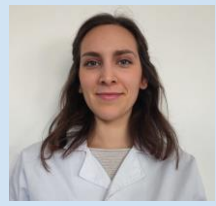
Development and application of micro- and nanotechnologies for cancer therapy



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Nanotechnologies in Cancer Therapy

Concept

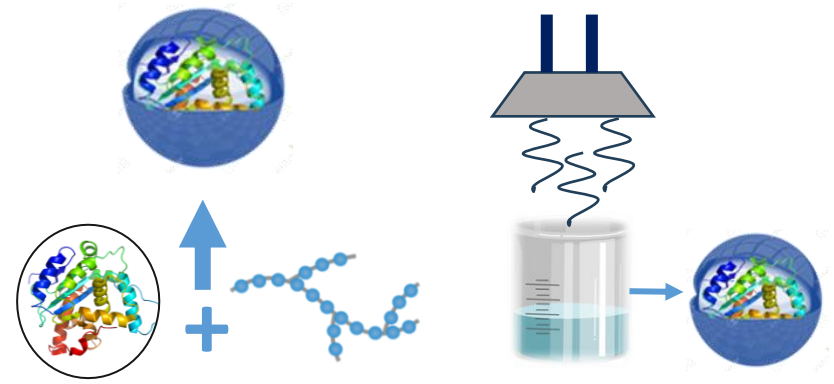
Cancer remains a significant global health challenge, accounting for nearly 10 million of deaths in 2020, whose incidence and mortality cases are steadily increasing. Conventional chemotherapy is the most common approach in the treatment of the disease, but it is hindered by the lack of selectivity towards cancerous cells and the premature drug degradation, resulting in the administration of higher doses of chemotherapeutis and leading to drug resistance, which commonly determines the failure of the treatment. Both micro- and nanoparticles can be optimized to respond to this issue, selectively targeting the affected cells, protecting the administered drug, and increasing its efficacy, as an innovation in the field of precision medicine**.** Moreover, these systems are designed to release the compounds upon exposure to several possible types of triggers, such as a change in pH values or the presence of a reducing environment, that only occur near the area of interest or within tumor cells, making delivery of the therapeutic agent even more specific.

Scientific approach

The synthesis and selection of degradable coatings for lytic enzymes and the synthesis of electron-beam irradiated nanogels will be performed. Both the nanogels and the drug delivery system for lytic enzymes will then be functionalized and linked to bioactive molecules via bioconjugation reactions, such as pH-sensitive and glutathione-sensitive linkers, chemotherapeutics and targeting agents. The final steps of the project will involve the validation of the produced systems on 2D and 3D breast cancer cell cultures, and the evaluation of tumor regression in vivo after the combined treatment.

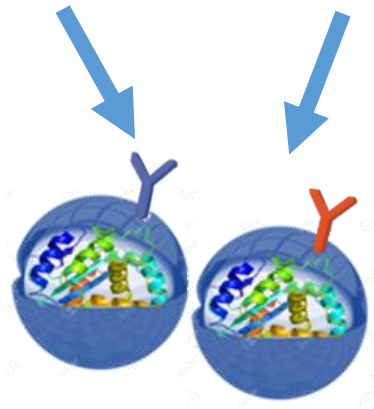
Research objectives

The project aims to develop "smart" micro- and nanoparticles targeting cells, inducing controlled release of associated molecules. Enzyme coatings will decompose solid tumor matrices, improving access to therapeutic compounds. Coatings deactivate enzymes, removed upon reaching tumor extracellular matrix. Future research will explore their use in cellular systems and animal models.

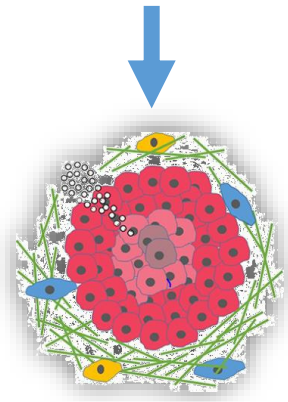


1. Synthesis and selection of degradable coatings for lytic enzymes.

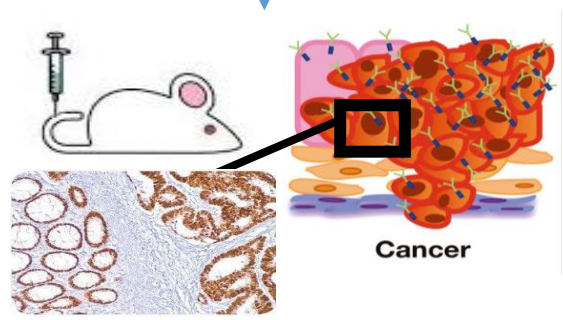
2. Synthesis of electron-beam irradiated nanogels.



3. Generation and selection of functionalized nanoparticles capable of targeting cells (red) or the extracellular matrix (blue).



4. In vitro nanoparticles validation on 2D and 3D cell cultures.



5. In vivo validation of tumor regression after treatment.