Use of Clay-Based Bionanocomposites as Drug Delivery Systems

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Abstract

Clay-based bionanocomposite materials attract much research for numerous applications ranging from bioplastics in food-packaging to uses in biomedicine [1]. In this last research field, biopolymers are relevant components that combined with clays of diverse structure, in which bioactive species are previously incorporated, may produce materials of interest as drug delivery systems (DDS) [2]. In these DDS the clay component can be a layered (e.g. smectites) or a fibrous silicate (sepiolite & palygorskite), a tubular container, as it is in the case of halloysite, or layered double hydroxides (LDH), also known as anionic clays. The biopolymeric counterpart is frequently a polysaccharide, as for instance alginate, though proteins can also be used. The association of clays and biopolymers attempts to combine the advantages offered by each of them to produce more efficient and even targeted DDS. In this context, the present communication will introduce various examples of DDS based on the assembly of clay minerals to biopolymers, developed in our Group, addressed to illustrate the relevance and potential of bionanocomposites in biomedicine. For instance, the incorporation of gentamicin intercalated in montmorillonite into a hydrophilic biopolymer, e.g., hydroxypropylmethyl cellulose, may contribute to increase mechanical and other properties of the polymer matrix. Similarly, the bioactive component can be incorporated in the lumen of halloysite nanotubes that can be further assembled to sepiolite and cellulose nanofibers to produce bionanocomposite films for wound dressing applications [3]. The combination of biopolymers of opposite wetting behaviour, for instance alginate and zein, allows the production of bionanocomposite beads with controllable speed of release for oral administration of ibuprofen intercalated into a LDH [4]. Moreover, the possibility to produce core-shell beads combining biopolymers has been applied to prepare bionanocomposite systems that combine pectin and chitosan biopolymers to target the oral administration of mesalazine or metformin drug in the intestinal tract [5,6].

References

[1] E. Ruiz-Hitzky, P. Aranda, M. Darder (2008), in Kirk-Othmer Encyclopedia of Chemical Technology, John Wiley & Sons http://onlinelibrary.wiley.com/doi/10.1002/0471238961.bionruiz.a01/abstract).
[2] E. Ruiz-Hitzky, M. Darder, B. Wicklein, F.A. Castro-Smirnov, P. Aranda (2019), *Clays Clay Miner.* 67, 44.
[3] L. Lisuzzo, B. Wicklein, G. Lo Dico, G. Lazzara, G. del Real, P. Aranda, E. Ruiz-Hitzky (2020), *Dalton Trans.* (*in press*).
[4] A.C.S. Alcântara, P. Aranda, M. Darder, E. Ruiz-Hitzky (2010), J. *Mater. Chem.* 20, 9495.
[5] L.N.M. Ribeiro, A.C.S. Alcântara, M. Darder, P. Aranda, F.M. Araújo-Moreira, E. Ruiz- Hitzky (2014), *Int. J. Pharm.* 463, 1.
[6] E.P. Rebitski, M. Darder, R. Carraro, P. Aranda, E. Ruiz-Hitzky (2020), *New J. Chem.* (under revision).

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