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Development of new dental compositions for early treatment of dental caries

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INTRODUCTION & AIM

Dental caries remains the most common dental problem. Due to the high cost of treatment, there is a growing interest in the use of more preventive and minimally invasive biotechnological methods. Hydroxyapatite (HA), due to its excellent biocompatibility, finds wide application in dentistry as a remineralizing component. The use of enzymes is promising for the destruction of cariesogenic bacterial biofilms. The low resistance of bacteria to the action of enzymes is a great advantage of this approach.

Thus, this work is devoted to the development of new composite dental materials of prolonged action based on hydroxyapatite, enzyme-destructors and biodegradable polymers for caries treatment.

METHOD

The compositions were prepared by mixing gelatin, HA and enzymes (glucoamylase, glucose oxidase, lysozyme) in aqueous solution in a given ratio. The suspensions were poured into molds, frozen and subjected to lyophilic drying. Structural and morphological characteristics of the obtained biomaterials in the form of plates were analyzed using SEM with EDS analysis system. The absorbance and degradation kinetics of the plates were measured in PBS medium at 37 °C. Antibacterial properties were studied against microorganisms found in the oral cavity.

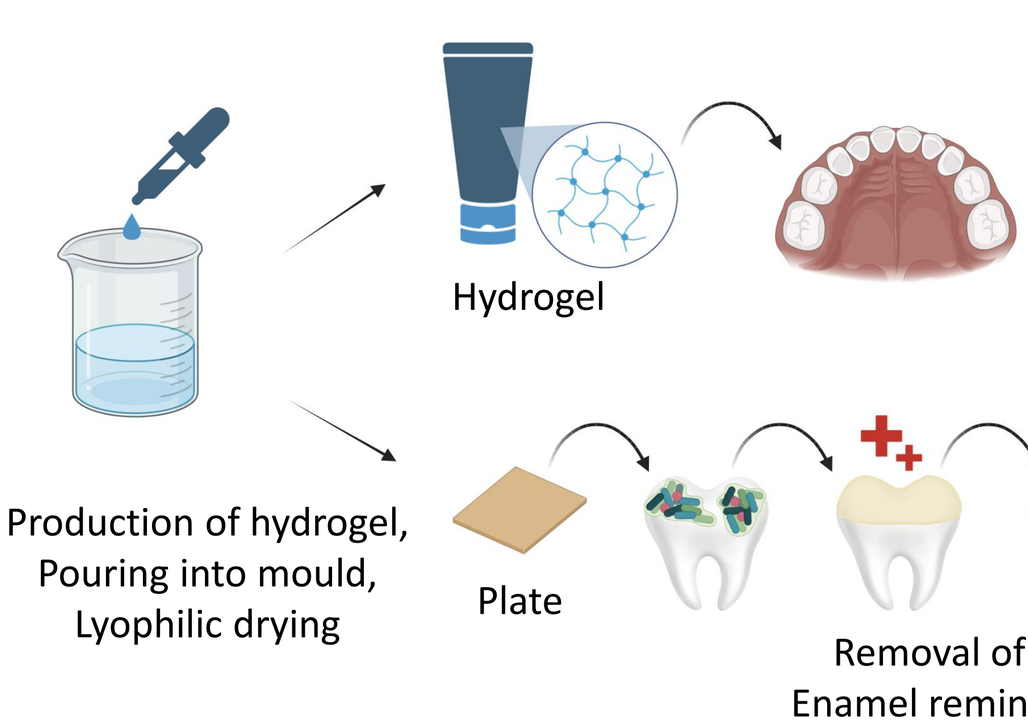

Figure 1. Scheme for the production of biomaterials in the form of hydrogels and plates

CONCLUSION

Based on the results, the obtained biomaterials are suitable for the treatment and prevention of dental caries, indicating the potential for their further in vivo study.

RESULTS & DISCUSSION

In the course of the study, new biomaterials in the form of plates were obtained, which can be active against pathogenic microflora of the oral cavity and have a mineralizing effect in the processes of restoration of damaged enamel. The plates have a slightly hydrophobic surface and their dissolution in PBS starts only after 30 min, which are positive factors for prolonged action in the composition of active components.

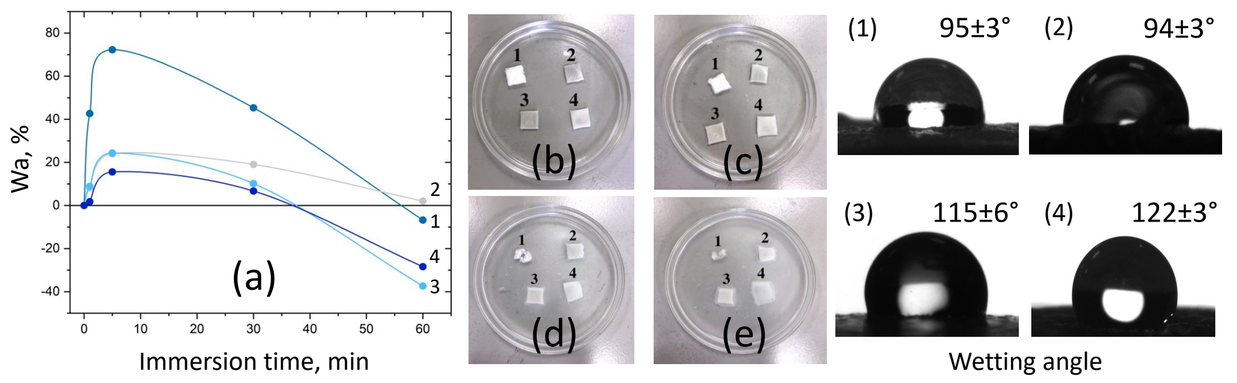

Figure 2. Kinetics of plate degradation in PBS (a) and corresponding images: at the initial moment of immersion (b); after 5 min in PBS (c); after 30 min in PBS (d); after 1 h in PBS (e); where 1 - Gel, 2 - Gel/HA; 3 - Gel/HA/Gla; 4 - Gel/HA/Gla+Ca^{2+}

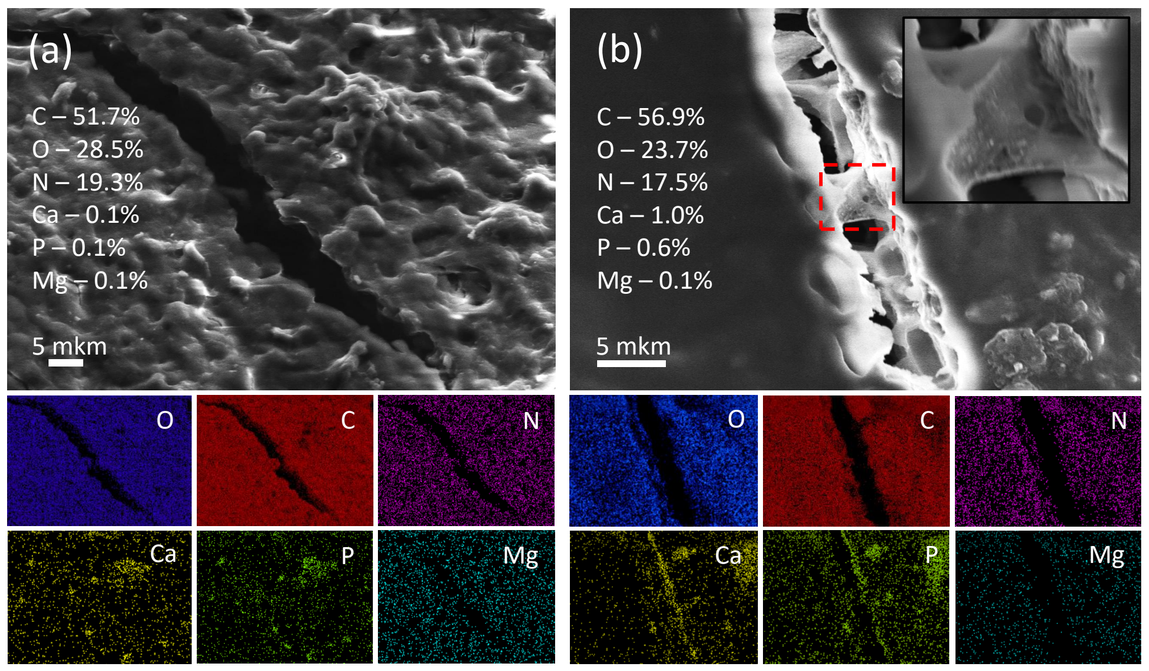

Figure 3. SEM images and corresponding EDS elemental maps of tooth surface cracks: before treatment (a) and after one treatment for 2 hours (b)

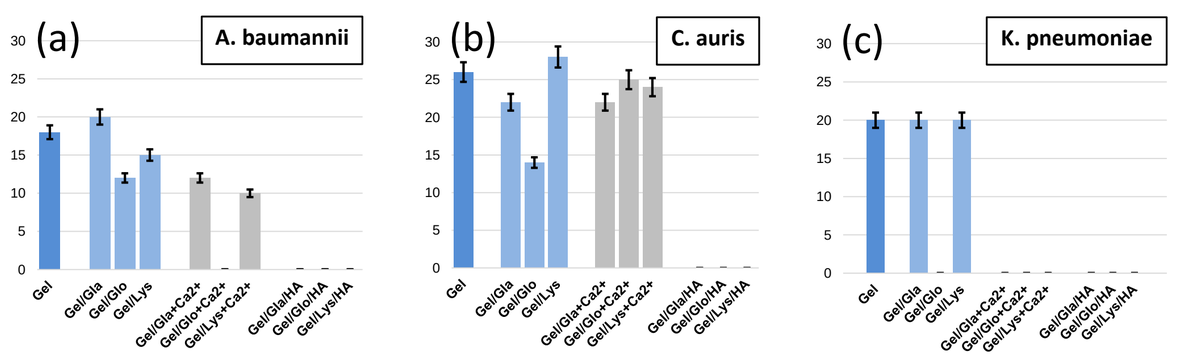

Figure 4. Evaluation of the antibacterial efficacy of the obtained biomaterials based on the diameter (mm) of the zone of inhibition of strains of (a) A. baumannii, (b) C. auris, and (c) K. pneumoniae under aerobic conditions