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PROJECT TITLE
Innovative Systems for Localized Delivery of Anticancer Drugs: From Development to Preclinical Validation

Project description
Cancer remains one of the major global public health challenges, with incidence steadily increasing. Conventional therapies (e.g., chemotherapy and radiotherapy), as well as more advanced approaches such as immunotherapy, often show limited efficacy, particularly in advanced or recurrent solid tumors [1].
Despite their potential, current treatments face significant limitations, primarily due to their lack of selectivity. This non-specific action causes damage to healthy cells, leading to side effects and systemic toxicity. Such effects are mainly attributable to the mechanism of action of most chemotherapeutic agents, whose efficacy relies on cytotoxic processes aimed at inhibiting cell proliferation.
As cytotoxicity is intrinsic to anticancer drugs, improving targeting strategies to selectively affect only cancer cells remains a key objective in oncology research. Additional challenges include the poor solubility of active compounds and the limited effectiveness of systemic administration routes.
To overcome these issues, research is increasingly focused on the development of advanced localized drug delivery systems, capable of releasing therapeutic agents directly to the tumor site, even in anatomically inaccessible areas. Among the most promising solutions are implantable, bioadhesive, or microneedle-based devices [2-4], which offer an innovative and targeted alternative to conventional administration routes. This approach could significantly reduce systemic toxicity and enhance therapeutic efficacy. An emerging evolution of these systems lies in the theranostic field, where therapeutic and diagnostic functionalities are integrated into a single platform. These multifunctional systems offer the potential for real-time monitoring, greater therapeutic precision, and improved patient quality of life, thanks to their high tolerability and safety.
To validate these technologies, the use of biomimetic three-dimensional models that replicate the tumor microenvironment in vitro is essential. Compared to traditional 2D cultures, 3D models provide a more realistic representation of in vivo conditions [5-6], enabling more accurate assessment of drug delivery performance, diffusion dynamics, and therapeutic efficacy.

REFERENCES
[1] Miller KD, Nogueira L, Mariotto AB, Rowland JH, Yabroff KR, Alfano CM, Jemal A, Kramer JL, Siegel RL. CA Cancer J Clin. 2019, 69, 363-385.
[2] De Martino S, Battisti M, Napolitano F, Palladino A, Serpico L, Amendola E, De Stefano L, Dello Iacono S. Biomaterials Advances. 2022, 142, 213169.
[3] Miranda B, Battisti M, De Martino S, Nocerino V, Dardano P, De Stefano L, Cangiano G. Hollow. Adv. Mater. Technol. 2023, 8, 2300037.

[4] Serpico L, Dello Iacono S, Cammarano A, De Stefano L. Gels 2023, 9, 451.
[5] Fasolino I, Bonadies I, Ambrosio L, Raucci MG, Carfagna C, Caso FM, Cimino F, Pezzella A. ACS Appl Mater Interfaces. 2017, 9, 40070-40076.
[6] D'Amora U, Scialla S, Fasolino I, Ronca A, Soriente A, De Cesare N, Manini P, Phua J W, Pezzella A, Raucci MG, Ambrosio L. Biomaterials Advances, 2025, 170, 214214.

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