Desorption electrospray ionization high-resolution mass spectrometry for the fast investigation of natural polysaccharide interactions with a model drug in controlled release systems

Lisa Elviri*, Simona DeRobertis, Stefania Baldassarre and Ruggero Bettini
Department of Pharmacy, University of Parma, Parco Area delle Scienze 27/A, 43124, Parma, Italy

RATIONALE: The control of drug release involves gaining an understanding of the complex interaction networks among drug-excipients-matrix-biological fluids. Thus, novel analytical methods that will lead to a better understanding of these interaction networks are urgently required.

METHODS: Desorption electrospray ionization high-resolution mass spectrometry (DESI-HRMS) was used to evaluate the behaviour of four biocompatible polysaccharides (chondroitin sulfate, chitosan, sodium alginate and κ-carrageenan) in the release of atenolol (ATN) from drug tablets. An aqueous solution at three different pH values (pH 7.4, 4.5 and 1.2) was electrosprayed onto the tablets, allowing direct, fast, sensitive detection of atenolol as the protonated molecule in positive ion mode. Information about the desorption mechanism was obtained by analyzing the ATN [M+H]+ ion signal as a function of time. ATN–polymer interactions in the drug/polymer mixtures were also studied by Horizontal Attenuated Total Reflectance (HATR) Fourier transform infrared (FTIR) spectroscopy.

RESULTS: The DESI-MS results revealed statistically different ATN desorption trends as a function of the polysaccharide investigated and the pH of the desorbing solution. Different release kinetics were ascribed to the drug–polymer interactions, and to the diffusion process of the drug through the hydrated polymer mesh. In particular, the alginate and κ-carrageenan matrices were able to sustain drug release from the tablet even for a highly soluble drug. The HATR results confirmed the presence of ATN–polymer interactions that, depending on the polymer–drug-solvent combination used, might affect ATN diffusion.

CONCLUSIONS: These results suggest that DESI-MS has a potential role for the micro-environmental analysis of drug diffusion and surface distribution in polymeric matrices. Copyright © 2014 John Wiley & Sons, Ltd.