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Diversity of plants used for oral hygiene in Benin

Yédomonhan Hounnankpon, Dangboe Nestor and Houénon Hurgues

Abstract

The use of plant brush is the oral hygiene measure most practiced by different set of people throughout the world since antiquity. The objective of this work is to establish a more or less exhaustive list of plants used for oral hygiene in Benin. The study was conducted through ethno botanical surveys on 1,697 respondents, from 26 districts and 27 ethnic groups. A total of 163 species in 132 genera and 47 families have been identified as plants used for oral hygiene in Benin. Most of them are trees (47.24%) and shrubs (39.26%), and *Azadirachta indica* (27.05%), *Prosopis africana* (15.62%), *Pseudocedrela kotschy* (14.91%) and *Zanthoxylum zanthoxyloides* (8.90%). The number of species mentioned per respondent varies from 1 to 12. The best categories contributing to the diversity of these plants are adults who hold 89% of the flora for oral use, illiterate (89%), farmers (89%), Christians (75%) and animists (73%) then the fon (39%) and bariba (28%). The plant organs used are the stem (97.08%) and the root (28.56%). We use four criteria to select them: the taste (37.41% of which 23.51% for bitter taste and 13.50% for bland taste), tenderness (30.47%), therapeutic properties (5, 66%) and organ availability (3.24%).

Keywords: taxons, hygiene, diversity, plant brush, Benin

1. Introduction

The oral cavity is a functional crossroads on which several functions depend (chewing, tasting, salivation, suction, phonation, ventilation, swallowing) ^[1]. Negligence and lack of oral care can have serious consequences for humans. In fact, there are multiple relationships between oral health and overall health. Oral health is not only synonymous with healthy teeth, but it is an integral part of overall health and is essential to the physical well-being of humans. Oral diseases such as dental caries can contribute to many health problems, including malnutrition, heart and respiratory diseases, and diabetes. According to ^[2], oral diseases are a real public health problem in the world in general and in Africa in particular.

The reduction of these conditions requires good oral hygiene, including the use of toothbrushes with toothpaste, antibacterial mouthwash liquids and vegetable brushes ^[3]. The latter is the most widely used oral hygiene measure by different populations throughout the world since antiquity ^[4] because these brush sticks are available and free ^[5-6] has already reported that plant brushes are the most appropriate means of oral hygiene for the economic and social conditions of the vast majority of African populations, whether rural or urban. According to ^[7], the use of vegetable brushes reveals three roles, namely the cleaning of dental surfaces, massage of the gingival tissues which stimulates the gingival circulation and increases the keratinization of the oral mucosa and then the drug action due to the numerous chemicals that these plants contain. For example, the synthesis of various studies carried out by ^[3] has shown that the regular use of *Salvadora persica* significantly reduces the tartar and gingivitis and then helps to prevent paradontopathies and tooth decay. Therefore, there is a need to upgrade the plant resources whose proper use will ensure good oral health. But in order to do so, it is necessary first to know all the species used as vegetable brushes and then to search among them those which have the best therapeutic properties. While in West Africa, nearly 300 plant species have been identified as plant brushes ^[8], in West Africa, inventory work remains limited ^[3].

In Benin, ^[6] provided the first list of 10 plant species used as a plant brush with indications on their pharmacological properties. Later, 33 species were identified as plant brushes in eight districts, all in southern Benin, and taking into account only 11 socio-linguistic groups ^[9, 10]. The analysis of this work shows that the current knowledge on plants for oral use remains incomplete enough in Benin. In fact, on the one hand, they did not take into account the existence of a floristic variability from one sector to another at the level of the vegetation of Benin ^[11], and on the other hand, the use of plants varies from one ethnic group to another.

This work makes it possible to have the exhaustive list of the plants used as plant brushes in Benin.

1.1 Area of study

The study covered all Beninese territory, which lies between 6 ° 15 'and 12 ° 25' north latitude and between 0 ° 40 'and 3 ° 45' longitude east. With an area of 112.600 km², Benin is limited to the north by Niger, to the south by the Atlantic Ocean, to the east by Nigeria and to the west by Togo and Burkina Faso [12]. The climate is subequatorial to the south, tropical humid transition to the center and tropical dry to the north. The rainfall is between 900 and 1400 mm of water per year with an increasing west-east and north-south gradient. On the phytogeographic level, three phytogeographical zones apporportioned into ten sectors and each having its floristic specificity were recognized [11]. The soils encountered are: ferrallitic soils, ferruginous soils, crude mineral soils and eutrophic brown soils, hydromorphic soils and halomorphous soils [12]. The population has 9,983,884 inhabitants, with an annual growth rate of 3.51% and a density of 87 inhabitants / km² [13]. This population is expressed in 60 languages, the most important being fon (39%) [14]. Agriculture is the main activity carried out and occupies 49% of the population [13]. It is followed by trade (27%) and crafts (17%).

2. Method of study

2.1. Data gathering

The census of the plants used for oral hygiene was carried out by means of ethnobotanical surveys after 1697 surveyed, chosen at random, and distributed in 24 communes. Surveys were conducted through individual interviews using a semi-structured questionnaire. The different categories of the questionnaire are: identification of the respondent, identification of the plant material used (scientific and vernacular names, organ), mode and place of supply and preference criteria (taste, tenderness, availability, therapeutic virtues).

The respondents range in age from 12 to 100 years and are 68.89% male and 31.11% female. They are divided into 4 religions: animism (34.18%), Christianity (33.12%) and Islam (32.70%). The sample surveyed included 49.50% illiterate, 29.29% primary, 17.74% secondary and 3.48% higher. The respondents belong to 7 occupational categories, the most important being that of farmers (42.31%). They are grouped into 27 ethnic groups, the most frequent being the fon (14.08%), the tchabè (12.43%), the berba (6.54%) and the bariba (6.19%).

The botanical nomenclature used is that of [12]. The collected data were analyzed by means of frequency calculations and

the determination of the specific richness. The latter was assessed by survey and socio-professional category. Analysis of Variance (ANOVA) was carried out, using the software MINITAB 14.0, to check the variability of the number of cited species per surveyed within the socio-professional categories. The similarity index of Jaccard was used to compare the similarity of the floristic processions exploited by the different socio-professional categories. The software used for this purpose is the CAP (Community Analysis Package).

3. Results

3.1. Taxonomic diversity

A total of 163 plant species used for oral hygiene were identified (Table 1). They are distributed in 132 genera and 47 families, the most diverse in terms of species are Leguminosae (39 species, 23, 93% of the flora for oral use), Euphorbiaceae (11 species, 6,75%), Rubiaceae (10 species, 6,13%) and Combretaceae (9 species, or 5,52%).

The species listed are predominantly trees (47,24%) and shrubs (39,26%). The herbs account for only 13,50% of the total. The oral flora consists of 139 indigenous plants (85,28%) and 24 exotic cultivated or semi-spontaneous plants (14,72%). These are introduced species in Benin as fast growing woods (*Acacia auriculiformis*, *Azadirachta indica*, *Casuarina equisetifolia*, etc.), ornamental plants (*Duranta erecta*, *Murraya paniculata*, *Jatropha multifida*, etc.), food taxa (*Irvingia gabonensis*, *Citrus* spp., *Ocimum gratissimum*, etc.) or soil fertilizer (*Leucaena leucocephala*).

Of the 163 species listed, *Azadirachta indica* is the most popular with a citation rate of 27,05%. Followed by *Prosopis africana* (15,62%), *Pseudocedrela kotschy* (14,91%), *Zanthoxylum zanthoxyloides* (8,90%), *Parkia biglobosa* (7,25%), *Vitellaria paradoxa* (6,01%), *Dialium guineense* (5,42%), *Anogeissus leiocarpa* (5,30%), *Diospyros mespiliformis* (5,13%) and *Bridelia ferruginea* (5,01%).

The number of species cited per respondent varies from 1 to 12, with an average of 2,23 ± 0,90. The respondents who cited 3 species are in the majority and represent 43,37% of the total. They are followed by those who listed 2 species (28,58%) and those that evoked a single species (25,99%). The respondents who reported more than 3 species (4 to 12) are very poorly represented (2,09%).

The number of species reported varies significantly according to the sex of the respondents (ddl = 1, F = 8,60, P = 0,003), occupation (ddl = 6, F = 8,43, P = 0,000), (ddl = 3, F = 3,03, P = 0,028), their religion (ddl = 2, F = 35,85, P = 0,000), their ethnicity (ddl = 26, F = 23,85, P = 0,000) and their phytogeographic zone (ddl = 2, F = 178,69, P = 0,000).

Table 1: Comprehensive List of Plants Used for Oral Care in Benin FB: biological form (A: tree, a: shrub, H: herbaceous), org. : organ used (T: rod, R: root), FC: frequency of quotation. The numbers 1 to 27 of the column of vernacular names indicate the ethnicities in which these names are attributed (1: adja, 2: agou, 3: ani, 4: bariba, 5: berba, 6: boo, 7: dendi, 9: foodo, 10: gown, 11: gourmanth, 12: holly, 13: idaatcha, 14: kotafon, 15: kotokoli, 16: koutimba, yendé, 21: otamari, 22: peuhl, 23: sahouè, 24: tchabè, 25: waama, 26: wachi, 27: yoom).

Scientific names	FB	Vernacular names	Org.	FC (%)
<i>Acacia auriculiformis</i> A. Cunn. ex Benth. (Leg.-Mimosoideae)	A	alikipatin (8), acacia (7, 9, 15, 22, 23, 25), yovotin (14)	T	2,59
<i>Acacia macrostachya</i> Rochb. ex DC. (Leg.-Mimosoideae)	a	kourandambou (4)	T	0,06
<i>Acacia nilotica</i> (L.) Willd. ex Delile (Leg.-Mimosoideae)	A	bani (3, 15)	T	0,24
<i>Acacia polycantha</i> Willd. ssp. <i>campylacantha</i> (Hochst. ex A. Rich.) Brenan (Leg.-Mimosoideae)	A	sankan irikonkhkoh (4), Iwéwé (13)	T, R	0,24
<i>Acacia</i> sp. (Leg.-Mimosoideae)	a		T	0,18

<i>Acridocarpus alternifolius</i> (Schumach. & Thonn.) Nied. (Malpighiaceae)	a		T	0,12
<i>Afzelia africana</i> Sm. (Leg.-Caesalpinioideae)	A	atchakpa (24)	R	0,65
<i>Agelaea pentagyna</i> (Lam.) Baill. (Connaraceae)	a		T	0,06
<i>Albizia ferruginea</i> (Guill. & Perr.) Benth. (Leg.-Mimosoideae)	A	djouwaglo (1)	T	0,06
<i>Allophylus africanus</i> P. Beauv. (Sapindaceae)	a		T	0,06
<i>Anacardium occidentale</i> L. (Anacardiaceae)	A	kadignou (3), tahan (4), tchiontiga (5), tiamou (5), acadjoutier (7, 11, 25), atcha (15), fayori koïfè (21), acadjou (24), atignan (27)	T	1,83
<i>Angylocalyx oligophyllus</i> (Baker) Baker.f. (Leg.- Papilionoideae)	a		T	0,35
<i>Annona senegalensis</i> Pers. (Annonaceae)	a	guépagnipi (3), bahtoko (4), hourhoun (5), gniglo, agnoglé (8), gbégnanglé (14), n'moutoumou (21), doukouhi (22), fillohou (27)	T	1,83
<i>Annona squamosa</i> L. (Annonaceae)	a	lolo (9), lolo (15)	T	0,18
<i>Anogeissus leiocarpa</i> (DC.) Guill. & Perr. (Combretaceae)	A	goukancla (3), kakarah, agbanga (4), tchiéga (5), kanhoula (6), sclli (6), wliwon (8), assonsonguilln (10), bouatamou (11), wèwè (18), bounassi (19), doukouhi (22), agni (24)	T, R	5,30
<i>Aphania senegalensis</i> (Juss. ex Poir.) Radlk. (Sapindaceae)	a	djewitin (14)	T	0,18
<i>Azadirachta indica</i> A. Juss. (Meliaceae)	A	saboulagbé (1), neem (2, 4, 6, 11, 16-22, 24,25), kintcho (3), titousk (5), godji (7), kininou (8, 10), gwogué (9), katitontoga (11), quininetin (14, 23), godji (15), iribou (19), greentin (26), godji (27)	T	27,05
<i>Bambusa vulgaris</i> Schrad. ex Wendel (Poaceae)	A	dawé (8)	T	0,06
<i>Baphia nitida</i> Lodd. (Leg.-Papilionoideae)	a	sotin, wolo (8)	T	0,47
<i>Blighia sapida</i> König (Sapindaceae)	A	n'lè (3), n'foromou (21)	T	0,47
<i>Breonadia salicina</i> (Vahl) Hepper & J. R. I. Wood (Rubiaceae)	A	mounonwètinou (21)	T	0,06
<i>Bridelia ferruginea</i> Benth. (Euphorbiaceae)	a	bembemkou (4), yampo (5, 22), lassinah (6), hounssoukouekoue (8), koblégna (9), era (12), ahihontin, hounhoutin (14), koblégna (15), honsoukouwé (18), mogni (21), oha (24), bamou (27)	T	5,01
<i>Bridelia scleroneura</i> Müll. Arg. (Euphorbiaceae)	a	lassinboua (6), kouyampo (11), nairoubou (16, 20), pèkoukoubou (25)	T	0,82
<i>Burkea africana</i> Hook. (Leg.-Caesalpinioideae)	A	atakpati (2), kouami (5), soohli (6), takpla (8), atakpla (18)	T	2,77
<i>Caesalpinia benthamiana</i> (Baill.) Herend. & Zarucchi (Leg.-Caesalpinioideae)	a	kpouehoundo, kpofin (8), kporphinoun (14)	T, R	0,29
<i>Caesalpinia bonduc</i> (L.) Roxb (Leg.- Caesalpinioideae)	a	adjikouiman (13)	R	0,06
<i>Caesalpinia pulcherrima</i> (L.) Sw. (Leg.- Caesalpinioideae)	a	orguene de chine (14, 23, 26)	T	0,47
<i>Cajanus cajan</i> (L.) Millsp. (Leg.-Papilionoideae)	a	sodja (7), otéré (25)	T	0,47
<i>Calotropis procera</i> (Aiton) W. T. Aiton (Asclepiadaceae)	a	tounkpotou-kpakpalè (15)	T	0,06
<i>Carapa procera</i> DC. (Meliaceae)	A	agbanlo, totin (10), hito (18)	T	1,94
<i>Carpolobia lutea</i> G. Don. (Polygalaceae)	a	avian (14)	T, R	0,24
<i>Casuarina equisetifolia</i> L. (Casuarinaceae)	A	filao (8, 18, 24)	T, R	1,06
<i>Chionanthus niloticus</i> (Oliv.) Stearn (Oleaceae)	A	wantibou (25)	T	0,29
<i>Chrysobalanus icaco</i> L. ssp. <i>orbicularis</i> (Schumach.) Souza (Chrysobalanaceae)	a	kokoué (8)	T	0,12
<i>Chysohyllum albidum</i> G. Don (Sapotaceae)	A	azonbébé (8)	T	0,06
<i>Citrus aurantifolia</i> (Christm. & Panzer) Swingle (Rutaceae)	A	lemounou (4, 6), klétin (8), lobouétin (23), demounou (25), noutchichi (26)	T	1,06
<i>Citrus limon</i> (L.) Burm.f. (Rutaceae)	A	klétin (14), lobouéklétin (23), gbodohoutchi (26)	T	0,53
<i>Citrus sinensis</i> Osbeck. (Rutaceae)	A	yovozintin (14)	T	0,12
<i>Cochlospermum planchonii</i> Hook.f. (Cochlospermaceae)	H	n'krouko (3), koulouka (9, 15), koubouka (15)	T	0,65
<i>Cola millenii</i> K. Schum. (Sterculiaceae)	H	alloviaton (8)	T	0,06
<i>Cola nitida</i> (Vent.) Schott & Endl. (Sterculiaceae)	A	egui-obi (4, 24)	T, R	2,12
<i>Combretum collinum</i> Fresen. (Combretaceae)	a	goutchallo (u) (3), tchakpa tchiré (4, 7, 21), gbodomi (4), yawii, ayawii, dosso, ahahoui, agnahoui, toso (8), coualiou, koulouhou (9, 15), gbodomi (24), gonkou (27)	T, R	4,12
<i>Combretum glutinosum</i> Perr. ex DC. (Combretaceae)	a	timtabouk (5), litinli (6)	T	0,24
<i>Combretum racemosum</i> P. Beauv. (Combretaceae)	A	dandanclamin (1)	T	0,18
<i>Crossopteryx febrifuga</i> (G. Don) Benth. (Rubiaceae)	A	bohbian (4), blégbonan (6), djoguahi (22)	T	0,24
<i>Croton gratissimus</i> Burch. (Euphorbiaceae)	A	glélé (23)	T	0,18
<i>Daniellia oliveri</i> (Rolfe) Hutch. & Dalziel (Leg.- Caesalpinioideae)	A	gnambourou (4), iya (13), kohilahy (22), ouya (24)	T	0,71
<i>Deinbollia pinnata</i> (Poir.) Seumaeh. & Thonn.	a	zounblatin (14)	T	0,24

(Sapindaceae)				
<i>Desmodium velutinum</i> (Willd.) DC. (Leg.-Papilionoideae)	H	kloklophinv (1), sèhèla (6), tètè (14), tchangapoutoua (27)	T	1,06
<i>Detarium microcarpum</i> Guill. & Perr. (Leg.-Caesalpinioideae)	A	bèsègounou (4), boussounli (6), kankédi (25)	T	0,35
<i>Dialium guineense</i> Willd. (Leg.-Caesalpinioideae)	A	touetouetin (1, 23), monsôsô (4, 24), assonsonwin (8), atouetouetin (14), ouya (24), atitouetin (26)	T, R	5,42
<i>Dichapetalum madagascariense</i> Poir. (Dichapetalaceae)	a	kpotortin (23)	T	0,24
<i>Dichrostochys cinera</i> (DC.) Wight & Arn. (Leg.-Mimosoideae)	a		T	0,06
<i>Diospyros mespiliformis</i> Hochst. ex A. DC. (Ebenaceae)	A	dohounko (2), goutchra (3), wibouanh (4), yéssika (5), tokoï (7), kinwoui (8), bougorbou (11, 16), koguigolorhou, kognigalorlor (15), boupi, m'pi (21), gahoun (27)	T, R	5,13
<i>Duranta erecta</i> L. (Verbenaceae)	a		T	0,06
<i>Ehretia cymosa</i> Thonn. ex Schum. (Boraginaceae)	a	zozo-man (8)	T	0,06
<i>Entada africana</i> Guill. & Perr. (Leg.-Mimosoideae)	A	n'takpa (3), kpankpanrou (4), wonmandonrou (4), tchanssitchakoun (5), kpageaafou (6), hortoukoubou (15)	T	1,00
<i>Eucalyptus camaldulensis</i> Dehn. (Myrtaceae)	A	ecalyptus (3, 22, 25), lapotiga (4, 5), touri kparè (7), kouyou koufourou (9, 15), itipéni, kotigiéga (11), tiépouédja (16), katépienkè, katiéga (20)	T, R	3,71
<i>Feretia apodanthera</i> Delile (Rubiaceae)	a	toumouh daka (4)	T	0,06
<i>Ficus exasperata</i> Vahl. (Moraceae)	A	tohlor (23)	T	0,12
<i>Ficus sur</i> Forssk. (Moraceae)	a	couguankado (9, 15), boukantoukou (21), kankaha (27)	T	0,53
<i>Flueggea virosa</i> (Roxb. ex Willd.) Voigt (Euphorbiaceae)	H	hétré (1), siansian (4), ghahgahla (6), zétré, chachakè (8), gbangbalié (9, 15), tidondonti (21), tchamire (22), tchéguérifa (25), tcharaou (27)	T	3,01
<i>Garcinia kola</i> Heckel (Clusiaceae)	A	ahwelo (8), kpako (12)	T	4,60
<i>Garcinia ovalifolia</i> Oliv. (Clusiaceae)	A	tiwu, takou twtè (21), pékroudiguitigua (25)	T	0,65
<i>Gardenia erubescens</i> (Stapf. & Hutch.) (Rubiaceae)	a	kannanlah (6), dakpla (8), baladissoré (15), gabdé touri (17), sambona (25), vouga (27)	T	0,18
<i>Gardenia ternifolia</i> Schumach. & Thonn. (Rubiaceae)	a	kannanlah (6), dakpla (8), baladissoré (15), gabdé touri (17), sambona (25), vouga (27)	T, R	0,35
<i>Glyphaea brevis</i> (Spreng.) Monachino. (Tiliaceae)	a	donboliba (14)	T, R	0,24
<i>Gmelina arborea</i> Roxb. (Verbenaceae)	A	monwouroussou (4), mangatigou (25)	T	0,35
<i>Grewia bicolor</i> Juss. (Tiliaceae)	a	danhli (6)	T	0,24
<i>Grewia carpinifolia</i> Juss. (Tiliaceae)	a	houanzozotchi (1)	T	0,12
<i>Grewia lasiodiscus</i> K. Schum. (Tiliaceae)	a	srahoun (5)	T	0,12
<i>Grewia mollis</i> Juss. (Tiliaceae)	a	lèlè (8), hractédé (25)	T	0,06
<i>Grewia pubescens</i> (Tiliaceae)	a	orra (24),	T, R	0,06
<i>Griffonia simplicifolia</i> (Vahl ex De.) Baill. (Leg.-Caesalpinioideae)	a	afatlomandou (14)	T	0,24
<i>Hexalobus monopetalus</i> (A. Rich.) Engl. & Diels (Annonaceae)	A	tibahkah (4)	T	0,24
<i>Hibiscus surattensis</i> L. (Malvaceae)	H	kporphin (1)	T	0,12
<i>Hoslundia opposita</i> Vahl. (Lamiaceae)	H	agbanlidogbo (14)	T	0,06
<i>Hymenocardia acida</i> Tul. (Euphorbiaceae)	a	sin man (4), kpinningannala (6), sotivè (8)	T	0,29
<i>Indigofera dendroides</i> Jacq. (Leg.-Mimosoideae)	H	natimouna (25),	T	0,06
<i>Indigofera pulchra</i> Willd. (Leg.-Mimosoideae)	H	kékétou (5)	T	0,06
<i>Indigofera</i> sp. aff <i>trita</i> L.f. (Leg.-Mimosoideae)	H	assèkè (27)	T	0,53
<i>Irvingia gabonensis</i> (Aubry-Lecomte ex O'Rorke) Baill. (Irvingiaceae)	A	atortin (1)	T	0,35
<i>Jatropha curcas</i> L. (Euphorbiaceae)	a	gbolitchi (1), n'boriyéyé (3), boukatounou (4), orporporhou (4, 24), lapohoun (5), bahtoun (6), gninkpotoun (8, 13), adjangbogboé (14), yovokpatin (23), tanokpantamou (25)	T, R	3,06
<i>Jatropha multifida</i> L. (Euphorbiaceae)	a	orlor (9), tinture (14)	T	0,06
<i>Khaya senegalensis</i> (Desr.) A. Juss. (Meliaceae)	A	goussa (3), gbiribou (4), mouhanli (6), fèlè touri (7), orlor (9, 15), noibou (11), khaya (19), kohy (22), djigou (27)	T, R	2,06
<i>Lannea microcarpa</i> Engl. & K. Krause (Anacardiaceae)	A	sapha (5)	T	0,06
<i>Lecaniodiscus cupanioides</i> Planch. Ex Benth (Sapindaceae)	A	tototin (23), gakpotin (26)	T	0,35
<i>Leptoderris brachyptera</i> (Benth.) Dunn (Leg.-Papilionoideae)	A		T	0,12
<i>Leucaena leucocephala</i> (Lam.) De Wit (Leg.-Mimosoideae)	a	gantin (8)	T	0,06
<i>Lonchocarpus sericeus</i> (Poir.) Kunth (Leg.-Papilionoideae)	A	batin, housoubada (8)	T, R	0,18
<i>Macrosphyra longistyla</i> (DC.) Hiern (Rubiaceae)	a		T	0,06
<i>Mallotus oppositifolius</i> (Geisel.) Müll.Arg. (Euphorbiaceae)	a	kissè kissè (8), tchidede, chichidè (14), chichidessou (23), oodja (24), soti (26)	T, R	2,47

<i>Mangifera indica</i> L. (Anacardiaceae)	A	mango (3, 4), lapotanga (5), mohli (6), mangou touri (7), mangatin (8), bigué (9), manguier (19), mangou (27)	T, R	1,30
<i>Manilkara multinervis</i> (Baker ex Oliv.) Dubard (Sapotaceae)	A	kotanga (25)	T	0,82
<i>Manilkara zapota</i> (L.) P. Royen (Sapotaceae)	A	chapotier (8)	T	0,06
<i>Maranthes polyandra</i> (Benth.) Prance (Chrysobalanaceae)	a	klèyè (2), assoukoussi (2)	T	0,18
<i>Margaritaria discoidea</i> (Baill.) Webster (Euphorbiaceae)	A	souapounanh (6)	T	0,41
<i>Millettia thonningii</i> (Schumach. & Thonn.) Baker (Leg.-Papilionoideae)	A	tintin (1), otiètiè (12), siansiantin, ganwétin (14), chanchan (23)	T	1,30
<i>Mitragyna inermis</i> (Willd.) Kuntze (Rubiaceae)	A	boremborerou (4), krouyéhou (5), bouyélimbou, bouyélimou (11, 22)	T	0,53
<i>Morinda lucida</i> Benth. (Rubiaceae)	A	hedoutin (8)	T	0,06
<i>Moringa oleifera</i> Lam. (Moringaceae)	a	kpataloue (1), yorouyarah (4), kpatomantin (14)	T	0,06
<i>Murraya paniculata</i> (L.) Jack var. <i>exotica</i> (L.) M.R.Almeida (Rutaceae)	a	wedo (8)	T	0,24
<i>Napoleonaea vogelii</i> Hook. & Planch. (Lecythidaceae)	a	zadou (2), zèdou (8)	T, R	1,94
<i>Nesogordonia kabingaensis</i> (K. Schum.) Capuron ex R. Germ. (Sterculiaceae)	A	afaki ahouvè, afaki ahounvè, afaki ahouanvè (8, 18)	T	1,94
<i>Newbouldia laevis</i> (P.Beauv.) Seemann ex Bureau. (Bignoniaceae)	A	hounmanhounmantin (14)	T	0,12
<i>Ocimum gratissimum</i> L. (Lamiaceae)	H	yandoudou (1), guafitiri (3), kossou kparè (7), chayo (8), kossou kparè (9), dounoudouli (15), wanriwansa (22), chamadido (23), tchayo (24), djindjinou (27)	T	1,65
<i>Olex subscorpioidea</i> Oliv. (Olacaceae)	a	mitin (8), ifan (18)	T	0,35
<i>Opilia amentacea</i> Roxb. (Opiliaceae)	a	nindo (4, 24)	T, R	1,36
<i>Parinari congensis</i> F. Didr. (Chrysobalanaceae)	A	akoopa, oopa (24)	T, R	1,00
<i>Parinari curatellifolia</i> Planch. ex Benth. (Chrysobalanaceae)	A	kpahkpikouh (4), fougannanh (6), dosso touri (17)	T	0,53
<i>Parkia biglobosa</i> (Jacq.) R.Br. ex Benth. (Leg.-Mimosoideae)	A	gourè (3), hraboro tchakpa (7, 15), sèssè (9, 15), koutchoum (15), dorbou (25), kangou, kongou, dor (27)	T, R	7,25
<i>Parkinsonia aculeata</i> L. (Leg.-Mimosoideae)	a	pouintiga (5)	T	0,06
<i>Paullinia pinnata</i> L. (Sapindaceae)	H	éyitchan (1), gangahisse (14), akouba (18), nonchorvidouhoukoui (23, 26)	T	0,53
<i>Pericopsis laxiflora</i> (Benth. ex Baker) Meeuwen (Leg.-Papilionoideae)	A	guafla (3), souhtinnan (6), sousouvi wahouin (8), diran (27)	T, R	0,71
<i>Petiveria alliacea</i> L. (Phytolacaceae)	H	essenceman (14)	T, R	0,06
<i>Phyllanthus reticulatus</i> Poir. (Euphorbiaceae)	A	kpinkpera (4)	T	0,12
<i>Piliostigma thonningii</i> (Schumach.) Milne-Redh. (Leg.-Caesalpinioideae)	a	n'tchériman (3), bakourouh (4), lamouangou (5), baahla (6), klontin (8), babakor (9, 15), kparouman (13, 24), barrkou (27)	T, R	2,42
<i>Pouteria alnifolia</i> (Baker) Roberty var. <i>alnifolia</i> . (Sapotaceae)	A	kpafion (26)	T	0,06
<i>Premna angolensis</i> Gürke. (Verbenaceae)	A	hlewi (1)	T	0,06
<i>Prosopis africana</i> (Guill. & Perr.) Taub. (Leg.-Mimosoideae)	A	akèkè (2), guinsobah (4), kombérinouhi (5), sinli (6), kakè (8, 13), likpangli, télabou, kombérinouhi (11), kpangli, likpangli, télabou, oukountandomou (16), oukountandomou, kàngli, likpangli (20), mouanoi, bouanoi (21), likpangli, kohy, kohy tchégléhi (22), akakagni (24), gnakapibou (25)	T, R	15,62
<i>Pseudocedrela kotschy</i> (Schweinf.) Harms (Meliaceae)	A	awocha (2), n'chéché (3), bisisombou (4), lassanhi (5), dohoukpe, tchaklikli (8, 13), kobèdè (9), lissinssilé (11, 16, 22), kobèdè (15), tchakiki (18), moussétamou (21), kohyloumi (22), tchaguigui (24), totossiré, totohiré (25), tagmassèhou (27)	T, R	14,91
<i>Pseudospondias microcarpa</i> (A. Rich.) Engl. (Anacardiaceae)	A	shigu (18), ito (18)	T	0,06
<i>Psidium guajava</i> L. (Myrtaceae)	a	n'panwèré (3), gbaafoun (4), guayave (6, 7, 9, 15, 19, 21, 25), kinkountin (8, 10), akinkountin (14), agogbetin (26)	T, R	4,07
<i>Psychotria calva</i> Hiern. (Rubiaceae)	a	djenoutin (1)	T	0,06
<i>Pteleopsis suberosa</i> Engl. & Diels (Combretaceae)	a	bangobokourou (4), youank (5), témon (6), kouklou (8), n'kpantombou (21), okoukou (24), kotika, kotanga (25), gwk (27)	T, R	3,12
<i>Pterocarpus erinaceus</i> Poir. (Leg.-Papilionoideae)	A	kosso (8), ara (13), moutamou (21)	T, R	0,29
<i>Rhizophora racemosa</i> G. Mey. (Rhizophoraceae)	A	wuitohin (8)	T	0,06
<i>Ritchiea capparoides</i> (Andr.) Britten. (Capparidaceae)	H	linvoké (1)	T	0,06
<i>Rourea coccinea</i> (Thonn. ex Schumach.) Benth. (Connaraceae)	a	ganganlisè (8), triman, hounsitogbé (14), hounsitogbé (26)	T	0,82
<i>Sarcocephalus latifolius</i> (Sm.) E.A.Bruce (Rubiaceae)	a	ganrerou (4), deefou (6), borowiri tchakpa (7), kaffadétadé	T, R	1,94

		(9), igbèssi (13), kaffadétadé (15), padawanoï (22), kodor (23), konkonbou (25), djimougou (27)		
<i>Schrankia leptocarpa</i> DC. (Leg.-Mimosoideae)	H	ewora alakoun (4), ewon akakou (24)	T, R	1,71
<i>Sclerocarya birrea</i> (A. Rich.) Hochst. (Anacardiaceae)	A	bonawak (5)	T	0,06
<i>Securidaca longepedunculata</i> Fresen. (Polygalaceae)	A	goumènin (3, 7), guinzinah (6), fanongou (27)	T, R	0,71
<i>Senna occidentalis</i> (L.) Link (Leg.-Caesalpinioideae)	H	adjangoulou (4, 24), kinkeliba (8, 18), yegniman (14)	T, R	1,71
<i>Senna siamea</i> (Lam.) H. S. Irwin & Barneby (Leg.-Caesalpinioideae)	a		T	0,35
<i>Sida acuta</i> Bunn.f. (Malvaceae)	H	baiyona (6), solo (8, 10)	T, R	1,30
<i>Sida garckeana</i> Pol. (Malvaceae)	H		T	0,12
<i>Siphonochilus aethiopicus</i> (Schweinf.) B. L. Burt (Zingiberaceae)	H	Tchacoco (13)	R	0,06
<i>Solanum americanum</i> Mill. (Solanaceae)	H	odou (4, 24)	T, R	0,88
<i>Sorindeia grandifolia</i> Engl. (Anacardiaceae)	a	afatonnonmandou (8)	T	1,36
<i>Spondias mombin</i> L. (Anacardiaceae)	A	kicon (8), aklicon (14), kliconman (23)	T	0,47
<i>Stachytarpheta indica</i> (L.) Vahl (Verbenaceae)	H		T	0,18
<i>Streospermum kunthianum</i> Cham. (Bignoniaceae)	A	wessassonah (6), palémalèga (27)	T	0,35
<i>Strychnos innocua</i> Delile (Loganiaceae)	a	louabeparamah (6)	T	0,18
<i>Swartzia madagascariensis</i> Desv. (Leg.-Papilionoideae)	A	moutchocbou (21)	T	0,06
<i>Synsepalum dulcificum</i> (Schumach. & Thonn.) Daniell. (Sapotaceae)	a	assisreur (14)	T	0,12
<i>Tamarindus indica</i> L. (Leg.-Caesalpinioideae)	A	gougimou (3), pisque (5), sanmanli (6), djèvi (8, 18), kèdidi (9, 15), napibou (11, 16), djabi (22)	T, R	3,95
<i>Terminalia avicennioides</i> Guill. & Perr. (Combretaceae)	A	kouri (5), bèrèla (6), bouk pangou (21)	T	4,36
<i>Terminalia glaucescens</i> Planch. ex Benth (Combretaceae)	A	zogbetin (1), oundi, egi-orin (24)	T, R	2,18
<i>Terminalia laxiflora</i> Engl. (Combretaceae)	A	boussikouabou, lissibouagou (11), kpinkpinkou (16)	T	0,18
<i>Terminalia mantaly</i> H. Perrier (Combretaceae)	A	terminalia (25)	T, R	0,65
<i>Trichilia emetica</i> Vahl (Meliaceae)	A	akouna apain (3), wampègou (27)	T	0,41
<i>Triclisia subcordata</i> Oliv. (Menispermaceae)	H	voundrinnin (23)	T, R	0,12
<i>Uapaca togoensis</i> Pax (Euphorbiaceae)	A	koubohoun (25)	T	0,71
<i>Uvaria chamae</i> P.Beauv. (Annonaceae)	a	hovikokwé (8), gbadatin (23), agbannantin (26)	T	0,94
<i>Vernonia adoensis</i> Sch. Bip. ex Walp. (Asteraceae)	H	mouanou pank (27)	T	0,12
<i>Vernonia amygdalina</i> Delile (Asteraceae)	a	gbolé (2), touhan (4), bembemkou (4), boritchagarou (5), boritchagahou (5), pouhanhi (6), souaka (7, 15, 22), amanvivè (8), tikpintiré (11), anoukoro (12), ogbèlo (23), eho (24), pomorgue (27)	T, R	3,36
<i>Vitellaria paradoxa</i> C. F. Gaertn. (Sapotaceae)	A	gouché (3), somboub (4), tanga (5), kouli (6), boulanga touri (7), ougo, kotoblè (8), couthékou (9), boussambou (11), couthékou, tamou (15, 22, 25), kokodjikoma (19), koutchamou (20), moutamou, boutamou (21), èmin (24), tchigagon (27)	T, R	6,01
<i>Vitex doniana</i> Sweet (Verbenaceae)	A	goussou donou (3), kouhouli (6), bouhormou, mougamou (11), koporto (15), bouhormou (16), mougamou (19), wirilla (25), sogmadjèhoun (27)	T	1,36
<i>Waltheria indica</i> L. (Sterculiaceae)	H	sissacpohoun (5), kouk pangonpiégou (11), nondi-nondi (24), adoufèchou (26)	T, R	1,94
<i>Ximenia americana</i> L. (Olacaceae)	a	manmantinnanla (6)	T	0,06
<i>Zanthoxylum zanthoxyloides</i> (Lam.) Zepernick & Timler (Rutaceae)	A	héhé (1), hetin (2, 14, 18), gouka (3), egui ata (4), boubou (5, 20, 22), xhètin (8), dépoumpoumssalé (9, 15), hedo (10), boubou (11, 16), itannan (12), ohètin (23), egui ata (24), hebouitin (26)	T, R	8,90
<i>Ziziphus abyssinica</i> A. Rich. (Rhamnaceae)	A	poussakouani (16)	T	0,06

3.2. The cumulative contribution of the respondents to the knowledge of oral flora for their socio-professional categories

The cumulated contribution of the respondents to the knowledge of oral flora varies according to their socio-professional category. It is 73.01% for women and 90.80% for men. Within each of the other socio-professional strata, none of the categories of respondents alone holds the full diversity of plants used for oral hygiene (Figure 1).

The best contributing categories to the diversity of these plants are adults who account for 89% of the diversity in terms of age, illiterate (89%) considering educational

attainment, farmers (89%) considering the profession then the Christians (75%) and animists (73%) considering the religion. On the other hand, the phytogeographical areas of the surveyed have almost similar contributions. They are 49% (79 species) for Sudanese respondents compared with 50% (80 species) for those in the Sudano-Guinean zone and 55% (88 species) for those in the Guinean zone.

At the level of the ethnic groups, the respective contributions of the linguistic groups are clearly low compared to those of the other socio-professional categories (Figure 2). The ethnic of fon (39%), bariba (28%), boo (23%) and kotafon (20%) were the strongest contributors.

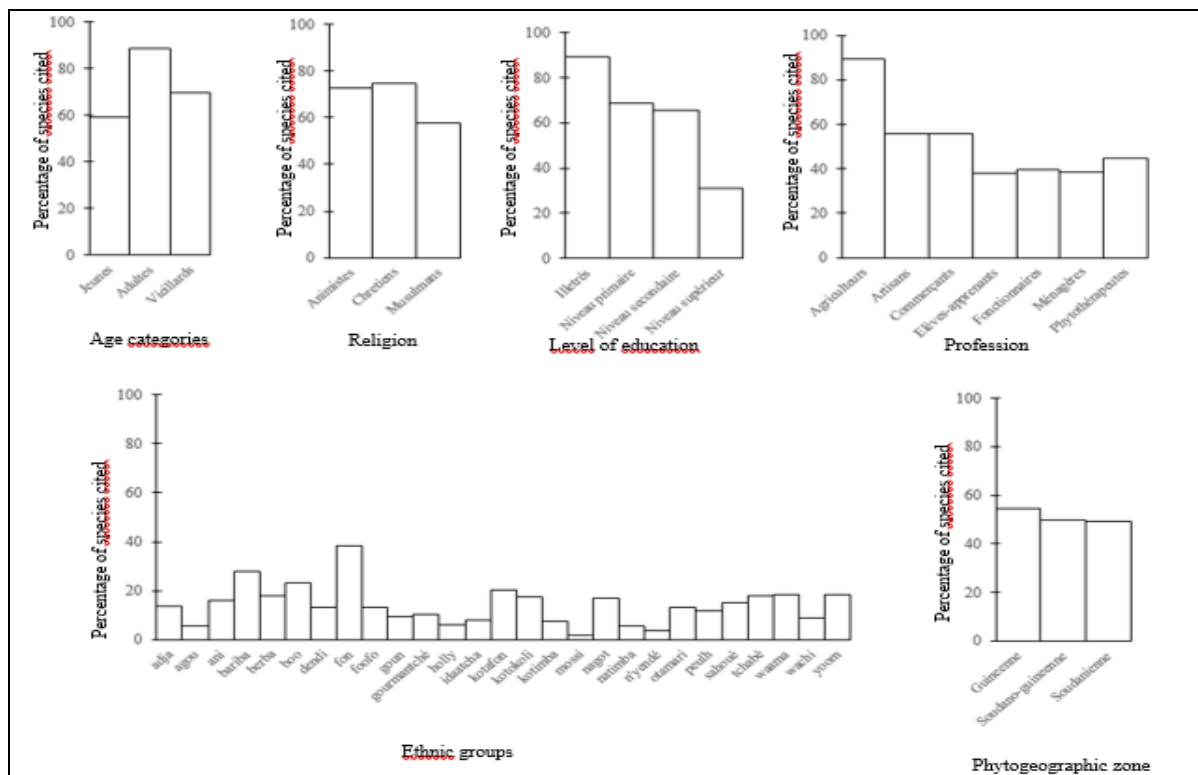


Fig 1: Relative contribution of the different socio-professional categories to the knowledge of the diversity of plants for oral use in Benin

3.3 Variability of the flora for oral use held by the various socio-professional categories of the respondents

The similarity index of Jaccard (Ij) showed a similarity between the plants enumerated by the various socio-professional categories except the ethnic group and the area of the respondents.

Considering the gender of the respondents, Ij is 0.63 and indicates that 63% of the species are cited by the two genera and 37% are specific, 10% recognized by women exclusively and 27% by men. These species specific to either genus are mostly cited (7% in women and 22% in men), only by one respondent. Nevertheless, they are mostly reported by illiterate farmers and at least 30 years of age. Taking into account the age of the respondents, 63% of the species listed are cited by both youth and adults, 56% by young and old, and 62% by adults and the elderly. In the case of the profession, the percentage of species common to the different strata, taken in pairs, varies from 40 to 57% (56%), traders and phytotherapists (53%), artisans and trainees (53%), the highest artistic similarities are established between officials and traders (57%). Of respondents level of education, the high resemblance of the species used is recorded between the illiterate and the primary (66%) and the lowest between the illiterate and the higher (35%). The respondents at the primary and secondary levels have a rate of 58% and those at secondary levels and illiterates have a rate of 57%. Christians share 58% of species with animists and 57% with Muslims. The latter have in common 50% of the flora with the animists. On the contrary, Jaccard's index showed a great inter-zonal and inter-ethnic floristic dissimilarity. It is 0.18 between the Guinean and Sudanian zones, 0.23 between the Guinean and Sudano-Guinean zones and then 0.49 between the Sudanian and Sudano-Guinean zones. Only twenty-two species were cited in all 3 areas. They are made up of 8 introduced species and 14 autochthonous species, the most frequently mentioned being: *Acacia auriculiformis*, *Anogeissus leiocarpa*, *A. indica*,

Bridelia ferrugina, *Diospyros mespiliformis*, *Eucalyptus camaldulensis*, *Flueggea virosa*, *Mangifera indica*, *Zanthoxylum zanthoxyloides*. The similarity index of Jaccard varies from 0.05 to 0.69 between the two ethnic groups taken in the two groups. In the case of ethnic group, Jaccard's similarity index varies from 0.05 to 0.69 between ethnic groups taken two together. But only couples of ethnic groups "foodo" and "kotokoli", then "gourmantché" and "kotimba" have a Jaccard index of more than 0.50 and can be considered as ethnic groups with a floristic similarity. The other ethnic groups have a floral procession different from one ethnic group to another.

These trends are even similar to those obtained in the 7 multi-ethnic communes, except in Cobly and Ouaké where ethnic groups taken 2 to 2 use at least 50% of plants together; the Jaccard index being 0.53 between the "gourmantché" and "kotimba" in Cobly and then 0.62 between the "foodo" and "kotokoli" in Ouaké. The respondents "bariba", "yendé" and "peuhl" all of Cobly share a very small floristic procession with the 2 previous ones ("gourmantché" and "kotimba") as evidenced by the Ij which are between 0.08 and 0.44. In Djougou, where the "dendi" and the "waama" live together, Jaccard's similarity index is only 0.32. In Djidja, where 3 different communities live together (agou, fon and nagot), Ij ranges from 0.26 to 0.29 between these communities considered 2 to 2. In Natitingou, the index of Jaccard is between 0 and 0.33 for the pairs of ethnic groups for the 8 ethnic groups ("dendi, foodo, gourmantché, kotokoli, otamari, peuhl, waama and yoom"). Finally, 11 ethnic groups live together in Tanguiéta ("bariba, berba, dendi, gourmantché, kotimba, mossi, natimba, otamari, pehl, waama and yoom") and have between them a value between 0 and 0.29 only.

3.4 Bodies used and preference criteria of interviewees

The plant organs serving as a plant brush are the stem and the root (Table 1). The species used exclusively for their stem are

the majority (116 species, ie 71.17%). Among them, the most cited are *Azadirachta indica* (27.05%) and *Bridelia ferruginea* (5.01%). The root is exclusively applied to only 3 species, ie 1.84% of plants for oral use, *Afzelia africana* cited by 0.65% of the respondents, *Caesalpinia bonduc* (0.06%) and *Siphonochilus aethiopicus* (0.06%). Forty-four species (26.99%) are stressed for their stem and root at the same time. The most frequently mentioned are *Prosopis africana* (15.62%) and *Pseudocedrela kotschy* (14.91%).

In total, 99% of the respondents mentioned the criteria for choosing the species they use for their oral hygiene, compared to 1% of the sample, which are without any preference criteria. These preference criteria listed were 4 characters, namely: taste (bitter or bland), tenderness, therapeutic properties and availability of the organ. Among the characteristics evoked, the taste is the most quoted with a citation rate of 37.41% of which 23.51% for the bitter taste and 13.90% for the tasteless taste. Followed by the organ's tenderness (30.47%), its therapeutic property (5.66%) and its availability (3.24%).

For 76% of the respondents, only one character motivates their choice. On the other hand, 23% of the interviewees use a combination of several characters (2 to 4) as criteria of preference of one or the other species.

The preferred plants for the combination of 4 characters are the majority (68 species, 41.72%). (50 species, 30.67%), those selected for 3 criteria (23 species, 14.11%) and those whose choices are motivated by 2 characters (22 species, 13, 50%).

The reasons for the preference of the same species often vary from one interviewee to another. *Azadirachta indica* is preferred for its bitterness by 20.44% of respondents, tenderness of its wood (7.48%), its availability (0.89%) and its therapeutic properties (0.82%).

4. Discussions

The present work has identified 163 species used as plant brushes in Benin. This flora is predominated by Leguminosae, Euphorbiaceae and Rubiaceae. These 3 families are also the predominant ones of the flora of Benin alongside the Poaceae, Asteraceae and Cyperaceae [11]. The predominance of these botanical families is not a peculiarity for plants for oral use but for the flora of Benin. This may lead to the hypothesis that populations select plants for oral use, especially among taxons with high diversity in their environment. But this would be the taxons of woody plants because herbaceous plants used as vegetable brushes make up only 13.50% of the plants surveyed, while among the 6 most rich in species in Benin are three families of plants herbaceous plants including Poaceae, Asteraceae and Cyperaceae [11].

The diversity of the plants listed is well beyond the 35 species reported by [9, 10] in the southern and central regions of Benin. This is explained by the fact that these authors have restricted the inventory of plants to the southern and central areas of the country. The oral flora listed in this study takes into account the 10 species reported by [6] and 25 of the 33 species reported by [9, 10]. It then brings the number of species used as plant brushes in Benin to 170. Indeed, the species identified exclusively by the work of [9, 10] are: *Clausena anisata*, *Entada gigas*, *Lansea humilis*, *Microdesmis puberula*, *Monodora tenuifolia*, *Ochna siveinurthiana*, *Phyllanthus muellerianus* and *Rothmannia urcelliformis*. Of these 8 species, *L. humilis* would be cited by mistake of botanical identification because it is not part of the flora of Benin [12]. This work therefore provided a more or less exhaustive list of plants used as plant brushes in Benin. It deserves to be

realized in the other countries of West Africa so that a synthesis is made for the sub-region, as [8] in East Africa where 300 plant species are recognized as plants used for oral hygiene.

The diversity obtained represents 5.81% of all species in Benin. This reflects a strong selection of species to be used as plant brushes in the wide range of available plants. This selection is motivated by 4 characters according to the results obtained of which 2 (tenderness and therapeutic virtues) respond well to the expected properties of the vegetable brushes which are the cleaning and aseptis of the oral cavity. It is the search for these same properties which also motivate the choice of the stem and the root among the vegetable organs to be used as vegetable brushes. [2] also reported that the stem and root are the 2 plant organs used, with strong stem predominance. According to [15], stem, root, twigs and bark are the only plant organs with the plant brush design. Indeed, it is the plant organs that can be transformed into sticks. Moreover, the cleaning property requires the fibrous state of the organs [16] so that they are chewable. The curious selection made by local populations is easily found by the fact that many taxons used as a plant brush have therapeutic properties. For example, *Anogeissus leiocarpa* and *Zanthoxylum zanthoxyloides* have antimicrobial properties and have a positive effect on oral pathogens such as *Candida albicans*, *C. krusei* and *C. tropicalis* [17] (*Abutilon*, *Anogeissus*, *Cola*, *Glyphaea*, *Citrus*, *Clausena*, *Commiphora*, *Cymbopogon*, *Daniellia*, *Zanthoxylum* and *Teclea*) [16].

The results also showed the strong dissimilarity of the floristic processions used between the ethnic groups sharing or not the same floristic landscape. This is due to the great variability of the selection criteria used, even for a given species. [5], therefore, have rightly claimed that the use of *Salvadora persica* as a plant brush is a cultural practice and a scientific inheritance.

5. Conclusion

The present study provided an exhaustive list of plants used as plant brushes in Benin. This is a remarkable contribution compared to previously known taxons. Among the species listed, some have proven antibacterial properties and others are recognized as plants used to eliminate bad breath. These results then make it possible to say that the local populations succeed in adopting useful plants by experiments. The choices made are guided by reasons that vary from one individual to another within the same ethnic group and in the same floristic environment.

Phytochemical and pharmacological studies are necessary in order to know the actual values of the plants used. This will make it possible to promote the species with strong biological activities on the pathogens of the oral cavity.

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