Student Speech Contest 2024

Incorporation of boron and strontium in silicate bioactive glasses for enhanced antibacterial properties

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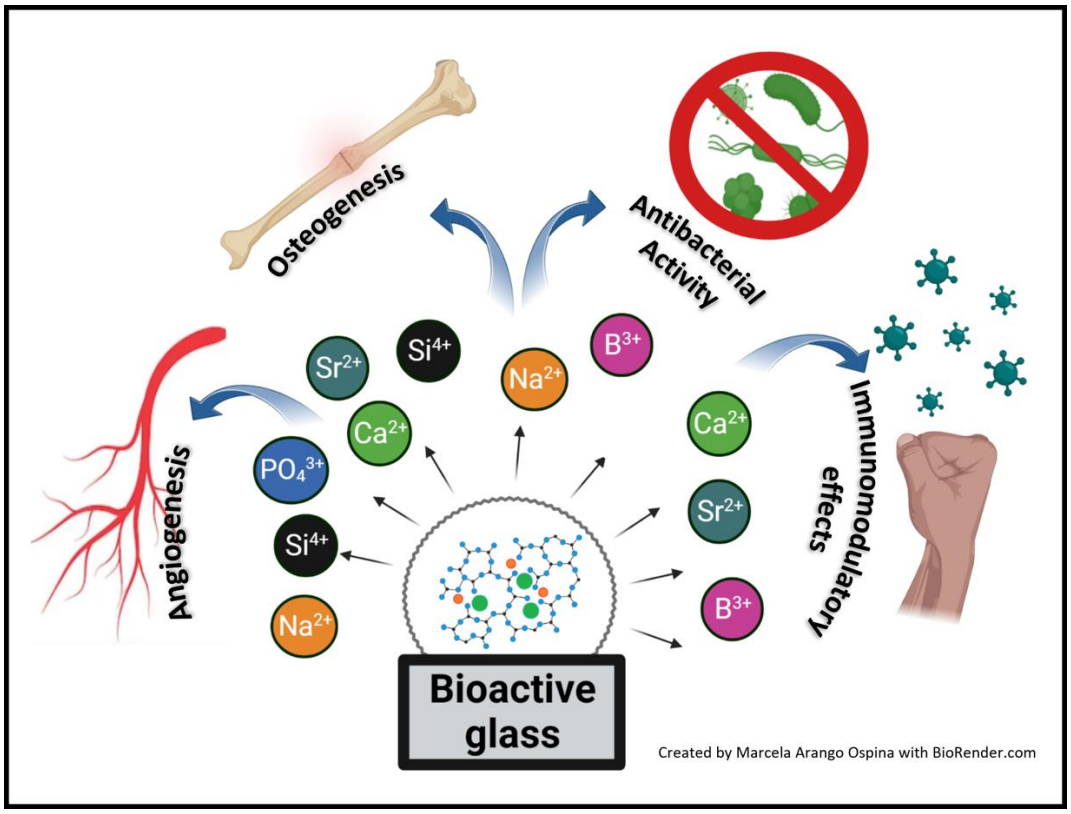
Project: Bioactive glasses incorporating therapeutic ions with antibacterial, angiogenic and osteogenic properties



Abstract

Since the discovery of bioactive glasses (BGs) in the late 1960s, research in the field of synthetic materials for bone tissue regeneration has increased [1]. This growth has been motivated by the development of new glass compositions with multiple functionalities, not only from a material perspective, but also in terms of stimulating biological responses for tissue regeneration BGs react with the surrounding environment and bond to hard tissue by forming an apatite-like layer similar to the inorganic composition of bones. Additionally, during the dissolution process, the release of ions has a stimulatory effect at the cellular level. Consequently, the addition of metallic ions to the BG composition is a potential approach to provide relevant functionalities such as antibacterial properties [2]. BGs have shown significant antibacterial properties by inhibiting the growth of a wide range of anaerobic and aerobic bacteria. The mechanism of action might be related to the increase in pH caused by the dissolution products of the material, as well as the damage to cell walls, leading to bacterial inactivation. However, it has also been reported that the specific antibacterial effect can vary depending on the BG composition and type of microorganism [3]. In this study, silicate-based BG glasses were obtained using the melt quench method. In this study, silicate-based BG glasses were produced using the melt quench method. 45S5 BG, a well-known reference material, was used alongside new compositions containing boron and strontium. The in vitro antibacterial effect of Sr and B containing BGs was quantified via turbidity measurements, counting of colony-forming units, and metabolic assays using Gram-positive and Gram-negative bacteria, S. aureus and E. coli, respectively. The results indicate that the incorporation of Sr into BGs leads to a superior antibacterial effect, highlighting the potential enhancement of standard BG compositions by adding therapeutic ions.

References:

[1] Hench L.L., J. Mater. Sci. Mater. Med. 17, 967–978 (2006).

[2] Hoppe, A., et al., Biomaterials. 32, 2757-2774 (2011)

[3] Leppäranta, Outi, et al. Journal of Materials Science: Materials in Medicine 19, 547-551 (2008).