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Abstract

Application of Nanotechnology for the Development of a Next Generation Dental Restorative Material †

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Abstract: The two most common oral diseases, caries and periodontal disease, are very abundant among the population of industrialized countries, having a major impact on the well-being of the population and medical service providers. Millions of people around the world suffer from toothache due to tooth decay and this often leads to permanent tooth loss. The aim of the current study is to present the development and characterization of a composite material containing a glass ionomer cement and phytosynthesized metallic nanoparticles, intended for dental applications.

Keywords: nanotechnology; dental materials; green synthesis; nanoparticles; natural compounds

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1. Introduction

Dental-related issues greatly influence the quality of life, both in the costs related to dental treatments, as well as in the discomfort experienced by most of the patients, and, last but not least, in the issues related to self-conscious emotions. One of the main problems associated with dental treatments is the durability of the materials used for dental restoration [1]. Considering those aspects, we have evaluated the potential to develop alternative dental restoration materials, using a nanotechnology approach, in order to provide enhanced antimicrobial and mechanical properties.

2. Materials and Methods

Two approaches were evaluated for the development of innovative materials: the incorporation of synthesized green into glass ionomer cements [2,3], the deposition of green nanoparticles and natural compound in an apatitic material carrier, respectively, followed by their incorporation into the glass-ionomer cements. The developed materials were characterized in terms of crystallographic structure using X-ray diffraction, antimicrobial potential, as well as physic-mechanical properties (according ISO 9917-1:2003) [4,5].

3. Results

In order to determine the antimicrobial effect, the phytosynthesized nanoparticles and the developed materials were tested on standard strains (ATCC) as well as clinical strains (CL), with sources of isolation from the sphere of the oral cavity, involved in dental pathologies (Figure 1): Pseudomonas aeruginosa ATTC 27853, Pseudomonas aeruginosa

CL, Candida albicans ATCC 10231, Candida albicans CL, Enterococcus faecalis ATCC 25212, Lactococcus lactis CL (isolated from dental plaque).

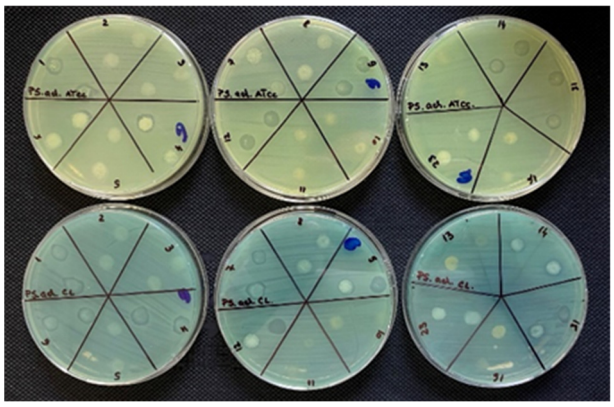

Figure 1. Antimicrobial potential of the developed materials.

4. Conclusions

The results support the conclusion that addition of metallic nanoparticles with an antimicrobial effect does not negatively affect the physical/mechanical properties of the glass ionomer cement. The final materials have superior compression strength compared to the blank sample, while also exhibiting superior antimicrobial properties.

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