Polyhydroxyalkanoates nanocarriers: a platform for hydrophobic bioactive delivery

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Polymer nanoparticles (NPs) have gained interest in environmental, sensing and biomedical applications. As far as the latter, nanosystems can encapsulate and vehiculate bio-active molecules that are toxic in systemic administration or insoluble in physiological fluids, such as hydrophobic ones. In the design of a drug delivery system, biocompatibility is a key factor that drives the choice of materials, chemicals and processing to avoid or reduce side effects. Polyhydroxyalkanoates (PHA), are interesting polymers due to their non-immunogenicity. However, their hydrophobicity causes NPs aggregation reducing the compatibility towards living systems. Surfactants are essential excipients in NP preparation as they increase the wettability of matrices, ensure dimensional stability and dispersion and help cellular interaction. In this work, poly-3hydroxybutirate-co-3hexanoate (PHBH) has been chemically modified using the ionic liquid choline taurinate ([Ch][Tau]) as a non-cytotoxic and eco-friendly reagent. More in detail, PHBH chains have been cleaved and functionalized by aminolysis exploiting the amino group of [Ch][Tau] as a nucleophilic agent with the scope to obtain amphiphilic molecules with a self-surfactant behaviour. Sulfonated chains with different hydrophobic tail lengths were obtained in non-toxic ethyl acetate/ethanol medium by varying the molar ratio between PHBHHx repeating units and [Ch][Tau]. NPs were then prepared by an oil-in-water emulsion and solvent evaporation method. The safety of the chemicals used has made it possible to avoid the time-consuming and complex purification process. The aminolysis reaction product was characterized by GPC, FTIR and the NPs by dynamic Light Scattering DLS. The NPs were loaded with usnic acid, and the drug uptake was evaluated by UV-vis spectroscopy. The study of in vitro biological activity is currently under investigation.