**Development, characterization and evaluation of the biocompatibility, bioactivity and biodegradability of a polymeric nanocomposite for bone regeneration**

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**INTRODUCTION:** Millions of people suffer from degenerative problems related to fractures in bone tissues, usually due to a lack of calcium or phosphorus. The main causes are traffic accidents and advanced age (Cope *et al.,* 2019). In this sense, scaffolds are promising 3D porous structural materials for the regeneration and repair of different functional tissues (Hosseinpour *et al.,* 2019). The study and use of nanotechnology in biomaterials seek to increase their properties, making them attractive for applications in various processes involving bone tissue regeneration, for example, magnesium oxide nanoparticles (nMgO), nanobioglass (nBV), nanobioglass doped with magnesium nanoparticles (nBV-nMgO), nanostructured montmorillonite (nMMT) and montmorillonite nanoreinforcement containing nanobioglass doped with magnesium nanoparticles (nMMT/nBV-nMgO) (Druzian *et al.,* 2024). **OBJECTIVE:** In this context, the present work aims to develop and characterize a polymeric nanocomposite (HEC@nMMT/nBV-nMgO), with hydroxyethylcellulose (HEC) as the matrix and nMMT/nBV-nMgO as the reinforcement, for application in bone regeneration. **MATERIALS AND METHODS:** HEC@nMMT/nBV-nMgO was synthesized and characterized by the *in situ* polymerization technique combined with the experimental design, clustering and correlation, where the biological properties, for example, *in vitro* safety profile using OFCOL II cells, bioactivity, and biodegradability were evaluated. **RESULTS:** K-means clustering indicated 3 centroid groups with high similarity (> 78%) between [HEC] and [nMMT/nBV-nMgO]. The ideal condition was [HEC] of 1.50 w $w^{-1}$, and [nMMT/nBV-nMgO] of 0.12 w $w^{-1}$. HEC@nMMT/nBV-nMgO presented crystalline phases (Muscovite, Low Quartz, and Phosphorus Pentoxide), and textural properties of $S_{BET}$ = 0.33 $m^2$ $g^{-1}$, $V_p$ = 0.002 $cm^3$ $g^{-1}$ and $D_p$ = 31.6 nm. Cellular assays demonstrated that HEC@nMMT/nBV-nMgO ensured cellular protection after 24 hours (84.8 to 72.1%) and increased cellular protection after 72 hours (0.1% to 170.3%), being considered non-cytotoxic (<70%) compared to the negative control. HEC@nMMT/nBV-nMgO showed weight loss of approximately 65.7% after 56 days due to $Mg^{+2}$ and $K^+$ ions masking the partially hydrophobic effect of HEC. **CONCLUSION:** Therefore, it was possible to synthesize a polymeric nanocomposite with possible properties suitable for use in the area of bone regeneration.

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**References:**

COPE, P.J. *et al.* Models of osteoarthritis: the good, the bad and the promising. **Osteoarthritis Cartilage**, v. 27, p. 230-239, 2019.

DRUZIAN, D.M *et al.* Fabrication and Properties of the Montmorillonite/Nanobioglass Hybrid Reinforcement from Agroindustrial Waste for Bone Regeneration. **ACS Applied Materials & Interfaces**, v. 16, p. 19391-19410, 2024.

HOSSEINPOUR, S. *et al.* Molecular impacts of photobiomodulation on bone regeneration: a systematic review. **Progress in Biophysics and Molecular Biology**, v. 149, p. 147-159, 2019.