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Modeling of the Behavior of Natural Polysaccharides Hydrogels for Bio-pharma Applications

Diego Caccavo, Sara Cascone, Gaetano Lamberti, Annalisa Dalmoro and
Anna Angela Barba

Abstract - Hydrogels, even if not exclusively obtained from natural sources, are widely used for pharmaceuticals and for biomedical applications. The reasons for their uses are their biocompatibility and the possibility to obtain systems and devices with different properties, due to variable characteristics of the materials. In order to effectively design and produce these systems and devices, two main ways are available: i) trial-and-error process, at least guided by experience, during which the composition of the system and the production steps are changed in order to get the desired behavior; ii) production process guided by the a-priori simulation of the systems' behavior, thanks to proper tuned mathematical models of the reality. Of course the second approach, when applicable, allows tremendous savings in term of human and instrumental resources.

In this mini-review, several modeling approaches useful to describe the behavior of natural polysaccharide-based hydrogels in bio-pharma applications are reported. In particular, reported case histories are: i) the size calculation of micro-particles obtained by ultrasound assisted atomization; ii) the release kinetics from core-shell micro-particles, iii) the solidification behavior of blends of synthetic and natural polymers for gel paving of blood vessels, iv) the drug release from hydrogel-based tablets. This material can be seen as a guide toward the use of mathematical modeling in bio-pharma applications.