ANÁLISE DAS PROPRIEDADES FÍSICAS DA INCORPORAÇÃO DO ÓLEO DE CANNABIS EM PRODUTOS PARA CONTROLE DA ALVEOLITE

Analysis of the physical properties of incorporating cannabis oil in products for the control of alveolitis

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RESUMO

Este estudo avaliou a incorporação do óleo de *Cannabis sativa* em formulações odontológicas destinadas ao controle da alveolite, complicação pós-operatória comum caracterizada por dor intensa e inflamação após extrações dentárias. O objetivo foi verificar se o óleo de *Cannabis*, altera propriedades físicas essenciais ao desempenho clínico, em comparação ao eugenol tradicionalmente utilizado. Foram preparados dois grupos de amostras experimentais associadas à tetraciclina: um com óleo de cannabis full spectrum e outro com eugenol. Os materiais foram submetidos a ensaios padronizados de escoamento, radiopacidade e solubilidade, segundo normas ISO. O escoamento foi avaliado em discos padronizados, a radiopacidade mensurada por meio de radiografias oclusais com escala de alumínio, e a solubilidade testada em moldes de teflon sob condições controladas de temperatura e umidade. Os resultados mostraram que a associação de tetraciclina e óleo de cannabis apresentou escoamento significativamente superior ao grupo com eugenol, favorecendo maior adaptação do material ao alvéolo. A análise de radiopacidade revelou valores semelhantes entre os grupos, dentro dos padrões clínicos recomendados. O teste de solubilidade não pôde ser concluído, uma vez que os materiais não apresentaram presa adequada. Conclui-se que a substituição do eugenol pelo óleo de cannabis em formulações odontológicas não compromete a radiopacidade e melhora o escoamento, característica desejável para adaptação clínica. Esses achados sugerem que o óleo de *Cannabis* pode representar uma alternativa promissora no desenvolvimento de novos curativos alveolares, embora sejam necessários estudos adicionais de biocompatibilidade e eficácia clínica.

Palavras-chave: Cannabis sativa, canabinoides, CBD, manejo da dor, inflamação.

ABSTRACT

This study evaluated the incorporation of *Cannabis sativa* oil into dental formulations designed for the management of alveolitis, a common postoperative complication characterized by severe pain and inflammation following tooth extraction. The aim was to determine whether cannabis oil, modifies essential physical properties compared with eugenol, traditionally used in alveolitis dressings. Two experimental groups were prepared, both combined with tetracycline: one with full-spectrum cannabis oil and the other with eugenol. The materials were subjected to standardized flow, radiopacity, and solubility tests according to ISO guidelines. Flow was measured using standardized discs;

radiopacity was assessed by occlusal radiographs with an aluminum step wedge; and solubility was tested using Teflon molds under controlled temperature and humidity conditions. The results demonstrated that the association of tetracycline and cannabis oil exhibited significantly greater flow than the tetracycline-eugenol group, indicating improved adaptability of the material to the alveolar socket. Radiopacity analysis revealed no statistical difference between groups, remaining within clinically acceptable ranges. The solubility test could not be completed, since both materials failed to set under the experimental conditions. It is concluded that replacing eugenol with cannabis oil in dental formulations did not compromise radiopacity and provided superior flow, a desirable characteristic for clinical adaptation. These findings suggest that *Cannabis sativa* oil formulations may represent a promising alternative for alveolitis management. However, further studies on biocompatibility, antimicrobial activity, and clinical efficacy are required to confirm its applicability in routine dental practice.

Keywords: Cannabis sativa, cannabinoids, CBD, pain management, inflammation.

INTRODUCTION

Post-operative alveolitis, also known as alveolar osteitis, is one of the most frequent complications following tooth extractions, especially lower third molar extractions. It is characterized by intense pain that manifests itself between the first and third day after surgery, associated with partial or total disintegration of the blood clot in the alveolus, usually accompanied by halitosis and inflammation in the affected area (BLUM, 2002). This increases the recovery period, requiring additional clinical monitoring and, in certain situations, the application of additional drug therapies (FIGUEIREDO FILHO *et al.*, 2023).

Various therapeutic strategies have been used to prevent and treat alveolitis, including topical or systemic antibiotics, analgesics, anti-inflammatories and dressings containing eugenol, tetracycline and iodoform (SOUSA *et al.*, 2023). Although they are effective in certain circumstances, these approaches have limitations, such as the occurrence of side effects, the possibility of developing bacterial resistance and a palliative effect that is limited only to pain relief (FERREIRA e OLIVEIRA, 2023). It is therefore essential to investigate new alternatives that integrate biocompatibility, anti-inflammatory properties and safety in clinical application, expanding the options available to the dental surgeon.

The endocannabinoid system has been widely investigated for its role in regulating homeostasis and essential biological processes such as pain, inflammation and tissue regeneration (FRANCISCHETTI e ABREU, 2006). This system is mainly composed of CB1 and CB2 receptors, which are activated by endogenous cannabinoids and phytocannabinoids, such as tetrahydrocannabinol (THC) and cannabidiol (CBD), both derived from *Cannabis sativa* (CABRAL *et al.*, 2015). Cannabidiol (CBD), one of the main components of *Cannabis sativa*, is proving to be a promising alternative for managing pain and inflammation. CBD connects to receptors in the endocannabinoid system and has analgesic, anxiolytic, anti-inflammatory and even neuroprotective properties; however, it does not have the psychoactive effects of tetrahydrocannabinol (THC) (CAMPOS *et al.*, 2012; BHASKAR *et al.*, 2021). CBD has been studied for its modulating properties in the inflammatory response, tissue healing and synergism in alveolar regeneration, which positions it as a strong potential for dental compositions for the management of alveolitis (SILVIANO *et al.*, 2022).

In this scenario, exploring the inclusion of CBD in dental compositions represents a fundamental step in validating its applicability in clinical practice. Standardized laboratory tests of flow, radiopacity and solubility are important to verify whether cannabidiol alters physical characteristics that are essential for the clinical performance of pastes used to control alveolitis.

MATERIALS AND METHODS

To evaluate the incorporation of cannabidiol into the physical properties of a paste for the control of alveolitis, flow, radiopacity and solubility tests were used and the samples divided into two groups: eugenol (n=10) and cannabidiol (n=10) (Table 1).

Table 1 - Group composition

Grup	Composition	Batch
Cannabinol	Active compounds such as CBD (cannabidiol), THC (tetrahydrocannabinol), CBG (cannabigerol), CBC (cannabichromene), and others. Excipients: Corn oil and butylated hydroxyanisole.	5000844609
Eugenol	Molecular Formula: $C_{10}H_{12}O_2$ IUPAC Name: 4-allyl-2-methoxyphenol Chemical Structure: Consists of a benzene ring Aromatic chemical compound found in cloves, cinnamon, sassafras and myrrh. The IUPAC nomenclature for egenol is 4-Allyl-2-Methoxyphenol and the CAS number is 97-53-0.	44424

Tetracycline, a compound with the formula $C_{22}H_{24}N_2O_8$, was used in the tests. The IUPAC name is (4S,4aS,5aR,12aS) -4-(dimethylamino)-1,4,4a,5,5a,6,11,12a-octahydro-3,6,10,12,12a-penta-hydroxy-6-methyl-1,11-dioxo-naphthacene-2carboxamide. It consists of a tetracyclic system with several functional groups, including hydroxyl groups (OH), a carboxamide group ($CONH_2$) and a dimethylamino group ($N(CH_3)_2$).

Sample preparation

The samples were mixed for the control group in a ratio of 1:1 by weight, using tetracycline and eugenol, and for the experimental group, in the same ratio, tetracycline and *Full Spectrum Cannabis Oil* (Table 2). A total of 14 samples were used, 7 *cannabis* + tetracycline and 7 containing eugenol + tetracycline. The samples were placed on two glass plates for testing.

Table 2 - Details of the samples

Substance	Drops	Weight	Tetraciclina (weight)
Cannabis (oil)	27	0.47g	0.53g
Eugenol	07	0.47g	0.53g

The samples consisted of tetracycline capsules weighing 0.53 grams each, *cannabis* and eugenol. 27 drops were used in the *Full Spectrum Cannabis Oil* samples and 7 drops in the eugenol samples. The weight of both *cannabis* and eugenol was 0.47 grams. The dropper and viscosity of the *cannabis* was different to the dropper and viscosity of the eugenol. In other words, the amount of eugenol liquid that fits into a drop is greater than that of *cannabis.*

Flow test

Using a 5.0 ml disposable syringe, 0.5 ml of each material was inserted into the center of a glass plate.) After 180 seconds from the start of mixing, a second glass plate was placed on top of the materials, and an additional 120g weight was placed on top of the last one. After 10 minutes from the start of spatulation, the weight on the glass plate was removed and the smallest and largest diameters of the disks formed were measured using a digital caliper (Digimess, Shoko, China).

To validate the test, the disks formed had to be uniformly circular and show a variation of no more than 1.0 mm in their smallest and largest diameters. Samples that did not meet these requirements were discarded and the test repeated until 10 discs of each cement had been obtained in accordance with ISO6876 (STANDARDIZATION, 2012).

Radiopacity test

A light-curing resin matrix 1.0 mm thick and 10.0 mm in diameter was made. This matrix was molded with 3M ESP silicone 10 times for each group. The materials were inserted into these molds, covered with a polyester strip and then placed in an oven at 37°C.

After hardening, occlusal radiographs were taken with the aluminum scale. The radiographs were taken using a FOCUS 65 Kv X-ray machine (Instrumentarium Dental PaloDEx Group Oy Nahkelantie 1,60 FI-04300 TUUSULA, Finland) with an exposure time of 0.45s.

An apparatus was used so that the samples were 30 centimeters from the X-ray cylinder. This apparatus was made from a 30-centimeter plastic ruler. The images were evaluated by a calibrated observer, the evaluation was repeated 3 times, and an average was made for each sample, determining the radiopacity scale for each sample according to ISO 6876 (STANDARDIZATION, 2012).

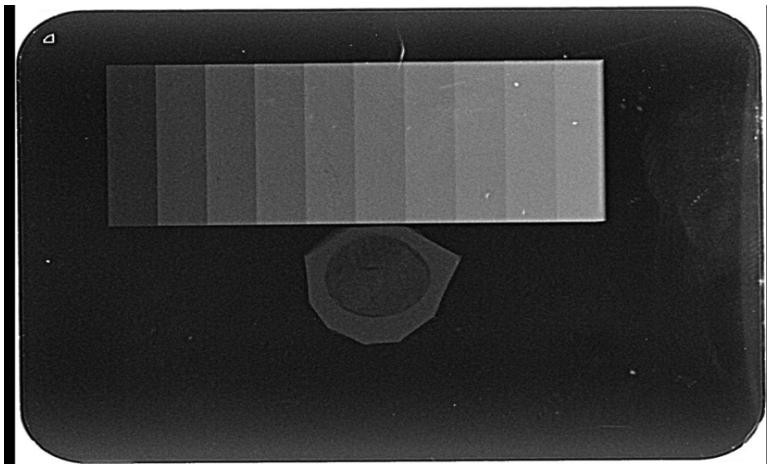

Figure 1. Radiograph of a sample with an aluminum scale positioned on an occlusal radiographic film.

Solubility test

A circular Teflon matrix 1.0 mm high and 15.0 mm in diameter was made and molded 20 times with Silicone Adhesive (Dentsply). The molds were filled with the materials studied (n=10), covered with a polyester strip and taken to an oven at 37°C and 95% relative humidity for a period 3 times longer than the hardening time of each cement (Figure 2). The solubility test was suspended because the substances did not harden.

Figure 2 - Samples of the materials tested in a silicone matrix

RESULTS

Flow

From the results obtained in the flow analysis, it was observed that the cannabidiol-based material showed significantly greater flow when compared to eugenol (Table 3).

Table 3 - Flow in mm (mean± SD) according to material type

Eugenol	21.23±1.41 b
Cannabis (oil)	29.31±3.83 a

Different letters indicate statistical difference by Tukey's test at 5% significance level

Radiopacity

The results obtained from the radiopacity analysis showed that there was no statistical difference between the groups

Table 2 - Aluminum flow in mm (Minimum - Median - Maximum) according to material type

Eugenol	1.0 – **2.0** – 2.0 a
Cannabis (oil)	1.0 – **2.0** – 2.0 a

Different letters indicate statistical difference using the Kruskal-Wallis test at 5% significance level

Solubity

The solubility test was not performed because the specimens from both groups did not harden.

DISCUSSION

The combination of tetracycline and cannabis oil had a considerably higher flow rate than the control, which used tetracycline and eugenol (and showed similar radiopacity). The solubility test could not be carried out because the materials had set. *Cannabis* oil was the material of choice instead of CBD, since due to its composition, the conditions of interaction with tetracycline would be more challenging and its result would be valid for interaction with any of the product's components.

Clinically, a more pronounced drainage may contribute to a better adaptation of the dressing to the surfaces of the alveolus and the exposed bone bed, increasing

the effectiveness of the protective covering of the bone, a desired principle in the treatment of alveolitis (GAETA *et al.*, 2023). For this condition, a dressing that is resorbable but maintains stability is recommended, protecting the alveolus for a few days and attenuating pain until initial re-epithelialization. However, excessive drainage can increase susceptibility to salivary flow and mechanical displacement, which makes it essential to adopt release methods that ensure adhesion and a controlled stay in the alveolus, such as fibrous matrices or absorbable sponges used as drug reservoirs (GAETA *et al.*, 2023). Recent research into intra-alveolar dressings, such as Alvogyl® or absorbable gelatine sponges, highlights the importance of providing immediate analgesia on the one hand and, on the other, ensuring that the dressing remains in place for as long as necessary, allowing for gradual self-elimination as the healing process develops. These concepts shed light on why there is more pronounced drainage with cannabis oil, emphasizing the need to adjust the *Cannabis (oil)* formulation (matrix/thickeners) in order to balance adaptation and resistance to saliva (CAMPANA *et al.*, 2025).

The similarity in the radiopacity of the formulations is a practical aspect, as radiographic visibility makes it possible to confirm the correct positioning and maintenance of the dressing in post-operative situations (KIEŁBRATOWSKI *et al.*, 2025). Several studies have highlighted the importance of a formulation maintaining adequate levels of radiopacity for efficient clinical monitoring, adjusting its composition with radiopacifiers, such as bismuth oxide or zirconium, when necessary (ALRAHLAH *et al.*, 2022).

From a biological point of view, the insertion of *Cannabis (oil)* is scientifically plausible for the treatment of alveolitis, which is a local condition that causes pain and inflammation. In the preclinical sphere, cannabidiol (CBD) interferes with inflammatory mediators, reduces pro-inflammatory cytokines such as TNF-α and IL-1β, and promotes the acceleration of tissue repair processes (MULLA *et al.*, 2024). Studies have already shown that cannabidiol (CBD) can aid healing and reduce inflammation in gingival fibroblasts (CAMPANA *et al.*, 2025). According to recent reviews in the field of dentistry, CBD also has analgesic and osteoinductive properties, which are significant for the protection of the alveolus after extraction (MULLA *et al.*, 2024).

One aspect that should be emphasized is CBD's antimicrobial capacity. Studies have shown that it is active against Gram-positive bacteria such as Staphylococcus aureus and Streptococcus agalactiae (TAHSIN *et al.*, 2025). In addition, there is evidence that CBD can increase the efficacy of certain antibiotics, such as bacitracin, although the evidence for tetracycline is still limited (KIEŁBRATOWSKI *et al.*, 2025). With specific regard to oral microorganisms

associated with alveolitis, the impact of antibiofilm indicates that the application of topical formulations containing CBD may be effective in reducing bacterial colonization (KIEŁBRATOWSKI *et al.*, 2025).

About tissue safety, replacing eugenol with CBD could represent a promising alternative. Although eugenol has historically been used in ZOE-containing dressings, its cytotoxicity occurs in a dose-dependent manner, which can result in a delay in the tissue repair process (ALRAHLAH *et al.*, 2022). On the other hand, CBD proves to be more biocompatible in adequate concentrations, showing anti-inflammatory properties and acting as a modulator of the healing process (MULLA *et al.*, 2024).

From a methodological point of view, the absence of setting in the solubility test is an even stronger indicator that the formulation evaluated behaves more like a non-hardening pasty dressing than a cement. This does not imply that it cannot be applied clinically, since there are self-eliminating dressings that are recommended for the treatment of alveolitis (GAETA *et al.*, 2023). However, the literature emphasizes that clinical efficacy is more related to the local retention capacity of the material and rapid symptom reduction than to the isolated properties of an active substance (CAMPANA *et al.*, 2025).

As far as this laboratory research is concerned, the information should not be extrapolated to clinical results such as pain, frequency of dressing changes and duration of re-epithelialization. Subsequent steps involve pharmacotechnical optimization by including thickeners and radiopacifying agents, performing cytocompatibility tests on gingival fibroblasts, carrying out microbiological tests against oral pathogens and conducting comparative clinical studies in relation to standard dressings (MULLA *et al.*, 2024). The evidence of CBD's osteoinductive properties in bone repair models also indicates that it may provide other benefits that should be investigated in future studies.

CONCLUSIONS

Replacing eugenol with *Cannabis* oil did not alter the radiopacity of the compound associated with tetracycline and showed better flow, which is a desirable characteristic in this form of use.

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