

ANTIOXIDANT EFFECTS OF MEDICINAL PLANTS WITH APPLICABILITY IN ORO-DENTAL MEDICINE

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ABSTRACT

The correlation between the high incidence of oro-dental pathologies (periodontitis, oral cancer) and the increased level of ROS in the human body have led to the need to use alternative treatments, namely to the use of active principles from medicinal plants that have a considerable antioxidant effect, thus reducing the risk of producing these oro-dental pathologies. In this sense, some of the bioactive compounds present in medicinal plants such as turmeric acid extracted from *Curcuma longa*, polyphenolic compounds extracted from *Camellia sinensis*, apigenin extracted from *Moringa oleifera*, timolol extracted from *Thymus vulgaris*, etc. are already used in oral care products, giving consumers the opportunity to capitalize on the therapeutic properties of natural plant extracts. Although many medicinal plants exhibit remarkable antioxidant properties, observed in vitro studies, when switching to in vivo studies these antioxidant properties are no longer similar due to interference between physiopharmacological processes such as absorption, metabolism, excretion. Therefore, additional studies are needed to prove even more clearly the antioxidant capacities of medicinal plants and implicitly their applicability in the prevention of oro-dental pathologies.

Key words: antioxidant properties, herbs, periodontitis, oral cancer, oxidative stress.

INTRODUCTION

Oxidative stress is an imbalance of free radicals and antioxidants in the body, which causes damage to tissues and cells by damaging proteins, enzymes, lipids and DNA [1,2,3].

There are studies showing that oxidative stress and inflammation are directly correlated with some chronic pathologies such as neurodegenerative diseases, diabetes, cardiovascular diseases, liver diseases and

including aging [4,5,6,7].

Regarding the classification of free radicals, they can be: reactive oxygen species (ROS) and reactive nitrogen species (RNS), both types of free radicals having in their structure unpaired valence electrons. ROS can be subclassified into: oxygen-centric radicals such as superoxide anion, peroxy radicals, alkoxyl radicals, hydroxyl radicals and oxygen-centric non-radicals such as singlet oxygen and hydrogen peroxide. SNR is represented by peroxynitrite, nitric oxide,

nitrogen dioxide[8].

Regarding the correlation between oro-dental diseases and increased levels of oxidative stress in the body, there are numerous studies to confirm this aspect. Many systemic pathologies have an oral origin [9]. In the oral cavity, saliva is a first line of defense that acts specifically against free radicals through antioxidants such as superoxide dismutase, catalase and glutathione peroxidase [10]. Assessing the level of endotoxins in the blood (pro-inflammatory factors) after the mastication process in patients with periodontitis, it was found that endotoxin levels are significantly higher in patients with severe periodontitis, suggesting damage to other organ systems[11]. Numerous clinical and preclinical findings were subsequently reported, with ROS resulting from periodontal inflammation diffusing into the bloodstream and leading to gradual damage to other organs [12,13].

The correct understanding of oxidative stress, its pathways of action, free radicals and inflammatory markers associated with oro-dental pathologies is of particular importance for establishing the most effective treatment. An exogenous source of antioxidants with beneficial therapeutic effects for the human body is represented by plants, as it is considered that two thirds of all plants in the world have medicinal properties and approximately as many plants are considered to have an important antioxidant potential [14].

Herbs are still an unexplored source of powerful natural products with antibiotic potential, especially when antibiotic resistance continues to grow worldwide. Thus, we highlight the potential of biochemical compounds extracted from medicinal plants, compounds used to treat some common oral pathologies, such as tooth

decay and periodontitis, which are mainly caused by the formation of bacterial oral biofilms.

In phytotherapy, natural compounds are considered valuable and with undeniable therapeutic advantages, showing low toxicity and increased efficiency. Therefore, the investigation of extracted bioactive compounds from medicinal plants is seen as an innovative alternative to synthetic substances in the prevention and treatment of oro-dental pathologies. The potential of plant extracts to inhibit the growth and adhesion of oral pathogens and the development of biofilms is increasingly being studied, thus reducing the progress of oral diseases such as tooth decay, periodontitis, etc.

The global need for alternative prevention and treatment options and products for oral diseases that are safe, effective and economical stems from the increasing incidence of diseases, especially in developing countries, the increased resistance of pathogenic bacteria to antibiotics and chemotherapy currently used. For example, bacterial resistance to most synthetic antibiotics commonly used to treat oral infections (penicillin and cephalosporins, erythromycin, tetracycline and derivatives, and metronidazole) has been increasingly studied in recent decades. These drugs alter the oral microbiota and have unwanted side effects such as vomiting, diarrhea, and staining of tooth enamel. Plant-based products today symbolize safety, in contrast to synthetic materials that are considered unsafe for humans and the environment.

Despite the fact that medicinal plants have a high antioxidant and antimicrobial potential, studies already carried out, in vitro, cannot demonstrate the effectiveness of the investigated potential when referring to in vivo clinical trials.

Therefore, the challenge of future research

is to extend studies to the generation of standard protocols for the application of phytochemicals extracted from medicinal plants in the treatment of oro-dental pathologies.

METHODOLOGY

The reference studies used in our study were searched in databases containing scientific articles (such as ScienceDirect, Google Scholar). We used the following keywords: "antioxidant properties", "herbs", "periodontitis", "oral cancer", "ROS",

"exogenous sources of antioxidants", "oxidative stress". The selection process took place regardless of the publication date of the articles and included articles published until February 2024. First the articles were analyzed by title, then by the content of the abstract, then by the entire content. Finally, the most significant studies were selected to highlight the purpose of our study, namely to highlight the importance of the antioxidant effect of medicinal plants on oro-dental pathologies and also the correlation between ROS and periodontitis.

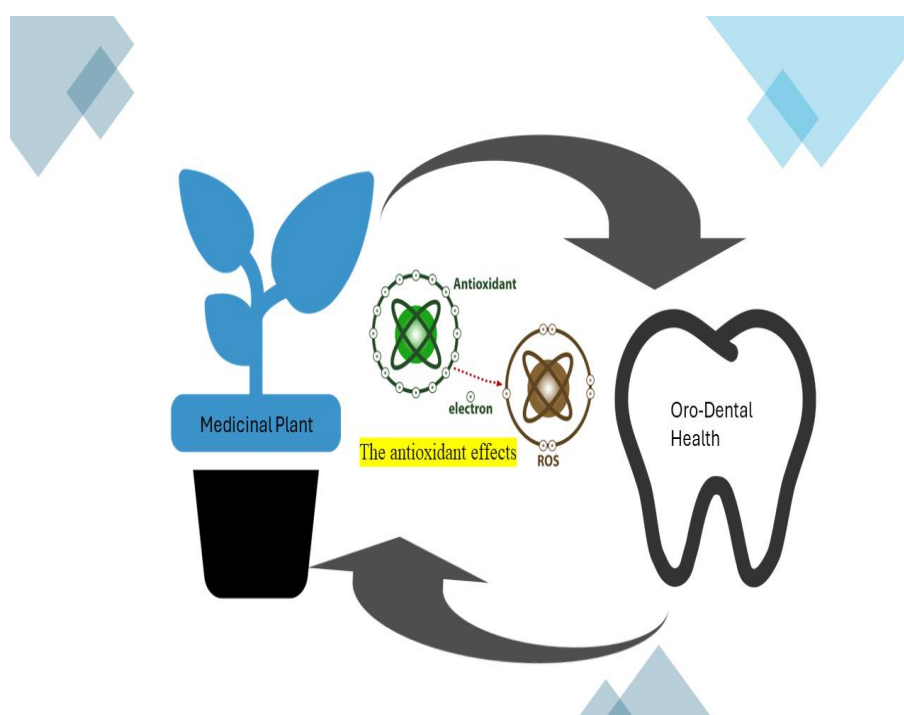


Figure 1. Antioxidant effect of bioactive compounds existing in medicinal plants on oro-dental health

ROS are chemical species (atoms or groups of atoms) that have **an unpaired electron** (an odd number of electrons), being highly reactive species. They convert other molecules into free radicals, generating and propagating chain reactions

Through various oxidation reactions, ROS can be formed, both in the environment (eg waste burning, cigarette smoke, etc.) and in the endogenous environment (radicals produced in the body). ROS are inevitably produced in biological systems, the damage caused by them being such as degenerative disorders such as mutagenesis, carcinogenesis, cardiovascular disorders and aging. **Antioxidants** are substances that are able to neutralize / inhibit reactive molecules (eg ROS) and reduce oxidative damage caused by the production of free radicals. These are compounds that combat ROS, respectively stop chain reactions by

removing ROS intermediates (eg by intervening in any of the three major stages of the oxidative process, ie initiation, propagation and interruption, but also by inhibiting other oxidation reactions). By reacting the antioxidant with a free radical, an electron is transferred (from the antioxidant) to the unpaired electron of the free radical. Thus, it will result: neutralization of the ROS (it will present a stable electron pair); conversion of the antioxidant into a stable free radical (radical that can be stabilized by internal conjugation). Antioxidants can come from two sources: **endogenous sources** - result from metabolic processes, being synthesized by the body (eg *superoxide dismutase (SOD)*, *catalases (CAT)*, *glutathione peroxidases (GPx)*); **exogenous sources** (occur naturally in vegetables and fruits with high content in vitamins C, E, polyphenols, b-carotenes, flavones, anthocyanins; minerals - Se, Fe, Zn, Cu and Mn, etc.). The balance of oxidants and antioxidants in the body plays an essential role in each individual's health

ANTIOXIDANT POTENTIAL OF PLANTS AND ITS IMPORTANCE

Plants exhibit highly complex antioxidant defense systems, both enzymatic and non-enzymatic, to combat the toxic effects of free radicals. In terms of their classification, enzyme systems include catalase, glutathione peroxidase and glutathione reductase, and non-enzyme systems include low molecular weight antioxidants such as phenolic acids, flavonoids, ascorbic acid, carotenoids, proline, glutathione, etc. and high molecular weight secondary metabolites such as tannins [15].

At the plant cell level, chloroplasts and mitochondria are the headquarters where ROS are produced, also here the balance between energy functions and those related to ROS production is controlled. Proxizomes are also involved in the production of ROS, e.g. hydrogen peroxide, nitric oxide or superoxide. These cellular organelles, peroxisomes, contain enzymatic constituents such as catalase that produce flavin oxidases. In plant cells, ROS production occurs in photosystems I and II of the chloroplast, in complex I and complex III of the mitochondrial electron

transport chain, in the proxysome matrix [16]. SNRs such as nitric oxide radical and peroxynitrite are produced in complex compartments of cell organelles, including chloroplasts, mitochondria and peroxisomes [17].

Currently, there are a number of studies, both in vitro and in vivo, evaluating the antioxidant activity of plant extracts [18]. Thus, in vitro studies, to a considerable extent, demonstrate that plants have a strong antioxidant activity. This remarkable antioxidant capacity is due to the fact that plants have an innate ability to produce non-enzymatic antioxidants such as gltatione and ascorbic acid, but also secondary metabolites such as phenolic compounds. However, only a few of these antioxidant activities are also found in vivo studies. The main reason why the antioxidant activity of plants determined in vitro is not similar to that determined in vivo is represented by the interference between physiopharmacological processes such as absorption, metabolism, excretion, etc. [19].

Further studies are therefore needed to support the in vivo applicability of

exogenous antioxidants from plants, so that they can be widely used in phytotherapy of various human pathologies, including dental medicine

No. Crt.	Scientific name	Botanical family	Part used of the plant	Reference
1	<i>Aegle marmelos</i>	Rutaceae	Fruit	[20]
2	<i>Allium onion</i>	Amaryllidaceae	Bulb	[21]
3	<i>Aloe vera</i>	Xanthorrhoeaceae	Leaves	[22]
4	<i>Asparagus racemosus</i>	Liliaceae	Stem	[23]
5	<i>Azadirachta indica</i>	Meliaceae	Leaves	[24]
6	<i>Bacopa monniera</i>	Plantaginaceae	Leaves	[25]
7	<i>Beta vulgaris</i>	Amaranthaceae	Root	[26]
8	<i>Camellia sinensis</i>	Theaceae	The friezes	[27]
9	<i>Cinnamomum tamala</i>	Lauraceae	Bark	[28]
10	<i>Curcuma longa</i>	Zingiberaceae	Rhizomes	[29]
11	<i>Cuscuta reflexa</i>	Convolvulaceae	Stem	[30]
12	<i>Daucus carota</i>	Apiaceae	Root	[26]
13	<i>Emblica</i>		Leaves	[31]

	<i>officinalis</i>	Euphorbiaceae		
14	<i>Eucalyptus camaldulensis</i>	Myrtaceae	Leaves	[32]
15	<i>Foeniculum vulgare</i>	Apiaceae	Fruit	[33]
16	<i>Lavandula angustifolia</i>	Lamiaceae	Herb	[34]
17	<i>Mangifera indica</i>	Anacardiaceae	Root	[35]
18	<i>Murray the koenigs</i>	Rutaceae	Leaves	[36]
19	<i>Ocimum sp.</i>	Lamiaceae	Leaves	[37]
20	<i>Phaseolus vulgaris</i>	Fabaceae	Leaves	[38]
21	<i>Piper nigrum</i>	Piperaceae	Leaves	[39]
22	<i>Plantago asiatica</i>	Plantaginaceae	Seed	[40]
23	<i>Prunus domestica</i>	Rosaceae	Fruit	[41]
24	<i>Salvia officinalis</i>	Lamiaceae	Herb	[42]
25	<i>Santalum album</i>	Santalaceae	Bark	[43]
26	<i>Solanum nigrum</i>	Solanaceae	Tubercles	[44]

27	<i>Solanum tuberosum</i>	Solanaceae	Fruit	[45]
28	<i>Terminalia bellarica</i>	Combretaceae	Herb	[46]
29	<i>Withania sleeping pill</i>	Solanaceae	Fruit	[47]
30	<i>Zingiber officinale</i>	Zingiberaceae	Rhizomes	[48]

Table 1. The main medicinal plants known to have remarkable antioxidant effects, being used as exogenous sources of antioxidants.

The table presents most plants that can constitute an exogenous source of natural antioxidants with a special importance in maintaining the body's homeostasis. Beyond the importance of these plants recommended to be included in the diet, we included in the structure of the table the scientific name of the plants presented, the botanical family to which they belong, the part of plants that are used in food and phytotherapy (flowers, leaves, stems,

roots, bark, fruits, seeds etc.) and the corresponding bibliographic sources.

It is well known that a balanced lifestyle, based on a healthy diet, can prevent and even reduce the risk of pathologies associated with the degradations generated in the body by oxidative stress. Plants have this antioxidant property due to their chemical composition, rich in: anthocyanins, flavones, flavonoids, catechins, etc.[49]

ROS FUNCTION IN PERIODONTAL DISEASE

Periodontitis is a chronic inflammatory pathology that affects the supporting tissues of dental elements that results in resorption of the alveolar bone and left untreated can lead to tooth loss [50]. It has multiple pathogenic bacteria [51].

Free radicals are chemical species (atoms or groups of atoms) that have an unpaired electron (an odd number of electrons), being highly reactive species. Free radicals are inevitably produced in biological systems, where their damage is such as degenerative disorders such as mutagenesis, aging,

etiology, being a multifactorial disease, which can be determined both by genetic factors and by the presence and action of periodontal

carcinogenesis, etc.[52].

Antioxidants are substances capable of neutralizing free radicals and reducing oxidative damage resulting from the production of free radicals. It stops chain reactions by removing free radical interferences, by intervening in any of the three major stages of an oxidative process,

namely initiation, propagation and interruption, but also by inhibiting other oxidation reactions. The reaction of the antioxidant with the free radical results in the transfer of an electron from the antioxidant to the unpaired electron of the free radical, thus resulting in the neutralization of the free radical (with a stable pair of electrons) and also the conversion of the antioxidant into a stable free radical (radical that can be stabilized by internal conjugation) [53].

ROS has a multitude of roles within periodontal tissue, so that at the moment of concrete balance of oxidative stress, ROS acts as a cellular messenger, stimulating the production of molecules to trigger the immune system response, which reacts appropriately against pathogens [54]. During the activity of macrophages, free radicals are produced that lead to an increase in the concentration of ROS. With the persistence of pathogenic activity, ROS becomes in a high concentration, a cause of oro-dental pathology. Within a healthy body there is a balance between ROS and antioxidant

ANTIOXIDANT EFFECTS OF MEDICINAL PLANTS USED IN THE PREVENTION AND TREATMENT OF ORO-DENTAL PATHOLOGIES

Especially due to the fact that in recent decades the incidence of deaths from oral cancer has increased considerably, there has been an urgent need for an alternative treatment, based on the antioxidant capacities of medicinal plants. The treatment of oral cancer includes chemotherapy, which have adverse effects on the human body [58]. The active principles of medicinal plants exhibit anticancer and antioxidant properties, which makes them advisable in prophylaxis against this deadly pathology. Among the biologically active compounds

concentrations, but this homeostasis is imbalanced when the concentration of ROS exceeds the concentration of antioxidants causing inflammation in periodontal tissue. The oral microbiota is gradually being replaced by virulent microbiota, which leads to the development of a chronic condition[55]. The abnormal concentration of ROS and substances produced by the destruction of periodontal tissue are elements that stimulate the production of cytokines in the immune system. Thus, the persistence of chronic inflammation is achieved, even in direct relation to risk factors such as smoking, diabetes and cardiovascular disease [56].

It is well known that a balanced lifestyle, based on a healthy diet, can prevent and even reduce the risk of pathologies associated with degradation generated in the body by oxidative stress. Plants have this antioxidant property due to their chemical composition, rich in: anthocyanins, flavones, flavonoids, catechins, etc.[57]

with antioxidant properties are: turmeric acid extracted from *Curcuma longa*, polyphenolic compounds extracted from *Camellia sinensis*, apigenin extracted from *Moringa oleifera*, timolol extracted from *Thymus vulgaris*, etc.[59,60,61,62, 63]. So far, present studies highlight the importance of bioactive compounds extracted from medicinal plants in prophylaxis and treatment of oral cancer, as they stabilize ROS levels, regulate cell cycle and protect DNA structure[64]. The multiple roles of natural extracts from *Camellia sinensis* used in the treatment and prophylaxis of periodontitis are demonstrated through several studies. Inhibition of anaerobic pathogens *Porphyromonas gingivalis* and *Prevotella* sp. was observed under the action of catechins

[65]. Also, catechins have a major role in suppressing bone resorption mediated by the inflammatory response observed in periodontal disease [66]. Toothpastes containing green tea extracts bring an improvement in periodontal status in patients with chronic periodontitis [67]. The plant complex in the Triphala mixture (*Embolica officinalis*, *Terminala chebula*, *Terminalia belerica*) exhibits a powerful antioxidant effect, the antioxidants in this complex composition reducing the oxidative load thus protecting cells from damage caused by free radicals [68]. At the same time, Triphala is known to inhibit collagenases from polymorphonuclear leukocytes, which are responsible for connective tissue damage in periodontal disease[69].

Natural extracts from Ginko biloba leaves have multiple therapeutic effects such as reducing oxidative stress levels[70], anti-inflammatory effect [71] and eliminating

ROS[72]. In animal model studies on rats, it has been found to significantly reduce inflammation and the number of osteoclasts [73]. The piperine alkaloid, present in plants such as *Piper nigrum*, has well-known anti-inflammatory and antioxidant properties, capturing ROS [74]. In animal model studies on rats, piperine has been shown to significantly reduce inflammation infiltration into soft tissues [75]. *Psidium guajava* exhibits remarkable antioxidant properties, with a rich content of ascorbic acid, carotenoids and polyphenols[76]. In oro-dental medicine, decoction of root bark is used as well as mouthwash and decoction of leaves to treat gynival bleeding[77]. *Rubia cordifolia* exhibits, through its main component, molugin, strong antioxidant properties[78]. In vivo studies in rat animal models have demonstrated that molugin inhibits bone resorption activity in mature osteoclasts [79].

Scientific name	Botanical family	Therapeutic effects	References
1. <i>Achillea millefolium</i>	Asteraceae	Active ingredient in mouthwash, reduces bleeding gums	[80]
2. <i>Capsella bursa-pastoris</i>	Brassicaceae	Stops the bleeding after tooth extractions	[82]
3. <i>Clematis virginica</i>	Ranunculaceae	Mouthwash containing plant extracts is used to relieve pain caused by lesions characteristic of oral cancer, also used to help with mouth sores.	[81]

4. <i>Commiphora myrrha</i>	Burseraceae	Fights halitosis	[80]
5. <i>Gaultheria procumbens</i>	Ericaceae	Natural antiseptic, the oil extracted from the plant is applied directly to the painful area	[83]
6. <i>Mentha piperita</i>	Lamiaceae	Mouthwash with mint extracts soothes dental pain and gum inflammation	[81]
7. <i>Melaleuca alternifolia</i>	Myrtaceae	Mouthwash soothes oral inflammation	[84]
8. <i>Rosmarinus officinalis</i>	Lamiaceae	Used in the treatment of gingival lesions	[85]
9. <i>Sanicula europaea</i>	Asteraceae	Powerful antioxidant, used in the treatment of oral diseases	[85]
10. <i>Thymus vulgaris</i>	Lamiaceae	Used against <i>Streptococcus mutans</i> .	[86]
11. <i>Trifolium pretense</i>	Fabaceae	Treats abscesses and pain caused by inflammation	[85]
12. <i>Zanthoxylum simulans</i>	Rutaceae	Soothes dental pain	[83]

Table 2. Common herbs which are used in dental treatment

The table below presents some of the most used medicinal plants that have applicability in the prevention and treatment of oro-dental pathologies. It includes both the scientific name of plants, the botanical family to which they belong and the therapeutic effects they present in relation to oro-dental pathologies and the corresponding bibliographic references.

Beyond the therapeutic properties, well known since ancestral times, a number of factors must be taken into account when applying the use of these plant extracts with remarkable effects in what means slowing down and treating oro-dental pathologies. Among them, we mention the need to standardize extraction protocols and dosing of alternative treatment so as to successfully avoid possible unpleasant effects or toxicity of the extract if the dose administered during treatment is not appropriate. It must also be taken into account the protocols for harvesting plant species and, last but not least, the evolutionary degree of pathology to be treated.

Arctium lappa has multiple beneficial properties, used in the treatment of oro-dental diseases. Among them are antibacterial, antioxidant, HIV inhibitory action, etc. In dentistry, plant extracts from *Arctium lappa* are used in the treatment of endodontic infections [87,88].

Morinda citrifolia is used for its various actions such as anti-inflammatory, antibacterial, antifungal, and immune system enhancer. In dentistry, plant extracts are used as endodontic irrigator [89,90].

Punica granatum exhibits antioxidant and antibacterial properties against microorganisms that cause gingivitis. Therapeutic products based on pomegranate

extracts relieve pain caused by aphthous stomatitis and considerably reduce the time for complete healing of ulcers [91].

At the same time, periodontal disease and its evolution imply the production of endogenous ROS during the immune response process, and exogenous ROS, originating from plant extracts, can help regress pathology or diminish specific symptoms.

Periodontal pathologies are inflammatory conditions that give rise to tissue damage and destruction, which are the result of the complex interaction between pathogenic bacteria and the host's immune response. During the progesis of the disease there is a high colonization of the oral cavity with bacteria called periodontal pathogenic bacteria. Pathogens such as gram-negative bacteria species have the ability to invade gum tissues. Following the dynamics of the alteration of the oral flora, an immune response is generated, as a result of which the level of cytokines increases, expression of immunological activity in gum tissues. Research has demonstrated that PMNs (polymorphonuclear leukocytes) are involved in the host's immune response as primary mediators against pathogenic bacteria, producing a number of antibacterial factors, including ROS, during the phagocytosis process of pathogenic bacteria that cause periodontitis [92].

Although the antioxidant effects of medicinal plants are well known, since antiquity, possible interactions with biological systems, involving their own metabolic pathways, can lead to a significant decrease in these effects, which is why further studies are needed to prove the less severe toxicity of plant extracts and the

actual therapeutic effects, compared to conventional medication. Thus, plants represent a point of scientific interest for the development of alternative treatments that present minimal adverse effects on the human body.

FUTURE PROSPECTS

Interdisciplinary approaches are needed to further interconnect existing phytotherapeutic and phytochemical studies with preclinical and clinical medicine. Thus, protocols and work procedures can be standardized to transmit concrete and unitary results aimed at the antioxidant properties of plant extracts used in the prevention and treatment of oro-dental pathologies.

Phytotherapy could represent a universal panacea in terms of treating oro-dental pathologies, plant extracts having reduced toxicity and fewer adverse effects compared to synthetic drugs. Therefore, it is imperative to standardize the nomenclature of natural medicines obtained, to standardize the harvesting practices of the plants used, to standardize the clinical application of the treatment, involving optimal doses and time intervals, personalized according to the degree of disease evolution, in order to ensure, ultimately, the quality, safety and efficacy of alternative treatment, based on plant extracts with important bioactive compounds.

Since the main factors influencing the virulence of pathogenic bacteria in the oral cavity are the formation of biofilm and the production of ROS, the introduction of natural extracts from medicinal plants into oral hygiene products is an essential element to combat these types of pathologies[93].

At the same time, the use of essential oils in oral hygiene products facilitates the reduction of free radicals and prevents proliferative processes of cancer cell

formation[94].

With regard to maintaining eubiosis in oral tissues, in-depth studies demonstrating the effect of natural compounds in medicinal plants in vivo are needed.

POSSIBLE LIMITATIONS OF THE APPLICABILITY OF ANTIOXIDANT CAPACITY OF MEDICINAL PLANTS IN THE CONTEXT OF ORO-DENTAL MEDICINE

Even though there are a promising number of in vitro studies demonstrating the antioxidant effect of medicinal plants and its effectiveness in the treatment of oro-dental pathologies, there are still a number of limitations that must be taken into account for the field of phytotherapy to evolve with the other branches of medical science.

Therefore, the type of plant extract used in preclinical studies and thus the type of solvent must be taken into account. Then there are variations in the quantity and quality of bioactive compounds, due to geographical variations, local ecotypes, therefore intraspecific variations due to the biogeography of the studied plants.

Further studies are absolutely necessary to complement the biochemical analysis of compounds extracted from medicinal plants and to fully understand the complex mechanisms by which these substances act in the treatment of oro-dental pathologies.

Beyond the limitations, there are notable studies that represent a perspective for future clinical applications.

A good example is the demonstrated antioxidant effect of *Rosa damascena* and *Hypericum perforatum* species [95], but also of *Mimusops elengi* species [96].

The first example cited shows in addition to the remarkable antioxidant capacity of

plant extracts and their efficacy oral antibiofilm, which may represent a potential new perspective for approaching oral biofilm management. However, it is noted the need to optimize extraction parameters and implement clinical trials to support the efficacy and safety of using plant extracts in the treatment and prevention of oro-dental diseases.

The second example cited above shows that *Mimusops elengi* bark extract has significant antioxidant properties and can be used without leading to the destruction of gum tissues.

Both studies mentioned above emphasize the urgent need to implement clinical studies demonstrating the usefulness of plant extracts in the treatment of oro-dental diseases.

In an interdisciplinary approach, future studies need to explore interactions between oral microbiota and bioactive compounds present in medicinal plants, thus validating the effectiveness and safety of using these alternative therapeutic practices in the prevention and treatment of oro-dental pathologies.

CONCLUSIONS

Medicinal plants are an excellent exogenous source of antioxidants that can be used in the prevention and treatment of oral dental diseases. As a result, there is currently an upward trend towards the use of oral health care products containing natural extracts of medicinal plants. Medicinal plants are also used from a phytotherapeutic point of view, as dietary supplements to maintain the ROS level in the body within normal limits, to support the maintenance of the general health of the body.

With all these notable aspects, it must be sublimated that further in vivo studies are needed to demonstrate the real value of using medicinal plants as sources of antioxidants, necessary in the prevention and treatment of periodontitis, dental caries and even oral cancer.

At the same time, an interdisciplinary approach is needed to interconnect dental medicine and phytotherapy, to standardize treatment modalities that include the use of biologically active compounds extracted from medicinal plants.

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