


## Herbal medicines in dentistry

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### ABSTRACT

The popular use of medicinal plants has brought important knowledge of their biological applications. Thus, therapeutics using medicinal plants was legally called Phytotherapy. In dentistry, herbal medicines still have a timid participation, although much research is being developed in the area. The main applications in dentistry are in the relief of pain and inflammation, the treatment of periodontal disease, and the treatment of caries. In this chapter we will discuss a little about the aspects involved in the use of phytotherapy in dentistry.

**Keywords:** Medicinal plants, Natural products, Odontogenic infections.

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## INTRODUCTION

Phytotherapy, as defined by Ordinance No. 971/2006 of the Ministry of Health, is conceptualized as a therapeutic modality that is characterized by the use of medicinal plants in different pharmaceutical forms, without resorting to the use of isolated active substances, even if of plant origin. Generally, herbal compounds are available in various dosage forms, such as: capsules, tablets, gels, ointments, aqueous solutions, hydroalcoholic solutions (extracts) and infusions (teas).

In the dental field, in recent years, research with natural products has gained prominence, driven by the search for products with greater therapeutic activity, lower toxicity to tissues, better biocompatibility and more affordable costs for the population. These factors, together with the rich Brazilian flora that expands the possibilities of using natural raw materials in the manipulation of drugs, reveal a promising future for the dental phytotherapy market.

## HISTORY AND EVOLUTION OF HERBAL MEDICINE

The use of products derived from medicinal plants for the treatment of diseases is an ancient practice, dating back to the dawn of humanity, with archaeological records of its use by the Sumerians in 4000 BC. This ancient practice continued to be valued until modernity, with more than 80% of the world's population making use of it. In 1978, the World Health Organization (WHO), in the Alma-ata declaration, proposed the integration of these therapies into public health systems and this fact boosted the use of phytotherapy in Brazil. Thus, in the 1980s there was a call for the introduction of the use of medicinal plants in the primary care of the health system. However, it was only in 2003 that the creation of the National Policy for Integrative and Complementary Practices in the Unified Health System (SUS) began, which includes phytotherapy, officially approved in May 2006.

Currently, phytotherapy in dentistry continues to be considered limited, and the various biological activities of phytotherapies need to be constantly studied for their efficient use in this field. Infectious disease therapy, analgesia, inflammation control, and anxiety management are recurrent therapeutic goals in dental treatment. The literature presents several plants that have potential for these purposes. Therefore, it is crucial to review what already exists in research and what is new for the use of new plant derivatives of interest to dentistry.

## IMPORTANCE OF PHYTOTHERAPY IN CONTEMPORARY DENTAL PRACTICE

Contemporary dentistry has increasingly turned to alternative therapies and the use of natural products to promote oral health. These natural plant-derived compounds have been the subject of recent studies and research due to their therapeutic properties and potential benefits for the oral health of individuals. One of the reasons for the growing interest in the research and use of medicinal



plant derivatives was the emergence of multi-resistant microorganisms, which resulted in the obsolescence of classical antimicrobials and fostered the search for new compounds with antimicrobial activity. Today there are already studies that demonstrate the ability of plant infusions to inhibit bacterial growth, its adhesion to dental surfaces and the reduction of the production of extracellular acids and polysaccharides.

Even today, the pharmaceutical industry has been investing in new methods of research into new bioactive chemical entities, with effective therapeutic potency. Molecular biology and new genetic techniques have allowed the isolation and purification of many enzymes, receptors directly associated with pathological processes, representing molecular targets for new drugs. These advances allowed the adoption of test systems, allowing thousands of new substances, usually obtained by combinatorial chemistry, to be evaluated *in vitro*, promoting a revolution in the way of conceiving organic synthesis practiced, until then, in the pharmaceutical industry. In this context, natural products have been recovering space and importance in the pharmaceutical industry, inspiring new bioactive molecular standards. In Europe, phytotherapy is already part of traditional medicine, and plant extracts and active components, as well as finished medicinal products, are described in many pharmacopoeias.

## OBTAINING HERBAL COMPOUNDS

Knowing the different methods of extraction and preparation of active ingredients is fundamental in phytotherapy. Among the various methods of obtaining plant extracts are infusion, decoction, maceration, percolation, microwave-assisted extraction, continuous hot extraction, turbolysis, counter-current extraction, supercritical fluid and ultrasound, the most traditionally used method being decoction. In addition, to obtain plant samples to be used for extraction, the method of drying the plants is often used, as well as crushing to obtain their powdered form.

Another important point to highlight is the type of solvent used. Depending on the polarity and the type of solvent used in an extraction, there may be interference in the transfer of hydrogen and electrons, which are essential aspects when dealing with extracts with antioxidant purposes. Therefore, to perform the extractions, it is possible to use some solvents, such as acetone, ethanol, hexane, methanol, chloroform, among others. To choose the solvent to be worked with, one should keep in mind a solvent that presents a good solubility with the component to be used, a good volatility, low toxicity, that presents good evaporation at low temperatures, and good cost-benefit.

Different phytochemical components can be obtained through the use of different solvents. Ethanol and acetone-based extractions can obtain phenols and polyphenols as components; Extractions based on methanol, chloroform and ethanol can obtain quinones; chloroform-based extractions can obtain flavonoids; Terpenoids can be obtained through ethanol, ether, water, and



chloroform-based extractions; coumarins can be obtained through ether-based extractions; alkaloids can be obtained through ether and ethanol-based extractions; ethanol-based extractions can obtain glycosides; tannins can be obtained through ethanol and water-based extractions; and lectin and polypeptides can be obtained through water-based extractions. Therefore, it is important to know which components are intended to be obtained and to evaluate them, in order to make the correct choice of the solvent to be used for extraction.

## APPLICATIONS OF HERBAL MEDICINES IN DENTISTRY

Based on growing evidence, herbal medicines have been widely studied and applied in different dental areas, from relieving pain and inflammation to treating periodontal disease and tooth decay. In this section, we will explore some of the key applications of herbal medicines in dentistry, highlighting their benefits and therapeutic potential in the context of oral health.

### PAIN AND INFLAMMATION RELIEF

Herbal medicines for relieving pain and inflammation in the oral cavity have been the subject of increasing interest in dentistry, offering natural alternatives to conventional analgesics and anti-inflammatories. Products extracted from arnica (*Arnica montana*), aloe vera (*Aloe vera*) and calendula (*Calendula Officinalis*), are known as tissue repair inducers, while copaiba (*Copaifera* spp.) has gained prominence for its analgesic, anti-inflammatory and antimicrobial properties. Another compound with well-known therapeutic activities is propolis, a resinous compound made by bees, which has anti-inflammatory, healing and antiseptic action. The analgesic activity of honey has also been described in the literature by delaying tissue oxygenation, inhibiting the exposure of damaged mucosa to oxygen. The efficacy of honey in wound repair is also suggested, which may be due to its hygroscopic nature, viscosity and acidic pH, which inhibit microbial growth in damaged mucosa, in addition to containing enzymes, growth factors, vitamins and minerals that directly assist in mucosal repair, with studies demonstrating reduction of oral mucositis lesions through the use of honey.

### TREATMENT OF PERIODONTAL DISEASES

Essential oil-based mouthwashes represent a natural and effective approach as adjuvants in non-surgical periodontal treatment. These products contain a combination of active components derived from essential oils, each with specific properties that contribute to their antimicrobial and anti-inflammatory effectiveness. Natural compounds found in species such as Cloves (*Syzygium aromaticum*), Pomegranate (*Punica granatum*), Sage (*Salvia officinalis*), Plantain (*Plantago major*), Chamomile (*Matricaria chamomilla*) and Malva (*Malva sylvestris*) have been indicated for the



treatment of oral conditions such as gingivitis and abscesses. Pomegranate extract, for example, had its antimicrobial activity proven by Veloso *et al.* (2020), in the face of different microorganisms in the oral cavity, including *Fusobacterium nucleatum* and *Porphyromonas gingivalis*, both known to be periodontopathogens.

The chemical constituents of essential oils have been investigated as a promising therapeutic approach for the treatment of chronic diseases, such as periodontal disease, conditions associated with inflammation and microbial infection. Essential oils, which are obtained by steam distillation, are concentrates of volatile plant compounds which have been shown to have antimicrobial, anti-inflammatory, and healing properties, which may be beneficial in controlling inflammation and reducing bacterial load in the oral cavity.

Among the main active ingredients found in essential oils are terpenes, which are a group of organic compounds, such as limonene and pinene – found in the essential oils of lemon (*Citrus limon*), tea tree (*Melaleuca alternifolia*) and rosemary (*Salvia rosmarinus*) – which fight bacterial growth in the oral cavity by inhibiting protein synthesis and damage to the cell membrane. In addition to interference in the transport of nutrients. Phenols are another group of organic compounds present in oils such as clove and peppermint (*Mentha piperita*) that also offer a strong antimicrobial action against several types of microorganisms due to their disruptive mechanism of action on cell membranes. The next group of relevance in essential oils are aldehydes, such as citral. These contribute to freshness and exert their antimicrobial action through a number of mechanisms, including the formation of cross-links with proteins, the inactivation of essential enzymes, the destabilization of microorganisms' cell membranes, and possible damage to genetic material. These interactions lead to the coagulation of proteins, interference with metabolic processes, disruption of cell membranes, and the inability of genetic replication and transcription, resulting in the death of the microorganisms. The group of esters, present in oils such as lavender (*Lavandula angustifolia*) and eucalyptus (*Eucalyptus* spp.), also offer soothing and anti-inflammatory properties, being able to reduce the production of inflammatory mediators, such as prostaglandins, and modulate the body's immune response, helping to reduce gingival inflammation. Finally, the group of alcohols such as menthol and eugenol provides a feeling of freshness and temporary pain relief through interactions with ion channels in the membrane of nerve cells, temporarily deactivating pain receptors, in addition to having antiseptic properties. These different active components work together to fight plaque, reduce inflammation, and promote improved oral health. As a result, essential oil-based mouthwashes are an effective and natural option to aid in periodontal treatment and maintain the health of the oral cavity.



## TREATMENT OF CARIES DISEASE

In the context of the treatment of dental caries, papain, a proteolytic enzyme extracted from papaya (*Carica papaya*), stands out due to its bactericidal and bacteriostatic action. This enzyme is widely used in the pharmaceutical industry for its ability to accelerate healing. It is the main component of PAPERIES®, a drug widely used in restorative procedures, especially in the field of pediatric dentistry, because it helps to preserve as much healthy dental tissue as possible.

The activity of ethanolic and aqueous extracts of green tea (*Camellia sinensis*) inhibition of the development and progression of biofilms of *Streptococcus mutans* was confirmed by Zayed's study *et al.* (2021). This is because one of the main flavonoids present in the composition of green tea, epigallocatechin gallate, targets the enzymes glycosyltransferase, which are responsible for converting the sucrose contained in the diet into glycan, the building block of the exopolysaccharide matrix of these microorganisms. This compound can be used in various formulations in order to combat the formation of dental caries.

Another effective extract to inhibit the formation of supragingival dental biofilm, related to cariogenic activity, with efficacy similar to the chlorhexidine solution, is the hydroalcoholic pomegranate, according to Pereira *et al.* (2006). *et al.* (2014) also demonstrated the inhibitory activity of pomegranate extract against *S. mutans*, which is considered a possible anticariogenic agent. In other words, pomegranate extract has antimicrobial properties for both the management of periodontal diseases and caries.

Considering *S. mutans* as a cariogenic bacterium, copaiba oil, from species of the genus *Copaifera*, are also known for their biological activities, including antimicrobial action against different strains of this species (Machado and Oliveira, 2014).

## REGULATORY ASPECTS

The products of plant origin that can be used in phytotherapy are divided by the National Health Surveillance Agency (ANVISA) into three distinct categories, namely "plant drug/medicinal plant", "derived from plant drug" and "medicine", and classified according to their use in pharmaceutical input or medicine, and these must follow the provisions of RDC Resolution No. 30/08 (BRASIL, 2008) and require registration.

According to Collegiate Board Resolution No. 48 (RDC 48/2004), herbal medicines are defined as any medicine obtained using exclusively plant active raw materials; These drugs are characterized by knowledge of the efficacy and risks of their use, as well as by the reproducibility and constancy of their quality. In addition, an herbal medicine is not considered to be one that, in its composition, includes isolated active substances, of any origin, nor the associations of these with plant extracts.



According to RDC 10/2010, a plant drug can be defined as a medicinal plant or its parts, which contain the substances, or classes of substances, responsible for the therapeutic action, after processes of collection or harvesting, stabilization, drying, and can be whole, erased or crushed.

Another term to be considered is that of phytopharmaceutical, which according to RDC No. 24/2011 can be considered a purified substance isolated from plant raw material with defined chemical structure and pharmacological activity. It is used as an active ingredient in medicines with prophylactic, palliative or curative properties. Isolated phytopharmaceuticals that undergo any stage of semi-synthesis or modification of their chemical structure are not considered.

### **POLICIES ON MEDICINAL PLANTS AND HERBAL MEDICINES**

In Brazil, the use of medicinal plants and herbal medicines (PMF) occurs routinely, being a practice extremely rooted in cultural issues throughout the national territory. Thus, several policies were implemented, especially the Proposal for a National Policy on Medicinal Plants and Phytotherapies (BRASIL, 1981 - Ordinance No. 212, of September 11, of the Ministry of Health); the Medicinal Plants Research Program of the Central de Medicamentos (BRASIL, 1982); National Policies on Integrative and Complementary Practices and Medicinal Plants and Herbal Medicines (PNPIC and PNPMF, respectively), which together include phytotherapy and other integrative practices in the Unified Health System (SUS), but for Dentistry, this therapeutic resource is still little used.

In the field of medicinal plants and herbal medicines, the pharmacist is the professional responsible for indicating and/or prescribing medicinal plants aimed at the prevention of diseases and well-being based on the patient's health needs, in addition to promoting their rational use and assisting in the practice of handling, dispensing and guiding on the safe use of medicinal plants. derivatives and herbal medicines manipulated and industrialized in response to a prescription by a qualified professional, acting in consonance with the dental surgeon.

It is worth noting that the recognition of the practice of Phytotherapy by the dentist was regulated in 2008 by the Federal Council of Dentistry together with the World Health Organization. In addition, the prescription of herbal medicines by the dentist is provided for and supported by current legislation. The dentist may prescribe medications whose purpose is the adjuvant or non-adjuvant treatment of a specific or nonspecific dental procedure that is being adopted for the treatment of an oral health problem, of odontogenic, periodontopathogenic origin, related to the maxillary bones, masticatory muscles, soft tissues of the oral cavity and temporomandibular joint.

In this context, dental professionals and pharmacists can contribute to the success of the therapeutic efficacy of herbal medicines by acting in their fields supported by the law, in which the dental surgeon is able to identify the patient's symptom and be able to prescribe homeopathic





medicines, herbal medicines and floral therapy, according to CFO Resolution No. 82/08, respecting their limit of action in the professional field. While the pharmaceutical professional, in addition to being able to perform the indication of medicinal plants and herbal medicines free of prescription, supported by Resolution/CFF No. 546, of July 21, 2011, is also able to perform the quality control of plant and herbal drugs, through RDC 17/2010, of the National Health Surveillance Agency (Anvisa), which determines the Good Manufacturing Practices of Medicines, by presenting the procedures of handling, storage, transport and commercialization aiming concomitantly at the quality, safety and efficacy of herbal medicines and dental clinical management.

### **ETHICAL AND SAFETY CONSIDERATIONS**

The use of herbal medicine in dentistry entails certain ethical and safety considerations. It is undeniable that the use of medicines based on natural products has increased considerably in the last three decades. However, despite the fact that phytotherapy shows promising potential, many herbal medicines are still used empirically, being little or not monitored at all, presenting no scientific proof for their use. The traditionality of the use of phytotherapy suggests that drugs of plant origin are safe to use, presenting no adverse reactions or toxicity, however, the natural character of these products does not rid them of potential health risks or adverse reactions.

With the increase of natural products used in clinical practice, there is a growing demand for more research to investigate the safety and efficacy of such products, as it is crucial that professionals are aware of the guidelines for the safe and responsible use of phytotherapy. Although natural medicines refer to the idea of fewer side effects than conventional medicines, it is necessary to study their mechanisms and possible effects on oral tissues. That is, before recommending any herbal medicine, dental surgeons need to act with caution, as the products can have significant side effects. Therefore, the professional must have in-depth knowledge about pharmacological properties, indications, recommended doses, and possible effects when prescribing a certain herbal medicine, in addition to educating the patient about these issues. It is also necessary for each patient to be evaluated individually, taking into account their clinical history, pre-existing health conditions, and concomitant use of other medications. It is important to correctly follow the recommended dosages in order to avoid compromising the effectiveness of the treatment or causing adverse effects. Monitoring should be done throughout treatment, and adjustments to therapy may be made as needed.

Due to the presence of a mixture of bioactive compounds, herbal medicines can interact with other medications, enhancing or decreasing their effects. It is essential, therefore, to be aware of these potential interactions to avoid complications. However, these interactions with conventional drugs and their respective contraindications are not fully understood, highlighting the need for





further studies in this field. Some effects of interactions between herbal medicines and conventional medicines have already been elucidated, as is the case of artichoke (*Cynara cardunculus*) when administered with loop diuretics and thiazides, which may result in hypokalemia and hypotension. Aloe vera has also been studied in relation to its interaction with the anesthetic sevoflurane, being able to potentiate the antiplatelet effects resulting in bleeding, as well as the use of willow, which can also result in bleeding when administered together with anticoagulants. Not only that, herbal medicines may be contraindicated in certain health conditions or in specific patients, such as pregnant women, breastfeeding women, children or people with chronic diseases, or in case the patient is already using allopathic medicines whose interaction has already been identified. In addition, some herbal medicines do not have a well-described list of their constituents, and often these agents can be added to the formulation and may interact with possible medications used in the patient's routine.

Therefore, by assuming professional responsibility in prescribing and monitoring herbal treatment, dentists can then ensure safe and effective therapy with the use of these products, promoting the oral health of their patients. Phytotherapy can be represented as a model, where excessive medicalization is reduced by new therapeutic options. However, more professional qualification and listening to patients are necessary for the practice to be established in the best way.

## **FUTURE PERSPECTIVES AND CHALLENGES**

Continuous technological and scientific advancements have provided a promising scenario for the growth and development of herbal medicine in dentistry. With a better understanding of the properties and mechanisms of action of medicinal plants, there is a wide range of opportunities for the use of these natural resources in oral care. The growing interest in natural approaches to health drives the demand for new treatment options in dentistry that are not only natural but also sustainable. Therefore, the future of herbal medicine in dentistry is promising, with the potential to significantly improve patients' oral health and well-being.

The investigation of the therapeutic potential of herbs in dentistry has been the subject of several scientific studies and the growing body of scientific evidence supports the use of these herbal medicines as promising alternatives to conventional treatments and also in combination with traditional antimicrobials. In this sense, with the growth of bacterial resistance, research in the area of microbiology and dentistry has aimed to understand the synergistic antibacterial activity of plant extracts combined with antimicrobials. Natural extracts, when combined with antimicrobials, can increase the sensitivity of multidrug-resistant bacteria, damaging their membranes and facilitating the permeability of these compounds. An interesting example is *Escherichia coli*, which is resistant to colistin but shows sensitivity to this drug when combined with the Chinese herbal medicine shikonin.



Natural substances have been shown to improve the efficiency of antibacterial treatment, reduce the development of bacterial resistance and minimize adverse reactions to common drugs.

Despite the numerous benefits that the use of natural compounds derived from plants presents, the incorporation of phytotherapy in dental practice is not without challenges and further studies should be carried out to compare the effects produced by natural compounds on the resident microbiota to the effects produced by artificial products, in addition to their action in the inhibition of dental biofilm. Issues related to quality assurance, standardization and regulation of herbal products, as well as the management of drug interactions and the need for education of professionals and patients, also stand out as critical points to be addressed. A careful and informed approach to the selection and prescription of herbal medicines is essential to ensure their efficacy, safety, and acceptance in clinical dental practice.



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