



Characteristics of Medicinal Plants used in Traditional Medicine for Oral Diseases Treatment in Southern Benin

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background of the Study: In the oral health field, dental caries and periodontal diseases are the most frequent pathologies that affect all population to different degrees. In Benin, oral diseases constitute a serious public health problem. Care, whether curative or preventive, requires an investment that many cannot afford in developing countries like Benin. Because of oral diseases extent, appropriate solutions must be found to improve oral health in Benin. Place and Duration of Study: Data were collected through ethnobotanical surveys in the districts of Allada, Abomey-Calavi, Cotonou and Porto-Novo from May to August 2021.

Aim: This study aims to identify the medicinal plants used in traditional medicine to treat oral diseases.

Methodology: Prior to the ethnobotanical study itself, we proceeded to locate the markets where medicinal plants are sold in the study area. Then, in order to ensure a high objectivity degree of the data obtained during our study, the survey is carried out used a preestablished questionnaires. The questionnaire focused on the following main points: (1) Profile of the respondent (surname, first

name, age, gender, education level and experience in the field), (2) informations on the recipe (oral uses, vernacular and scientific names, parts used, preparation method, route and mode of administration, contraindications and side effects). The medicinal plants vendors were selected based their availability displays size and frequency level of displays.

Results: One hundred and three (103) medicinal plants species were identified, divided into forty-four (44) families and ninety-one (91) genera. The most used plants are *Zanthoxylum zanthoxyloides* (11.72%), *Ocimum americanum* (4.88%), *Ocimum gratissimum* (4.39%), *Lantana camara* (2.93%), *Bridelia ferruginea* (2.93%), *Moringa oleifera* (2.44%), *Lippia multiflora* (2.44%), *Mangifera indica* (2.44%), *Dialium guineense* (2.44%), *Pseudocedrela kotschyi* (1.95%), *Justicia flava* (1.95%), *Uvaria chamae* (1.95%) and *Xylopia aethiopica* (1.95%). The most commonly plant parts used were leaves and roots. The decoction of these parts in mouthwash or gargle is most used for oral diseases treatment.

Conclusion: The flora of Benin contains a rich diversity of plants. Many of which are used in traditional Beninese medicine and have the potential to provide pharmacologically active natural products. In order to know the different plants used to treat oral diseases, an ethnobotanical survey was conducted in southern Benin (district of Allada, Abomey-Calavi, Cotonou and Porto-novo).

Keywords: Medicinal plants; oral diseases; public health; ethnobotanical study; Benin.

1. INTRODUCTION

Oral diseases are a group of diseases and disorders that affect the teeth and mouth, including a craniofacial disorder, congenital anomalies, injuries and various infections. Oral diseases have a huge impact on the individual's well-being, social behaviour and physical behaviour. They are characterised by various dental and periodontal lesions that can lead to the formation of infectious foci [1]. The high frequency of oral diseases, their impact on general health and on life quality, as well as their very unequal distribution in the population, make them a major public health [2]. In oral health field, the most frequent pathologies are dental caries and periodontal diseases because of their frequency, which affect all population class to varying degrees, their consequences on the individual and society and the expense of their treatment [3]. According to the World Health Organisation, it is the fourth most common global disease after cancer, heart disease and HIV/AIDS, affecting over 3.5 billion people worldwide [4]. In Africa, between 54.28% and 73.70% of the population is affected by oral diseases [5]. Like in other developing countries, oral diseases are a serious public health problem in Benin. Over 50% of the population suffers from oral diseases, both in rural and urban areas [6]. These diseases are caused by risk factors common to all non-communicable diseases including the consumption of sugar, smoking, alcohol and poor hygiene practices, as well as the socio-economic factors that underpin them [7]. Both curative and preventive care require an investment that many people in developing

countries are unable to afford. In addition, as in other health sectors, there is a shortage of staff and other necessary resources [8]. As such, in low and middle income countries, as well as in disadvantaged populations, the morbidity rate of these diseases is undeniably higher. Antibiotic use, surgeries, debridements and tooth extractions are common treatment methods. These treatments are expensive and require specialised dental workers, both of which are lacking in developing countries such as Benin. Modern oral hygiene products, such as mouthwash, contain chemical agents such as chlorhexidine and ethanol. In this context, the search for a solution deserves to go beyond the conventional medicines used. In Africa, due to our limited financial resources, there is a tradition of oral hygiene based on toothpaste sticks and mouthwash teas use for oral diseases management. Thus, this study aims to identify the medicinal plants commonly used in oral health care in southern Benin.

2. MATERIALS AND METHODS

2.1 Study Area

Benin is a West Africa country bordered by Burkina Faso, Niger, Nigeria, Togo and Atlantic Ocean (Fig. 1). Benin lies between the Niger River in the north and the coastal plain in the south. The present study was carried out in southern Benin. This region belongs to the Guinean-Congolese zone, contains a mosaic dense rainforest, savannahs, grasslands, mangrove swamps and fallow lands. It is located between 6°25 N and 7°30 N over an area of

17,109 km². The climate is sub-equatorial, characterised by a bimodal rainfall regime (April-June and September-November) with two rainy seasons alternated by two dry seasons. The average rainfall is 1200 mm per year. The average annual temperature is 28 °C and the air humidity between 69% and 97% [9]. Ferralitic soils on clayey sediments, hydromorphic soils in valleys, lowlands and alluvial plains, vertisols in the Lama depression and tropical eutrophic brown soils are the most dominant soils [10].

2.2 Data Collection

The study was conducted during the period from May to August 2021. Data were collected through ethnobotanical surveys in the districts of Allada, Abomey-Calavi, Cotonou and Porto-Novo. Prior to the ethnobotanical study itself, we proceeded to locate the markets where medicinal plants are sold in the study area. Then, in order to ensure a high objectivity degree of the data obtained during our study, the survey is carried out by using a preestablished questionnaires. The questionnaire focused on the following main points: (1) Profile of the respondent (surname, first name, age, gender, education level and

experience in the field), (2) informations on the recipe (oral uses, vernacular and scientific names, parts used, preparation method, route and mode of administration, contraindications and side effects). The medicinal plants vendors were selected based their availability displays size and frequency level of displays. Fifty-five (55) displays of medicinal plant and 17 markets (Ouando, Agbokou, Dantopka, Wologuèdè, Fifadji, Gbégamey, Mènontin, Godomey, Kpota, Cococodji, Cocotomey, Hèvié, Ouèdo, Akassato, Glo-djibgé, Allada and Sékou) were visited (Fig. 1). The plants cited by the respondents were purchased and placed in an herbarium for taxonomic identification at the botanical garden of Abomey-Calavi university (Benin).

2.3 Data Analysis

The data collected from the surveys were processed using Excel 2007 spreadsheet software to establish the use frequencies of medicinal plan. The use frequency (F) of each plant was calculated using the formula: (Number of plant citations under consideration) / (Total number of citations for all plants).

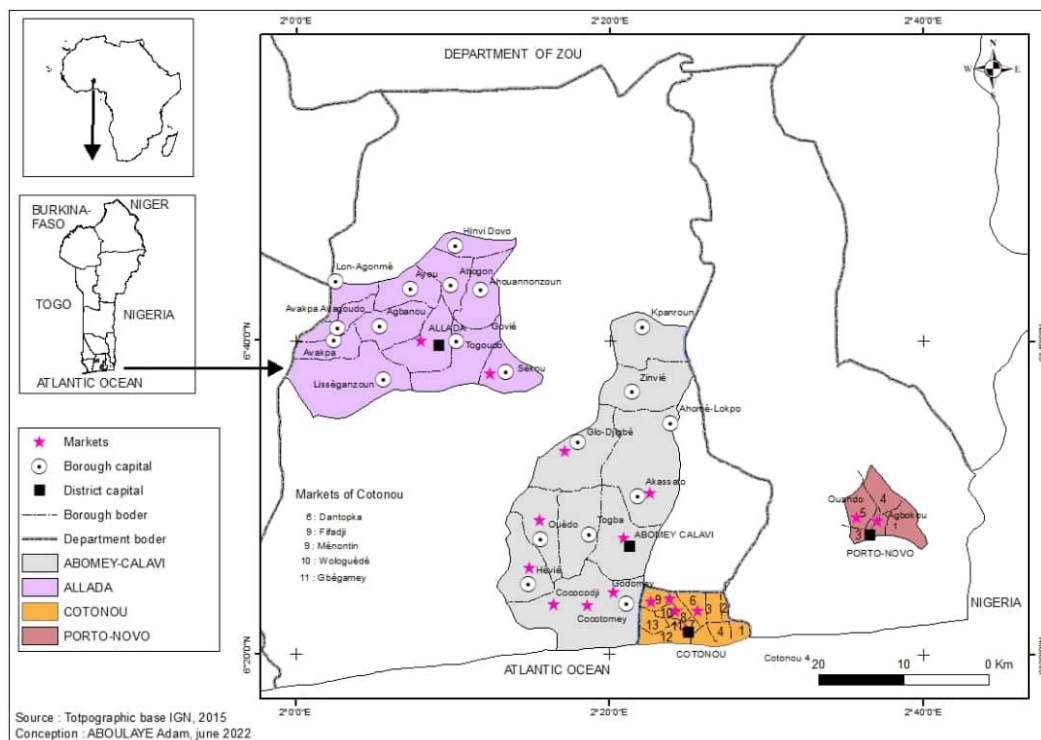


Fig. 1. Overview of medicinal plant markets involved in this study

3. RESULTS

3.1 Social-Cultural Profile of Respondents

The present study enrolled 55 herbalists (51 females and 4 male). These herbalists were divided into four age groups. Table 1 analysis shows that the age range of the herbalists surveyed is between 20 and 72 years with an average age of 45. The age group of 41-50 was the most represented (43.63%). Of these, 56.36% were illiterate, 30.90% had a primary level and 12.72% had a secondary level. As regards the respondents experience in traditional medicine, they have at least ten (10) years of experience. As for the origin of the knowledge, 78.18% of the herbalists surveyed were initiated into traditional medicine practices within the family, while 21.81% acquired it through their experiences outside the family framework.

3.2 Characteristics of Medicinal Plants used to Treat Oral Diseases in Southern Benin

One hundred and three (103) species were identified. These medicinal plants species belong to 91 genera and 44 botanical families. Among these 44 families the most represented were: Leguminosae (15.90%), Euphorbiaceae (11.36

%), Lamiaceae (11.36%) then Annonaceae, Asteraceae, Meliaceae, Sterculiaceae and Verbenaceae (9.09%) (Fig. 2A). The medicinal plant species most commonly sold by herbalists for oral diseases treatment are: *Zanthoxylum zanthoxyloides* (11.72%), *Ocimum americanum* (4.88%), *Ocimum gratissimum* (4.39%), *Lantana camara* (2.93%), *Bridelia ferruginea* (2.93%), *Moringa oleifera* (2.44%), *Lippia multiflora* (2.44%), *Mangifera indica* (2.44%), *Dialium guineense* (2.44%), *Pseudocedrela kotschyi* (1.95%), *Justicia flava* (1.95%), *Uvaria chamae* (1.95%) and *Xylopiya aethiopica* (1.95%). Regarding the parts used, the survey revealed that almost all organs are used in the oral diseases treatment. The most used parts are: leaves (27.77%), roots (22.22%), leafy stems (19.04%), bark (17.46%), stems (7.93%), fruits (2.38%), seeds (1.58%), flowers (0.79%) and tubers (0.79%) (Fig. 2B). Overall, 6 preparation methods were recorded in this study. Decoction is the most used (86.66%), followed by trituration (10.47%), maceration (6.66%), crushing (4.76%), infusion (2.85%) and then poultice (0.95%) (Fig. 2C). Regarding the mode of administration, gargling is the most used (94.17%) followed by dressing (4.85%) and inhalation (0.97%) (Fig. 2D). Six (6) oral diseases are most frequently treated with medicinal plants: Tooth decay, gingivitis, odontology, bad breath, dental disorder and mouth ulcers (Table 2).

Table 1. Socio-cultural data of respondents

| Socio-cultural parameters | Frequency | Percentage (n=55) |
|--------------------------------|-----------|-------------------|
| Gender | | |
| Female | 51 | 92.72 |
| Male | 4 | 7.27 |
| Age | | |
| 20-30 | 9 | 16.36 |
| 31-40 | 18 | 32.72 |
| 41-50 | 24 | 43.63 |
| 51-72 | 4 | 7.27 |
| Level of study | | |
| Illiterate | 31 | 56.36 |
| Primary | 17 | 30.90 |
| Secondary | 7 | 12.72 |
| Experience in the field | | |
| 10-20 | 19 | 34.54 |
| 21-30 | 26 | 47.27 |
| > 30 | 10 | 18.18 |
| Origin of knowledge | | |
| Family legacy | 43 | 78.18 |
| Experience | 12 | 21.81 |

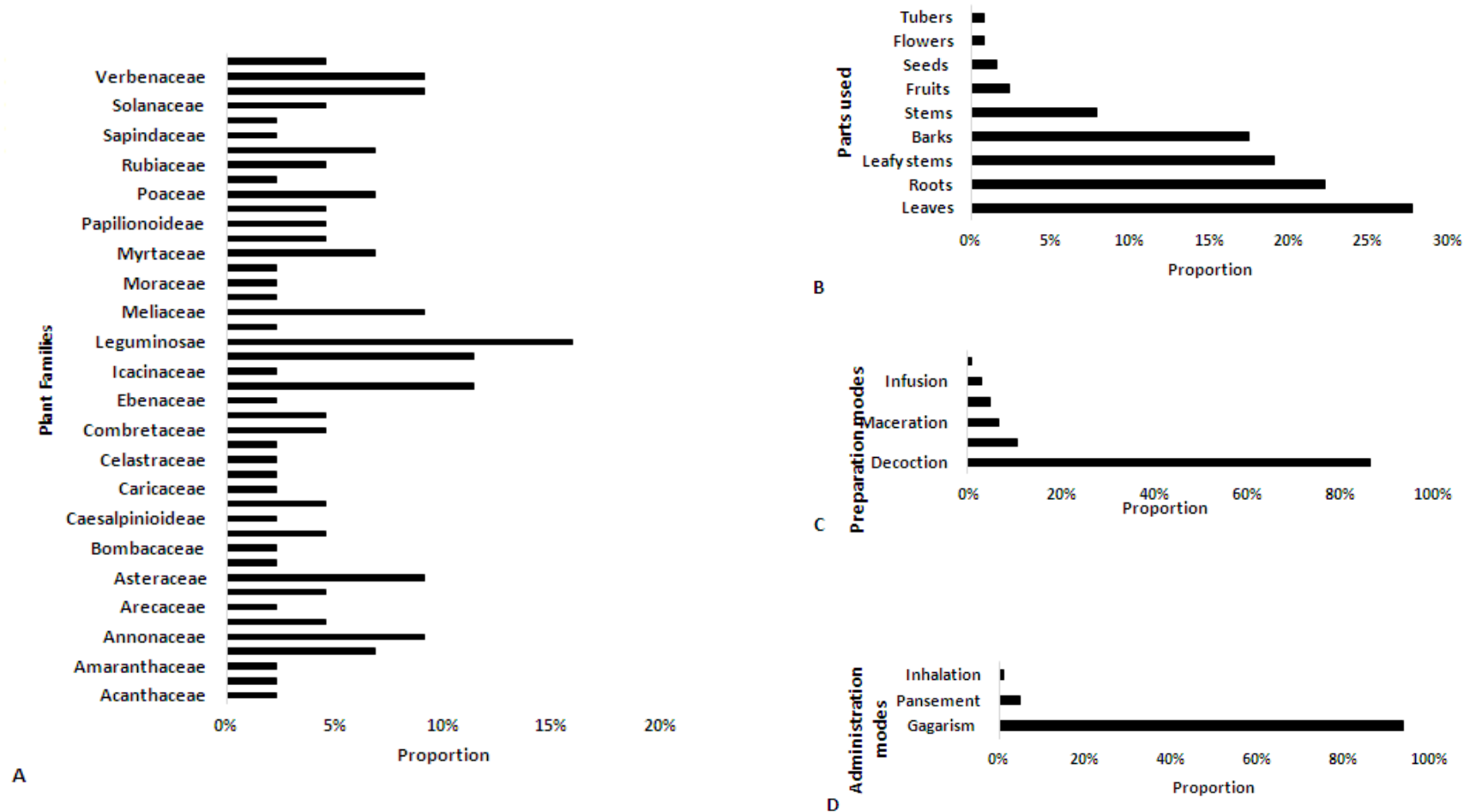


Fig. 2. Botanical families, parts used, preparation and administration modes of medicinal plants

Table 2. Overview informations on medicinal plants used to treat oral diseases identified F = Fon, ba = Bariba, y = Yorouba, g = Goun, d = Dendi

| Scientific name | Family name | Local name | Part used | Diseases treated | Preparation modes | Utilisation modes | FC (%) |
|--|------------------------------|---------------------------------------|-------------------------------|------------------------------------|---------------------|-------------------|--------|
| <i>Zanthoxylum zanthoxyloides</i> (Lam.) | Rutaceae | Hèdo | Root, root bark | Tooth decay, gingivitis, toothache | Decoction, infusion | Mouthwash | 11.22 |
| <i>Ocimum americanum</i> L., | Lamiaceae | Kesu kesu, bohnoroku | Leafy stem | Tooth decay, gingivitis | Trituration | Mouthwash | 4.88 |
| <i>Ocimum gratissimum</i> L., | Lamiaceae | Tchao (f), chukula (ba) | Leafy stem | Tooth decay | Trituration | Mouthwash | 4.39 |
| <i>Lantana camara</i> L., | Verbenaceae | Nyèya, Hlatchiayo(f) | Leafy stem | Tooth decay | Decoction | Mouthwash | 2.93 |
| <i>Bridelia ferruginea</i> Benth., | Euphorbiaceae | Honsou kokoué (f, g); tona (ba) | Trunk bark | Tooth decay | Maceration | Mouthwash | 2.93 |
| <i>Moringa oleifera</i> Lam., | Moringaceae / Myristicaceae | Kpatima (f) | Root, leafy stem | Toothache | Decoction | Mouthwash | 2.44 |
| <i>Lippia multiflora</i> Moldenke, | Verbenaceae | Aglala (g) | Leafy stem | Tooth decay, toothache | Pounding | Bandage | 2.44 |
| <i>Mangifera indica</i> L., | Anacardiaceae | Manga (f), mango (ba) | Trunk bark | Tooth decay, gingivitis | Decoction | Mouthwash | 2.44 |
| <i>Dialium guineense</i> Willd., | Leguminosae-Caesalpinioideae | Asswensswen (f, g) | Stem, root, leaves | Tooth decay, gingivitis | Decoction | Mouthwash | 2.44 |
| <i>Pseudocedrela kotschyi</i> (Schweinf.) Harms. | Meliaceae | Atindodokpwe(f) | Root, leaves, root bark, stem | Tooth decay, bad breath | Decoction | Mouthwash | 1.95 |
| <i>Justicia flava</i> (Forssk.) Vahl | Acanthaceae | Fiofioma (f). | Leafy stem | Tooth decay | Decoction | Mouthwash | 1.95 |
| <i>Uvaria chamae</i> P.Beauv., | Annonaceae | Ayadaha (f), tijera (ba) | Root | Tooth decay | Decoction | Mouthwash | 1.95 |
| <i>Xylopiya aethiopica</i> | Annonaceae | Kpédjélékoun | Seed | Tooth decay, bad breath | Decoction | Mouthwash | 1.95 |
| <i>Capsicum annum</i> L., | Solanaceae | Gbatakin (f, g). | Fruit | Gingivitis, toothache | Decoction | Mouthwash | 1.46 |
| <i>Carissa spinarum</i> L., | Apocynaceae | Ahanzodo (f) | Root | Tooth decay | Decoction | Mouthwash | 1.46 |
| <i>Hyptis suaveolens</i> (L.) Poit., | Lamiaceae | Azongbidi (f), disibu (ba) | Leafy stem | Gingivitis, bad breath | Decoction | Mouthwash | 1.46 |
| <i>Piper guineense</i> Schumach. & Thonn., | Piperaceae | Poivre de guiné (fr)lènlènkoun (f, g) | Fruit | Tooth decay | Decoction | Mouthwash | 1.46 |
| <i>Allium sativum</i> L., | Alliaceae | Ayo (f, g, y) | Leaves | Tooth decay | Decoction | Mouthwash | 1.46 |
| <i>Ceropegia racemosa</i> N.E.Br | Asclepiadaceae | Tchirigoun | Root | Bad breath, gingivitis | Decoction | Mouthwash | 1.46 |

| Scientific name | Family name | Local name | Part used | Diseases treated | Preparation modes | Utilisation modes | FC (%) |
|---|----------------------------------|-----------------------------|--------------------------|------------------------------|-------------------|-------------------|--------|
| <i>Caesalpinia pulcherrima</i> (L.) Sw., <i>Acacia nilotica</i> (L.) | Leguminosae- Caesalpinioideae | Orgeuil de Chine (fr) | Leafy stem | Toothache, teething disorder | Decoction | Mouthwash | 0.98 |
| | Leguminosae- Mimosoideae | Bani (ba) | Leafy stem | Gingivitis, bad breath | Decoction | Mouthwash | 0.98 |
| <i>Securidaca longepedunculata</i> Fresen., <i>Parkia biglobosa</i> (Jacq.) R.Br. ex Benth., <i>Petiveria alliacea</i> L., <i>Periploca nigrescens</i> Afzel., <i>Azadirachta indica</i> A. Juss. | Polygonaceae | Kpatado | Root | Tooth decay | Decoction | Mouthwash | 0.98 |
| | Leguminosae- Mimosoideae | Néré(fr) | Trunk bark | Gingivitis, canker sores | Decoction | Mouthwash | 0.98 |
| | Piperaceae | Zoroma (f), | Leafy stem | Tooth decay, gingivitis | Decoction | Mouthwash | 0.98 |
| | Asclepiadaceae | Déssi kanwé | Leafy stem | Tooth decay, gingivitis | Decoction | Mouthwash | 0.98 |
| | Meliaceae | Quininetin (f), , neem (ba) | Trunk bark, leaves, stem | Tooth decay, bad breath | Decoction | Mouthwash | 0.98 |
| <i>Ehretia cymosa</i> Thonn. ex Sehum. var <i>Trilepisium madagascariensis</i> De., | Boraginaceae | Myoma (g) | Leaves | Teething disorder | Trituration | Mouthwash | 0.98 |
| | Moraceae | Hunde hunde | Trunk bark, leaves, stem | Gingivitis | Decoction | Mouthwash | 0.98 |
| <i>Anacardium occidentale</i> L., <i>Khaya senegalensis</i> (Desr.) A.Juss., <i>Baphia nitida</i> Lodd | Anacardiaceae | Akaju (f) | Trunk bark | Canker sores, tooth decay | Decoction | Mouthwash | 0.98 |
| | Meliaceae | Zunzatin (f) | Trunk bark | Tooth decay | Decoction | Mouthwash | 0.98 |
| <i>Pteleopsis suberosa</i> Engl. & Diels, <i>Senna alata</i> (L.) Roxb. | Leguminosae- Papilionoideae | Sokpakpè | Leafy stem | Toothache | Trituration | Mouthwash | 0.49 |
| | Combretaceae | Kluklu godo | Trunk bark | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| | Leguminosae- Caesalpinioideae | Amasu yovotèm (f) | Leafy stem | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Eugenia unijlora</i> L., <i>Tetrapleura tetraptera</i> (Schumach. & Thonn.) | Myrtaceae | Pitanga (y, n) | Leafy stem | Toothache | Decoction | Mouthwash | 0.49 |
| | Leguminosae- Mimosoideae | Lendja (f) | Leafy stem | Tooth decay, bad breath | Decoction | Mouthwash | 0.49 |

| Scientific name | Family name | Local name | Part used | Diseases treated | Preparation modes | Utilisation modes | FC (%) |
|--|----------------------------|---------------------------------------|--------------------|--|---------------------|-------------------|--------|
| <i>Taub., Imperata cylindrica (L.) P.Beauv.,</i> | Poaceae | Sè (f), abosu (ba) | Root, leaves | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Clausena anisata (Willd.) Hook.f. ex Benth.,</i> | Rutaceae | Gbozohouin (f). | Root | Gingivitis, teething disorder | Maceration | Mouthwash | 0.49 |
| <i>Phyllanthus amarus Schumach. & Thonn.,</i> | Euphorbiaceae | Henlenwe (f), sobaru (ba) | Leafy stem | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Casuarina equisetifolia L.,</i> | Casuarinaceae | Filao (fr) | Trunk bark | Tooth decay, canker sores | Decoction | Mouthwash | 0.49 |
| <i>Ocimum basilicum L.,</i> | Lamiaceae | Akohun (g) | Leafy stem | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Chenopodium ambrosioides L.,</i> | Chenopodiaceae | Amahun kokwe(f) | Leafy stem | Tooth decay | pounding | Bandage | 0.49 |
| <i>Monodora myristica (Gaertn.) Dunal,</i> | Annonaceae | Sasalikun (f), dukubinu (ba). | Root | Tooth decay, toothache | Decoction | Mouthwash | 0.49 |
| <i>vernonia cinerea (L.) Less.,</i> | Asteraceae | Hunsi kouse | Trunk bark, root | Toothache | Maceration | Mouthwash | 0.49 |
| <i>Jatropha curcasL.,</i> | Euphorbiaceae | Gbagidi kpotin (f, g), Bukatu (ba) | Root, stem, leaves | Tooth decay, canker sores | Decoction | Mouthwash | 0.49 |
| <i>Chromolaena odorata (L.) R.M.King,</i> | Asteraceae | agatouma | Leafy stem | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Zingiber officinale</i> | Zingiberaceae | Dote | Tuber | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Citrullus lanatus (Thunb.) Matsum. & Nakai,</i> | Cucurbitaceae | Goussi (f, g) | Fruit | Toothache | Decoction, infusion | Mouthwash | 0.49 |
| <i>Abrus precatorius L.,</i> | Leguminosae-Papilionoideae | Vivima (f), | Leafy stem | Tooth decay, gingivitis, teething disorder | Decoction | Mouthwash | 0.49 |
| <i>Triclisia subcordata Oliv.,</i> | Menispermaceae | Yfoglosu (g) | Leaves | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Landolphia dulcis (Sabine) Pichon,</i> | Apocynaceae | Aboto (f) | Stem | Bad breath | Decoction | Mouthwash | 0.49 |
| <i>Newbouldia laevis</i> | Bignoniaceae | Hounmanhounmantin (f) | Stem | Bad breath | Decoction | Mouthwash | 0.49 |
| <i>Crateva adansonii DC. ssp. adansonii,</i> | Capparaceae | Onton zunzen (f, g), gorigiberu (ba). | Leaves | Canker sores, teething disorder | Cataplasm | Mouthwash | 0.49 |
| <i>Cocos nucifera L.,</i> | Arecaceae | Gonkè (tin) (f);kpaakpa | Trunk bark, | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |

| Scientific name | Family name | Local name | Part used | Diseases treated | Preparation modes | Utilisation modes | FC (%) |
|---|------------------------------|--------------------------------------|-------------------------|----------------------------|-------------------|-------------------|--------|
| <i>Prosopis africana</i> (Guill. & Perr.) Taub., | Leguminosae-Mimosoideae | agbo (ba) Kakè (t); | root Stem, leaves | Tooth decay, bad breath | Decoction | Mouthwash | 0.49 |
| <i>Psidium guajava</i> L., | Myrtaceae | Kenkuntin (f) | Stem, leaves | Tooth decay, bad breath | Decoction | Mouthwash | 0.49 |
| <i>Vitellaria paradoxa</i> C.F.Gaerth. ssp. | Scrophulariaceae | Limutin (f) | Trunk bark | Gingivitis | Maceration | Mouthwash | 0.49 |
| <i>Olex subscorpioidea</i> Oliv., | Oleaceae | Mitin | Leaves | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Triplochiton scleroxylon</i> K.Schum., | Sterculiaceae | Xwetin (f) | Leaves | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Sarcocephalus latifolius</i> (Sm.) E.A.Bruce, | Rubiaceae | Kodo (g) gàyèru (ba) | Root | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Senna siamea</i> (Lam.) H.S.Irwin & Barneby | Leguminosae-Caesalpinioideae | Acacia do | Root | Toothache | Decoction | Mouthwash | 0.49 |
| <i>Acanthospermum hispidum</i> DC., | Asteraceae | Kponomi (g) | Leafy stem | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Momordica charantia</i> L., | Cucurbitaceae | Nyensinken(f) | Leafy stem | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Pavetta corymbosa</i> (DC.) F.N.Williams var. <i>corymbosa</i> , | Rubiaceae | Loxu (g) | Leafy stem | Toothache, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Pterocarpus erinaceus</i> Poir., | Leguminosae-Papilionoideae | Kozo (g) kosso (d) | Trunk bark | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Carica papaya</i> L., | Caricaceae | Kpèn | Leafy stem | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Raphiostylis beninensis</i> Planch. ex Benth., | Icacinaceae | Kpakplakan (1) | Leafy stem | Toothache | Maceration | Mouthwash | 0.49 |
| <i>Philenoptera cyanescens</i> (Sehumacb. & Thonn.) Roberty, | Leguminosae-Papilionoideae | Aho (f) | Root | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Melaleuca leucadendron</i> L., | Loganiaceae | Gunswe (f) | Root | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Acacia sieberiana</i> DC. var. <i>vil/osa</i> , | Myrtaceae | Kpenma | Leaves | Tooth decay, bad breath | Trituration | Mouthwash | 0.49 |
| | Leguminosae-Mimosoideae | Aduwe, caga (f) sagunu kpika (ba) | Trunk bark | Tooth decay, toothache | Decoction | Mouthwash | 0.49 |

| Scientific name | Family name | Local name | Part used | Diseases treated | Preparation modes | Utilisation modes | FC (%) |
|--|----------------------------------|---|-----------------------|--------------------------------|-------------------|-------------------|--------|
| <i>Annona senegalensis</i> Pers. | Annonaceae | Nyiglwe, wenglema (f), sampuru (ba) | Leaves | Canker sores, bad breath | Trituration | Mouthwash | 0.49 |
| <i>Jatropha gossypifolia</i> L., | Euphorbiaceae | Nyikpotin vovo (f), bukatu duabinu (ba) | Leaves | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Hymenocardia acida</i> Tul., | Euphorbiaceae | Sokpintin, sojatin (f) | Leaves | Canker sores | Decoction | Mouthwash | 0.49 |
| <i>Paullinia pinnata</i> L., | Sapindaceae | Seseleviken (f, g), afatoka (ba) | Leaves | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Senna occidentalis</i> (L.) Link, | Leguminosae- Caesalpinioideae | Kinikiniba, kpayoywe(f) | Stem, leaves | Teething disorder | Trituration | Mouthwash | 0.49 |
| <i>Siphonochilus</i> <i>aethiopicus</i> (Schweinf.) | Zingiberaceae | Limun (f) | Root | Tooth decay, toothache | Decoction | Mouthwash | 0.49 |
| <i>Vernonia adoensis</i> Sch.Bip. ex Walp., | Asteraceae | Alomaklu | Root | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Waltheria indica</i> L., | Sterculiaceae | Adassounsoun-ma (f, g), nangara (ba). | Leaves | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Amaranthus dubius</i> Mart. ex Thell., | Amaranthaceae | | Leaves | Tooth decay | pounding | Bandage | 0.49 |
| <i>Chamaecrista rotundifolia</i> (Pers.) | Leguminosae-Caesalpinioideae | | Leaves | Teething disorder | Trituration | Mouthwash | 0.49 |
| <i>Gymnosporia</i> <i>senegalensis</i> (Lam.) Loes., | Celastraceae | Jaduma, howutinm(f), sasisakinè (ba). | Leaves | Canker sores | Trituration | Mouthwash | 0.49 |
| <i>Nicotiana tabacum</i> L., | Solanaceae | Agboke, azowiwi | Leaves | Tooth decay | pounding | Bandage | 0.49 |
| <i>Heliotropium indicum</i> L., | Boraginaceae | Koklosu denpaja, agamasiru (ba) | Leaves | Tooth decay, teething disorder | Decoction | Mouthwash | 0.49 |
| <i>Afraegle paniculata</i> (Schumach. & Thonn.) Engl., | Rutaceae | Atinkeke | Trunk bark, leaves | Tooth decay, gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Lannea A.Rich.</i> , | Anacardiaceae | Zuzu (f), mon (ba) | Trunk bark | Tooth decay | pounding | Bandage | 0.49 |
| <i>Ceiba pentandra</i> (L.) Gaertn., | Bombacaceae | Guédéhunsou (f) | Trunk bark, leaves | Gingivitis | Decoction | Mouthwash | 0.49 |
| <i>Capparis tomentosa</i> Lam., | Capparaceae | Koto (d) | Root | Teething disorder | Maceration | Mouthwash | 0.49 |

| Scientific name | Family name | Local name | Part used | Diseases treated | Preparation modes | Utilisation modes | FC (%) |
|--|-------------------------|---------------------------------------|--------------------------|-----------------------------------|-------------------|-------------------|--------|
| <i>Tamarindus indica</i> L., | Caesalpinioideae | Bokoso, mupèn (f) | Leaves | Toothache | Decoction | Mouthwash | 0.49 |
| <i>Diospyros mespiliformis</i> Hochst. | Ebenaceae | Ken, kenwi (f), wonyibu, wibi (ba) | Leaves | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Indigofera tinetoria</i> L. var. <i>tinetoria</i> , | Papilionoideae | Agonjema (f) | Root | Toothache, teething disorder | Decoction | Mouthwash | 0.49 |
| <i>Pterocarpus erinaceus</i> Poir., | Papilionoideae | Kozo, gbèngètìn (f) | Trunk bark | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Hyptis spicigera</i> Lam. | Lamiaceae | | Leaves | Tooth decay | Decoction | Mouthwash | 0.49 |
| <i>Trichilia emetica</i> Vahl, | Meliaceae | Civi,tchivi (f) | Root | Toothache | Decoction | Mouthwash | 0.49 |
| <i>Acacia seyal</i> Delile var. <i>seyal</i> , | Leguminosae-Mimosoideae | Menè (d) | Trunk bark, leaves | Tooth decay, canker sores | Decoction | Mouthwash | 0.49 |
| <i>Ximenia americana</i> L., | Oleaceae | Klivovwe (f), so munoro (ba) | Root, trunk bark, leaves | Tooth decay | Infusion | Mouthwash | 0.49 |
| <i>Cymbopogon giganteus</i> (Hochst.) Chiov., | Poaceae | Gbezen (f) | Leaves | Toothache | Decoction | Mouthwash | 0.49 |
| <i>Zea mays</i> L., | Poaceae | Gbadé (f) | Flower | Tooth decay | Trituration | Mouthwash | 0.49 |
| <i>Sterculia setigera</i> Delile, | Sterculiaceae | Nyinnyinfou (f, g) | Leafy stem | gingivitis, teething disorder | Decoction | Mouthwash | 0.49 |
| <i>Waltheria indica</i> L., | Sterculiaceae | Adassounsoun(f, g) | Root | Tooth decay, gingivits, toothache | Decoction | Mouthwash | 0.49 |
| <i>Stachytarpheta indica</i> (L.) Vahl, | Verbenaceae | | Stem, leaves | Toothache | Decoction | Mouthwash | 0.49 |
| <i>Vitex doniana</i> Sweet, | Verbenaceae | Fontin, koto (f) | Root | Tooth decay | Maceration | Mouthwash | 0.49 |
| <i>Mimosa pigra</i> L., | Leguminosae-Mimosoideae | Ènwa agogo (y) | Root | Tooth decay | Decoction | Mouthwash | 0.49 |

4. DISCUSSION

This ethnobotanical study collected information on medicinal plants commonly used in oral health care in four districts in southern Benin, namely Allada, Abomey-Calavi, Cotonou and Porto-Novo. In this study, the choice of traditional herbalists is based their experiences and their rich knowledge in the medicinal uses of plant species acquired through generations. The results of this survey show that a large number of plants are traditionally used in the treatment of oral diseases in Benin. About 92 % of herbalists are women. This shows that the medicinal plants trade is dominated by women in southern Benin. This result confirms those obtained by Agbankpé et al. [11] and Dougnon et al. [12] in which the practice of traditional medicine is much more reserved for older women in southern Benin. These results are also contrary to the findings of Najem et al. [13] who proved that traditional medicine is more practiced by the male gender in Morocco. Similarly, it contradicts the findings of Mutie et al. [14] in Kenya who showed that 66.67% of herbal medicine traders are male. It should be noted that in Benin, it is the men who pick the medicinal plants mainly in the forests. They then sell them to women who set up shop in the markets. Also, in some countries like Morocco, women work less than men because of their culture. Furthermore, most of the respondents notably 43.63% belong to the age group of 41-50 years, 32.72% are in the age group of 31-40 years, 16.36% are below 30 years and 7.27% are above 50 years. This shows a clear trend of rejuvenation of the herbalist profession and the return of the society to the use of traditional herbal medicine with a good transmission of popular knowledge from the elderly to the young. Also, the current study shows an increasing involvement of young people in the medicinal plant trade, which could be due to the lack of employment but not necessarily to their expertise in plant knowledge. These results are close to those obtained by Fatiha et al. [15] who showed that trading and traditional herbal medicine are day by day activities carried out by the youth. Illiterates represent 56.36% of the respondents. Although people are becoming aware of the side effects of pharmaceutical treatments based on chemical molecules, the lack of formal training may be a contributing factor to poor handling of medicinal plants. The use and trade of medicinal plants is no longer restricted to traditional healers but has entered the informal and increasingly formal commercial sector. This presents a health hazard

due to the lack of education. Regarding the origin of medicinal plants knowledge, family heritage predominates (78.18%). Agbankpé et al. [11] noted, following a survey in South Benin that 87.86% of respondents had inherited this practice from their ancestors. Our survey allowed us to observe that knowledge of a recipe in traditional medicine is above all a family secret that is transmitted from generation to generation through customs and oral tradition without distinction of gender or age. Indeed, the elderly are believed to provide the most reliable information and have some confidence that they hold much of the ancestral knowledge that has been transmitted orally [16]. This same observation has also been made by other researchers [17,18]. Our results also indicate that 47.27% of the respondents have been practicing the herbalist profession for a long period (21 to 30 years), 34.54% have been practicing the same profession for 10 to 20 years, and 18.18% have more than 30 years of experience as an herbalist. This is a positive indicator, as the profession requires longer experience, especially in plant identification, diagnosis and patient therapy. These results are close to those of Haouari et al. [19] who demonstrated the importance of experience in traditional herbal medicine.

One hundred and three different plant species are used in oral diseases treatment according to our study. This correspond to 3.67% of Benin total flora, estimated at 2807 species [20]. The most represented plant families are: Leguminosae, Euphorbiaceae, and Lamiaceae. Ahouanse [21] noted the predominance of Leguminosae in oral diseases treatment through an ethnobotanical study of plants for oral use in the district of Kétou in Benin. Our study identified *Zanthoxylum zanthoxyloides* as the most used plant for oral diseases treatment. These results are close to those obtained by Dangboe [6]. Indeed, this specie seems to contain chemical active principles with antimicrobial activity against bacteria responsible for several oral diseases [22,23]. Different oral diseases treatable by herbal medicine are common in traditional health practices namely: dental caries, toothache, gingivitis, ulcerative gingivitis, canker sores, swollen tonsil, oral thrush, tonsillitis and black tongue [24]. This study shows that the major oral diseases frequently treated by medicinal plants in southern Benin are dental caries (43.87%), gingivitis (20.64%) and odontology (14.19%). Indeed, the main oral diseases, namely caries and periodontal

diseases constitute a health problem in the world. They affect all segments of the population and remain a cause of morbidity closely linked to the difficulty of access to care and to socio-economic, cultural and environmental problems. All parts of the different plant are used against a variety of diseases. For the treatment of oral diseases, the part of the plant to be used depends on the traditional recipe advocated. Therefore, traditional medicine practitioners seem to have acquired knowledge about the properties of each part, allowing them to know which one is the most effective. Sometimes more than one organ of the same plant species, especially a combination of parts, is used in the preparation of different therapies [25]. However, in this study, the commonly used plant parts were found to be the aerial parts of the plant especially the leafy leaves and stems for oral diseases treatment (46.81%). This is close to the literature provided by [25] who showed that leaves are the seat of photosynthesis and synthesize exudates containing biooxidative secondary metabolites that protect the plant from external aggressions. As such, they contain many chemical groups responsible for the biological properties which have medicinal value for humans. They are also easy to collect and do not pose a threat to the plant [26-28]. In order to treat oral diseases, and depending on the plants part and the pathology treated, traditional practitioners use different modes of preparation and administration. As some preparation methods allow higher concentrations of active components to be extracted than others, the best way to use a plant is the one that preserves its properties while allowing the extraction of all active components. The southern Benin community uses different methods of preparing medicines such as decoction, trituration, maceration, pounding, infusion and poultice for the treatment of oral diseases. The most frequently used method is decoction. Indeed, decoction allows to collect the most active principles and attenuates or cancels the toxic effect of certain recipes. These results confirm the findings of ethnobotanical studies conducted on medicinal plants by several authors [29]; [14]; [30]. Finally, regarding administration method, gargling is the most used route for the treatment of oral diseases. According to herbalists, gargling allows traditional remedies to reach the entire oral cavity. These results are supported by Najem et al., [14] who demonstrated the effect of gargling in the treatment of oral diseases from medicinal plants.

5. CONCLUSION

The flora of Benin contains a rich diversity of plants. Many of which are used in traditional Beninese medicine and have the potential to provide pharmacologically active natural products. In order to know the different plants used to treat oral diseases, an ethnobotanical survey was conducted in southern Benin (district of Allada, Abomey-Calavi, Cotonou and Porto-novo) It identified one hundred and three (103) species of medicinal plants commonly used in the treatment of oral diseases. Among these species, *Zanthoxylum zanthoxyloides* is the most used. These plants are divided into forty-four (44) families and ninety-one (91) genera. The family Leguminosae is the most represented (15.21%). The plants parts most used in the traditional treatment of oral diseases are the aerial parts (leaves and stems). Decoction is the mode of preparation most often used in mouthwash or gargle for the treatment of oral diseases.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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