HABILITATION THESIS

Unraveling the Health-Associated Potential of Polyphenolic Compounds through Nanobiotechnologies

Domain: Biotechnology

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ABSTRACT

The current habilitation thesis synthesizes the most relevant scientific and professional achievements conducted after publication of the doctoral thesis of the author (since 2009), emphasizing the development and application of nanobiotechnological platforms for enhancing the therapeutic potential of bioactive polyphenols subclasses like anthocyanins and stilbenes. The research aligns with current challenges in biomedical sciences, particularly in cancer and retinal disease management, and demonstrates interdisciplinary research at the interface of biochemistry, cell biology, phytochemistry, and nanobiotechnology.

First research line was focused on the detailed phytochemical profiling of anthocyanins in blueberries and elderberries and their potential use for an intracellular targeted delivery, fluorescently tracked delivery system.

A second research line targeted the engineering of an innovative resveratrol-based therapeutic microsystem, functionalized with gold nanobipyramids to allow near-infrared (NIR)-induced photothermal release. This biocompatible delivery system addresses the limitations of conventional intravitreal therapies and supports minimally invasive treatment approaches. It was possible via a fluorescence-based tracking for an accurate intracellular monitoring.

These interdisciplinary contributions reflect a sustained scientific interest in using natural polyphenols and biocompatible polymers to design formulations for a targeted therapy, integrating advanced analytical techniques, cell-based assays, and nanobiotechnology. The results, developed in collaboration with national and international partners, have been published in ISI-indexed journals. The research presented may serve as a foundation for future developments with potential translation into clinical and pharmaceutical applications.