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Cu nanoparticles/PVC composites: Thermal, rheological and antibacterial properties

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The effect of Cu nanoparticle (NP) content (0.3-3.0 wt.%) on antibacterial, thermal and rheological properties of PVC composites prepared by melt blending method was investigated. The composites were characterized by scanning electron microscopy (SEM) with energy dispersive X-ray spectroscopy (EDX), transmission electron microscopy (TEM), capillary rheology, thermogravimetric analysis (TGA) and inductively coupled plasma atomic emission spectroscopy (ICP-OES). A homogeneous distribution of copper on the composite surface was observed by SEM-EDX. TEM images of Cu NPs/PVC composite films showed well-dispersed and distributed Cu NPs and microparticles in the PVC matrix, but the size of particles increased with increasing copper content. The shear thinning and power law behavior were observed for all samples. At low shear rates ($100s^{-1}$) apparent viscosity of composites with copper loading lower than 1.2 wt.% exhibited a "ball bearing" effect. The Cu particles enhanced the thermal stability of Cu NPs/PVC composites compared with neat PVC. The copper ion released from Cu NPs/PVC composite films into the aqueous medium was negligible after 6 h of immersion. Polymer films with Cu NP amount higher than 0.6 wt.% showed a similar kinetics of bacterial growth therefore a substantial improvement of antimicrobial activity was not observed with increasing Cu NP content.

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Chitosan and derivatives modified with HAp/ß–TCP microparticles and nanoparticles

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Bone repair or regeneration is a common and complicated clinical problem in orthopedic surgery. The importance of chitosan and its derivatives and calcium phosphates has grown significantly over the last two decades due to its renewable and biodegradable source, increasing in the knowledge of its functionality in the technological and biomedical applications. The properties of bone in health and disease attract much attention. With an ever greater proportion of the population need those medical devices for hard tissue regeneration and/or replacement, making the pressure on the health systems in all countries. Aging, diseases, fractures and demineralization are musculoskeletal disorder, which contribute and improve the suitability and developments of new materials and methods in hard tissue engineering. The excellent biocompatibility, biofunctionality, and non-antigenic property make those materials a good choice for hard tissue regeneration. This work has shown the composites of chitosan and its derivatives with calcium phosphates in different forms (sponge, fibres) containing organic and inorganic materials, including chemical characterisation, mechanical properties, particles size, morphology, solution stability and also a new method to obtain nanoceramic formation in chitosan solution. All sponge preparations, with MCCh/ß-TCP have a well-shaped 3-dimentional structure, a highly porosity and interconnected, homogenous pore structure to ensure a biological environment conducive to cells attachment and proliferation and passage of nutrient flow. The fibres form showed nanoceramic formation with two different kinds of calcium phosphates, great mechanical properties performance in wet conditions and not finishing agent was required in the wet spinning process of fabrication. These materials can be used in future for medical applications as a base for scaffolds production as implants in regenerative medicine.

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