Nanomaterials

POLYMERIC CYD-BASED FOR THE DELIVERY OF MULTIPLE THERAPEUTIC AGENTS TO TREAT SEVERE DISEASES

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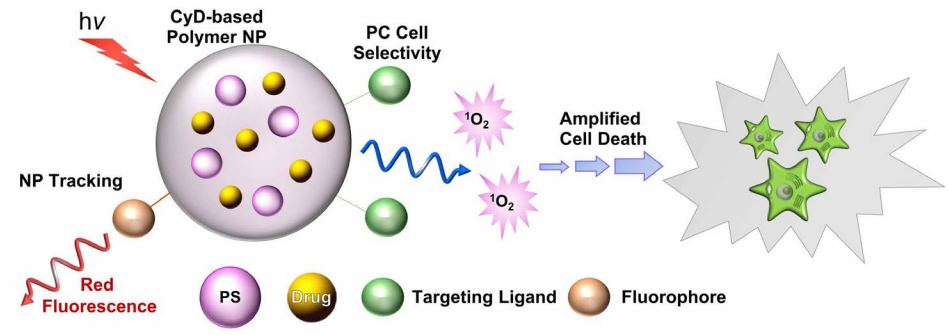
Drug-resistant cancer and bacterial infections are two of the main health threats that human kind is facing. In fact, cancer causes nowadays 9.6 million deaths/year and drug-resistant infections are expected to reach the same figures by 2050. On this basis, Europe is engaged in supporting an increasing number of projects proposing innovative solutions to overcome the drawbacks of traditional therapeutic agents.
The ITN Cyclon Hit and the MSCA-IF Polar Star were two examples of this European commitment focusing on cyclodextrin (CyD)-based nanocarriers to encapsulate, protect and potentiate traditional free drugs to fight resistant bacteria and prostate cancer, respectively (Scheme 1).
In the frame of Cyclon Hit project, we developed biocompatible and biodegradable polymeric CyD nanoparticles (pCyD NPs) able to coencapsulate two potent anti-tuberculosis molecules which are insoluble in biologically-compatible solvents. The formulation process was complicated by the completely different physico-chemical properties of the two active agents and by the strong tendency to crystallize of one of them. The developed carriers were spectroscopically characterized proving that the drugs were encapsulated at a molecular level not only in the CyD cavities but also in the intermingled polymeric chains. The efficacy of the developed NPs was demonstrated in vitro and in vivo. In particular, the aerosolized NPs suspension led to a 3-log decrease of the pulmonary bacterial load of infected animals after only 6 administrations. Impressively, the unloaded pCyD NPs exhibited themselves a good antibacterial effect contributing to the action of the two active molecules.
Within the project Polar Star, CyD-based NPs were tailored to increase the effectiveness and the specificity of Cabazitaxel against castrate-resistant prostate cancer. The NPs are composed of innovative mixed polymers combining α, β and γ-CD in single polymers to improve loading capacity of cabazitaxel with other therapeutic agents acting across multiple oncogenic pathways.[1-3]



Scheme 1

1. Machelart A., Salzano G., Li X., Demars A., Debrie A-S., Menendez-Miranda M., Pancani E. et al. *ACS Nano*, **2019**, 13, 3992-4007.
2. Costa-Gouveia J., Pancani E. et al. *Sci. Rep.*, **2017**, 7, 5390.
3. Wankar J., Salzano G., Pancani E. et al. *Int. J Pharm.*, **2017**, 531, 568-576.

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