Chitosan Nanocapsules loaded with Aloe-Emodin for Cancer Treatment

Anastasia Fornari [1,2], Marco Rossi [1], Leonardo Mattiello [1], Fabiana Pandolfi [1], Federico Purificato [3], Daniela De Vita [4], Marisa Colone [5], Annarita Stringaro [5]*

[1] Department of Basic and Applied Sciences for Engineering, Sapienza University of Rome, Via Antonio Scarpa 16, 00161 Rome, Italy

[2] Nanoshare S.r.l., Via Foscolo 24, 00185 Rome, Italy

[3] Scuola Normale Superiore di Pisa, Nanoscience, Fondazione Istituto Italiano di Tecnologia, Via Piazza dei Cavalieri, 7, 56126 Pisa, Italy

[4] Department of Environmental Biology, Sapienza University of Rome, P.le A. Moro 5, 00185 Rome, Italy

[5] National Center for Drug Research and Evaluation Italian, National Institute of Health (ISS), Viale Regina Elena, 299, 00161 Rome, Italy

anastasia.fornari@uniroma1.it

Millions of deaths are caused every year by cancer, which is one of the most widespread diseases in the world. New innovative therapies have been developed by nanomedicine in recent years to address this issue, specifically using drug delivery methods and approaches. Among the many materials used to create nanocarriers, biopolymers like chitosan are widely utilized. The aim of this work is to describe the synthesis of chitosan nanocapsules (NCs) and the encapsulation of anticancer compounds. Two substances have been chosen: doxorubicin (DOX), a drug largely employed in the treatment of cancer for decades, and aloe-emodin (AE), an anthraquinone isolated from the plant of *Aloe vera* L., that has been shown to have a strong anti-carcinogenic effect. The commercially available *A.vera latex* was used to extract AE. The obtained Dox-loaded and AE-loaded chitosan NCs were characterized by Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), and Dynamic Light Scattering (DLS). Moreover, UV-vis spectroscopy was used to analyze the encapsulation efficiency of these nanomaterials. Finally, cytotoxicity and in vitro release studies of active agents have been conducted on the cell line of human adenocarcinoma breast MDA-MB-231. The results obtained showed that doxorubicin and aloe-emodin were released gradually from NCs over time and with a dose-dependent effect, resulting in a significant reduction in cellular viability. Moreover, immunofluorescence observations have revealed the uptake of DOX-NCs and AE-NCs in MDA-MB-231 cells and their localization both in the cytoplasm and in the nuclear region.

Keywords: Nanocapsules; Aloe-emodin; Doxorubicin; drug delivery; nanotechnology; nanomaterials; anticancer.