

April 15, 2026

Dual drug-loaded polymeric mixed micelles for pancreatic cancer: A QbD-based approach



Inês Sousa-Oliveira

LAQV REQUIMTE, Department of Pharmaceutical Technology, Faculty of Pharmacy of the University of Coimbra, University of Coimbra, Coimbra, Portugal.
uc2015240665@student.uc.pt

Pancreatic cancer (PC) is one of the tumors with the highest mortality rates worldwide. [1, 2] Paclitaxel (PTX) is one of the drugs approved by FDA for the first-line treatment of patients with metastatic adenocarcinoma of the pancreas. [3-5] However, its toxicological profile and the subsequent side effects hamper its therapeutical efficacy. In this sense, our study envisaged the integration of PTX into polymeric micelles, which constitute a very promising class of nanomaterials with excellent properties, including smaller size, tunable hydrophobicity/hydrophilicity ratio, longer shelf life, better penetration into deeper tumor regions and easy functionalization with tumor-specific ligands (such as sugars, peptides or even monoclonal antibody molecules), enabling additional targeting. [6-8]

To further improve the therapeutic outcomes of PTX, the nanosystem was further designed to incorporate an immunomodulator capable of modulating the dense and desmoplastic microenvironment characteristic of PC.

An efficient and optimized nanosystem was developed based on Quality by design (QbD) approach, ensuring batch-to-batch consistency and providing a robust foundation for clinical translation in an evolving regulatory landscape. [9-11] The optimal formulation presented a small particle size and low polydispersity, improved dilution stability and low critical micelle concentration (CMC). Furthermore, to promote long-term stability, this formulation was further lyophilized, demonstrating good reconstitution after freeze-drying.

The release profile exhibited an initial burst of up to 30% for PTX, followed by a progressive release

over 144 hours, while IND release demonstrated a rapid profile, reaching values of at least 80% within 24 hours.

The cytotoxic potential of the formulated micelles was superior to that of the drugs alone, as assessed by MTT assays on pancreatic cell lines. Furthermore, in normal cell lines, the formulation demonstrated a significant less cytotoxic potential compared to the free drugs.

In conclusion, the developed nanomicelles for co-delivering PTX and IND show promising results in improving therapeutic outcomes in pancreatic cancer treatment.

Short Bio

Inês Sousa-Oliveira is a final-year PhD student in Pharmaceutical Technology in the Faculty of Pharmacy of the University of Coimbra. During her PhD, Inês expanded her research internationally by working in prestigious universities, as the University of Santiago de Compostela and the University of Strathclyde, where she gained invaluable expertise in the drug delivery systems. She has been co-authored in several scientific papers on drug delivery systems published in high-impact journals.

Inês also has experience in Pharmaceutical Industry, particularly in the Research and Development field, where she worked until 2023. This experience has been marked by the perception of the importance of improving and preserving human life and health through the development, production, and marketing of pharmaceutical products with a strong focus on quality and technological innovation.

Acknowledgements

This work received financial support from FCT/MCTES (Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior), ESF (European Social Fund) through NORTE 2020 (Programa Operacional Região Norte) and LAQV/REQUIMTE for PhD grant ref. 2022.12155.BD.

Webinar Host

Cláudia Nunes, Nanoplatforms for Life Group

More details here: <https://laqv.requimte.pt/gazette/>