over the sum of the endogenous knowledge associated with man and his environment. Each ethnico-linguistic group presents its peculiarities on the exploitation of phytodiversity, in spite of divergences and convergences of uses (Bouquet, 1969; Kimpouni, 2001; Mpassi, 2007; Kimpouni et al., 2011, 2012; Bokatola, 2013).

This study makes an inventory of useful plants and their ethnobotanical interest among Kouni village Mvouandzi. It enhances the endogenous knowledge of the ethnico-linguistic base of this community. Indeed, by its location and the historical context of the Bantu's migration, Mvouandzi is a fragile site with restricted area in the district of Kayes. Almost geographically isolated from the Kouni area, this community is losing its socio-cultural values, due to the lack of communication with other members of the Kouni group and the influence of the Kamba and the other ethnic-linguistic communities which surrounds it.

As with all traditional societies around the world, useful plants are of great importance to the Kouni ethnic-linguistic group. At the same time symbol of the cultural base, it is the inherited legacy from generation to generation and a source of knowledge that the Kouni use on a daily basis to satisfy their needs. The worldly attraction coupled with the use of manufactured products, the virtues of plants are gradually abandoned, even unknown or poorly exploited by the youngest. The use of the virtues of these medicinal, food, artisanal plants confirms this interest of the Kouni through the preparation of remedies, dishes, the construction of homes and other everyday work.

Surveys have identified a variety of useful plants (medicinal, food and craft). However, they have shown that plant utilization varies from one individual to another, depending on how the plants are used (Nkounkou-Loufoukou, 2012). But, everyone expresses their cultural identity through the particular use of plants. Indeed, the elderly are depositories of knowledge about useful plants and their traditional values in Mvouandzi.

The mentioned facts integrate well the major problematic of the valorization and the conservation of the traditional knowledge on the use of the floristic biodiversity of the natural formations in general and the useful plants in particular. The ethnobotanical interest in the village Mvouandzi makes it possible to contribute to the knowledge of the biological diversity and the specificities of uses constituting the sociocultural base Kouni.

2. Material and method

2.1. Study site

The study area is located in the sub-prefecture of Kayes (Bouenza-Congo). The village Mvouandzi (4° 10′00 ″ S, 13° 25′00 ″ E) located on the right bank of the Niari River midway between the chief towns of the district of Kayes and Madingou, particularly in the North East of Kayes district (Fig. 1). The interest in conducting this research in Mvouandzi and on the ethno-linguistic group Kouni lies on the fact that it is the only one in the region, founded by this community and where it is subservient. Evolving far away and without contacts with the rest of its community, Mvouandzi's Kouni ethnic-linguistic group, without being self-sufficient, is isolated within an area dominated by the Kaamba, Beembé and Bayadi ethnic groups. The study area is influenced by the AW4 climate (Köppen, 1900, 1936; Kottek et al., 2006; Beck et al., 2018). This climate, described as humid tropical or low Congolese climate, covering the south of the country, has as its main markers: an average annual temperature of 25 °C for a low temperature range; average annual rainfall of the order of 1200 mm; alternating season (Fig. 2). A rainy, hot and humid season with peaks of precipitation in November, for the first, and the second in March and April (Samba et al., 2008; Samba and Nganga, 2011). The dry and cool season settles from June to September.

The vegetation consists of shrubby savanna and riparian forests rich in timber species. The work of Olson et al. (2001) shows that the study site is located in the Afrotropic ecoregion and more precisely in the tropical and subtropical moist broadleaf forests zone. According to African chorology (White, 1983), this flora and vegetation belongs to the Guinean-Congolese Region, in particular to the Lower-Guinea endemism subcentre. By integrating Congo's phytogeographic data into the White (1983), Kimpouni et al. (1992) show that the flora and vegetation of Mvouandzi belongs to the Niari District, in the Lower Guineo-Zambezian transition Sector of the Lower-Guinea Domain within the Guineo-Congolese Region. Thus, this vegetation, composed of shrubland, woodland and forests, corresponds to the drier peripheral semi-evergreen Guineo-Congolian rain forest, and Zambezian dry evergreen forest and transition woodland Grassland and wooded grassland (White, 1983).

These ecosystems and their flora are subject to the harmful effects of human activities on a recurrent basis. In addition to the industrial exploitation of timber that degrades the forest, slash-and-burn agriculture coupled with violent bush fires, which systematically occur at the end of the dry season, is one of the factors that most transform landscapes and permanently affect flora (Kimpouni et al., 2017, 2018; Bergonzini, 2004). In addition to these facts, the collection of Non-Timber Forest Products (NTFPs) for commercial purposes to supply the city of Nkayi is a growing activity in the study area since the opening on the Pointe-Noire - Brazzaville highway. Finally, the construction of physical communications infrastructure, in particular National Road No. 1 in its Nkayi - Madingou section, without environmental and social impact studies, has affected ecological niches and therefore flora. It should be noted that the impact of these anthropogenic activities is all the more severe in that only about 50% of species are inventoried on an estimate of 6000–8000 (Cusset, 1989; Lachenaud, 2011) on the one hand, and very little ecological data are available on knowledge of Congolese ecosystems in general and the study area in particular, on the other hand (Kimpouni et al., 2013a).

2.2. Material

The medicinal plants that are the basis of the study were collected in Mvouandzi, in September 2016. They are cited and selected by a group of 46 people holding knowledge on the virtues of plants and followers of herbal medicine. The material was harvested around the huts, in the hut gardens, the fields, along rivers and in the riparian forests. For each species, status is indicated (Spontaneous, Sub-spontaneous, Cultivated, Aboriginal or Allochthones); habitat; morphological and phytogeographic types; and the part used. The specimens were identified in situ and confirmed at the National Herbarium (IEC) in Brazzaville. The ordination followed is the APG IV (Angiosperm phylogeny group, 2016) and the adopted nomenclature is that of Lebrun and Stork (1991–2015).

2.3. Group of informants

The group of informants whose age varies from 15 to 50 years and

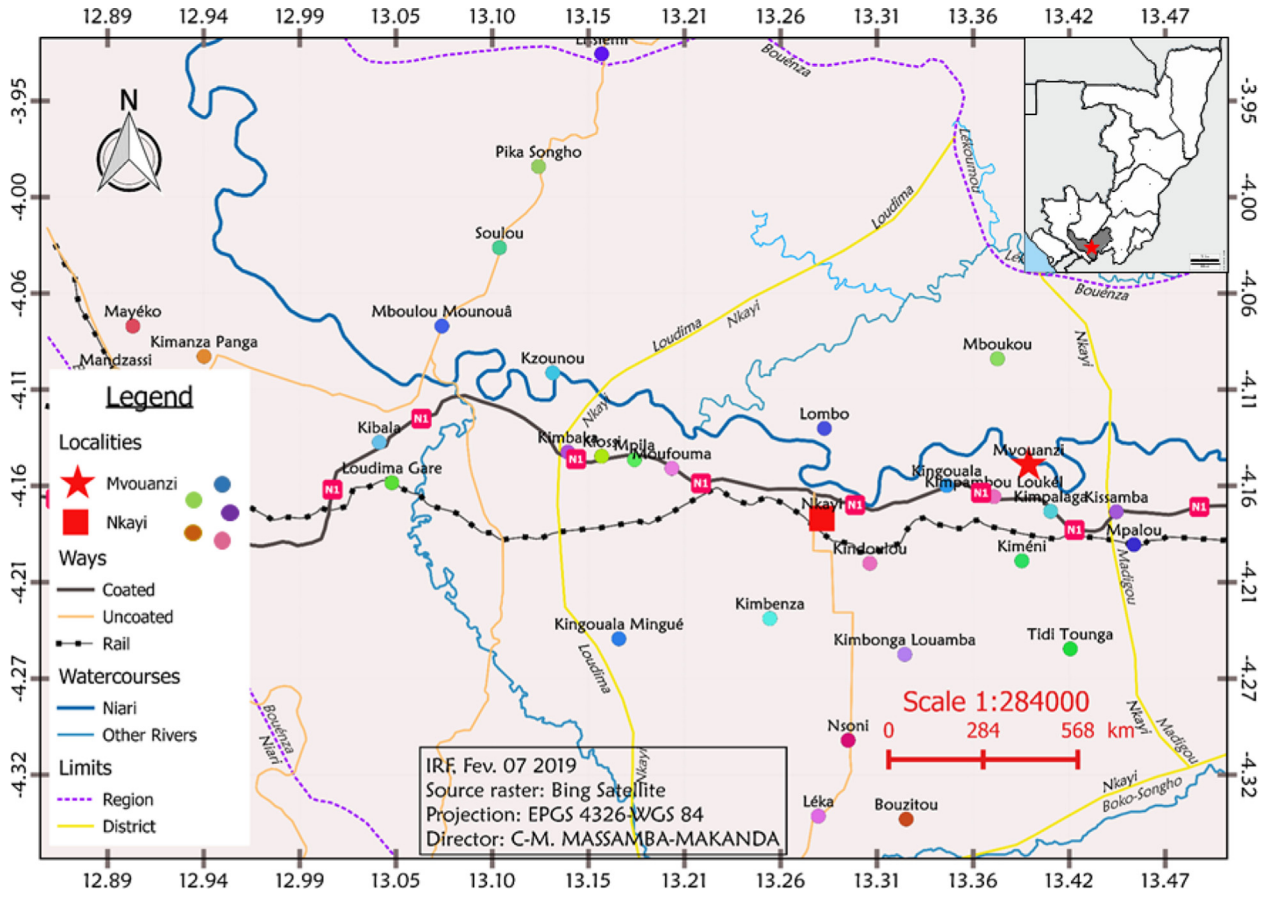

Fig. 1. Geographical location of Mvouandzi in the Kayes sub-prefecture.

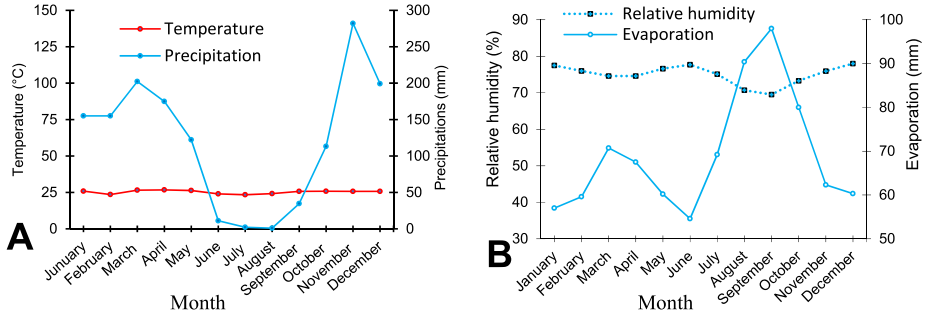

Fig. 2. Climate parameters of the study area (2000–2016 period, source ANAC). Legend: Ombrothermal curve (A); Relative humidity and evaporation curves (B).

more, consists of 46 persons possessing secrets of the plants. It is based on gender diversity, and consisted mainly of adolescents and adults with some phytotherapeutic knowledge (Table 1). The proportions of ¼ and ¾ observed between genders are based on 3 main reasons associated with the habits and customs of this traditional society, and worldly life. The rural exodus, which is of particular interest to young boys, has resulted in demographic imbalance within genders and age groups; the focus groups have identified and recognized that women, who are more numerous in all age groups, are the proven holders of plant secrets; finally, the female guardian of the socio-cultural and family base is responsible for the education of children, with a particular focus on girls.

2.4. Study method

The method of data collection is based on the review of the bibliographic and the ethnobotanical survey (Martin, 1995).

2.4.1. Literature review

The data of the literature made it possible to make an inventory of the ethnobotanical studies in general and particularly phytotherapy, in Congo and in our zone of study (Bouquet, 1969; Raponda-Walker and Sillans, 1961; Adjanohoun et al., 1988; Kimpouni and Motom, 2012;

Table 1
Synoptic on the profile of the informants surveyed.

Age group (year)	Informants					
	Men		Women		Total	
	Number	%	Number	%	Number	%
15–25	2	16.67	7	20.59	9	19.57
25–50	6	50	17	50	23	50
≥50	4	33.33	10	29.41	14	30.43
Total	12	26.09	34	73.91	46	100

Kimpouni et al., 2017, 2018). They also provided information on the status (autochthonous or exotic) of inventoried species, their phytogeographic distribution, known uses within their range.

2.4.2. Ethnobotanical inventory

The ethnobotanical inventory was conducted in two phases, namely: focus groups and/or personalized interviews selected the informants; to know the mechanisms of knowledge transmission; and sample collection coupled, when it was possible, with the participatory approach (Adjanohoun et al., 1994). During this inventory, emphasis is placed on the habitat, the availability of the bioresource and the threats to it, the nature of the organs collected and the morphological and phytogeographic types of plants. The possession of secrets associated with the exploitation of plant diversity, within reach, is the criterion used by informants. It is underpinned by the services provided to the community.

- The first phase is based on personalized or group interviews involving both genres. This work is conducted following an open-ended interview guide, in order to gather as much information as possible, and occasionally closed questions for specific information. The interviews are semi-directive (Martin, 1995) and deal with the initiation and transmission of endogenous knowledge within the community; diseases and symptoms treated and/or relieved.
- The second phase, which consisted of verifying the data collected during the interviews and discussions, targets the collection of samples plant, the parts used, and to identify tangible signs of their use. Finally, the participatory approach made it possible to monitor the process of preparing and administering herbal medicines, including the composition of recipes, dosages, modes of use and, the addition of minerals and other non-native plant components to recipes.

2.5. Expressions of the results

Ecosystem services fall into three categories, according to the Millennium Ecosystem Assessment (2003, 2005): supply services make it possible to obtain appropriable property through the exploitation of ecosystems; regulatory services; and cultural services. The data are analyzed on the basis of ethnotherapeutic indicators. The ethnobotanical use value (Vu) is calculated for this category of ecosystem goods and services (Dossou et al., 2012; Albuquerque et al., 2006), according to the formula

$$VU = \sum_{i}^{n} Ui/\mathrm{n} \qquad \text{either} \qquad \mathrm{VUt} = \sum_{1}^{p} \mathrm{VU}$$

Ui = number of citations per ecosystem service and n = total number of people surveyed.

The Informative Consensus Factor (FCI) adapted from Heinrich et al. (1998) and Loyalty Level (NF) are used to determine the relative importance of ecosystem services that underlie the sociocultural base of the community. The FCI generally supports ethnotherapy to identify species that are valued by the community, to agree on their uses and possibly to consider in-depth studies (Heinrich et al., 1998; Andrade-Cetto and Heinrich, 2011; Uddin and Hassan, 2014). The value of the FCI varies from 0 to 1 and indicates a high consensus when it tends to 1.

FCI = (Nur – N1) / (Nur – 1)

Nur = number of citations in each category of ecosystem services and N1 = number of ecosystem services that comprise it.

The level of fidelity (NF) is calculated within this category of ecosystem services, based on the adapted formula of Friedman et al. (1986).

NF = (Np / N) x 100

With Np = number of people citing a type of ecosystem service or use and N = total number of people who derive an ecosystem service of some kind.

3. Results

3.1. Floristic inventory

The inventory shows 60 species divided into 53 genera grouped into 35 families (Tables 2 and 3). The specific diversity of families ranges from 1.67 to 11.67%. The Fabaceae (11.67%) dominate 6 other families (Anacardiaceae, Malvaceae, Rubiaceae, Rutaceae, Solanaceae, Verbenaceae) each of which represents 5% of species. Native plants contain 58.33% of inventoried species (Table 3).

3.2. Distribution of taxa

3.2.1. Habitat

Depending on the type of habitat, there is a preponderance of cultivated species (40.68%) compared to savanna (38.98%) and forest trees (20.34%).

3.2.2. Morphological type

A dominance of woody trees (57.63%) associating trees and shrubs is noted in this inventory, compared to herbaceous plants (35.59%) and vines that barely reach 6.78% (Fig. 3).

3.2.3. Phytogeographic type

The widely distributed element of paleotropical, pantropical and afrotropical taxa accounting for 71.19% overshadows the endemic element (Guinea-Congolese) which, with 28.81% of taxa, forms the natural foundation of indigenous knowledge (Fig. 4). These proportions of ¾ and ¼ are closely associated with the successive waves of introduction of non-native taxa and their recent integration into traditional herbal medicine. This preponderance is irrefutable proof of the appropriation of foreign knowledge.

3.3. Plant organs and exploitation

Ethnobotanical data on the use of different plant organs show very strong preferences from vegetables. The parts of generative origin with 13.41% have a very weak ethnotherapeutic contribution compared to the vegetative ones. The latter category accounts for 86.59% of inventoried taxa (Fig. 5).

3.4. Method of preparation and administration of the products

The survey revealed 60 medicinal plants for 57 diseases and symptoms treated. 8 types of organs are used for 7 types of preparation and 11 instructions for use. 109 recipes have been identified, 91.67% of which are composed of a single species and 8.33% of at least two species. However, it is worth noting the use of mineral, organic and even manufactured products based on mint and camphor. Thus, it is noted: 1 macerated with palm wine; 7 recipes to which palm oil is added; cooking salt (NaCl) in 1 recipe; firewood ash in two recipes; clay in one recipe; honey in one recipe; garlic in two recipes; milk in one recipe; and finally, mint and camphor products in two recipes.

Several methods of preparation of phytomedicines are used by the users of stated practices above. The most popular are the decoction (38%), the maceration and the poultice (Fig. 6).

The mode of administration is a resultant which confirms the observations at the level of the preparation. Thus, the dominance of the oral route, for the taking of phytomedicaments, is closely correlated to the mode of preparation (Fig. 7). Note that other routes of administration are

Table 2
Taxonomic and status of taxa identified in Mvouandzi village.

Taxa	Hierarchical taxonomic levels						Status					
	Families		Genus		Species		cultivated species		Spontaneous species		Spont.cult. species	
	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%
Dicotyledons	28	80	45	84.91	52	86.67	19	31.67	29	48.33	3	5.00
Monocotyledons	7	20	8	15.09	8	13.33	6	10.00	2	3.33	1	1.67
Total	35	100	53	100	60	100	25	41.67	31	51.67	4	6.67

Legend: number (Nb), percentage (%), native (Spont.), native cultivated (Spont. cult.)

almost marginal.

In terms of preparation and administration, 66% of informants use medicinal plants without considering the quantities of materials and other inputs. In addition, 34% of the population use medicinal plants with specific quantities.

3.5. Empiricism of knowledge

Monitoring the level of use of biodiversity in relation to endogenous knowledge shows that initiation is progressive and proportional to age. Along with the number of informants by gender, women make up the group that best exploits floristic diversity with more than 2/3 of quotations, both in number of plants and recipes. In terms of the specific uses of plants, 13 are recognized for women and 5 for men (Table 4). As for the recipes, 10 are specific to women, compared to 5 to men (Table 4).

In relation to age groups, the specificities for plants are as follows: 5 for 15–25 years old; 10 for 25–50 years old and 14 for 50 years old and over. Considering the recipes, 4 are associated with 15–25 years old, 9 with 25–50 years old and 13 with 50 years old and over.

3.6. The diseases or symptoms treated

The majority of species listed in the region are indicated for the treatment of diseases such as: cough, diarrhea, influenza, malaria, typhoid fever, hemorrhoids, abortion, and stomach aches. These high-prevalence diseases and symptoms are the daily lot of informants and the region (Fig. 8). The daily satisfaction of primary health care needs is based on simple recipes involving a plant or its organs, either complex, more than one plant or their organs (Table 4). Diseases and symptoms classified by sphere of disease reveal a predominance of infectious and parasitic diseases. Skin diseases and subcutaneous tissue are the least represented (Fig. 9).

3.7. Age group and gender

Rates of use of medicinal plants are proportionately associated with the age of the informants (Fig. 10). This rate is 76.67% in the age group $\geq$50 years, 55% for 25–50 years and finally 21.67% for 15–25 years (Table 5). Gender distribution shows that women's level of endogenous knowledge is higher than that of men. Notwithstanding this difference, the level of knowledge acquisition is correlated with age and is progressive within the genre. This degree of knowledge is translated in terms of citations of medicinal species to 68.13%, against 31.87% to men.

Like plants, recipes follow the same evolutionary trend. The revenue rate is intimately associated with age and gender. In relation to age, 12.84% of income for 15–25 year olds; 33.94% for 25–50 year olds; and 53.21% for those aged 50 and over. In addition to age, revenue is gender dependent, regardless of age group. The rate of income in use by age group varies from 10.09 to 38.53% for women and from 2.75 to 14.68% for men.

3.8. Ethnobotany use values of taxa

The ethnobotanical value of use of taxa is associated with the number of citations or informants who use them. In this study, it is calculated for the 16 species mentioned by at least 50% of informants and for these taxa the number of citations varies from 54.35 to 89.13%. The set of taxa with an informative consensus factor is equivalent to the absolute maximum of 1. The ethnobotanical use value of taxa varies from 0.54 to 0.89; while their fidelity level oscillates from 54 to 89% (Table 6). The high ethnobotanical use value of allochthonous taxa can be explained by the fact that these plants do not constitute the basis of the endogenous knowledge of this traditional society, and their use, which is a new acquisition, has become so widespread that it has become popular.

4. Discussion

4.1. Floristic analysis

The ethno-linguistic Kouni community presents us with a floristic diversity that seems insignificant with regard to the knowledge acquired on the Congolese medicinal flora (Bouquet, 1969; Adjanohoun et al., 1988; Profizi et al., 1993). Keeping with the opportunities offered by flora at hand, the Kouni community declines a very high amount of endogenous knowledge, with a ratio of almost 2 recipes per plant; an average of one disease per plant and two recipes per disease. By associating allochthones and autochthonous plants in therapeutic uses, the Kouni ethno-linguistic community values concomitantly the intrinsic values and those acquired secondarily, during meetings with other populations. These mechanisms allow the enrichment of the socio-cultural base and consequently the transfer of knowledge between communities (Kimpouni et al., 2017, 2018).

The traditional pharmacopoeia is fundamentally linked to native plants and the daily interest of these plants is proof of an intimate link between the populations and them (Ampofo, 1997; Tailfer, 1989; Grenand and Prevost, 1994; Emperaire and Lescure, 1994; Kimpouni and Nguembo, 2018). This recognition and exploitation of the medicinal virtues, of these plants, on a large geographical scale, is the proven affirmation of their utility in relations of humans and their environment. Recent data from phytochemical research show that several African plants have offered new drugs and/or molecules to humanity (Farsworth et al., 1986; Baker et al., 1995; Verpoorte, 1999; Sanogo, 2006).

4.2. Ethnophytogeographic analysis

All the phytotherapeutic quotations found in the Kouni ethnic-linguistic community are a fraction of the range of known medicinal uses in Congo and elsewhere, including the ethnic-linguistic groups in their geographical area (Raponda-Walker and Sillans, 1961; Bouquet, 1969; Adjanohoun et al., 1988; Lavergne and Véra, 1989; Hecketsweiler et al., 1991; Kimpouni, 1999; Kimpouni et al., 2012). The variations observed in uses, modes of preparation and administration, diseases and symptoms treated are none other than those specific to the socio-cultural base (Betti et al., 2013a, 2013b, 2013c; Kimpouni et al., 2007; 2017,

Table 3
Synopsis of plants for phytotherapeutic use inventoried in the Mvouandzi region.

Order No.	Species and family diversity	Status	Habitat	Used part	T.M	T.P	Kouni names
	Acanthaceae (1/1.67%)						
1.	*Brillantaisia patula* T.Anders.	Native	Forest	Leaves	Ha	Aftr	Lémbalémba
	Anacardiaceae (3/5%)						
2.	*Mangifera indica* L.	Alien	Cultivated	Bark	A	Pant	Mu manga
3.	*Spondias cytherea* L.	Alien	Cultivated	Leaves	A	Aftr	
4.	*Spondias mombin* L.	Alien	Cultivated	Leaves	A	Pant	Munguiéguié
	Annonaceae (2/3.33%)						
5.	*Annona muricata* L.	Alien	Cultivated	Leaves, Bark	A	Pant	Mucrossole
6.	*Annona senegalensis* Pers.	Native	Savanna	Bark, root	A	GC	Mulolo tsiéké
	Apocynaceae (1/1.67%)						
7.	*Landolphia owariensis* P. Beauv.	Native	Savanna	Fruit, Leaves	L	Aftr	Malombo
	Asteraceae (2/3.33%)						
8.	*Chromolaena odorata* (L.) R.M.King. & Robinson	Alien	Savanna	Leaves,	Hv	Pant	Kikalimina
9.	*Gymnanthemum amygdalimun* (Del.) Walp.	Native	Savanna	Leaves, root	Ar	Aftr	Midouridouri
	Bignoniaceae (1/2.27%)						
10.	*Newbouldia laevis* (P. Beauv.) Seem. ex Bureau	Native	Cultivated	Leaves, Bark	Ar	GC	Mussunissuni
	Burseraceae (1/1.67%)						
11.	*Dacryodes edulis* (G.Don) Lam.	Native	Cultivated	Fruit, resin, Bark	A	Aftr	Mussa mfu
	Caricaceae (1/1.67%)						
12.	*Carica papaya* L.	Alien	Cultivated	Leaves, fruit, seed, root, sap	Ar	Pant	Mulolo
	Chenopodiaceae (1/1.67%)						
13.	*Chenopodium ambrosioides* L.	Native	Savanna	Leaves, whole plant	Ha	Cosm	Makaya mu kuyu
	Combretaceae (2/1.67%)						
14.	*Terminalia superba* Engl. & Diels.	Native	Forest	Bark	A	GC	Mudimba
15.	Crassulaceae (1/1.67%)						
16.	*Kalanchoe crenata* (Anders.) Harv.	Native	Cultivated	Leaves	Hv	Aftr	Yuka yuka
	Cucurbitaceae (2/3.33%)						
17.	*Luffa cylindrica* (L.) Roam.	Native	Savanna Forest	Leaves, Fruit	Ha	Pant	Mu Tsaka-tsaka
18.	*Momordica charantia* L.	Native	Savanna Forest	Leaves, whole plant	Ha	GC	Lumbussi mbussi
	Euphorbiaceae (2/3.33%)						
	Alchornea cordifolia (Schumach. & Thonn.) Muell.Arg.	Native	Savanna	Leaves, root	Ar	Aftr	Mumboudzi
19.	*Manihot esculenta* Crantz	Alien	Cultivated	Leaves, tuber	Ar	Pant	Mumbeyi
	Fabaceae (7/11.67%)						
20.	*Cajanus cajan* L. Millps.	Native	Cultivated	Leaves	Ha	Pant	Cassa
21.	*Desmodium velutinum* (Willd.) DC.	Native	Savanna	Leaves	Sa	Aftr	Kinama
22.	*Dichrostachys cinerea* (L.) W. Wight & Arn.	Native	Savanna Forest	Leaves	Ar	Aftr	Luranga
23.	*Millettia versicolor* Baker	Native	Savanna Forest	Leaves	Ar	Cg	Lubota
24.	*Senna alata* (L.) Roxb.	Alien,	Cultivated	Leaves	Ar	Pant	Miyilabuissi
25.	*Senna occidentalis* L.	Native	Savanna	Leaves, root	Ar	Pant	Kinkéliba
26.	*Senna siamea* (Lam.) Irwin & Barneby	Alien	Cultivated	Root, Bark	A	Pant	Acacia
	Gnetaceae (1/1.67%)						
27.	*Gnetum africanum* Welw.	Native	Forest	Leaves, liana	L	GC	Mfumbu
	Lamiaceae (1/1.67%)						
28.	*Ocimum gratissium* L.	Native	Cultivated	Leaves	Ha	GC	Matsussutsussu
	Lauraceae (1/1.67%)						
29.	*Persea americana* Mill.	Alien	Cultivated	Leaves	A	Pant	Muvoka
	Malvaceae (3/5%)						
30.	*Gossypium hirsutum* L.	Alien	Cultivated	Leaves	Hv	Cosm	Makaya bissadi
31.	*Sida acuta* L.	Native	rural	Leaves, flower	Hv	Aftr	Lumvumvu
32.	*Waltheria indica* L.	Native	savanna	Leaves	A	Pant	Lumvumvu
	Moraceae (2/3.33%)						
33.	*Milicia excelsa* (Welw.) C. C. Berg.	Native	Forest Savanna	Sap, Bark	A	GC	Mbouyou
34.	*Trilepisium madagascariensis* DC.	Native	Forest	Leaves	A	GC	Musiékiéni
	Myrtaceae (2/3.33%)						
35.	*Eugenia uniflora* L.	Alien	Cultivated	Leaves, fruit	Ar	Cosm	Cerisier
36.	*Psidium guyava* L.	Alien	Cultivated	Fruit, Leaves	Ar	Pant	Mucrossole
	Passifloraceae (2/1.67%)						
37.	*Passiflora foetida* L.	Native	savanna	Leaves, fruit, whole plant	Hv	GC	Bipompolo
	Phyllanthaceae (1/1.67%)						
38.	*Bridelia ferruginea* Benth.	Native	Savanna	Bark	Ar	GC	Kirala
	Rubiaceae (3/5%)						
39.	*Gardenia ternifolia* T.	Native	Savanna	Leaves	Ar	Paleo	Kilembé Nzaou
40.	*Morinda lucida* Benth.	Native	Savanna	Ecorce, root	A	GC	Mussiki
41.	*Sarcocephalus latifolius* (Smith) Bruce	Native	Savanna	Leaves, root	Ar	GC	Mu tumbi
	Rutaceae (3/5%)						
42.	*Citrus aurantifolia* Swingle	Alien	Cultivated	Fruit; Leaves	Ar	Pant	Biguarathe
43.	*Citrus limon* Burm. f.	Alien	Cultivated	Fruit, Leaves	Ar	Pant	Citron
44.	*Citrus sisensis* Blanco	Alien	Cultivated	Fruit	Ar	Pant	Mulala
	Solanaceae (3/5%)						
45.	*Lycopersicum esculentum* P. Mille	Alien	Cultivated	Leaves; fruit	Ha	Cosm	Tumatu

(*continued on next page*)

Table 3 (*continued*)

Order No.	Species and family diversity	Status	Habitat	Used part	T.M	T.P	Kouni names
46.	*Nicotiana tabacum* L.	Alien	Cultivated	Leaves	Ha	Pant	Tsunga
47.	*Solanum melongena* L.	Alien	Cultivated	Leaves; fruit	Sa	Pant	Bitsoukoudou
	Urticaceae (1/1.67%)						
48.	*Urera repens* (Wedd.) Rendle	Native	Savanna	Leaves	Hv	Aftr	Matsiassa
	Verbenaceae (3/5%)						
49.	*Lantana camara* L.	Native	Savanna	Leaves	Hv	Cosm	*Lantana*
50.	*Lippia multiflora* L.	Native	Savanna	Leaves	Hv	GC	Bissankambou
51.	*Vitex madiensis* Oliv.	Native	Savanna	Leaves, fruit	Ar	Aftr	Filou
	Vitaceae (1/1.67%)						
52.	*Cissus rubiginosa* Baker	Native	Savanna	Leaves	Hv	GC	Kimfudakulu
	Arecaceae (1/1.67%)						
53.	*Elaeis guineensis* Jacq.	Native	Cultivated	Root, Leaves, fruit	A	Pant	Di ba
	Costaceae (1/1.67%)						
54.	*Costus afer* Ker Gawl.	Native	Forest Cultivated	stem	Hv	Aftr	Mukuissa
	Cyperaceae (1/1.67%)						
55.	*Cyperus articulatus* L.	Native	Humid zone Cultivated	Whole plant	Hv	Cosm.	Tsaku-tsaku
	Dioscoraceae (1/1.67%)						
56.	*Dioscorea liebrechtsiana* De Wild.	Native	Forest	liana	Hv	Cosm	Ntina
	Poaceae (2/3.33%)						
57.	*Cymbopogon citratus* L.	Alien	Cultivated	Leaves	Hv	Pant	Citronnelle
58.	*Saccharum officinarum* L.	Alien	Cultivated	stem	Hv	Pant	Lussangu
	Hypoxidaceae (1/1.67%)						
59.	*Curcoligo pilosa* L.	Native	Savanna	Tuber	Hv	Aftr	Ba dia tsiéké
	Zingiberaceae (1/1.67%)						
60.	*Zingiber officinale* Rosc	Alien	Cultivated	Rhizome	Hv	Pant	Tangawiss

Legend. Phytogeographical types (T.P): Pantropical (Pant); Afrotropical (Aftr); Cosmopolitan (Cosm); Guineo-Congolese (GC); Paleotropical (Paleo); Low-Guinean (Cg); Morphological types (T.M): Tree (A); Shrub (Ar); Perennial herb (Hv); Annual herb (Ha); Liana (L); Sub-shrub (Sa).

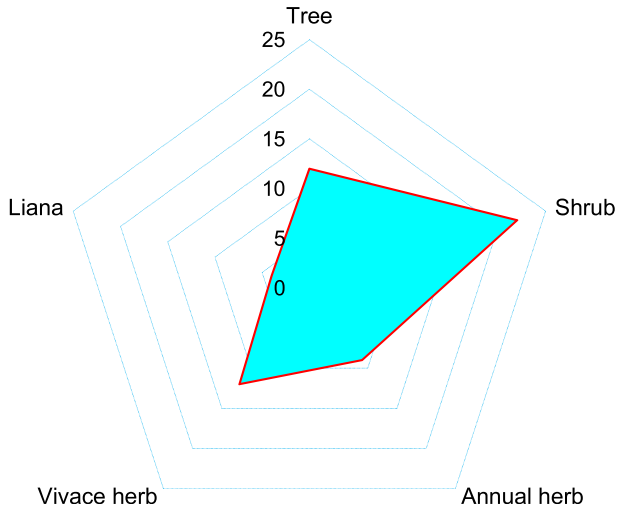

Fig. 3. Taxa contribution by morphological types (%).

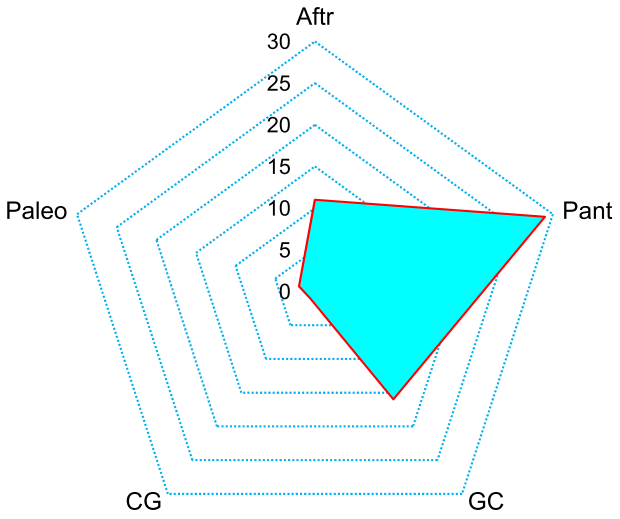

Fig. 4. Phytogeographic spectrum of taxa surveyed. Legend: Paleotropical (Paleo), Afrotropical (Aftr), Pantropical (Pant), Guineo-Congolese (GC), Low Guinean (CG).

2018). The unanimity of use of the majority of these plants at the scale of their distribution, by peoples of different and varied mores, can be cited as indisputable proof of their benefits. In this section, the specific values of phytotherapy of the Kouni group are very remarkable, and as an illustration let us quote (i) the local care based on *Nicotiana tabacum*; (ii) *Waltheria indica* for diarrhea; (iii) *Landolphia owariensis* for yellow fever; (iv) and finally, *Dioscorea liebrechtsiana* for hernia. In connection with known ethnobotanical data from Congo and the sub-region, these quotations would contribute to the endogenous exploitation of biodiversity.

Notwithstanding the bio-ecological factors that influence the physiological development of the plant, it is in this context that the reasons for not using certain taxa with medicinal properties controlled by other ethnic-linguistic groups and present in the study area must be found (Kimpouni et al., 2017, 2018). Some of these recognized species, while listed in the table of plants used in traditional African pharmacopoeia, have undergone chemical screening and conclusive pharmacological tests (Kerharo, 1974; Sofowara, 1996). Authenticated taxa are *Ageratum conyzoides, Mondia whitei, Hibiscus sabdariffa, Musa sapientum, Dioscorea* spp., *Euphorbia hirta, Gloriosa* spp., *Harungana madagascariensis, Rauvolfia* spp.

Of the species used by the Kouni ethnic-linguistic community, a large majority of them are involved in more than one daily field of application, in addition to phytotherapy, making them more vulnerable (Kimpouni and Motom, 2012).

4.3. Ethnobotany and phytodiversity

The therapeutic indications on the treated diseases or symptoms, discriminate a large dominance of infectious and parasitic diseases. This trend, which is not unique to this Kouni community, is noted in almost all

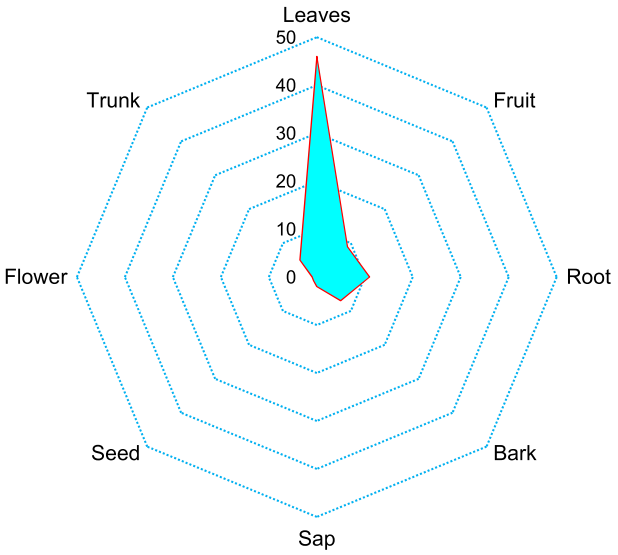

Fig. 5. Contribution of different parts of medicinal plants used (%).

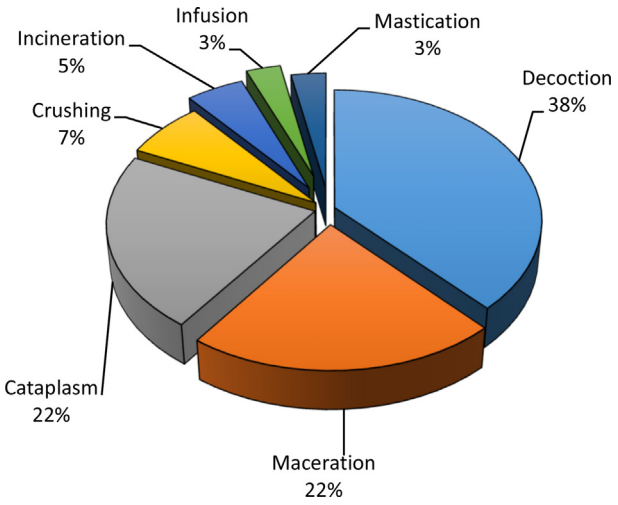

Fig. 6. Method for the preparation of phytomedicaments.

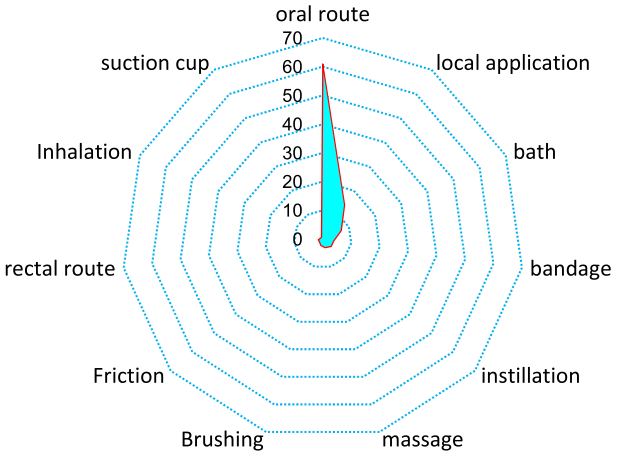

Fig. 7. Phytomedicine route of administration.

of the work inherent in endogenous knowledge, associated with

Table 4
Plants and recipes specifically mentioned by men or women.

Gender	Species	Pharmaceutical form and administration route	Diseases and symptoms treated
Men	*Spondias cytherea* L.	Decocted bark; oral route	sterility
	Landolphia owariensis P.Beauv.	Decocted fruit; oral route	yellow fever
	Urera repens (Wedd.) Rendle	Decocted leaves; oral route	coughing
	Terminalia superba Engl. & Diels.	Decocted leaves; oral route and mouthwash	Cavity (tooth decay)
	Waltheria indica L.	Decocted leaves; oral route	diarrhea
Women	*Morinda lucida* Benth.	Decocted with bark of *Morinda lucida* and, leaves of *Momordica charantia* and *Passiflora foetida*; oral route	typhoid
	Dioscorea liebrechtsiana De Wild.	Pilat of the leaves of *Dioscorea liebrechtsiana*, *Solanum melongena*, *Dacryodes edulis* and *Newbouldia laevis* mixed with palm wine plus snail shell; oral route	hernia
	Nicotiana tabacum L.	Leaf ash mixed with palm oil; oral route	tuberculosis
		Powder diluted in warm water; breech baths after delivery.	Local health
	Saccharum officinarum L.	Decocted from the bone marrow; oral route	yellow fever
	Dichrostachys cinerea (L.) W. Wight & Arn.	Macerated of the leaf pilat; oral route,	constipation
	Cyperus articulatus L.	Rhizome rasping's; local application	shingles
	Cissus rubiginosa Baker	Decocted leaves; oral route	bronchitis
	Newbouldia laevis (P.Beauv.) Seem. ex Bureau	Foliar juice; eye instillation	conjunctivitis cataract
	Dacryodes edulis (G.Don) Lam.	Dry leaf ash mixed with palm oil; local application	ringworm

medicinal properties, elsewhere in the Congo (Kimpouni et al., 2012, 2017; 2018; Bokatola, 2013). The problems of hygiene, environmental sanitation and lack of drinking water are the main causes of prevalence of this sphere of diseases. In order to relieve and/or heal these various ailments, vegetative organs (leaves, barks and roots) are the most sought after and involved in traditional herbal medicine. Satisfying the demand for plant products, the basis of traditional medicine, can affect exploited taxa and even the ecosystem, to varying degrees. Thus, the major factors in this degradation of biodiversity and ecosystems are the increase in frequency and the quantities harvested (Peters, 1997; Ticktin, 2004). The collection of vegetative and generative organs disrupts the stability and functioning of ecosystems, especially woody formations (Peters, 1997; Ticktin, 2004; Betti et al., 2013a, 2013b). The immediate consequences are the scarcity of useful taxa, which influences the transmission and perpetuation of knowledge within communities.

4.4. Sociocultural foundation and phytodiversity

Since endogenous knowledge is generally clannish, its transmission is governed by the rules of the customs and traditions of inheritance. This process of teaching and initiation is progressive and gender-oriented. In fact, the division of tasks and functions within the family means that the boy is assigned to the service of the father and the daughter to the mother. The latter despite her occupations, ensures the care, maintenance and education of children. The search for social welfare, the driving force behind the rural exodus, is no longer the plume of adolescents. For all these reasons, there is a better understanding of the gender imbalance in the informant population, the difference in the level of

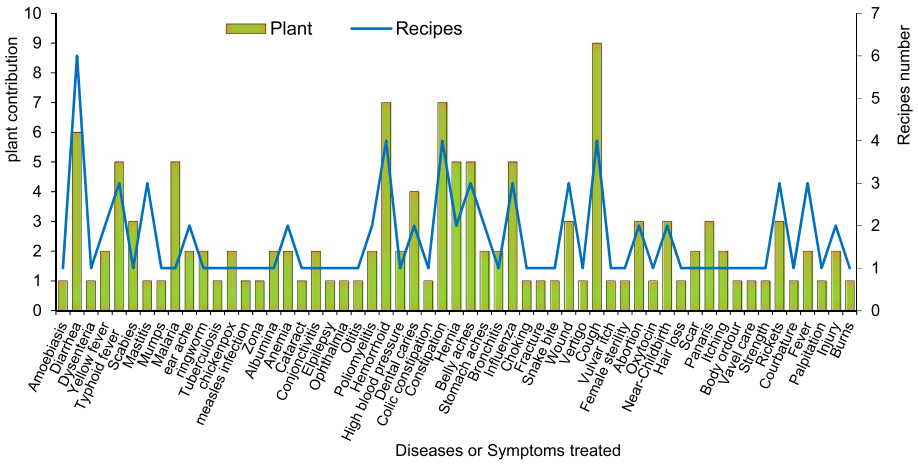

Fig. 8. Plants and recipes following the diseases or symptoms treated.

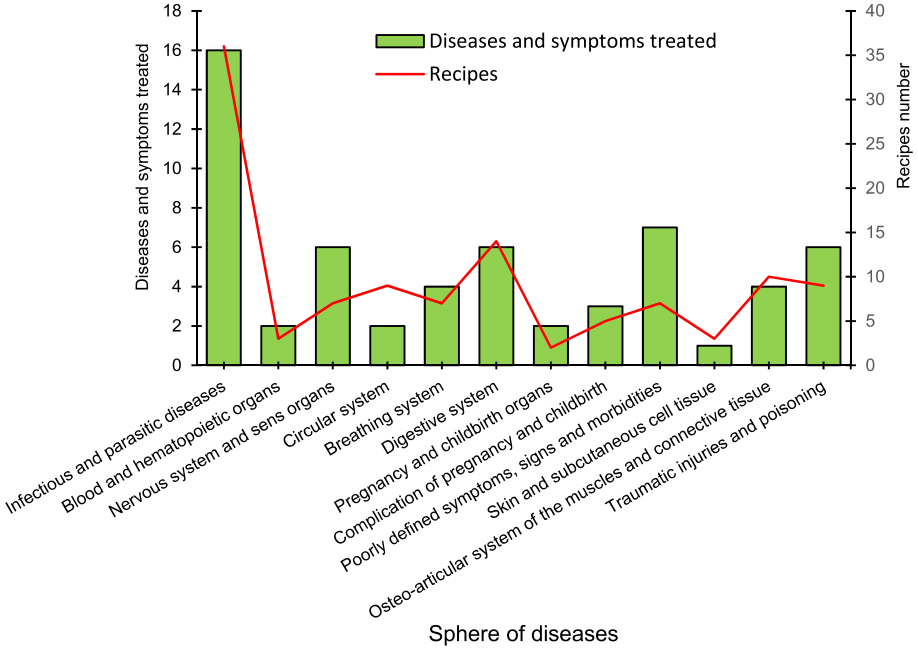

Fig. 9. Plants and recipes contribution by disease or symptom sphere.

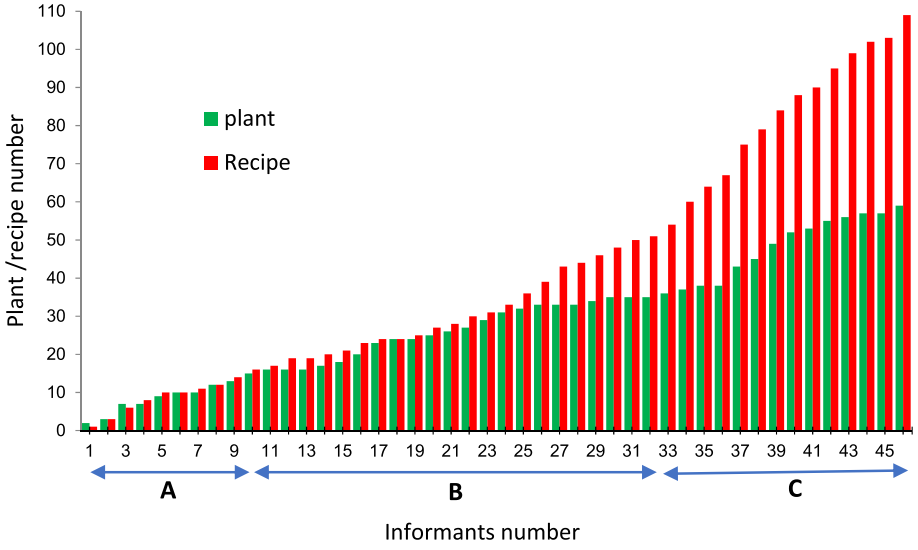

Fig. 10. Cumulative data by age group of informants. Legend: Age group 15–25 years (A); 25–50 years (B); 50 years and plus (C).

Table 5
Degree of exploitation of phytodiversity by age group.

Age group (year)	Gender	Plants used			Recipes in use		
		Number	%	Total	Number	%	Total
15–25	Men	3	5.00	13	3	2.75	14
	women	10	16.67		11	10.09	
25–50	Men	9	15.00	33	7	6.42	37
	Women	24	40.00		30	27.52	
≥50	Men	17	28.33	46	16	14.68	58
	Women	29	48.33		42	38.53	
Total		60	-	60	109	-	109

Table 6
Ethnobotanical values of the most quoted taxa in the survey.

Taxa	Citations number	VU	NF (%)
Chromolaena odorata (L.) R.M.King & Robinson	41	0.89	89.13
Mangifera indica L.	38	0.82	82.61
Citrus limon Burm. f.	36	0.78	78.26
Kalanchoe crenata (Andrews) Haw.	36	0.78	78.26
Alchornea cordifolia (Schum. & Thonn.) Muell.Arg.	35	0.76	76.09
Citrus aurantifolia Swingle	35	0.76	76.09
Momordica charantia L.	35	0.76	76.09
Senna alata (L.) Roxb.	35	0.76	76.09
Senna occidentalis L.	35	0.76	76.09
Bridelia ferruginea Benth.	32	0.69	69.57
Ocimum gratissimum L.	32	0.69	69.57
Senna siamea (Lam.) Irwin & Barneby	29	0.63	63.04
Passiflora foetida L.	28	0.61	60.87
Annona senegalensis Pers.	26	0.57	56.52
Lantana camara L.	26	0.57	56.52
Chenopodium ambrosioides L.	25	0.54	54.35

Legend: ethnobotanical use value (Vu); level of fidelity (NF).

knowledge and exploitation of biodiversity between genders, and age groups. At the level of our study site, although the number of plants recorded is small and the number of informants limited, the empirical knowledge remains alive, especially within the female gender (Wezel, 2002; Sanogo, 2006; Dupuis, 2011). This specificity may be associated with the matrilineal nature of this society.

Changes in plant diversity and ecosystems are due to human activities. Among the responsible facts let us quote the anarchic urbanization and its corollaries that are the building of the physical infrastructures. In addition to these aspects, the role of slash-and-burn agriculture that induces demographic pressure on agricultural land, not to mention the recurrent bush fires that occur at the end of the dry season. These combined facts are factors of vulnerability of ecological niches and erosion of phytodiversity (Frontier et al., 2008; Bergonzini and Lanly, 2000; Kimpouni et al., 2013b, 2014). Concomitantly with the increase of anthropic pressures, the endogenous knowledge of ethnico-linguistic communities is eroding with the difficulty of finding the related plants. Underpinned by empiricism, these gains are intrinsic values of the traditional social base whose loss is often irreversible (Grenand and Prevost, 1994; Emperaire and Lescure, 1994; Kimpouni, 2001; Kimpouni and Motom, 2012).

5. Conclusion

This study on the endogenous knowledge of the Kouni ethnico-linguistic community is nothing but an illustration of the facts of the decline of the Congolese socio-cultural base. The search for social welfare associated with the city generates a rural exodus affecting more young boys. The resulting consequences are (i) the gender imbalance, (ii) the endogenous knowledge is presented in a returned age pyramid, (iii) the fortification of the role of women in traditional society, (iv) a displacement of the center of gravity of knowledge towards the feminine gender, regent of the home. The gender imbalance within the informant group explains the preponderance of older women. This highlighting of women in endogenous knowledge is supported by the high number of receipts delivered, the majority of which focus mainly on diseases or symptoms inherent in children. Finally, it should be noted that for these reasons, the sociocultural bases of Congolese ethno-linguistic communities are threatened with extinction, under the combined effect of society and manufactured products.

Declarations

Author contribution statement

Victor Kimpouni: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Josérald Chaîph Mamboueni, Feldane Gladrich Mboussy Tsoungould: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data.

Elie Nsika Mikoko: Performed the experiments; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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