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## Equisetum extracts are anti-inflammatory and antibacterial, an oral potential therapeutic agent

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### Abstract

**Introduction:** Due to its ability to prevent chromosomal damage, the genus *Equisetum* is likely to have an interesting field of potential use in clinical applications.

**Objective:** To analyze the literature on *Equisetum*, particularly its anti-inflammatory, antibacterial and cytotoxicity effects, from a dental approach. Methodology: In PubMed, Science Direct, Google Scholar searched for information with combinations of the keywords: *Equisetum*, anti-inflammatory, antibacterial, and cytotoxicity.

**Results:** *Equisetum* possesses anti-inflammatory properties, inhibiting proinflammatory cytokine production and modulating T and B lymphocyte activity. It has antibacterial and antifungal effects against gram positive and gram negative bacteria, including *S. mutans* and *Candida*. Administered in controlled doses, toxicity with clinical signs is not detected, however, it shows antitumor effect.

**Conclusion:** *Equisetum* has anti-inflammatory and antibacterial properties and does not show cytotoxicity, it is a potential therapeutic agent for oral treatments.

**Keywords:** equisetum, anti-inflammatory, antibacterial, cytotoxicity

### 1. Introduction

Natural products are substances produced by a living organism in nature with biological activity, thanks to their secondary metabolites that include a wide category of compounds [1]. Since plants are the source of more than 25% of prescription and over-the-counter drugs, conventional medicine is becoming increasingly receptive to the use of plant-derived antimicrobials and other natural products. The increased use of herbal medicines has renewed interest in the effects of plant extracts to control plaque and other oral diseases [2]. Natural extracts have been shown to have a beneficial effect in the development of clinical therapies in the dental area, such is the case of *Aloe vera* which has been used for industrial, dental and wound healing applications [3], patients use natural remedies to treat oral ailments [4]. *S. mutans* begins colonization of the mouth early in life and is responsible for the formation of mature biofilms, resulting in early childhood caries, plant extracts are effective in reducing the bacterial load [5].

On the other hand, ethanolic extract of *Equisetum* may serve as an alternative anticancer agent for the treatment of pancreatic carcinoma with no or minimal side effects to the patient [6]. Methanolic extract of *Equisetum arvense* inhibits diabetes-induced detrimental effects [7]. The methanolic crude extract has antimicrobial activity [8].

Currently there is no review in the literature about the benefits of species of *Equisetum* genus from the odontological point of view, so in this work we analyze the literature on this subject, particularly its anti-inflammatory, antibacterial and cytotoxic effects, from an odontological point of view.

### 2. Material and Methods

Articles on the subject published through the PubMed, Scopus and Google Scholar databases were analyzed, with emphasis on the last 5 years.

The quality of the articles was evaluated using PRISMA guidelines, i.e., identification, review, choice and inclusion. The quality of the reviews was assessed using the measurement tool for evaluating systematic reviews (AMSTAR-2)<sup>[9]</sup>.

The search was performed using Boolean logical operators AND, OR and NOT.

It was performed with the words "Equisetum " in combination with "anti-inflammatory", "antibacterial" and "cytotoxicity". The keywords were used individually, as well as each of them related to each other.

Initially, the titles of all the articles were selected, the abstract of each one was evaluated and the articles were chosen for a complete reading review.

### 3. Results & Discussion

#### 3.1 Anti-inflammatory effects

A variety of works have reported and demonstrated the anti-inflammatory effect of various species of Equisetum. It accelerates wound healing and decreases pain, perhaps due to the presence of phenolic compounds and flavonoids<sup>[10-14]</sup>. The extract inhibits lymphocyte activation, decreasing the expression of CD69 and IL-2 receptors, thereby inhibiting IL-2 production, in addition it reduces the production of IFN-gamma and TNF-alpha<sup>[15]</sup>. Similarly, it inhibits the production of IL-6<sup>[16, 17]</sup>. It has an immunomodulatory effect on T and B lymphocytes<sup>[18]</sup>.

*Equisetum arvense* extract inhibits the production of TNF-alpha, a proinflammatory cytokine, induced by LPS from *Aggregatibacter actinomycetemcomitans*<sup>[19]</sup>.

The use of Equisetum extracts in hydrogel as an anti-inflammatory agent has been recommended<sup>[20]</sup>.

#### 3.2 Antibacterial effect

Equisetum has antibacterial effects on gram-positive cocci<sup>[16, 21, 22]</sup>, and antifungal effect<sup>[23]</sup>. In addition, it inhibits the growth of *S aureus* grown on hydroxyapatite or in culture<sup>[24-25]</sup>. In conjunction with silver nanoparticles its antibacterial capacity is increased<sup>[26]</sup>.

There are also reports that it presents antiviral effect against herpes simplex virus type 2, prevents entry into cells<sup>[27]</sup>.

Equisetum extracts added to denture adhesives prevent *Candida* growth and anti-biofilm capacity<sup>[25, 28-30]</sup>. Similarly, they prevent the growth of *Streptococcus mutans*<sup>[25]</sup>.

#### 3.3 Cytotoxicity

Equisetum extracts do not exhibit cytotoxicity in contact with human cells, these properties could qualify *E. giganteum* extract as a promising alternative for the treatment and prevention of oral candidiasis and prosthetic stomatitis<sup>[30]</sup>. They have even demonstrated protective effects on liver and gastric mucosa<sup>[31-33]</sup>.

Equisetum can also be toxic, depending on the dose, due to its alkaloid content<sup>[34-35]</sup>. It has compounds that can affect the action of Adenosine deaminase<sup>[36]</sup>. In conjunction with silver nanoparticles it presents strong toxic effect against HepG2 cell lines<sup>[26]</sup>. It is even independently toxic against breast, lung, cervix and liver cell lines<sup>[35, 37-38]</sup>.

### 4. Conclusions

The species of the genus Equisetum are definitely a line to be investigated in the dental area, since they have demonstrated anti-inflammatory and antibacterial effects without real cytotoxic effect, in addition, they have other positive effects as antioxidants and antinociceptive effects.

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