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Editorial Note on encapsulated hydrogels for Biomedical

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EDITORIAL NOTE

Hydrogels are three-dimensional hydrophilic networks with proven potential for applications in medicine and pharmaceutics. Biopolymer-based hydrogels clearly provide some advantages in terms of biocompatibility and biodegradability over synthetic polymers. Hydrogels are able to easily encapsulate and release various hydrophobic and hydrophilic therapeutic molecules, including nucleic acids, proteins and antibodies, in a controlled release manner, because of their inherent properties. In the literature, several approaches have been reported to minimize the possible burst release of encapsulated drugs, thus preventing their local accumulation and consequent toxic responses. Liposomes embedded in hydrogels have emerged in this context as an attractive strategy for reducing this undesirable effect. This tutorial analysis covers a collection of the most promising biopolymer-based cationic, neutral and anionic hydrogels containing liposomes, niosomes or vesicles for applications in drug delivery or tissue engineering.

Over the past few decades, the development of novel approaches for drug delivery, tissue engineering and Nano biotechnology has been stimulated by synthetic progress towards the manufacture of new polymeric materials that react to external stimuli (e.g. temperature, light and pH). This responsiveness to the environment induces substantial changes in the physicochemical and self-assembling properties of such macromolecular systems, which can be used to facilitate the encapsulation/release of active molecules. Indeed, there are several examples in the literature where synthetic polymers have been used in conjunction with small drugs, either as therapeutic macromolecules or as drug delivery vehicles.

Polymeric hydrogels are hydrophilic 3D polymer networks that, close to body tissues, can absorb significant quantities of water. This property enables hydrogels to encapsulate and protect therapeutic molecules against rapid degradation, making them useful for pharmaceutical and medical purposes. Their capacity to release trapped therapeutic molecules in a well-controlled manner is another valuable aspect of many polymeric hydrogels. This property is generally regulated by passive processes of diffusion and may also depend on additional variables (e.g., cross-linking degrees, hydrogel mesh sizes, stimuli-sensitive hydrogel capacity, etc.). The risk of receiving unintended initial release of the substance directly following interaction with the release medium is one significant factor to take into consideration during release experiments. Hydrogels are graded according to many attributes. They will, for instance, be categorized on the basis of ionic charges (neutral, anionic, cationic or ampholytic hydrogels), the nature of side groups (e.g. neutral or ionic), their physical composition (e.g. amorphous, semi-crystalline, hydrogen-bonded structures, super-molecular structures and hydro-colloidal aggregates), the nature of the crosslink (e.g. chemical or physical) and the process of their preparation (e.g., homo- or co-polymers).