Advanced nanomaterials for bone regeneration

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Abstract

Nanomaterials represent a very important category of materials used in medical engineering. Regarding bone regeneration, the most used nanomaterials are based on hydroxyapatite because it has a similar composition to bone and is also found at the bone level. This doctoral thesis aimed to synthesize new nanomaterials based on hydroxyapatite with antimicrobial effect. It was aimed at the nanomaterials, which also have an antimicrobial effect because infections due to bacteria can occur during operations at the level of implants. Two studies were carried out, the first being based on hydroxyapatite substituted with magnesium and cerium; the hydrothermal method assisted in the microwave field was used for the synthesis, with multiple advantages such as the control of particle morphology and size. The results obtained from this study demonstrated the antimicrobial effect on certain bacterial lines without producing a cytotoxic effect on the bacteria; also, the hydroxyapatite nanoparticles obtained had a wand-type shape, changing once with the addition of magnesium or cerium. In the second study, a nanocomposite was created based on hydroxyapatite and zinc oxide, containing thyme essential oil and rosemary essential oil. The results demonstrated that the samples had an antimicrobial effect, and the two oils inhibited the cytotoxic effect of zinc oxide, increasing cell viability at the level of osteoblasts; the zinc oxide had a "flower" type morphology covered by hydroxyapatite nanoparticles. In conclusion, the aim of the work was achieved by obtaining nanomaterials for bone regeneration with an antimicrobial effect.