

Multifunctional microencapsulation of phenethyl isothiocyanate targeting colon inflammation

Ana Sofia Sousa^{1*}, Ezequiel R. Coscueta¹, Celso A. Reis^{2,3,4}, Manuela Pintado¹

¹Universidade Católica Portuguesa, CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Rua Diogo Botelho 1327, 4169-005 Porto, Portugal; *assousa@ucp.pt.

²i3S – Instituto de Investigação e Inovação em Saúde, University of Porto, 4169-005 Porto, Portugal;

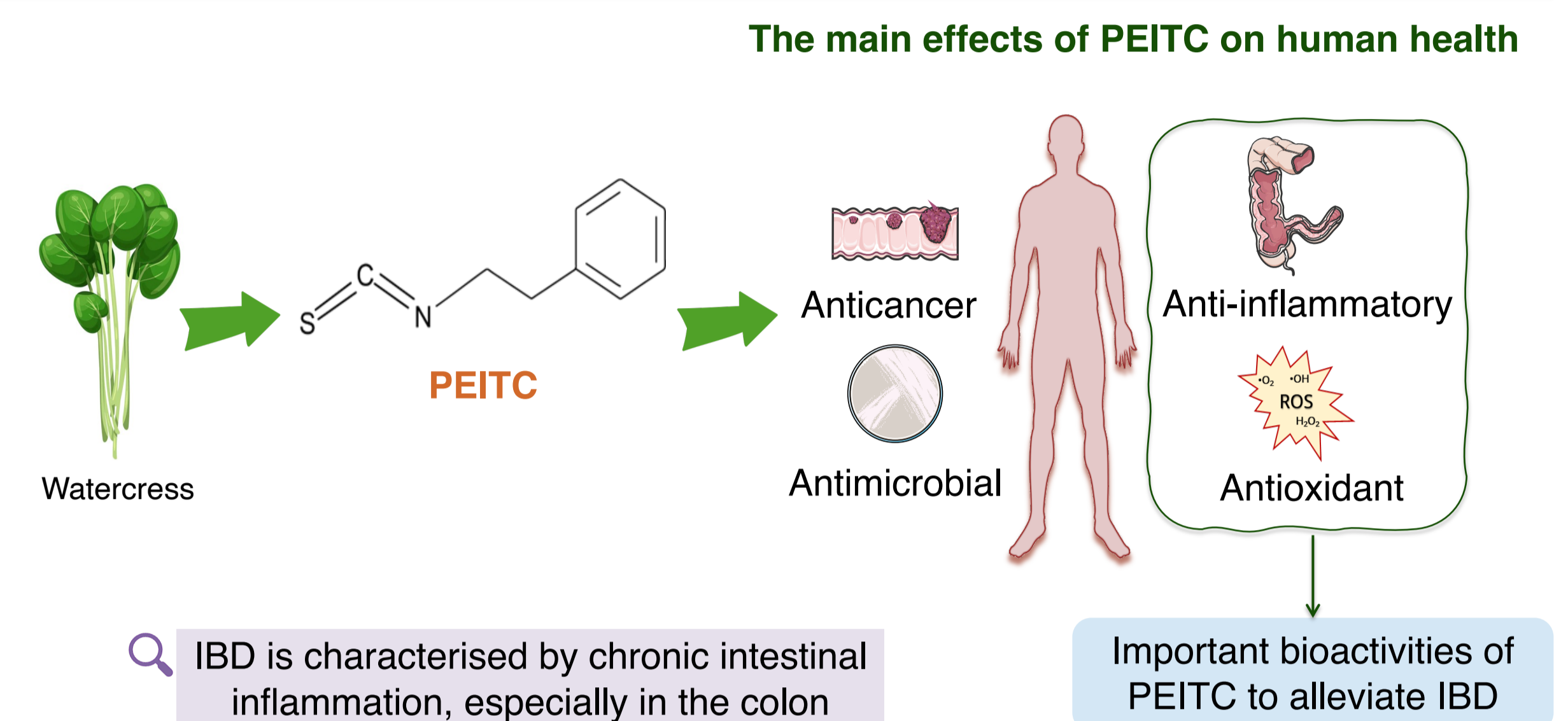
³IPATIMUP – Institute of Molecular Pathology and Immunology, University of Porto, 4169-005 Porto, Portugal;

⁴Medical Faculty, University of Porto, Al. Prof. Hernâni Monteiro, 4169-005 Porto, Portugal.



Background

Inflammatory bowel disease (IBD), including Crohn's disease and ulcerative colitis, is a global disease in the 21st century, with considerable morbidity and healthcare costs^{1,2}. Hence, there is a need to develop efficient solutions to alleviate IBD with minimal impact on patient quality of life and the environment. The combination of phytochemicals, such as the chemopreventive phenethyl isothiocyanate (PEITC) and microencapsulation, appears to be a promising alternative to the conventional drug to prevent and treat diseases^{3,4}. Furthermore, PEITC can be found in watercress and is a promising compound to alleviate inflammation of intestinal regions, mainly due to its antioxidant and anti-inflammatory properties. This is important, particularly considering the microenvironment around disease sites is marked by high levels of reactive oxygen species (ROS) and inflammatory cytokines⁵. However, PEITC tends to be volatile and unstable. Microencapsulation allows for stabilisation of PEITC and improves the delivery strategy, namely at the desired site (colon) and prevents premature degradation or release of PEITC in the upper gastrointestinal tract⁴.

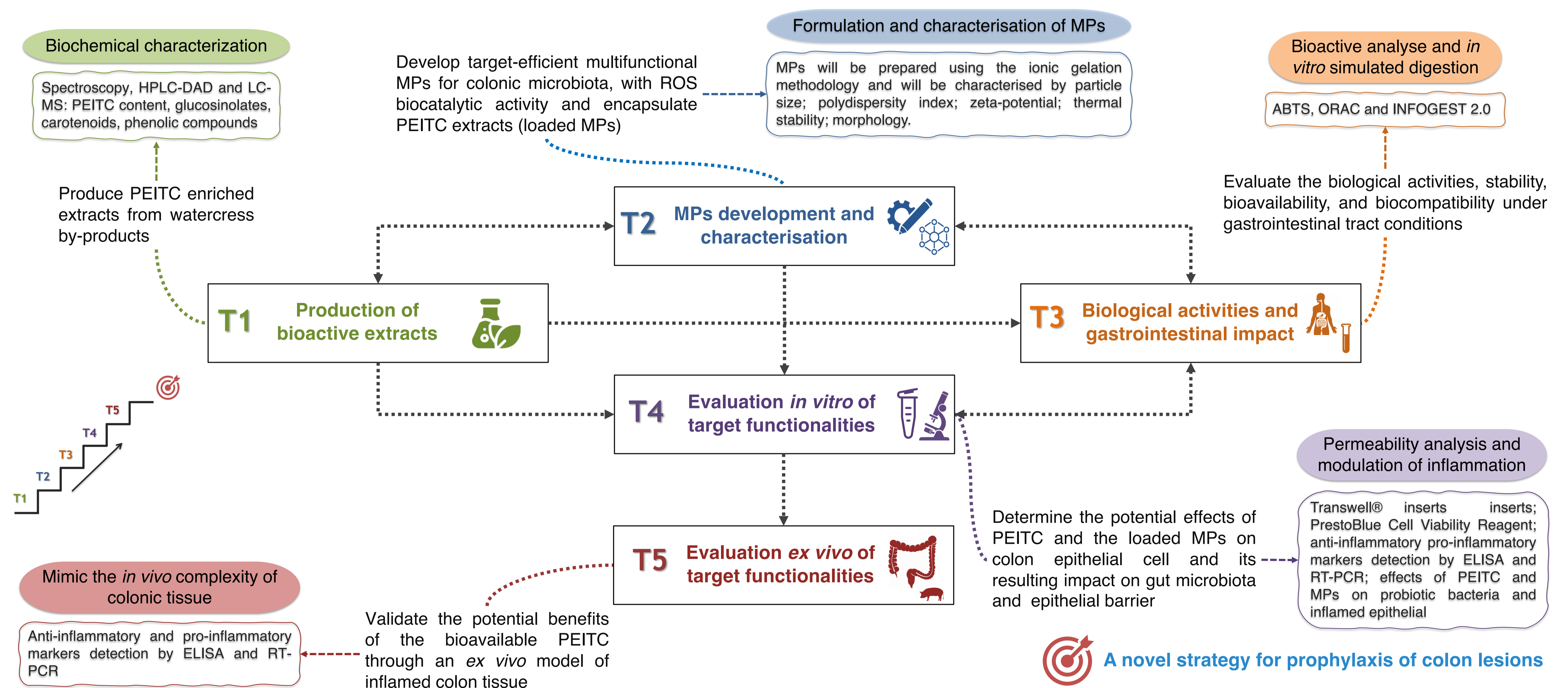


Objectives

The **MAIN GOAL** of this work is to engineer a multifunctional microparticle (MP) for PEITC delivery and catalytic reduction of excess microenvironmental ROS in the inflamed colon. The strategic approach to target the colon is the colonic microbiota-activated delivery system, using biodegradable polysaccharide coating such as chitosan. The loaded MPs will be tested *in vitro* and *ex vivo* for target functionalities and explore the interaction between PEITC and the gut microbiota.

PEITC is obtained in a circular economy context by valorising watercress by-products.

Methods



Expect outcomes

Attending IBD's microenvironment, just a delivery system may not be enough. With this research work, it is expected to engineer a multifunctional microparticle that will have an active function in loco behind the PEITC's delivery to the target. Besides, this study will allow an understanding of whether PEITC may positively affect the modulation of dysbiosis and intestinal barrier dysfunction (recurrent changes in IBD).

References

1. Ng, S. C. *et al.* Worldwide incidence and prevalence of inflammatory bowel disease in the 21st century: a systematic review of population-based studies. *Lancet* 390, 2769–2778 (2017); 2. Kudelka, M. R., Stowell, S. R., Cummings, R. D. & Neish, A. S. Intestinal epithelial glycosylation in homeostasis and gut microbiota interactions in IBD. *Nat. Rev. Gastroenterol. Hepatol.* 17, 597–617 (2020); 3. Coscueta, E. R., Sousa, A. S., Reis, C. A. & Pintado, M. M. Phenylethyl Isothiocyanate: A Bioactive Agent for Gastrointestinal Health. *Molecules* 27, (2022); 4. Coscueta, E. R., Sousa, A. S., Reis, C. A. & Pintado, M. Chitosan-olive oil microparticles for phenylethyl isothiocyanate delivery: optimal formulation. *PLoS One* 16, 1–21 (2021); 5. Lee SH, Bajracharya R, Min JY, Han JW, Park BJ, Han HK. Strategic approaches for colon targeted drug delivery: An overview of recent advancements. *Pharmaceutics*. 2020;12(1).

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