Revue-IRS

Revue Internationale de la Recherche Scientifique (Revue-IRS)

ISSN: 2958-8413

Vol. 3, No. 1, February 2025

Diversity and socio-economic aspects of toothpicks plant species in Abidjan district markets (Côte d'Ivoire, Africa)

Yao Konan[1,3,4], Koné Madoué[2], Kouassi Akossoua Faustine[1,3], Aké Assi Emma Ablan[1,2,3]

[1]Systematics Laboratory Herbarium and Botanical Museum, National Floristics Center, Félix HOUPHOUËT-BOIGNY university, 22 POB 582 Abidjan 22, Côte d'Ivoire

[2]Natural Environments and Biodiversity Conservation Laboratory, UFR Biosciences, Félix Houphouët-Boigny university, 22 POB 582 Abidjan 22, Côte d'Ivoire

[3]Aké-Assi Botanical Institute in Andokoi, 08 POB 172 Abidjan 08 Abidjan, Côte d'Ivoire

4Swiss Center for Scientific Research in Côte d'Ivoire, 01 POB 1303 Abidjan 01, Côte d'Ivoire

Abstract: A study on the diversity of plant species used as toothpick in the markets of the Abidjan District (Côte d'Ivoire) was performed. The aim of the study was to contribute to the sustainable management of plant resources used in the form of toothpicks to resolve oral hygiene problems and other pathologies encountered in Côte d'Ivoire. During the fieldwork in the study site, an ethnobotanical survey has been realized using a pre-established questionnaire, involving 150 people at markets in three communes in Abidjan district (Adjamé, Abobo and Yopougon). The study identified 45 species belonging to 43 genera and 18 families. The Fabaceae family is the most represented. The most used species are Parinari curatellifolia (Chrysobalanaceae) and Croton pseudopulchellus (Euphorbiaceae). The Shannon index values calculated show a variation in the diversity of species used in the form of toothpick depending on the municipalities ($F = 71.19$; $P < 0.001$). These toothpicks, used in the treatment of oral and dental disorders, erectile dysfunction and hypersalivation during pregnancy, are sold mainly by women. Many species used as toothpicks have been classified as "Least Concern" and "Vulnerable" by the IUCN. The most commonly used organ is the root (80%). The cost of these toothpicks varies from 0.04 to 0.83 $USD, making them accessible to all. It is therefore important to raise awareness of how these toothpick species are harvested, in order to prevent their disappearance.

Keywords: Plant diversity, Ethnobotany, Vulnerable plant species, Toothpick, Côte d'Ivoire, Africa

Digital Object Identifier (DOI): https://doi.org/10.5281/zenodo.**14878362**

1 Introduction

Humans have various relationships with plants, depending on their uses [1,2]. These relationships may concern medicinal plants, edible plants, plants with cultural significance, plants for craft use, plants for domestic use (firewood, charcoal and construction wood), etc. [3,4]. Medicinal plants have always been used by man to treat himself and fight against diseases [5]. Among these, oral and dental diseases represent the world's third biggest

scourge, after cardiovascular disease and cancer [6]. The most common are caries lesions, which affect 60-90% of children worldwide and almost 100% of adults[7].
Oral health represents a real economic burden for a country [8][8]. Care, whether curative or preventive, requires an investment that many are not able to afford, particularly in developing countries like Côte d'Ivoire [9]. The treatment of these oral conditions in modern medicine is always difficult for the population, especially those with low economic power. The cost of treating these conditions is high and programs for their prevention are very rare [8].
Thus, in Côte d'Ivoire, as in many African countries, populations use medicinal plants as an alternative therapy for many illnesses. Indeed, these plant resources have appreciable antibacterial activities and their uses have no adverse effects [10,11]. Also, it is widely accepted that natural plant resources represent a socio-economic interest for populations and allow them to satisfy their fundamental needs [12]. The study located in the city of Abidjan in the south of Côte d'Ivoire is mainly interested in plant resources used as tooth rubs by the populations of the area, when we know that oral health is essential for the quality of life. According to Tamboura *et al.* [13], knowledge related to plant resources is transmitted from generation to generation within society and remains a heritage either of the family or of a given social group in the village or region. Consequently, the risk of disappearance of this endogenous knowledge is very great if this knowledge is not documented [14].
In Côte d'Ivoire, very few studies have been carried out on plants for oral use. As a result, it is very difficult to identify the plant species used as toothpastes to treat oral and dental diseases on the markets. This situation led to the interest of this study on the diversity of plant species used as toothpick in the markets of the District of Abidjan. This study was initiated with the aim of contributing to the sustainable management of plant resources used in the form of toothpick to solve problems of oral diseases or other symptoms encountered in Côte d'Ivoire.
The specific objectives were to (i) identify the plant species used as toothpick by the population; (ii) determine the oral diseases and other symptoms treated by toothpick; and (iii) determine the socio-economic value of toothpick for sellers.

2 Material and Methods

2.1 Study area

The surveys took place in the city of Abidjan (Côte d'Ivoire, Africa), which enjoys a sub-equatorial, Attiean climate and belongs to the Guinean domain of the ombrophile sector [15]. A cosmopolitan city in sub-Saharan Africa, Abidjan, the economic capital of Côte d'Ivoire, has a population of over five million and covers an area of 2,119 km², or 0.6% of the national territory. Its population is spread across the thirteen communes that make it up: Marcory, Abobo, Adjamé, Attécoubé, Anyama, Bingerville, Cocody, Koumassi, Plateau, Port bouët [16]. The study was carried out in the marches of Abidjan district, more specifically in the marches of the communes of Adjamé (black market, behind the town hall, mosque), Abobo (petite and grande marche d'Abobo, sogephia market, samaké market, carrefour Diallo, N'dotré) and Yopougon (wassakara market, andokoi market, siporex market). These markets were selected because they are where many toothpicks traders can be found (Figure 1).

2.2 Ethnobotanical survey

Data was collected using a questionnaire from toothpick sellers. For these surveys, 150 people were randomly selected from the various markets in three communes of the city of Abidjan (Abobo, Adjamé and Yopougon). The various questionnaire items were: identification of the respondent, identification of the plant material used, diseases or symptoms treated, type of use, dosage, availability and economic aspect of the tooth fleets sold (Figure 2). The interviews were conducted in Malinké (an ethnic group in Côte d'Ivoire).

2.3 Plant collection, handling, and identification

The plants cited were sampled and identified by comparison with herbarium samples from the Centre National de Floristique (CNF) at the Université Félix HOUPHOUËT-BOIGNY. In addition to the vernacular names cited by the people interviewed and the endogenous knowledge associated with these toothpicks, the scientific name was associated using the Word Flora Online database (https://www.worldfloraonline.org/).

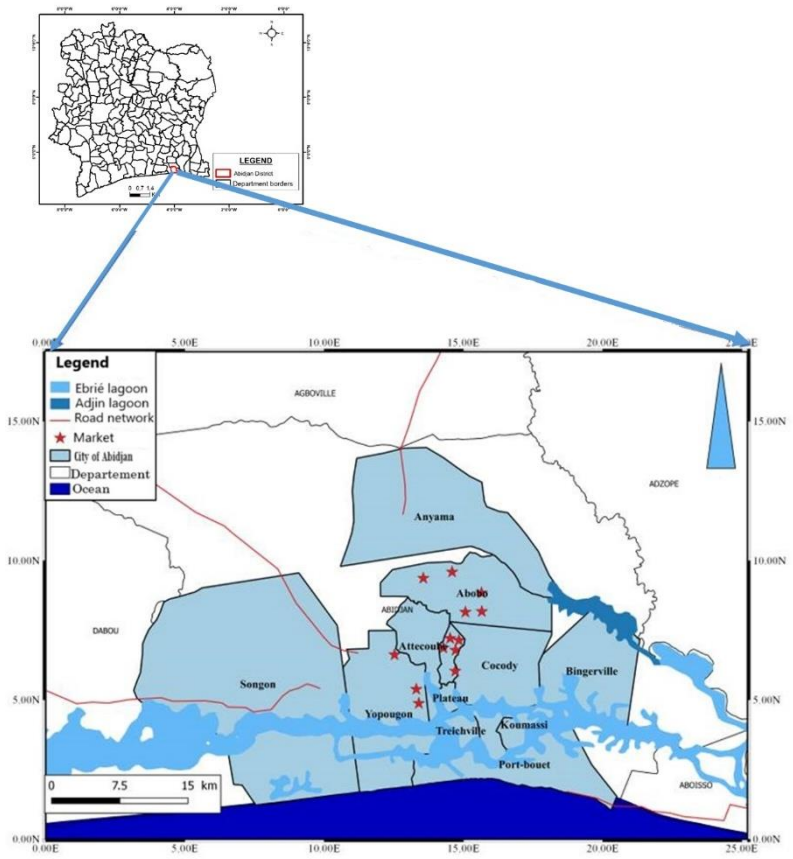

Figure 1. Representative map of the study area (sampled communes and markets)

2.4 Data analysis

The survey forms were analysed using an input mask previously prepared in EpiData software. The analysis tables and interpretation graphs relating to the ethnobotanical data were drawn up in the Excel spreadsheet and the species list was compiled using the Word Flora Online database (https://wfoplantlist.org/taxon/) and the families according to the phylogenetic classification according to APG IV [17] to name the species listed. Based on the processing of ethnobotanical, socio-economic and demographic data, analyses were carried out on the qualitative diversity (species richness, floristic composition, species of conservation value) and quantitative diversity of the species recorded in the various markets. To assess quantitative diversity, the following parameters were calculated.

Shannon diversity index (H')

$$H' = -\sum [(ni/N) \times \ln (ni/N)]$$

For this study, 'N' designates the total number of 'S' species considered, 'ni' the number of individuals of species i and ln (ni/N) the relative abundance of species i.

Pielou equitability index (E)

It is calculated using the following mathematical formula:

$$E = H' / \ln S$$

In this formula, 'E' represents the Piélou equitability index, 'H'' the Shannon index and "ln(S)" the maximum diversity of the site.

Fidelity index (IF)

The fidelity index (IF), which is the percentage of informants who cited the use of a given species as a toothpick, is calculated using the method of Begossi [18] according to the following formula:

$$IF = Ip / Iu \times 100$$

Where Ip is the number of informants who listed that a specific species was used in a given use category, and Iu is the total number of informants who quoted the plant.

Importance value (VIsp)

The importance value (VIsp) of the species represents the ratio between the number of different uses for the species (vi) and the number of different uses for all the species listed.

$$VIsp = = \frac{vi}{\sum vi} \times 100$$

As part of this work, two types of statistical analysis were carried out using XLSTAT software. These were the Analysis of Variance (ANOVA) test and the Chi-square test.
The ANOVA test was used to compare the averages of the indices calculated for the three communes of Abidjan. It is based on three principles: the independence of the observations, the normality of the distribution and the homogeneity of the variances (homoscedasticity). Normality was verified by the Shapiro-Wilk test, and homogeneity of variances by the Levene test. The significance level chosen for these analyses was 5% [19]. The Chi-square test was used to identify potential relationships between different parameters of floristic composition. A pairwise comparison was carried out by applying the same test (Chi-square) according to the procedure defined by Marascuil and Serlin [20] at the $\alpha = 5\%$ threshold.

3 RESULTS

3.1 Floristic diversity

3.1.1 Qualitative diversity of species used as toothpicks by the population

The survey identified 45 plant species used as toothpicks in the markets of 3 communes in the city of Abidjan. Table 2 shows the WFO codes, scientific names, families, vernacular names and UICN status of each species used as toothpicks. These plants belong to 18 botanical families, the best represented of which are, in descending order of importance, Fabaceae (9 species), Combretaceae (6 species), Apocynaceae, Malvaceae, Meliaceae, Phyllanthaceae and Rubiaceae, each grouping three species. The species listed are divided into 43 genera. The genera Terminalia, comprising three species, is commonly cited. Among the species recorded, of which 34 belong to the IUCN red list (2022), ether 75.56%. These are species of Least Concern (68.89%) and vulnerable species (6.67%). Most of these species are shrubs (67%). The other morphological types are represented in small proportions (Figure 2).

Table 1. List of species used as toothpicks in three communes of the District of Abidjan

WFO reference (ID)	Scientific names	Families	Vernacular/common names	IUCN
wfo-0000213207	*Afzelia africana* Sm. ex Pers.	Fabaceae	*linguè* (dioula)	VU
wfo-0000938571	*Alchornea cordifolia* (Schumach.) Müll.Arg.	Euphorbiaceae	*koyinan* (dioula)	LC
wfo-0000537928	*Annona senegalensis* Pers.	Annonaceae	*sounsougbè* (dioula)	LC
wfo-0000408839	*Terminalia leiocarpa* (DC.) Baill.	Combretaceae	*kalama* (dioula)	LC
wfo-0000212016	*Baphia nitida* G.Lodd.	Fabaceae	*tchoukpê* (attié)	LC
wfo-0000418247	*Bridelia ferruginea* Benth.	Phyllanthaceae	*sagba* (dioula)	LC
wfo-0000819442	*Catharanthus roseus* (L.) G.Don	Apocynaceae	*nivaquinelili* (dioula)	
wfo-0001133139	*Citrus limon* (L.) Osbeck	Rutaceae	*lomouroucoumou* (dioula)	
wfo-0000616553	*Combretum molle* R.Br. ex G.Don	Combretaceae	*magnaga* (dioula)	LC
wfo-0000926718	*Craterispermum caudatum* Hutch.	Rubiaceae	*kloètouè* (oubi)	LC
wfo-0000932085	*Croton pseudopulchellus* Pax	Euphorbiaceae	*gbêssê woulé* (dioula)	
wfo-0000166281	*Daniellia oliveri* (Rolfe) Hutch. & Dalziel	Fabaceae	*sanan* (dioula)	
wfo-0000166689	*Dialium guineense* Willd.	Fabaceae	*moae* (baoulé)	LC
wfo-0000946472	*Drypetes floribunda* (Müll.Arg.) Hutch.	Putranjivaceae	*krahain* (abbey)	
wfo-0000663387	*Ehretia cymosa* Thonn.	Boraginaceae	*Alebe* (baoulé)	LC
wfo-0000207886	*Entada africana* Guill. & Perr.	Fabaceae	*samanèrè* (dioula)	LC
wfo-0000967255	*Flueggea virosa* (Roxb. ex Willd.) Royle	Phyllanthaceae	*bala bala* (dioula)	LC
wfo-0000704656	*Glyphaea brevis* (Spreng.) Monach.	Malvaceae	*koula-gboè* (dioula)	LC
wfo-0000711729	*Guiera senegalensis* J.F.Gmel.	Combretaceae	*koudiengbé* (dioula)	LC
wfo-0001429040	*Guilandina bonduc* L.	Fabaceae	*awalélili* (dioula)	LC
wfo-0000216004	*Hymenocardia acida* Tul.	Phyllanthaceae	*gnanafi gbêssê* (dioula)	LC
wfo-0000356989	*Khaya senegalensis* A.Juss.	Meliaceae	*djara* (dioula)	VU
wfo-0000445972	*Lecaniodiscus cupanioides* Planch.	Sapindaceae	*boué* (attié)	LC
wfo-0000243099	*Microdesmis keayana* J.Léonard	Pandaceae	*lella* (bété)	
wfo-0000249572	*Nauclea latifolia* Sm.	Rubiaceae	*bati* (dioula)	LC
wfo-0001141135	*Nesogordonia papaverifera* (A.Chev.) Capuron ex N.Hallé	Malvaceae	*haya* (baoulé)	VU
wfo-0000390222	*Olax subscorpioidea* Oliv.	Oleaceae	*koromgbè* (dioula)	LC
wfo-0000176242	*Ormocarpum verrucosum* P.Beauv.	Fabaceae	*goumanlili* (dioula)	LC
wfo-0000261824	*Oxyanthus speciosus* DC.	Rubiaceae	*sléguéi* (dioula)	LC
wfo-0000817683	*Parinari curatellifolia* Planch. ex Benth.	Chrysobalanaceae	*gbêssê gbê* (dioula)	LC
wfo-0000471616	*Paullinia pinnata* L.	Sapindaceae	*kouroussaman* (dioula)	
wfo-0000474096	*Penianthus zenkeri* (Engl.) Diels	Menispermaceae	*kiouama* (agni)	
wfo-0000212085	*Pericopsis laxiflora* (Benth. ex Baker) Meeuwen	Fabaceae	*kolo kolo* (dioula)	LC
wfo-0000473666	*Pseudocedrela kotschyi* Harms	Meliaceae	*zapléka* (baoulé)	LC
wfo-0000295213	*Rauvolfia vomitoria* Wennberg	Apocynaceae	*manankala* (dioula)	LC
wfo-0000299252	*Saba senegalensis* (A.DC.) Pichon	Apocynaceae	*zama* (dioula)	
wfo-0000170926	*Tamarindus indica* L.	Fabaceae	*tomi* (dioula)	LC
wfo-0000407020	*Terminalia avicennioides* Guill. & Perr.	Combretaceae	*gbêssê finh* (dioula)	LC
wfo-0000408824	*Terminalia macroptera* Guill. & Perr.	Combretaceae	*wolo* (dioula)	LC
wfo-0000408564	*Terminalia schimperiana* Hochst	Combretaceae	*koman* (baoulé)	
wfo-0000455623	*Turraea heterophylla* Sm.	Meliaceae	*kplélé* (baoulé)	
wfo-0001066514	*Uvaria afzelii* Scott Elliot	Annonaceae	*kounlili* (dioula)	LC
wfo-0000427365	*Waltheria indica* L.	Malvaceae	*dabada* (dioula)	LC
wfo-0000429422	*Zanthoxylum zanthoxyloides* (Lam.) B.Zepernick & Timler	Rutaceae	*woh* (dioula)	LC
wfo-0000430322	*Ziziphus mauritiana* Lam.	Rhamnaceae	*thomonon* (dioula)	LC

IUCN status : Lc : Least concern ; Vu : Vulnerable.

3.1.2 Quantitative diversity of species used as toothpicks by the population

The Shannon index values calculated show a variation in the diversity of species used as toothpicks between communes (F = 71.19; P < 0.001). The highest mean value of the Shannon index (H'= 3.1 ± 0.07) was found in the commune of Adjamé. ANOVA test showed a significant difference between the mean values of the Piélou equitability indices in the three communes (F= 71.196; P < 0.001). In other words, the species used as toothpicks do not have the same abundance in these different communes (Table 2). The highest value of the Piélou equitability index was obtained at the Adjamé site (0.797 ± 0.02).

Parinari curatellifolia Planch. ex Benth. (Chrysobalanaceae), called *gbêssê gbê* in Dioula, is the species with the highest fidelity index (IF) (IF= 64.67). It is followed by *Croton pseudopulchellus* pax (Euphorbiaceae) with an IF equal to 45.33. The lowest values were obtained with *Afzelia africana* Sm. ex Pers. (Fabaceae), *Baphia nitida* G.Lodd. (Fabaceae), *Bridelia ferruginea* Benth. (Phyllanthaceae), *Drypetes floribunda* (Müll.Arg.) Hutch. (Putranjivaceae), *Flueggea virosa* (Roxb. ex Willd.) Royle, *Guiera senegalensis* J.F.Gmel. (Combretaceae), *Khaya senegalensis* (Desv.) A.Juss. (Meliaceae), *Paullinia pinnata* L. (Sapindaceae), *Penianthus patulinervis* Hutch. & Dalziel (Menispermaceae) and *Saba senegalensis* (A.DC.) Pichon (Apocynaceae) with a fidelity index of 0.67 each.

Species importance values show that *Annona senegalensis* pers (Annonaceae), *Pericopsis laxiflora* (Benth. ex Baker) Meeuwen (Fabaceae), *Rauvolfia vomitoria* Afzel (Apocynaceae), *Terminalia schimperiana* Hochst. ex Engl. & Diels (Combretaceae), *Turraea heterophylla* Sm (Meliaceae), *Uvaria afzelii* G.Elliot (Annonaceae) and *Zanthoxylum zanthoxyloides* (Lam.) Zepern. & Timler (Rutaceae) have an importance value of 100, ether five uses out of a total of five listed. Those with one use out of five are *Afzelia africana* Sm. ex Pers (Fabaceae), *Daniella oliveri* Hutch. & Dalziel (Fabaceae), *Ehretia cymosa* Thonn (Boraginaceae), *Flueggea virosa* (Roxb. ex Willd.) Royle (Phyllanthaceae), *Guiera senegalensis* J.F. Gmel (Combrotaceae), *Lecaniodiscus cupanioides* Planch (Sapindaceae), *Nesogordonia papaverifera* (A.Chev.) Capuron (Malvaceae), *Penianthus patulinervis* Hutch. & Dalziel (Menispermaceae) and *Saba senegalensis* (A.DC.) Pichon (Apocynaceae).

Table 2. Diversity indices for species used as toothpicks (Shannon index and Pielou index)

Communes	Shannon index ± Standard deviation			Pielou index ± Standard deviation		
Abobo	2,739212	±	0,08[b]	0,711456	±	0,02[b]
Adjamé	3,069965	±	0,07[a]	0,797363	±	0,02[a]
Yopougon	2,245380	±	0,11[c]	0,583193	±	0,03[c]
Statistical parameters of ANOVA						
dl	2			2		
X^2	71,196			71,196		
P	< 0,001			< 0,001		

dl: degree of freedom; X^2: Chi-square test value; P: probability value; ANOVA: Analysis of variance

3.2 Oral diseases and other symptoms treated by toothpastes

The results of the ethnobotanical survey show that the species listed are used for dental hygiene (59%), followed by medicinal uses and Medico-magic with 32% and 9% respectively (Figure 3). The most sought-after therapeutic uses are as an aphrodisiac (36%) and to reduce hypersalivation during pregnancy (18.81%).

The surveys carried out in the study area revealed a total of 13 illnesses (bad breath, tooth decay, sexual weakness, numerous sputum, gastric ulcer, haemorrhoids, malaria, oral ailments, all ailments; stops fatigue, hernia, diabetes, heart problem) and 02 mystical symptoms (good luck charm and evil spirit remover) treated by the species used as toothpicks (Figure 4). The use of these plant species to treat illnesses and other symptoms varied (F= 3739.438; P < 0.001). The treatment of bad breath (100%) was the most common, followed by tooth decay (81.68%). Other conditions and symptoms treated were rarely mentioned.

In terms of the plant parts used as toothpicks, the root is the part of the plant most commonly used as a toothpick (80%), followed by the stem, which accounts for only 20% of the parts used as toothpicks.

The species used in the form of toothpicks were in the majority available according to the people surveyed (92.33%). Very few species are not very abundant (Figure 5) and rare (X^2= 1306.61; P < 0.001).

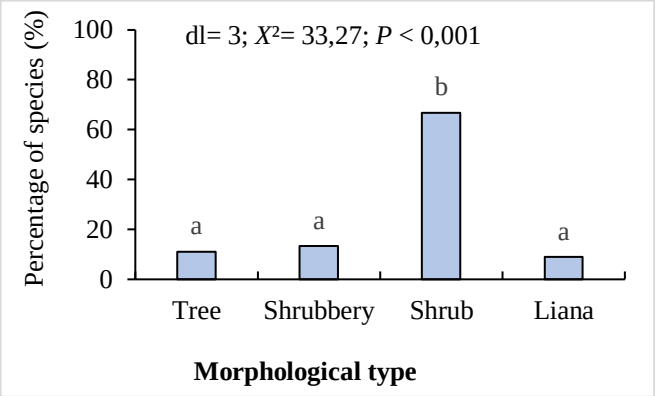

Figure 2. Diagram of morphological types of toothpaste species surveyed
dl: degree of freedom; X²: Chi

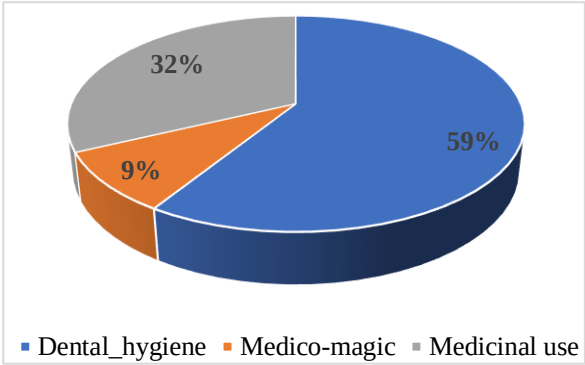

Figure 3. Spectrum of use of species used as toothpicks

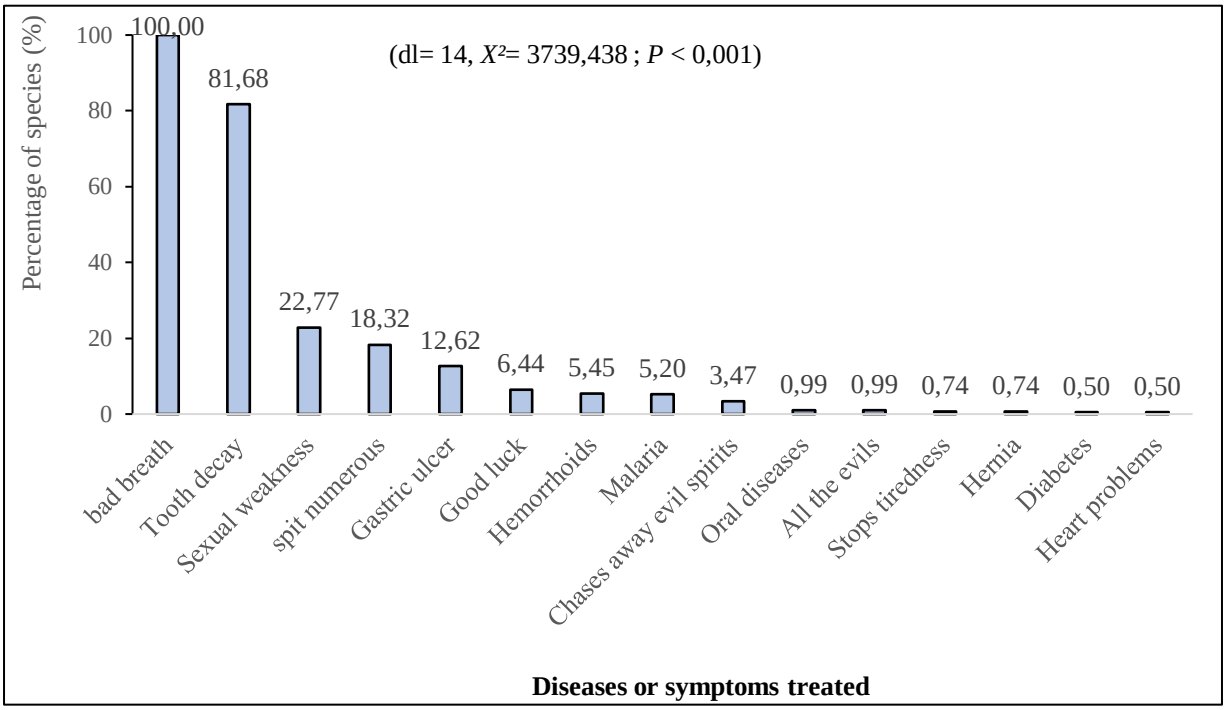

Figure 4. Diagram representing the diseases and symptoms treated with the species used as toothpicks (bands bearing the same letter are statically identical dl: degree of freedom; X^2: Chi-square test value; P: probability value).

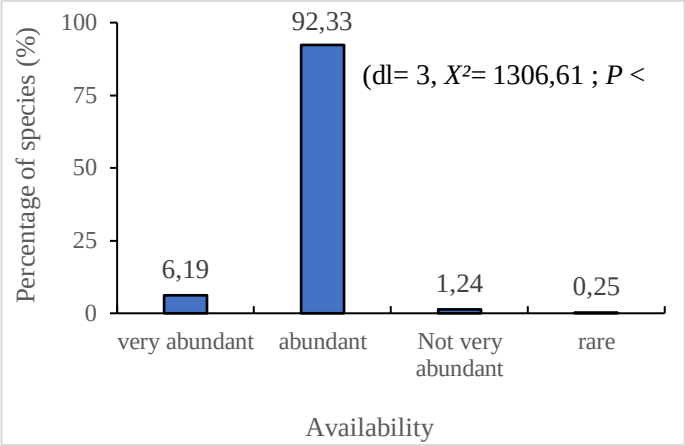

Figure 5. Diagram representing the percentages of the availability of toothpicks.
(Bands bearing the same letter are statically identical; dl: degree of freedom; X²: chi-square test value; P: probability value).

3.3 Profile of respondents and socio-economic value of species sold

The majority of those interviewed were women (97.33%) compared with men (2.67%). People in the 31 to 45 age group accounted for 64.67% of all the toothpicks traders interviewed. Most of the people surveyed were ivorians (96%). The majority of toothpaste traders were illiterate (57.33%). They are followed by primary school students (28.00%).

The price of toothpicks found in the markets visited varies between 25 and 500 CFA francs. The average cost is 100 CFA francs. Toothpicks with an aphrodisiac effect are the most expensive, costing between 200 and 500 CFA francs. This is the case with a portion of the root of *Zanthoxylum zanthoxyloides* (Lam.) Zepern. & Timler (Rutaceae) of around 15 to 20 cm (Figure 6), which is sold for 300 F CFA. The daily income of a toothpick trader is estimated at 1500 ± 500 F CFA.

Figure 6. Piece of root of Zanthoxylum zanthoxyloides (Lam.) Zepern. & Timler (Rutaceae)

4 Discussion

This study made it possible to identify 45 plant species used as toothpick sold in different markets in three municipalities in the city of Abidjan. It appears that the species used in the form of tooth healing are diversified. The majority of species recorded belong to Fabaceae, the most important botanical family of the Ivorian flora [21]. It is also one of the families richest in medicinal plants [22]. These results different from those presented by Bitsindou and Lejoly [23]. These authors have shown that the Euphorbiaceae family is the most represented. This is due to the fact that the geographical areas studied differ. The species most commonly used are *Parinari curatellifolia* Planch. ex Benth (Chrysobalanaceae) and *Croton pseudopulchellus* pax (Euphorbiaceae). This can be explained by the fact that these species are used for brushing teeth and treating bad breath, the uses most familiar

to the public. *Parinari curatellifolia* has always been used for oral hygiene. It has long been known for its use in oral hygiene. The decoction of the bark or leaves is used for mouthwash and the twigs are used as a toothwash once barked [24,25]. The organoleptic characteristics vary according to the user, whether for the tenderness of the wood, the bitter taste or the flattering character. This could lead to a preference for certain species over others. Also, the choice of species could be due to their availability and their effectiveness against several pathologies such as oral-dental affections, erectile dysfunction, hypersalivation during pregnancy and the medicinal-magical aspect. The number of species used as toothpick in this study is greater than that listed by Arbonnier [26] estimated at 40 species for the same use. It would represent double that of the species obtained by Diatta *et al*. [27]. in a study carried out in Widou Thiengoli (commune of Tessékéré) in Senegal. In Ghana, an average of 72 plants are used as toothpicks [28]. The difference between the results of the present study and those obtained in Ghana may be due to the fact that our studies were carried out in an urban environment, while that of Blay [28] was carried out in a rural environment. This is also explained by the fact that certain species used as toothpick in this work are not commercialized. Certain species used as toothpick have therapeutic properties. In this study, the species listed serve several purposes (dental hygiene, therapeutic, medical-magical). According to our surveys, plants used as toothpick for therapeutic uses show that 36% of species are aphrodisiacs and 18.81% against hypersalivation during pregnancy. Indeed, according to Diatta *et al.* [27], the reasons for using toothpick are multiple and cover various factors: ecological (availability of the plant species), pharmacological (therapeutic activity), organoleptic (tenderness of the stem of the species) and cultural (medico-magical and medico-religious properties). Thus the large multitude of species listed in this study compared to that of Diatta *et al*. [27] could be explained by the fact that the survey looked not only at dental hygiene scrubs but also at scrubs used for medicinal and other purposes. The tooth rub is very appreciated by certain populations for the pleasant breath it gives them, thus combating bad breath. The high use of sticks of certain species as toothpicks by the population of the commune of Abidjan is due to a religious reason [27]. It should be noted that it is easier to collect roots or stems from toothpick-shaped shrubs than stems or roots from trees which are difficult to access. These results differ from those of Diatta *et al*. [29] which indicate that trees are more used than shrubs as tooth rubs but are close to those of Monnet (2013), who showed that shrubs with 44.44% are the most represented. Thus, several studies [30–33] have shown that microphanerophytes are mainly used in traditional medicine. The roots are the most exploited parts, with 80%, followed by the stems; which can affect biological diversity. It should be noted that removing roots limits the possibility of supplying the plant with nutrients, which affects its vegetative aspect and physiology, leading to the death of the plant [34].

These toothpicks are mainly sold by women. Akpona *et al* [35] carried out a similar study in the communes of southern and central Benin (Cotonou, Porto-Novo, Comè, Abomey, Savè and Dassa). The results of this study showed that men are the most numerous in the plant trade. Marketing is carried out by wholesalers, most of whom are men, and retailers, who are often women, contrary to these results. In Côte d'Ivoire, it is the men who harvest the organs, while the women are more interested in marketing them, thus providing an important source of income for these women.

5 Conclusion

This study made it possible to identify 45 plant species used as toothpick in the Autonomous District of Abidjan **(**Côte d'Ivoire). It also reveals a multitude of choices of toothpick, depending on cultural and religious beliefs, medicinal properties, the tenderness or otherwise of the organ's fibers, the scent given off by the plant and its availability. The most important and most used species are *Parinari curatellifolia* Planch. ex Benth. (Chrysobalanaceae) and *Croton pseudopulchellus* pax (Euphorbiaceae). The Fabaceae family is the most represented. In Ivory Coast, it is the men who harvest the plant parts used as of toothpick and the women who do most of the trading. The toothpick trade is a major source of income for these women, who make a living from it. It is true that the species used as of toothpick in the communes of Abidjan are diverse. But the fact that the roots are often used constitutes a threat to the conservation of biodiversity, because the removal of the roots leads to the death of the plants, especially as the number of these species have become vulnerable.

In order to make better use of these toothpick, it would be appropriate to (i) continue the exhaustive inventory of all the plants used in hygiene and the treatment of oral and dental diseases in rural areas; (ii) raise people's awareness of the ways in which these species are harvested in order to prevent their disappearance; and (iii)

undertake research into the use and experimental validation of the effectiveness of tooth scrub species through pharmacological and toxicological analyses.

REFERENCES

[1] P. Kamari, A.M. Otaghvaria, H. Govindapyari, M. Bahuguna, P. Uniyal, Some Ethno-medically important of India, Int. Med. Aromat. Plant 1 (2009) 18–22.

[2] P. Kumar, H. Lalramnghinglova, India with special reference to an Indo-Burma hotspot region, Ethnobot. Res. Appl. 9 (2011) 379–420.

[3] M. Mutamba, Farming or Foraging? Rural livelihoods in Mafulira and Kabompo districts of Zambia, Cent. Int. For. Res. Rhodes Univ. 20 (2007).

[4] G. Perumal, Ethnomedicinal use of pteridophyte from Kolli hills, Namakkal district, Tamil Nadu, India, Ethnobot. Leafl. 2010 (2010) 5. https://opensiuc.lib.siu.edu/ebl/vol2010/iss2/5.

[5] J.R.S. Tabuti, K.A. Lye, S.S. Dhillion, Traditional herbal drugs of Bulamogi, Uganda: plants, use and administration, J. Ethnopharmacol. 88 (2003) 19–44. https://doi.org/https://doi.org/10.1016/S0378-8741(03)00161-2.

[6] Y.A. Hadouche, Traitement des affections bucco-dentaires par les plantes médicinales marocaines, Th-617.63/HAD (2000).

[7] WHO, Santé buccodentaire, World Heal. Organ. (2003). https://www.who.int/news-room/fact-sheets/detail/oral-health [Consulté le 15 juillet 2023]. (accessed July 15, 2023).

[8] O. Djakpa, H. Yedomonhan, J.G. Houenon, Ethnobotanique des plantes à usages buccodentaires dans les communes de Dassa-Zoumè et de Savè, EPAC/UAC, 2015.

[9] C. Bell, C. Fink, Aide et santé, Rev. d'économie Du Développement (2005) 135–166.

[10] T. Boonyanit, T. Sroisiri, T.D. Minh, Fermentation of various sugars and sugar substitutes by oral microorganisms, Asian Pac. J. Trop. Biomed. 1 (2011) S258–S260. https://doi.org/https://doi.org/10.1016/S2221-1691(11)60166-4.

[11] N. Takahashi, B. Nyvad, The role of bacteria in the caries process: ecological perspectives, J. Dent. Res. 90 (2011) 294–303.

[12] B. Badjaré, K. Kokou, N. Bigou-laré, D. Koumantiga, A. Akpakouma, M.B. Adjayi, G.A. Abbey, Étude ethnobotanique d'espèces ligneuses des savanes sèches au Nord-Togo: diversité, usages, importance et vulnérabilité, Base (2018).

[13] H. Tamboura, H. Kaboré, S.M. Yaméogo, Ethnomédecine vétérinaire et pharmacopée traditionnelle dans le plateau central du Burkina Faso: cas de la province du Passoré, BASE (1998).

[14] D. Devendrakumar, M. Anbazhagan, Ethnoveterinary medicinal plants used in Perambalur district, Tamil Nadu., (2012).

[15] Y.T. Brou, Climat, mutations socio-économiques et paysages en Côte d'Ivoire, Mémoire Synthèse Des Act. Sci. Présenté En Vue l'obtention l'Habilitation à Dir. Des Rech. Univ. Des Sci. Tech. Lille, Fr. 212 (2005).

[16] P.N. Akoguhi, H.N. Dibi, M.H. Godo, G.M. Adja, F.K. Kouamé, Évaluation des méthodes de classifications dirigées (spectrale et orientée objet) sur les images satellitaires à THRS: cas de la cartographie du tissu urbain de la commune de Cocody et d'Attécoubé (Abidjan, Côte d'Ivoire), VertigO 22 (2022) 1–32.

[17] A.P. Group, M.W. Chase, M.J.M. Christenhusz, M.F. Fay, J.W. Byng, W.S. Judd, D.E. Soltis, D.J. Mabberley, A.N. Sennikov, P.S. Soltis, An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV, Bot. J. Linn. Soc. 181 (2016) 1–20. https://doi.org/https://doi.org/10.1111/boj.12385.

[18] A. Begossi, Use of ecological methods in ethnobotany: diversity indices, Econ. Bot. (1996) 280–289. https://www.jstor.org/stable/4255843.

[19] A. Vessereau, Methodes statistiques en biologie et en agronomie., 1988.

[20] L.A. Marascuilo, R.C. Serlin, Statistical methods for the social and behavioral sciences., WH Freeman/Times Books/Henry Holt & Co, 1988.

[21] L. Aké-Assi, Flore de la Côte d'Ivoire: catalogue systématique, biogéographie et écologie, Genève, Suisse Conserv. Jard. Bot. Genève (2001).

[22] A.C. Adomou, H. Yedomonhan, B. Djossa, S.I. Legba, M. Oumorou, A. Akoegninou, Etude Ethnobotanique des plantes médicinales vendues dans le marché d'Abomey-Calavi au Bénin, Int. J. Biol. Chem. Sci. 6 (2012) 745–772.

[23] M. Bitsindou, J. Lejoly, Les plantes antidiarrhéiques chez les Sundi de la sous-préfecture de Kindamba (Congo), in: Biodivers. African Plants Proc. XIVth AETFAT Congr. 22–27 August 1994, Wageningen, Netherlands, Springer, 1996: pp. 722–726. https://doi.org/https://doi.org/10.1007/978-94-009-0285-5_89.

[24] J.M. Dalziel, The useful plants of west tropical Africa., (1937).

[25] P. Malzy, Some plants of the northern French Cameroons and their uses., J. d'Agriculture Trop. 1 (1954) 148–79.

[26] M. Arbonnier, Trees, shrubs and lianes of the dry zones of West Africa., La Librairie du Cirad, Montpellier, 2000.

[27] B.D. Diatta, O. Niass, M. Diouf, M. Guèye, E. Houel, G. Boetsch, Diversité et composition phytochimique des plantes utilisées comme bâtonnets frotte-dents (cure-dents) par les Peuls de la commune de Tessékéré (Ferlo Nord, Sénégal), Phytothérapie 19 (2021) 45. https://doi.org/DOI:10.3166/phyto-2019-0161.

[28] D. Blay, Dental hygiene and livelihoods: a case of chewing sticks in Ghana, For. Prod. Livelihoods Conserv. Case Stud. Non-Timber For. Prod. Syst. 2 (2004).

[29] C.D. Diatta, M. Gueye, L.E. Akpo, Les plantes médicinales utilisées contre les dermatoses dans la pharmacopée Baïnounk de Djibonker, région de Ziguinchor (Sénégal)., J. Appl. Biosci. 70 (2013) 5599–5607. https://doi.org/10.4314/jab.v70i1.98762.

[30] D. Ouattara, Contribution à l'inventaire des plantes médicinales significatives utilisées dans la région de Divo (sud forestier de la Côte-d'Ivoire) et à la diagnose du poivrier de Guinée: Xylopia aethiopica (Dunal) A. Rich.(Annonaceae), Rich.(Annonaceae). Dr. Diss. Thèse Dr. l'Université Cocody-Abidjan (Côte-d'Ivoire), UFR Biosci. Lab. Bot. (2006).

[31] K. N'guessan, Plantes médicinales et pratiques médicales traditionnelles chez les peuples Abbey et Krobou du Département d'Agboville (Côte-d'Ivoire), These Dr. d'État Es Sci. Nat. Spécialité Ethnobot. Option Plantes Médicinales, Univ. Cocody-Abidjan (Côte-d'Ivoire), UFR Biosci. Lab. Bot. Numéros d'ordre 216 (2008) 336.

[32] D.P.B. Lakouéténé, G. Ndolngar, B. Berké, J.-M. Moyen, E. KoshKomba, I. Zinga, S. Silla, J. Millogo-Rasolodimby, P. Vincendeau, J.-L. Syssa-Magalé, Enquête ethnobotanique des plantes utilisées dans le traitement du paludisme à Bangui, Bull Soc Pharm Bord 148 (2009) 123–138.

[33] T.M.S. Monnet, Étude ethnobotanique des plantes médicinales antidiabétiques vendues sur les marchés de la commune d'Abobo, dans le District d'Abidjan (Côte d'Ivoire), Mémoire Master II Bot. UFR Biosci. Univ. Félix Houphouët-Boigny (2013) 50.

[34] A.B. Yapi, Inventaire des plantes médicinales de la famille des Asteraceae des marchés de la commune d'Abobo (Abidjan, Côte d'Ivoire), Mémoire Master II Bot. UFR Biosci. Univ. Félix Houphouët-Boigny 50 (2013).

[35] T.J.D. Akpona, R.L. Glèlè Kakaï, A.H. Akpona, Ethnobotanique et structure des peuplements d'espèces de brosse végétale au Sud et au Centre du Bénin, Bull. La Rech. Agron. Du Bénin 63 (2009) 1–12.