



Science

PLANTS USED BY AFRICAN TRADITIONAL HEALERS IN THE MANAGEMENT OF ORAL DISEASES: A REVIEW

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Abstract

Background: Plants form the basis of African traditional medicine which has contributed to significantly to the reduction of mortality, morbidity and disability due to many diseases. Medicinal plants have been reported to be an essential aspect oral health delivery cutting across all facets of oral health care.

Method: Publications and reports on the use of African traditional medicine in oral health care were reviewed from published scientific journals, books, reports from national, regional and international organizations, research theses, conference papers and other grey material. International online databases such as MEDLINE, Science Direct, Scopus and Google were also searched up to 2015. Publications were limited to the English and French language

Results: This review identified medicinal plant use by traditional healers in preventive, therapeutic and surgical aspects in the oral health and also identified some research gaps which further studies should be carried out.

Conclusion: Medicinal plants has enormous benefits in the management of oral diseases but faces some challenges like toxicity, processing and follow-ups. Research on medicinal plants use in African traditional medicine in oral health is still scanty and most often incomplete.

Keywords: African Traditional Medicine; Dental Caries; Oral Health; Medicinal Plants.

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1. Introduction

Plants as the basis of African traditional medicines have been used for thousands of years and is still in use today. Plant-based medicines continue to play a key role in healthcare systems in many regions of the world especially in Africa where modern drugs are not affordable (1,2). These plants based medicine are used by the pharmaceutical industry for drug discovery for many years before the subsequent chemical synthesis (1). About 25% of drugs are directly derived from plants while a lot others are formed from prototype compounds isolated from plant species (3).

The reliability and usage of herbal products have become increasingly important due to the side effects and complications of synthetic drugs in the past two decades hence the need to identify and recognize the beneficial effects of medicinal plants (4,5,6). The use of plant-based drugs has reported to be far higher in many developing countries because modern life-saving drugs are beyond the reach of these countries despite spending nearly half of their total GDP on drugs and health care (7,8). This alternative constitute a drug financial burden reduction strategy (7, 8).

The global need for alternative prevention and treatment options for oral diseases that are safe, effective and economical has been deemed necessary for several reasons. The reasons include high oral disease incidence, increased resistance pathogenic bacteria to currently used antibiotics and chemotherapeutics, opportunistic infections in immunocompromised individuals and financial difficulties in developing countries (9,10). The resistance of bacteria to most antibiotics used to treat oral infections (penicillins and cephalosporins, erythromycin, tetracycline and derivatives of metronidazole) has been documented (11). In performing their antibacterial function, these drugs alter oral microbiota and exert undesirable side-effects such as vomiting, diarrhoea and tooth staining on affected individual (12).

The use of traditional medicine and medicinal plants in many developing countries as the normative basis for the maintenance of good health has been advocated (5, 6). Traditional medicines have been used to treat orofacial problems in Asia for more than two thousand years (13) and have been shown to be effective in treating recurrent aphthous stomatitis, oral lichen planus, leukoplakia, and Sjögren's syndrome. However, the treatment lacked standard criteria of post-treatment assessment and laboratory evidence (13). Traditional Chinese and Naturopathic medicine have also been shown to significantly reduce pain and psychosocial interference in temporomandibular disorders (14). Although many reviews have been published on different aspects of African traditional medicine yet paucity of information on the use of medicinal plants used by traditional practitioners in the provision of primary oral health care in Africa still exists. Hence, this present review was carried out to document the use of medicinal plants by African traditional healers in the oral health care delivery in order to provide a comprehensive overview, identify research gaps, and suggest areas for future research.

2. Materials and Methods

Publications and reports on the use of African traditional medicine in oral health care were reviewed from published scientific journals, books, reports from national, regional and international organizations, research theses, conference papers and other grey material. International online databases such as MEDLINE, Science Direct, Scopus and Google were also searched up to 2015. MeSH words used included “African Traditional medicine or healers”, “oral health”, “dental caries”, “dental”, “primary oral health care” and “medicinal plants”. Publications were limited to the English and French language. Relevant literature from textbooks, bibliographies of publications and review articles of suitable peer reviewed journals were also reviewed for additional information.

3. Results and Discussion

Despite the overwhelming influence and the dependence on modern medicine and the tremendous advances in synthetic drug manufacture, a large segment of the world's population are still dependent on drugs made from plants and plant material (4, 9). Over three-quarters of the world population rely on plants and their extracts for health care needs according to World Health Organization (15). The usage, conservation, processing and preservation of medicinal plants have therefore attracted increased attention from different stakeholders ranging from patients, plants conservative technicians to traditional healers (16, 17). Many plant materials used, have been shown to be cheaper and more effective than modern medicine against certain illnesses (18). The simultaneous mitigating of the many side effects that are often associated with synthetic antimicrobial agents is an added advantage of plant based medicine (19).

Phytotherapy is a medicinal and ancestral practice in Africa that deals with all fields of human pathology (20). The herbalists are the most significant custodian of the knowledge of the use of medicinal plants in the management of oral diseases. However, local people acquire information on the use of local plants for the management of their medical and dental problems through frequent use (21, 22). In Africa, herbalists are traditional healers trained to use specific plants for the management of oral and dental diseases. They are also trained to estimate the quantity required, methods of processing the plant material and the various routes of administration (21). The training are often done by apprenticeship (21,22) with a more experienced and elderly traditional healer.

Plants Metabolites and African Traditional Medicines

Plants produce chemicals known as primary and secondary metabolites which have beneficial long-term health effects, are used effectively to treat diseases. Specifically, it is the secondary metabolites that exert therapeutic actions in humans (7). More than a third of the entire plant species, are used for medicinal purposes due the amount and type of secondary metabolites that they contain (1,7).

Plants Used for Treating Dental Diseases

The need to identify and recognize the beneficial effects of traditionally used plants and medicaments has been acknowledged (24, 25). The most common plants used to treat oral and dental diseases include *Piper guineense*, *Xylopiiia ethiopica*, *Citrus aurantifolia* and *Aframomum melegueta* (1). The juice of *Ficus* species (Moraceae) is used for the treatment of toothache and has shown to have analgesic and anti-irritant properties (1). About a dozen different oral and dental conditions have been shown to be treatable with plants that are commonly used in traditional health practice namely: toothache/decay, gingivitis, ulcerative gingivitis, angular stomatitis, mouth ulcers, swollen tonsil, oral thrush, tonsillitis and black tongue (26). Sixty-two plants species belonging to 29 families were identified in the management of oral diseases in Burkina Faso, some of which show promise for the management of oral diseases at the primary health care level (27). Some medicinal plants screened for phytochemicals showed capacity to inhibit the growth of oral pathogens, reduce the development of biofilms and dental plaque, influence the adhesion of bacteria to surfaces and reduce the symptoms of oral diseases (9). Yam et al. (1997) studied the efficacy of some plants such as *Euphorbia balsamifera* that have traditionally been used as an analgesic for acute dental pulpitis (20). A stable paste constituted from the latex of the *Euphorbia* plant has shown to be an effective pulpal devitalizing agent (20).

In the Ivory Coast, *Parkia biglobosa* (Mimosaceae) is used in traditional medicine as an analgesic drug, especially against dental pain. Of the three extracts obtained from the plant bark, the hexane fraction was found to determine its analgesic and/or anti-inflammatory activities (28).

In South Africa, seventeen plant species belonging to 12 families were identified in the management of HIV and treatment of opportunistic oral infections (OIs). The identified plant species belonged mostly to the families *Asparagaceae* (12%), *Araliaceae* (12%), *Apiaceae* (12%), *Xanthorrhoeaceae* (12%) and *Lamiaceae* (12%). The remaining 40% of identified plant species were from seven families - *Urticaceae*, *Hypoxidaceae*, *Leguminosae*, *Verbenaceae*, *Rosaceae*, *Compositae* and *Rutaceae*. The most frequently used medicinal plants were *Hypoxis hemerocallidea* (85%), *Asparagus densiflorus* (68%) and *Lessertia frutescens* (68%). The leaves (43.5%) and roots (21.7%) were the most frequently used plant parts. The family *Asteraceae* accounted for 18% of the total species recorded. Sixteen species of the plants were edible and provide nutritional support (29, 30).

In Djibouti, the healing properties of some plant species were demonstrated by their use in eye diseases, mouth diseases, kidney problems and microbial infections. *Dodonea angustifolia*, *Solanum cordatum*, *Grewia erythraea*, *Acalypha indica*, *Acacia etbaica*, *Fagonia schweinfurthii*, *Solanum coagulans*, *Senna alexandrina* and *Grewia embensis* promise for future pharmacological screening against microbial infections (31).

In Uganda, pulp juice from *Zanthoxylum chalybeum* and *Euclea latidens* showed activity against all the bacteria, the former being most active. The hexane extract from the aerial part of *Helichrysum odor atissimum* was found to be most active (MIC: 0.125-0.5 mg/ml). Methanol extract from leaves of *Lantana trifolia* showed activity against all bacteria (MIC: 0.25-1 mg/ml) and several plants showed antibacterial activities against bacteria associated with periodontal disease and dental caries, meriting further investigation (32).

An ethno-medical survey in the Coast, Dar es Salaam, Morogoro and Tanga regions of Tanzania identified 36 plant species belonging to 21 plant families that are used traditionally for the treatment of *Candida* infections. Twenty-one plants constituting nearly two-thirds of all collected plants are used to treat of oral candidiasis which is one of the most common and important signs of HIV/AIDS. In addition, some plants were reported to be active against other species of fungi including *Cryptococcus neoformans*, an important pathogenic fungus found in HIV/AIDS (33). Hamza et al. (2005) in their investigation of the antifungal activity of traditionally used Tanzanian plants found a good correlation between traditional therapeutic use and *in-vitro* antifungal activity. They thereafter corroborated the importance of ethno-botanical surveys for screening plants as a potential source for bioactive components that may have preventive, prophylactic or treatment properties for oral and other diseases (67).

A few studies from the Cameroon have reported that native herbs are commonly used as self-medication for the treatment and management of oral diseases and that traditional healers not only carry out tooth extractions (21), but are also involved in the treatment of other oral diseases (22).

Plants Used for Medical Treatment and Also as Food

In addition, some plants are used for medical treatments and as well as eaten as part of diet (18). Reports of traditional healers using whole plants or plants parts such as roots, rhizomes, tubers, leaves, stem, wood, bark, flowers, seeds, and fruits (18, 35). These plants include *Canarium schweinfurth*, *Vernonia Amygdalina*, *Anacardium occidentale*, *Cocos nucifera*, *Allium sativum*, *Citrus sinensis*, *Carica papaya*, *Allium cepa*, *Ricinodendron heudoletti*, *Mandifera indica*, *Zea maize*, *Syzygium aromaticum* etc. (16). In African traditional medicine, any plant used as food by animals and human beings without adverse effects is assumed to be non-toxic.

Syzygium aromaticum (Clove) is used not only as a food spice, but has natural antiviral, antimicrobial, antiseptic, anti-fungal, aphrodisiac and circulation-stimulating properties (35-37). Approximately, 72-90% of the essential oil extracted from cloves contains eugenol which is used in dentistry for pulp dressings, cavity liners and dry socket dressings (35). Clove has been used in India and China, for over 2,000 years to control both tooth decay, sore gums, oral ulceration and bad breath (35). In Cameroon, it is used to treat toothache by direct application of a moist grinded paste to a painful tooth or mouth sore (16).

Allium sativum (Garlic) has broad spectrum antibacterial, antiviral and fungal activity (37). The paste made from the bulb of *Allium sativum* is a common food spice and medicinal plant. It is used on direct application to a painful tooth to relieve toothache and treat gingivitis (16). Although, less effective and cytotoxic to periodontal tissues when compared to chlorhexidine, *Allium sativum* has been reported to have a high antibacterial effect against human dental plaque microbiota (*Streptococcus mutans*, *S. sanguis*, and *S. salivarius*; *Pseudomonas aeruginosa* and *Lactobacillus* spp.) even at very low concentrations (38).

The bark of *Ricinodendron heudoletti* is boiled to make hot mouthwash that is used to treat toothache (16). It has been found to have anti-oxidant and antibacterial properties that are stronger than most antibiotics (39, 40).

The leaves of *Vernonia amygdalina* (bitter leaf) are used for toothache by direct application of the juice from the leaf on a cavity (16). Extracts of the plant have been used in various folk medicines as remedies against helminthic, protozoan and bacterial infections, cancer chemoprevention and the treatment of diabetes (41-42).

Capsicum frutescens (long pepper) is used for treating pulpitis (16) and has antibacterial properties against *Staph aureus* (43). The extracts have been reported to possess anti-inflammatory and analgesic effects comparable to diclofenac in experimental rat models (44). The whitish latex of *Carica papaya* is used by traditional healers for direct application to the affected areas of the tooth to cure toothache and the decoction is used for treating mouth sores and oral thrush (16). *Carica papaya* exerts bacteriostatic action against common oral microorganisms like *Staphylococcus* spp, and has been shown to reduce the growth of *Candida albicans* by 60%. The fruit when used as topical ulcers dressing has been found to promote desloughing, granulation and healing and is suitable for the treatment of mouth sores such as aphthous ulcers (45).

Extracts of *Psidium guajava* are used as a hot mouth rinse to treat mouth ulcers (16) and have been shown to have antibacterial properties against *S. sanguinis*, *S. mitis* and *Actinomyces* spp (46). The

bark and root-bark are used as astringent. The flavanoid content of aqueous extract of *P. guajava* leaves is believed to be responsible for the antibacterial activity (47).

Cocos nucifera (coconut) roots are boiled and used as mouth rinse for treating toothache and tooth sensitivity (16). Decoction obtained from coconut tree is used both as a mouth wash and a gargle (48). Extracts from this plant has been shown to have anti-bacterial, antifungal, antiviral and antioxidant properties (48, 49). The anti-caries effect is attributed to lauric acid obtained from coconut flour, which is sensitive to *Strep mutans*, reduces plaque bacteria and biofilm and exerts antifungal activities (48, 49).

Persea americana (avocado pear) possesses anti-inflammatory and antifungal properties, specifically against *Mycobacterium tuberculosis*, *Streptococcus pyogenes*, *Staphylococcus aureus* and a variety of fungi (50, 51). The avocado seeds are crushed and boiled to constitute a mouth rinse that is used in treating toothache, mouth sores and other inflammatory diseases of the throat by traditional healers (16, 51).

Ipomoea batatas (sweet potato) leaves are squeezed and the juice is placed into an open cavitation of the tooth to treat toothache (16). Antimicrobial studies have shown that low concentrations of the sweet potato freeze dried extract inhibits the growth of *Streptococcus mutans*, *S. mitis*, *Staphylococcus aureus*, and *Candida albicans* (52). It has also been shown to contain wound healing, anti-ulcers, anti-inflammatory, anti-mutagenic and anti-diabetic properties (53).

The bark of *Garcinia kola* is used as a mouth rinse to stop dental pain (15). The roots and stems are cut into short chew-sticks used for cleaning teeth. It has shown growth-inhibitory activity against the causal cariogenic pathogens in dental caries (54, 55, 56).

Other Plants Used for Treatment of Dental Diseases

Some plants not used as food exhibit some degree of toxicity. Traditional healers are trained in the harvesting, processing and storage of these plants. It is important to study the toxicity of these plants with respect to the dosage so as to advert adverse effects. Generally, medicinal plants have analgesic and antibacterial properties on oral health as well as some toxic effects.

Spilanthes africana that is used as a mouthwash for the treatment of halitosis due to its peppermint taste as well as its direct application to a cavity to alleviate toothache (16, 57-60). Analgesic and anti-inflammatory activities of different *Spilanthes spp.* has made them, a useful tool in the treatment of toothache, mucositis, sore throat and to relieve pain from wounds (61). Its use as a sialogue has also been reported. *Spilanthes* also possess antipyretic, anticancer, anti-fungal and anti-oxidant activities (57, 61).

Eucalyptus saligna has been reported to alleviate toothache, sore throat and halitosis (16). It is the essential oil of the leaves of *Eucalyptus globulus* that has antimicrobial activity against gram-negative bacteria (*E. coli*) as well as gram-positive bacteria (*S. aureus*) which are found in the oral cavity (35, 57).

The roots of *Moringa oleifera* is used to treat toothache by direct application onto the tooth. This plant has been found to be specific against *Staph aureus*, and *E. coli* but has no antifungal activity (58, 59). Its antibacterial activities are responsible for its ability to alleviate toothache.

The entire parts of *Argiratum conizoides* are used for pain and for tooth extraction by traditional healers (16). This plant possesses anticancer and antiradical properties inhibiting the growth of many micro-organisms. It also exhibit anti-inflammatory, analgesic and anti-diarrohea properties (62, 63).

Dichrocephala integrifolia is an annual herb that is used by traditional healers for tooth extractions (22, 64, 65). In *in-vitro* studies, anticancer, antimicrobial, anti-inflammatory and anti-oxidant activities of this herb have been shown (65).

Nicotinia tobacum is used for toothache by direct application of fresh leaves, or grinded dried leaves mixed with calcium carbonate (a mixture generally called snuff) into an infected tooth to calm down pain (16). Apart from its use in the management of toothache, it is also used by traditional healers from the northern regions of Cameroon in tooth whitening. Toxicity is a major concern for *Nicotinia tobacum* especially when the leaves are used fresh (16).

Plants Used for Prevention of Dental Diseases

Chewing sticks or tooth cleaning sticks are used for oral hygiene in many African homes (67, 68). Chewing sticks prevent tooth decay, arrest caries and treat periodontal diseases. Traditional dental care using chewing sticks has been reported to possess actions against oral microbial flora and contain various minerals that prevent plaque formation (69). Most of the chewing sticks have medicinal properties. For example, *Garcinia mannii*, *Zanthoxylum zanthoxyloides* and *Ancistrocladus abbreviatus* (Ancistrocladaceae), a Cameroon plant species, have shown strong anti-HIV activity in the laboratory (1, 68).

The antimicrobial activities of the individual chewing sticks are attributed to chemical substances (secondary metabolites, organic and minerals substances) present in the plants used as chewing sticks. For example, the action of *Zanthoxylum zanthoxyloides* is attributed to the presence of benzoic acid derivatives (70). Odusanya and colleagues (1979) reported that some African chewing sticks possessed fluoride ions but at insufficient concentrations to benefit oral health. They also stated that the contained silicon, tannic acid, sodium bicarbonate as well as other natural plaque-inhibiting substances reduce bacterial colonization and the eventual plaque formation in the mouth. It has been reported that the regular use of the African chewing stick, acting as an antiseptic, may control the formation and activity of dental plaque and therefore reducing the incidence of gingivitis and possibly dental caries and its sequelae (72). The fresh roots of *Euclea natalensis* used in South Africa were tested against *Streptococcus mutans* and organisms in saliva and from deep periodontal pockets, and were found to suppress aerobic as well as anaerobic bacterial growth (73).

Tooth Extraction with Medicinal Plants

Traditional medicine have been reported to relieve toothache with specific plant products and extract decayed and broken teeth in some African countries (1, 16, 23, 74). Traditional healers use *Dicrocephalia intergrifolia* in atraumatic tooth extractions and in the post-extraction management

of extraction site (23). The immature pericarp of *Ganipa americana* (Family Rubiaceae) is used for tooth extraction by placing in the pulp of the tooth, leaving it in place for several weeks until the tooth disintegrates, where after it is then removed in pieces with little or no trauma (75).

The stem-sap of the *Stigmaphyllon* species (Family Malpighiaceae) is placed on the carious tooth for about 4 hours followed by other repeated applications throughout the day. After one week, the tooth can be removed without bleeding or pain (1). One application, followed by repeated contact, using cotton swab of the latex of *Chlorophora tinctora* (Family Moraceae), is also used for tooth extraction. No pain, trauma or bleeding is involved (75). Careless applications resulting in spillage or damage to other teeth, adjacent to carious teeth, may lead to unintended extraction of unaffected teeth. Other plant species recorded for tooth extraction include *Conssapo aglaberima* (Moraceae) and *Asclepia curassavica* (Asclepidaceae) and for toothache include *Alchornia cordifolia*, *Curcuma domestica*, *Piper guineense* and *Syzgium aromaticum* (1).

Tooth extractions with medicinal plants have been reported to be atraumatic and painless. There is however paucity of literature of the post extraction management of cases in which plants have been used for dental extractions.

Preservation and Toxicity of Medicinal Plants

Most traditional medicines have been found to be stored in poor hygienic conditions (18). Medicinal plants and their components are sold in market places or prescribed by traditional healers from their homes or the marketplace (77, 78). The physical condition and infrastructure at markets are generally poor and most plant material are displayed in the open. Under these conditions, the material is exposed to microbial and insect attack as well as the detrimental effects of light, gases, and temperature. Furthermore, the informal markets are often situated close to both pedestrian and motor vehicle traffic, which puts the plant material in contact with various pollutants (79).

Another serious problem encountered with traditional medicine made from plant material is their hygienic quality: healers often collect plant material around or in bushes near habitations and prepare drugs without any preliminary treatment to eliminate indigenous microbes, processing of the plant materials are often carried out in homes with inadequate hygienic conditions, and the prepared medication are stored in inappropriate conditions (80).

Recent studies have shown that traditional concoctions sold in marketplaces are always assumed to be safe and efficient; however, they can be potentially toxic because of poor hygienic practices in plant processing or storage. de Souza and colleagues (81) carried out a study to assess for the microbial quality of market-sold vegetable drugs in Lomé. The results revealed that all formulations were contaminated by several microorganisms, except those made with alcohol-based mixtures. They suggested that quality control studies on market-sold remedies are needed to evaluate the microbial risk of these products and recommended that plant processing and storage must be standardised (81).

Over-use and harvesting of medicinal plants by traditional healers is a concern not only to plant conservationists, but also current trends in population growth and land use (82), are also compromising harvesting and conservation practices. Some major challenges of traditional

medicine are related to the prescription dosage, preservation and treatment of medicinal plants (16).

Conclusion: Though traditional healers are trained in handling plants material, additional training is required for plants to be safe for medicinal uses.

Side Effects of Treatment

One of the problems associated with the use of traditional medicines and treatments is that some of them have never been rigorously evaluated or standardized (in terms of a standard pharmacopeia) (21). It has been acknowledged that plants used by traditional healers can be toxic as some of their ingredients can have profound effects on the mouth, stomach, and the entire gastrointestinal tract with severe consequences like “iatrogenic gastritis and colitis”(21,83).

A prospective study was carried out on Nigerian children to determine the prevalence and pattern of oro-facial and dental injuries caused by traditional remedies used in a suburban Nigerian community. The oro-facial and dental injuries sustained from pre-hospital treatment at home were lacerations and bruising of soft tissues including lips, tongue, mucosa and commissures and tooth subluxation, displacement or avulsion. Other injuries sustained outside the mouth include second-degree burns to the feet, a chin laceration and facial bruises resulting from a fall. Many oral injuries were overlooked by paediatricians (84). Traditional medicine presents with some adverse effects which affects the oro-facial region. In some cases the gastro-intestinal tract is also affected. Proper dosage and follow-up is important in the reduction of these complications.

4. Conclusion and Recommendations

Medicinal plants have enormous benefits in the management of oral diseases but faces some challenges like toxicity, processing and follow-ups. Research on medicinal plants use in African traditional medicine in oral health is still scanty and most often incomplete. Some research gaps identified are listed below and it recommended to carry out research in these areas;

Research Gaps

- 1) Phytochemical analysis of medicinal plants used in many countries in Africa. Plants used for treatment of oral cancers were not reported by any study. This area needs to be exploited.
- 2) Processing, storage and preservation of medicinal plants need to be addressed. Further research is needed in this area.
- 3) Literature concerning the use of traditional medicines in maxillofacial injuries like jaw fractures is lacking.
- 4) Development of potential bio-product such as herbal toothpaste, mouth washes and gaggles and toothpowder to treat diseases of the oral cavity that may be more cost-effective and have fewer side effects than commercial brands already in the market.
- 5) There is no international research platform to address gaps in scientific knowledge of medicinal plants that may be useful in the management of oral and dental diseases.
- 6) Capacity building and training opportunities in ethnobotany, particularly in countries and regions with significant gaps in such resources.

- 7) Effect of the toothbrush chewing sticks against other common bacteria that are associated with dental diseases have not been adequately studied.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Authors' Contributions

AMA was involved in the conception, design, acquisition of data, and interpretation of data and drafting the manuscript from the beginning to the end.

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