



Quantitative Approach of *Sterculia setigera* Delile (Malvaceae) Ethnobotanical Uses Among Rural Communities in Togo (West Africa)

Wouyo Atakpama, Komlan Batawila, Atama Gnamkoulamba, and Koffi Akpagana

Research

Abstract

The relationship between human beings, their culture, and their environment has high importance in the framework of sustainable management of natural resources. This study aimed to assess the local uses of *Sterculia setigera* Delile within rural communities in Togo. Inquiries involving 15 ethnic groups were used to assess the interethnic convergence by using 4 use indices: reported use, plant part value, specific reported use, and intraspecific use value. The mean reported uses showed significant difference between geographic zones, ethnic groups, age, and occupations, but no significant difference between genders was found. Pharmacopeia (67%), followed by magico-mystic (15%) and food (10%) were the main quoted uses. The most used organ was the bark. Decoction was mentioned as the most used method of preparation. Considering the socio-economic and cultural importance of this species, it is important to promote its integration in agroforestry systems.

Résumé

Le rapport entre les être humains, leur culture et leur environnement est d'une grande importance dans le cadre de la gestion durable de ressources naturelles. La présente étude compte déterminer les usages locaux de *Sterculia setigera* Delile au sein des communautés rurales du Togo. La méthodologie suivie au cours de cette étude a été basée sur les enquêtes. Quinze groupes ethniques ont été enquêtés. La convergence d'usage interethnique a été évaluée en utilisant 4 indices d'usage: le nombre d'usage rapporté, la valeur de l'organe, la valeur d'usage spécifique, et la valeur d'usage intraspécifique. Les moyennes d'usages rapportés montrent une différence significative entre les zones géographiques, les groupes ethniques, l'âge et

les corporations. Par contre, aucune différence significative n'existe entre les genres. La pharmacopée (67%), suivie par l'usage magico-mystique (15%), et alimentaire (10%) étaient les principales catégories d'usages rapportés. L'organe le plus usagé est l'écorce et la décoction est le mode de préparation la plus citée. Compte tenu de l'importance socio-économique et culturelle de cette espèce, il est opportun d'encourager son intégration dans les systèmes agroforestiers.

Introduction

Indigenous people have local knowledge of plant resource uses. This knowledge varies according to locality, gender, ethnicity, cultural belief, and interrelation such as intercultural marriages, friendships, and religions (Atakpama *et al.* 2012, Atato *et al.* 2010, Avocevou-Ayisso *et al.* 2012, Ayantunde *et al.* 2008). It could be also influenced by age, occupation (Ayantunde *et al.* 2007, Poderoso *et al.* 2012, Schunko *et al.* 2012), environmental factors such as re-

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source availability (Gouwakinnou *et al.* 2011), and the variation of peoples' interactions with plants. Understanding local knowledge of native plant species can therefore help to identify research priorities for sustainable management (Ayantunde *et al.* 2008).

In sub-Saharan Africa, several studies have focused on knowledge of plant resources by the local people. Several plant species are widely recognized for their dietary, medicinal, and cosmetic uses (Adi *et al.* 2013, Akpavi *et al.* 2008, Atato *et al.* 2010, 2012, Batawila *et al.* 2005, 2007). Some indigenous plants such as *Adansonia digitata* L., *Blighia sapida* K.D.Koenig, *Parkia biglobosa* (Jacq.) G.Don, *Pentadesma butyracea* Sabine, *Tamarindus indica* L., *Sclerocarya birrea* (A.Rich.) Hochst., and *Sterculia setigera* Delile are well known by indigenous people for their multiple uses (Ademola *et al.* 2013, Atakpama *et al.* 2012, Avocevou-Ayisso *et al.* 2012, Ekué *et al.* 2010, Fandohan *et al.* 2010, Gouwakinnou *et al.* 2011, Kaboré *et al.* 2011, Koura *et al.* 2011).

A member of the Malvaceae (APG 2009) and also at times synonymized as *Sterculia tomentosa* Guill & Perr. and *Sterculia cinerea* A.Rich (Sacande *et al.* 2007), *S. setigera* is a multipurpose woody species well known in sub-Saharan Africa for its medicinal, cosmetic, and dietary uses, especially in Senegal where the commercialization of its gum contributes to increases in rural household income (Johnson *et al.* 2005). The gum is used in folk medicine to cure toothache (Musa *et al.* 2011) and in the preparation of various pharmaceutical products (Elkhalifa & Hassan 2010, Rhourri-Frih 2009). Traditionally, the leaves have been used in the treatment of malaria and rickets (Atakpama *et al.* 2012) while the bark is used to treat cough, hypertension, headache, asthma, bronchitis, wounds, fever, toothache, abscess, diarrhea, and snakebite (Belem *et al.* 2007, Betti *et al.*, 2011, Igoli *et al.* 2005, Lawal *et al.*, 2010, Musa *et al.* 2011, Tapsoba & Deschamps 2006). Several studies give supportive evidence to the use of this plant as an antimicrobial and anti-inflammatory in folk medicine (Babalola *et al.* 2012, Ouédraogo *et al.* 2013). Elsewhere *S. setigera* gum, seeds, and leaves have been used for dietary and cosmetic purposes (Idu *et al.* 2008, Johnson *et al.* 2005, Péréki *et al.* 2012).

In Togo, *S. setigera* is widespread and commonly used for pharmacopeia, dietary, magico-mystic, and cosmetic purposes. However, studies concerning this species are scanty and very recent. Its medicinal and cosmetic uses were noticed, respectively, by Adjanohoun *et al.* (1986) and Péréki *et al.* (2012). Ethnobotanical and structural aspects in the Sudanian zone of Togo had been investigated by Atakpama (2010) and Atakpama *et al.* (2012). The species is threatened in its natural habitat due to (1) harvesting of tissue, especially for medicinal purposes, (2) socio-cultural status (fetish tree or home to evil spirits according to the custom of each ethnic group), and (3) the total ignorance of the economic value of its gum (Atakpama *et*

al. 2012). Elsewhere, the species grows sometimes on hills with rocky, poor, and shallow soils in townships of savannas (Sacande *et al.* 2007). Therefore, its valorization could contribute to a sustainable management of the species as well as valorization of some unfit lands for agriculture and enhancement of indigenous households' income, consequently decreasing poverty, one of the millennium objectives and one of the root causes of plant resources deterioration.

The present study proposes to investigate *S. setigera* use in Togo. Specifically, we seek to (i) gather information on ethnobotanical knowledge about this species according to age, gender, occupation, and education level and (ii) compare the intercultural use convergence within 15 ethnic groups in Togo. The findings of this study could be very useful for a sustainable management and conservation program of plant genetic resources, especially *S. setigera* in Togo, and suggests perspectives for future research.

Methods

Study area

The Republic of Togo in West Africa is situated between 6°06'–11°08'N and 0°09'–1°49'W. The country is bordered by Burkina Faso to the north, the Atlantic Ocean to the south, Benin to the east, and Ghana to the west. With a total area of 56,600 km², its population approximates 6,191,155 inhabitants and a density of 119 inhabitants per km² (DGSCN 2011). This population is heterogeneous with 38 different cultural groups (Goeh-Akue & Gayibor 2010) (Figure 1). The most represented are Ewé, Kabyè, and Tem. The majority of the population is agricultural (70%). The high unemployment rate (32%), growing population, and youthfulness of the population accentuate the pressure on plant resources. This pressure becomes even more important in recent years with the recurrence of flooding and seasonal rainfall variations affecting harvests and decreasing outputs (Badjana *et al.* 2012). Based on geoclimatic factors, the country is subdivided into five ecological zones (Ern 1979) and into two major climatic zones from the 8th parallel. The climate type in the southern part is subequatorial with two rainy seasons and two dry seasons. In the northern part, it is a Sudanian type with one rainy season and one dry season. Togo is mainly covered by savannas with a few clumps and patches of semi-deciduous forest occurring in the southwest mountains (Adjossou & Kokou 2009).

Data collection

Data were collected from 12 December 2012 to 31 March 2013. Field surveys were conducted through multistage sampling design (Péréki *et al.* 2012). Three levels of stratification were considered: the 5 ecological zones of the country (first level) and the various ethnic groups (second

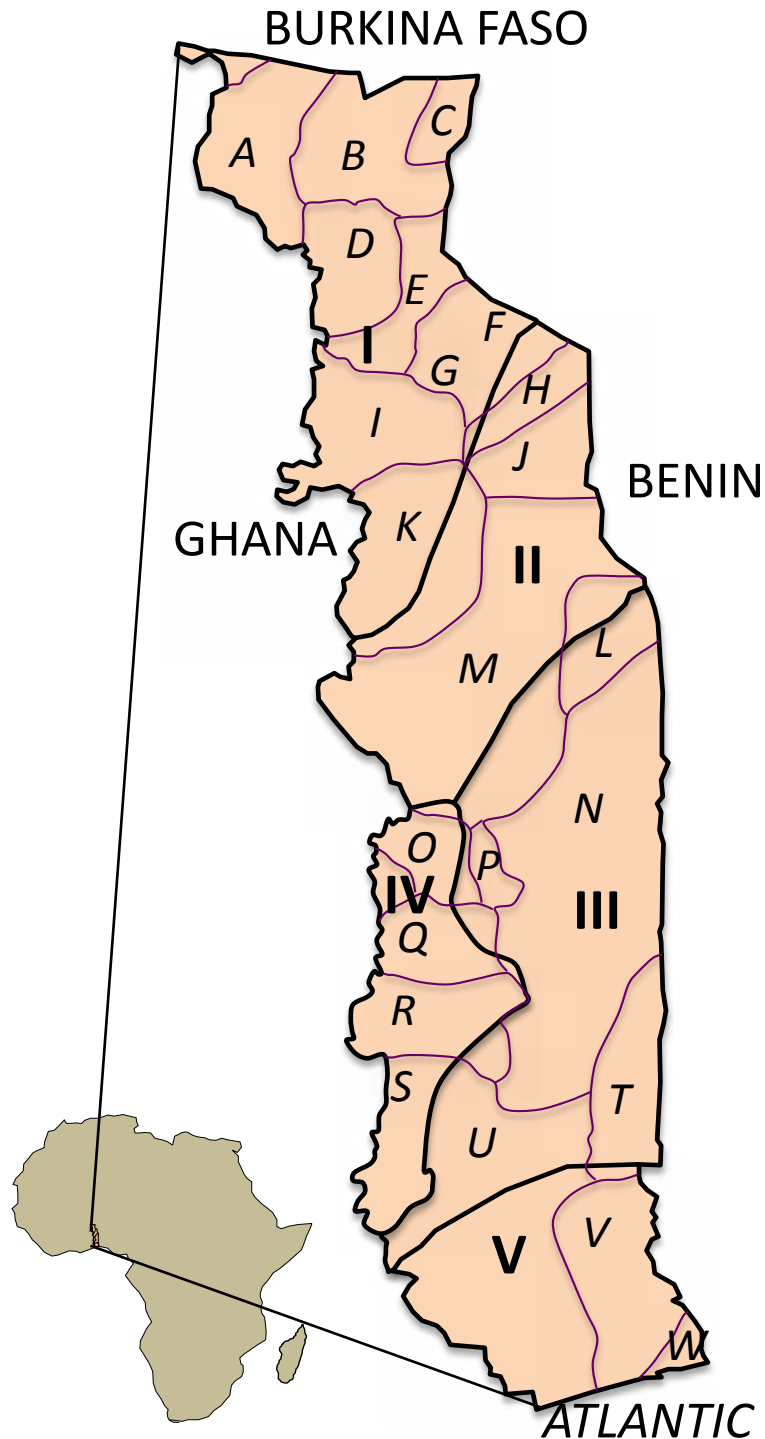


Figure 1. The Republic of Togo survey areas by ecological zones and ethnic groups. Ecological Zones: I. Northern plain zone, II. Northern mountain zone, III. Central plain zone, IV. Southern zone of Mount Togo, and V. Southern coastal zone. Ethnic groups: A. Moba, B. Gourma, C. Natchaba, D. Tchokossi, E. Gangan, F. Temberma, G. Lamba, H. Nawda, I. Konkomba, J. Kabyè, K. Tem, L. Tchambe, M. Bassar, N. Ana-lfè, O. Adele, P. Agnaga, Q. Akébou, R. Akposso, S. Ahlon, T. Adja, U. Ewé, V. Ouatchi, and W. Mina.

level) from which representative localities (third level) were randomly selected on the map of Togo (Atato *et al.* 2012). Data were gathered through 239 semi-structured individual interviews of informants belonging to fifteen ethnic groups (Table 1). Interviews were conducted individually to prevent informants from being influenced by one another. The mean age of respondents was 52 ± 17 years: female 52 ± 18 years and male 52 ± 17 years (Table 2). The sample was constituted in the majority by farmers (44%) (Figure 2). Most of them were illiterate (51%). Only 1% had completed education at the university level (Figure 3).

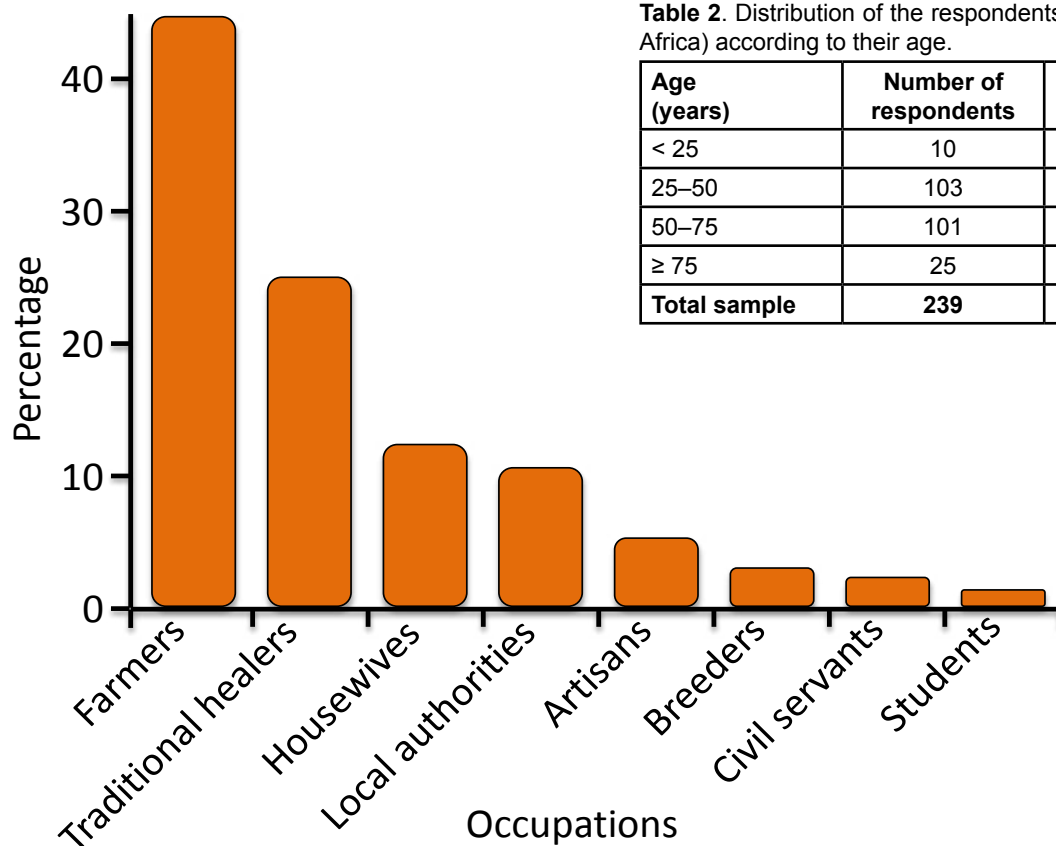
Consent was obtained by explaining the aim of the study, at first to local authorities who gave their approval to do the survey, then to respondents who were randomly selected (Collins *et al.* 2006, Uprety *et al.* 2012). Questionnaires were translated into local language by a field assistant for those who could not understand French. These questionnaires were preceded by presentations of the *S. setigera* pictures and samples of fresh leaves, fruits, and seeds. People were asked to identify and describe the species to assure us that they knew of it. Then questionnaires were administered to those who identified and described perfectly the species. Each respondent was asked to list and describe the plant parts and uses they knew including medicinal, cosmetic, timber, food, magico-mystic, and agro-pastoral uses. Magico-mystic use refers to the secret power of the species' plant parts or the tree itself to make impossible things happen by saying special words or doing special rituals. Agro-pastoral use refers to the use of plant parts for agricultural and breeding purposes. Several people we met in Guinean zone do not recognize the species or sometime they do not know the plant uses. This reason limited the number of respondents in this zone (Table 1).

Data analysis

The specific uses reported by respondents were categorized, and the frequencies of the use categories of the species and the different plant parts were computed (Houessou *et al.* 2012). The use values of *S. setigera* plant parts were assessed by comparing the mean reported use values between ethnic groups, gender, age, and occupation. The knowledge of local use of

Table 1. Distribution of the respondents through ethnic (sociolinguistic) groups of Togo (West Africa).

	Ethnic groups	Number of respondents	Female respondents	Female percentage	Proportion of sample (%)
Sudanian zone	Moba	41	7	17.1	17.2
	Kabyè	40	10	25.0	16.7
	Kotocoli	25	5	20.0	10.5
	Gourma	19	2	10.5	8.0
	Lamba	17	5	29.4	7.1
	Tchokossi	11	1	9.1	4.6
	Bassar	10	2	20.0	4.2
	Ngangam	8	1	12.5	3.4
	Peulh	7	0	0.0	2.9
	Konkomba	7	0	0.0	2.9
Guinean zone	Ifè	22	1	4.6	9.2
	Ewé	11	0	0.0	4.6
	Adja	8	2	25.0	3.4
	Agnanga	7	0	0.0	2.9
	Akébou	6	1	16.7	2.5
Total sample		239	37	15.5	100.0

**Table 2.** Distribution of the respondents from Togo (West Africa) according to their age.

Age (years)	Number of respondents	Percentage of sample
< 25	10	4.2
25–50	103	43.1
50–75	101	42.3
≥ 75	25	10.5
Total sample	239	100

Figure 2. Occupations of survey respondents from Togo (West Africa).

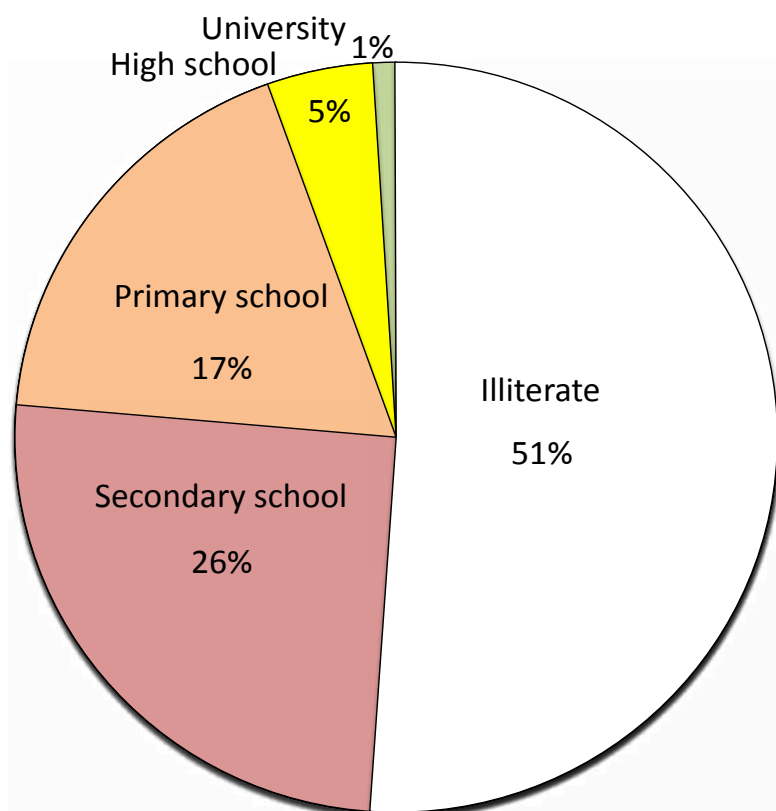


Figure 3. Education levels of survey respondents from Togo (West Africa).

S. setigera was assessed using four use indices (Atakpama *et al.* 2012, Avocevou-Ayisso *et al.* 2012): the reported use (RU), the plant part value (PPV), the specific reported use (SU), and the intraspecific use value (IUV).

The reported use (RU) is the total number of uses reported for each plant part ($RU = \sum RU_{\text{plant part}}$). The plant part value (PPV) is equal to the ratio between the number of total uses reported for each plant part and the RU for the plant ($PPV = RU_{\text{plant part}} / RU$). The most often used parts of the species by respondents from a given ethnic group are those having high values of PPV. The specific reported use (SU) is the use as described by respondents. It refers to the number of times a specific reported use is mentioned by respondents. The intraspecific use value (IUV) is the ratio of the specific reported use and the reported use for the plant part ($IUV = SU_{\text{plant part}} / RU_{\text{plant part}}$). It helps to identify the most reported specific uses for a given plant part.

Data were processed using Microsoft Excel 2010®, XLSTAT, and Minitab 16 software. These were used to calculate the different rates and to construct figures. One-way ANOVAs were performed using Minitab 16. These tests

aim to determine whether differences observed between three or more variables are significant or not.

Results

Reported use value of *S. setigera*

The mean reported use varied among ethnic (sociolinguistic) groups (Table 3). A comparison of these groups showed a significant difference ($p < 0.001$) between ethnic groups and geographic areas. There was a significant difference between occupations, especially between traditional healers and farmers ($p = 0.001$) (Figure 2). Plant use knowledge increased relative to age. Senior respondents older than 75 yrs ($RU = 3.2 \pm 1.5$) and those 50–75 yrs (2.7 ± 1.7) reported more use than the youngest respondents (< 25 yrs ($RU = 2.6 \pm 1.8$)) and those aged 25–50 yrs ($RU = 2.60 \pm 1.5$). The less aged respondents reported more dietary and less medicinal uses. No significant differences were observed between generations ($p = 0.479$).

No significant difference was observed according to gender ($p = 0.722$). The mean reported use by women (2.9 ± 1.4) and men (3.0 ± 1.5) was nearly equal.

Table 3. Mean reported use (RU) among each ethnic group from Togo (West Africa).

Ethnic groups	Mean RU/respondent
Bassar	4.5 ± 1.8
Moba	4.1 ± 1.9
Ngangam	3.4 ± 2.1
Tchokossi	3.4 ± 1.6
Gourma	3.3 ± 1.3
Kabyè	3.1 ± 1.5
Kotocoli	2.7 ± 1.2
Konkomba	2.7 ± 0.8
Ifè	2.6 ± 1.1
Lamba	2.4 ± 1.1
Fulani	2.1 ± 0.7
Ewé	1.7 ± 0.7
Akébou	1.50 ± 0.50
Adja	1.25 ± 0.38
Agnanga	1.14 ± 0.25

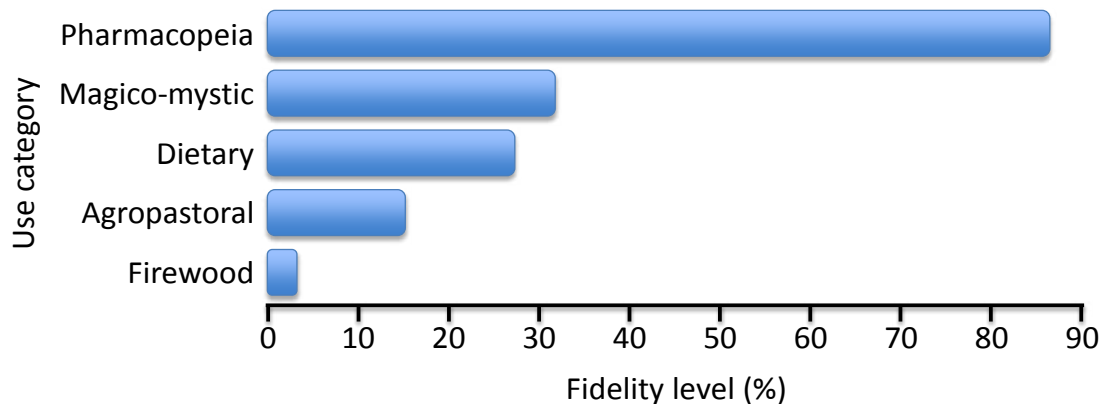


Figure 4. Main use categories of *Sterculia setigera* Delile as reported by survey respondents from Togo (West Africa).

Use types of *S. setigera*

Seventy-two specific uses of *S. setigera* were reported by respondents. These specific uses were clustered into 7 use categories: pharmacopeia, magico-mystic, dietary, agro-pastoral, fodder, firewood, and cosmetic. The majority of respondents (86%) used the species in pharmacopeia (Figure 4). Use categories such as firewood, fodder, and cosmetic were seldom mentioned.

Fifty-one pharmacopeia specific uses of *S. setigera* were reported (Figure 6, see next page). The most specific uses reported were treatment of cough, malaria, and rickets. These treatments are applicable for both genders and almost all ages, except in 6% of the cases the treatments are applicable only for children for diarrhea, rickets, and dentition.

The most utilized plant part is the stem bark (45%) which is used most of the time for medicinal purposes (Figure 5). It is followed by leaves and roots. The wood, young leaves, and young fruits are seldom used and then only for culinary purposes. Availability of young leaves and young fruits is seasonal while the other plant parts could be used year-around.

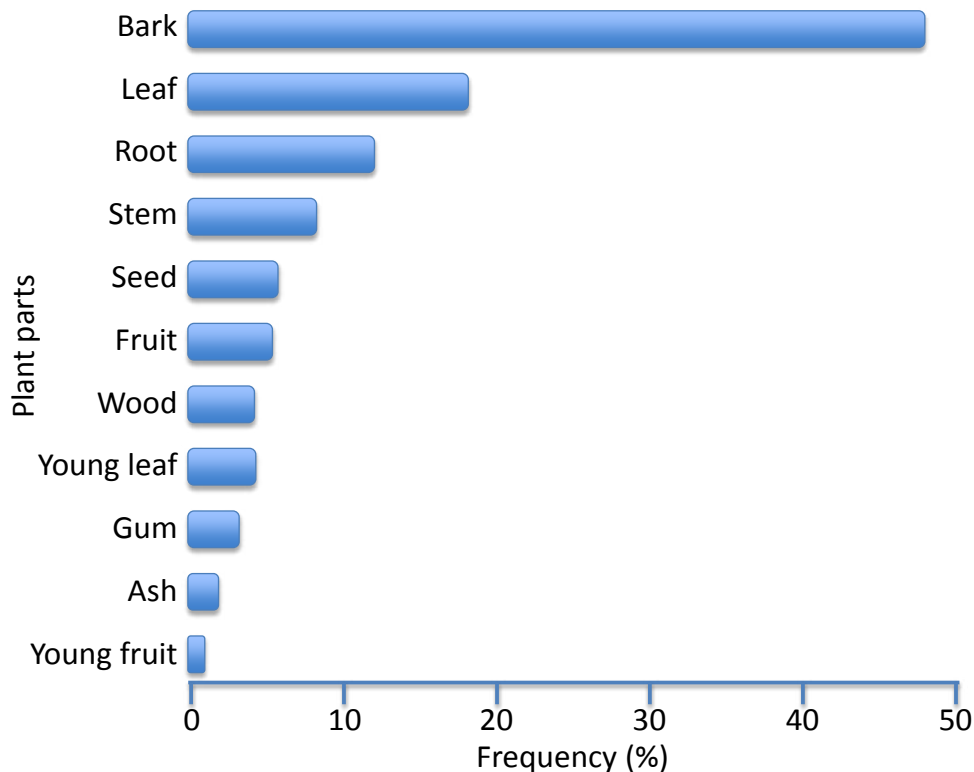


Figure 5. Importance of *Sterculia setigera* Delile plant parts as reported by survey respondents from Togo (West Africa).

The most prevalent mode of preparation is decoction (65%) (Figure 7). This mode of preparation concerns exclusively pharmacopeia. Trituration methods (11%) are also used by traditional healers in pharmacopeia. In 11% of cases, the species is used as a sauce for culinary purposes. Other modes such as powder, soaking, and infusion were seldom reported.

Inter-ethnic convergence of plant part value and specific uses of *S. setigera*

Tables 4 and 5 describe in detail the importance use indices within two of the fifteen ethnic groups: Kabyè and

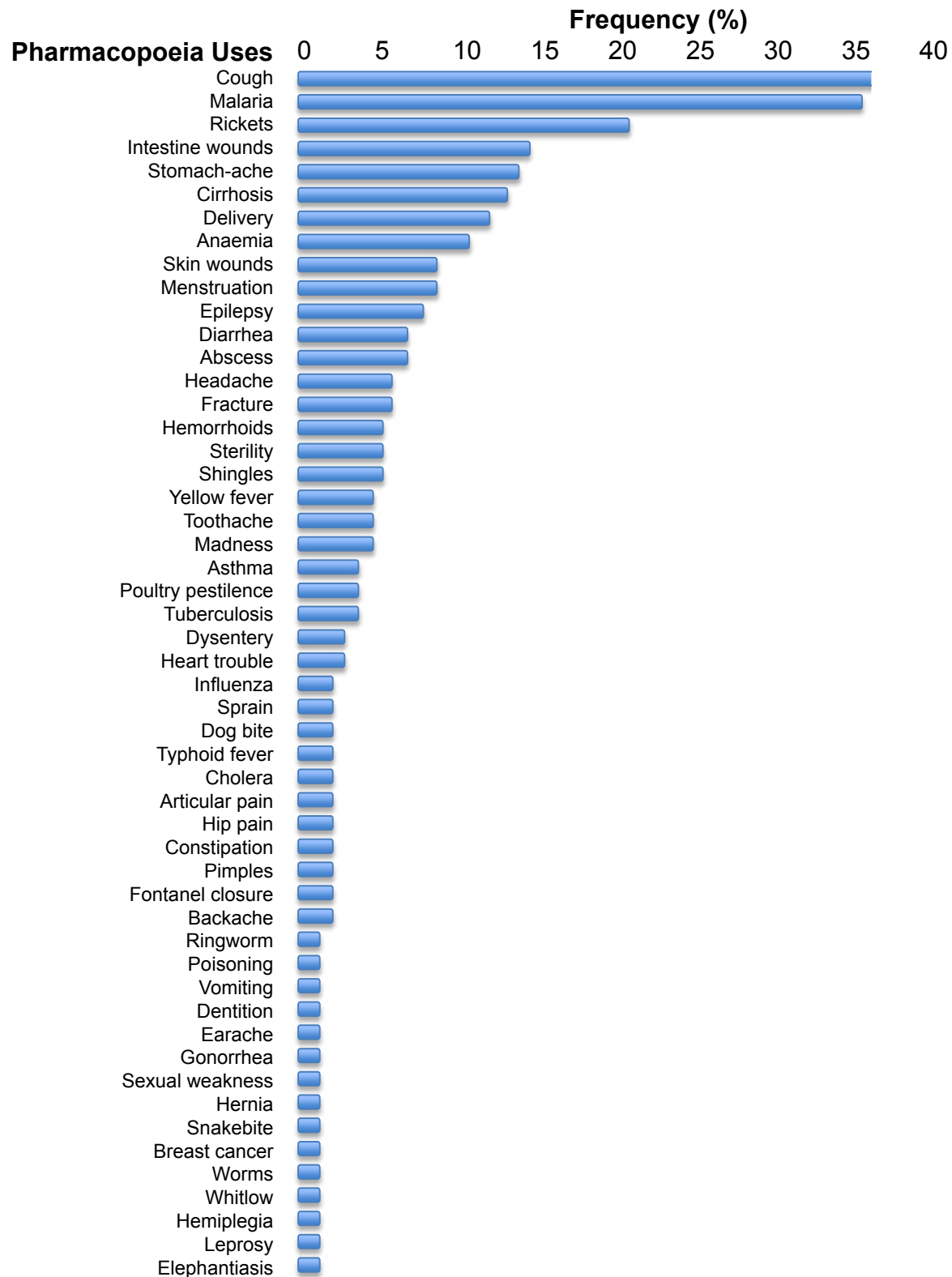


Figure 6. Pharmacopoeia uses of *Sterculia setigera* Delile reported by survey respondents from Togo (West Africa).

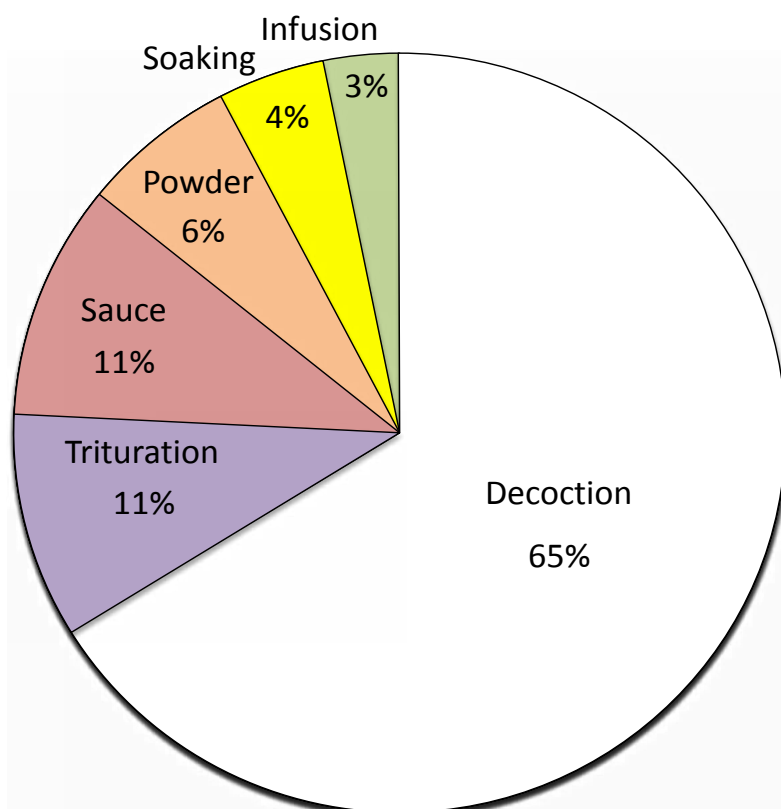


Figure 7. Mode of preparation of *Sterculia setigera* Delile as reported by survey respondents from Togo (West Africa).

Moba. Figure 8 presents the breakdown of plant part values according to each ethnic group.

Ethnic groups living in Guinean zone (except the Ewé) reported less than six plant parts. Only two plant parts, leaves and seeds, were mentioned among the Akébou. In contrast, all plant parts were reported among the Kabyè. The intra-specific use values (IUV) were significantly different ($p < 0.001$), especially between Guinean zone ethnic groups (the Agnanga and Adja) and Sudanian ethnic groups (the Gourma, Tchokossi, and Kotocoli).

Ashes from branches are used within five ethnic groups: the Konkomba, Gourma, Lamba, Moba, and Kabyè. Gourma use it in pharmacopeia while the others used it for dietary purposes.

Except the Akébou, all other ethnic groups use *S. setigera* stem bark especially in folk medicine. It was very often reported to treat cough and intestinal wounds. Sometime breeders use the bark to make rope to tie their livestock (cattle, sheep, and goats). Dietary use of bark was mentioned only by Bassar and

Table 4. Importance of plant use indices of *Sterculia setigera* Delile among the Kabyè ethnic group from Togo (West Africa). RU = reported use; PPV = plant part value; SU = specific reported use; IUV = intraspecific use value.

Plant parts	RU [plant part]	PPV	Specific reported use	SU	IUV
Ash	1	0.008	Traditional salt	1	1.000
Stem bark	51	0.415	Anemia	1	0.020
			Hunting rifle detonation	2	0.039
			Asthma	4	0.078
			Menstruation	5	0.059
			Rope	6	0.118
			Diarrhea	1	0.020
			Fontanel closing	1	0.020
			Rickets	2	0.040
			Hip pain	1	0.020
			Stomachache	1	0.020
			Cirrhosis	1	0.020
			Malaria	6	0.118
			Poultry pestilence	1	0.020
			Skin wound	2	0.039
Intestine wound	9	0.176			

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Plant parts	RU [plant part]	PPV	Specific reported use	SU	IUV
			Against dust mite	1	0.020
			Religious	2	0.039
			Sauce	1	0.020
			Yam growing	1	0.020
			Cough	3	0.059
			Tuberculosis	2	0.039
Gum	2	0.016	Magico-spiritual	1	0.500
			Headache	1	0.500
Fruit	1	0.008	Cough	1	1.000
Leaves	27	0.220	Delivery	2	0.077
			Fodder	2	0.074
			Anemia	1	0.037
			Hatching	1	0.037
			Fontanel closing	1	0.037
			Stomachache	1	0.037
			Malaria	5	0.185
			Rickets	4	0.148
			Against dust mite	9	0.333
			Ringworm	1	0.037
Seeds	4	0.033	Play	1	0.250
			Sauce	1	0.250
			Crunching as groundnut	2	0.500
Roots	13	0.106	Anemia	4	0.308
			Dysentery	1	0.077
			Madness	1	0.077
			Trace of spermatozoa	1	0.077
			Hip pain	1	0.077
			Stomachache	1	0.077
			Malaria	4	0.308
			Sauce	1	0.500
			Intestine wound	1	0.500
Stem	9	0.073	Religious	9	1.000
Wood	1	0.008	Firewood	1	1.000
Young fruit	5	0.041	Sauce	5	1.000
Young leaves	9	0.073	Sauce	9	1.000

Table 5. Importance of plant use indices of *Sterculia setigera* Delile among the Moba ethnic group from Togo (West Africa). RU = reported use; PPV = plant part value; SU = specific reported use; IUV = intraspecific use value.

Plant parts	RU [plant part]	PPV	Specific reported use	SU	IUV
Ash	2	0.012	Mustard	1	0.500
			Potash	1	0.500
Stem bark	78	0.467	Abcess	4	0.051
			Delivery	2	0.026
			Anemia	3	0.038
			Rickets	1	0.013
			Constipation	1	0.013
			Rope	2	0.026
			Diarrhea	1	0.013
			Medico-religious	1	0.013
			Epilepsy	1	0.013
			Yellow fever	1	0.013
			Typhoid fever	2	0.026
			Fracture	1	0.013
			Backache	1	0.013
			Headache	2	0.026
			Stomachache	6	0.077
			Cirrhosis	11	0.152
			Malaria	6	0.077
			Skin wound	3	0.038
			Rickets	1	0.013
			Magico-spiritual	2	0.026
Rhum	1	0.013			
Cough	20	0.256			
Tuberculosis	1	0.013			
Zona	4	0.051			
Gum	1	0.006	Tuberculosis	1	1.000
Fruit	9	0.054	Abscess	1	0.111
			Delivery	2	0.222
			Medico-religious	1	0.111
			Skin wound	2	0.222
			Elephantiasis	1	0.111
			Sterility	2	0.222
Leaves	27	0.162	Diarrhea	1	0.037
			Poisoning	1	0.037
			Epilepsy	1	0.037
			Yellow fever	4	0.148
			Stomachache	1	0.037
			Earache	1	0.037
			Cirrhosis	1	0.037

Plant parts	RU [plant part]	PPV	Specific reported use	SU	IUV
Leaves (cont.)			Malaria	6	0.222
			Menstruation	2	0.074
			Against dust mite	4	0.148
			Religious	2	0.074
			Cough	2	0.074
			Tuberculosis	1	0.037
Seeds	3	0.018	Sauce	1	0.333
			Crunching as groundnut	2	0.667
Roots	24	0.144	Abscess	3	0.375
			Delivery	1	0.125
			Dysentery	1	0.125
			Medico-religious	6	0.750
			Epilepsy	3	0.375
			Sexual weakness	1	0.125
			Poultry pestilence	1	0.125
			Menstruation	1	0.125
			Sterility	2	0.250
			Cirrhosis	1	0.125
			Zona	4	0.500
Stems	13	0.077	Religious	12	0.923
			Madness	1	0.077
Wood	8	0.048	Abscess	1	0.125
			Epilepsy	1	0.125
			Carving	5	0.625
			Elephantiasis	1	0.125
Young leaves	3	0.018	Sauce	3	1.000

Konkomba respondents who use it to make a rope called **lignale** (Figure 9). This type of rope is used to ferment local beer made from sorghum (*Sorghum bicolor* (L.) Moench). The Gourma, Konkomba, and Moba used bark for medico-religious and magico-spiritual purposes. The bark also has a historical cosmetic use as dye and thickener of the Ewé warriors, the **ablafo**.

Fruit uses were mentioned by seven ethnic groups during the study, being most used by the Gourma and Moba. The Gangam, Kabyè, and Kotocoli communities use the fruit, respectively, to treat dolorous menstruations, cough, and delivery. The use of young fruit is limited to the Kabyè where they are dried and ground and used in the preparation of a gluey sauce accompanying *Sorghum* or maize (*Zea mays* L.) porridge (IUV = 1.000).

Only the Bassar, Gourma, Kabyè, and Moba respondents reported the use of gum especially for pharmacopeia pur-

poses. Within Ewé ethnic group, gum is used for magico-spiritual purposes.

The use of leaves is as unanimous and diversified as use of bark within all ethnic groups. The Akébou use leaves to treat fractures and toothache. Leaves were also reported by some respondents to fight against dust mites of poultry. Young leaves are used for culinary purposes within the Agnanga, Ewé, Ngangam, Kabyè, Kotocoli, Moba, and Tchokossi. Women of these ethnics groups make a sauce with pounded young leaves (IUV = 1.000).

Except the Adja, Agnanga, and Akébou localized in the Guinean zone, the use of roots was reported within all other ethnic groups. Roots are used to treat fractures (Agnanga, IUV = 1.000), malaria (Ewé, IUV = 1.000; Kabyè, IUV = 0.308), anemia (Gourma, IUV = 0.500; Kabyè, IUV = 0.308), and epilepsy (Ifè, IUV = 0.500). Medico-religious use was reported by the Moba and Ifè.

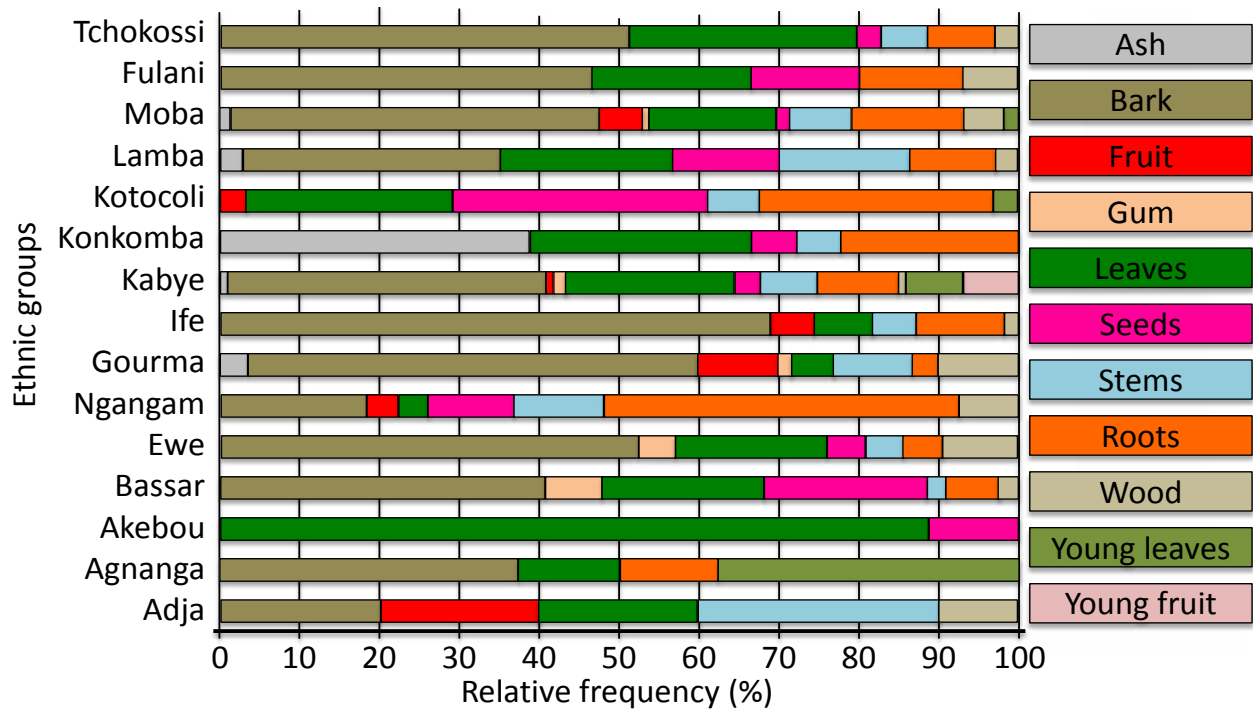


Figure 8. Comparison of plant part values according to ethnic groups of survey respondents from Togo (West Africa).



Figure 9. Lignale rope used to ferment a local sorghum-based beer (*Sorghum bicolor* (L.) Moench). The rope is made from *Sterculia setigera* Delile bark by the Bassar and Konkomba groups of Togo (West Africa).

The use of seeds was not reported by the Adja, Agnanga, or Ifè (all within Guinean zone). It was reported by others for occasional dietary use such as for roasting and crunching as groundnuts by children. The roasted seeds are also used to prepare a sauce by the Bassar, Kabyè, Konkomba, Kotocoli, Lamba, Moba, and Fulani.

Except for the Agnanga, Akébou, and Fulani, *S. setigera* stem had a significant religious role for respondents. It is considered as a god/protector of the house when it is planted at home. Especially within the Bassar, Konkomba, Lamba, and Moba, traditional healers place on forked branches an earthenware vessel in which they put plant species and other things during ceremonies and treatment of ailments (Figure 10). The Bassar people affirmed that the species can protect farm crops in a mystic way. Elsewhere it is considered as the dwelling of devil spirits and is very feared by people. For this reason they do not let it near the house, leave something in its shadow, or rest under its shadow.

Sterculia setigera wood was seldom reported as firewood (Ifè, Kabyè, Fulani, and Tchokossi, IUUV = 1.000) not only because it is less lignified, but also due to sociocultural considerations (shelter of evil spirits, embodiment of protective god). Within the Gourma, Lamba, and Moba customs, woodcarvings are used to stand in for a deceased person whose body could not be brought up to the village during the funeral (IUUV = 1.000, 1.000, and 0.625, respectively).

Discussion

Ethnic groups living in the Sudanian zone with more abundance of *S. setigera* reported more uses than those living in Guinean zone. The inter-ethnic marriages, kinships, and friendships between neighboring ethnic groups such as the Gourma, Moba, and Tchokossi could favor knowledge exchange. The variation of knowledge between ethnic groups could reflect ancestral knowledge which is proper to each ethnic group and transmitted orally through generations. In addition the Sudanian zone was less ur-



Figure 10. Venerated stem of *Sterculia setigera* Delile in Togo (West Africa).

banized than the Guinean zone. Within rural communities, plant resources impact one's livelihood, especially for economic, health, and food purposes. This contributes much to the discovery of so many potential uses of the trees and their products (Rabi'u & Rabi'u 2013). Thus urbanization possibly accelerates the vanishing of old traditions.

A similar difference according to geographic zone and occurrence of *Sclerocarya birrea* was reported by Gouwakinnou *et al.* (2011) in Benin. Atato *et al.* (2010) and Péréki *et al.* (2012) showed a difference of knowledge of wild edible fruits and cosmetic plant species between ethnic groups of Togo according to plant species availability and sociocultural customs. The variation of mean reported use of *Pentadesma butyracea* and *S. setigera* according to ethnic groups were also reported by Avocevou-Ayisso *et al.* (2011) and Atakpama *et al.* (2012), respectively, in the communes of Bassila and Toucountouna of Benin, and in the Sudanian zone of Togo.

The observation in this study that traditional healers had the greatest knowledge is likely due to the fact that they are commonly the part of local communities heavily using plant resources to treat diseases. Thus they have a great knowledge of local plants, especially their medicinal uses (Birhan *et al.* 2011, Cheikhyoussef *et al.* 2011, Moshi *et al.* 2012). The less reported uses by civil servants and students (younger respondents) can be justified by the fact that they have less experience with plant uses since they less frequently encounter the local natural environment. In addition, due to their education level, they use less folk medicine, since most of young informants and civil servants mostly rely on modern medicine.

Similar to what was found in Togo, several studies conducted around the world have reported that plant use steadily increases with age (Ayantunde *et al.* 2008, Cheikhyoussef *et al.* 2011, Merétika *et al.* 2010, Sousa *et al.* 2012). This could be justified by the accumulation of life experience (Dan Guimbo *et al.* 2011, Poderoso *et al.* 2012).

There were no differences in use reports according to gender. Merétika *et al.* (2010) and Sousa *et al.* (2012), when studying, respectively, medicinal plants known by fishers from southern Brazil and botanical knowledge in fishing communities of the Parnaíba Delta Environmental Protection Area had shown similar ethnobotanical results according to gender. However, previous studies focused on *S. setigera* ethnobotanical knowledge in Sudanian zone of Togo (Atakpama *et al.* 2012) showed a significant difference between genders. The present result could be explained by the fact that this survey took into account traditional healers which included women.

The same use categories of the species as those found here were reported by Atakpama *et al.* (2012) among three ethnic groups of the Sudanian zone of Togo. However, the overall number of specific uses and medicinal

indications were greater here than in the previous study. This could be due to the large number of ethnic groups and the large area covered during the present study.

The research of Babalola *et al.* (2012) provided scientific support for the ethno-medical anti-tuberculosis use of *S. setigera* leaves. Antifungal properties were revealed during *in vitro* analysis by Ouédraogo *et al.* (2013). Antimicrobial properties are dependent on certain active substances which included glycosides, alkaloids, saponins, tannins, flavonoids, and various other oils (Hamidu 2012). Organoleptic properties of leaves shown by Hamidu (2012) support evidence of its culinary use as reported in the present study.

Uses of *S. setigera* plant parts other than leaves have been documented elsewhere. Musa *et al.* (2011) reported the use of gum powder in the treatment of toothache, and Atato *et al.* (2011) found that the seeds were identified as a natural resource that is highly consumed during food shortage periods in Togo.

Use of *S. setigera* wood for funereal carvings was also reported by Atakpama *et al.* (2012) and Hamidine (2003) in the Sudanian zone of Togo and within Dagara society of Djokoligo in south-west of Burkina Faso, respectively. Other studies also documented the species as a shelter for evil spirits as reported by the Moba ethnic group in the Sudanian zone of Togo (Atakpama *et al.* 2012) and among the people of the Baatombus region of Pohunco in northern Benin (Langewiesche 2006).

Perhaps beyond all other uses, the heavy reported use of stem bark by Togo respondents gives potential cause for concern. According to conservationists, medicinal plants intensively harvested for their root and bark often tend to be the most threatened by over-exploitation (Flatie *et al.* 2009, Maroyi 2013). The use of bark in folk medicine is widely mentioned in the literature (Belem *et al.* 2007, Igoli *et al.* 2005, Lawal *et al.* 2010), especially in the treatment of cough and intestinal wounds. Moreover, several studies give supportive evidence of its use as antimicrobial and anti-inflammatory in folk medicine (Tor-Anyiin *et al.* 2011). Thus its efficacy as a phytomedicine places it in peril as a highly sought-after natural resource.

Conclusion

The present study confirmed that *S. setigera* is a multipurpose tree. Its different parts are used by local populations mainly for pharmacopeia purposes. The specific uses showed a significant difference between ethnic groups, geographic areas, species occurrence, age, and occupations of respondents. In contrast, no significant difference was found between genders. Ethnic groups of the Guinean zone, young respondents, and civil servants reported fewer uses. The diversity of plant parts used, the varia-

tion of specific uses, and beliefs concerning the species within the different ethnic groups could be explained by cultural heritage, species occurrence, and life experience. The use of gum is less known. Therefore, the study calls for further laboratory investigations in order to confirm the empirical uses as described. Considering the socio-economic and cultural importance of this species, it is important to promote its integration in agroforestry systems. In order to promote the species cultivation, more information on traditional management practices, ecological niche, regeneration pattern, genetic diversity, gum exudation, and economic potentiality should be further studied. Stakeholders' awareness on the economic value of this species as well as the impact of its organ harvesting on its survival are also areas in need.

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Authors' Contributions

Mr. Atama Gnamkoulamba helped to plan surveys and interviews. Prof. Koffi Akpagana and Dr. Komlan Batawila led the research project. Mr. Wouyo Atakpama organized the survey, compiled research data, carried out the statistical analysis, and wrote the article. All authors read and approved the manuscript.

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