Università degli Studi di Napoli Federico II

PhD in Biotechnology - 40th cycle

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Advanced next-generation cell factories for the conversion of lignocellulosic biomasses into high-value bioproducts

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The shift toward a circular bioeconomy requires sustainable biomanufacturing. In this context, *Haloferax mediterranei* emerged as a natural producer of poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV)[1] and the carotenoid bacterioruberin[2], making it a promising candidate for Next-Generation Industrial Biotechnology (NGIB)[3]. However, key industrial bottlenecks remain, including inefficient biomass pretreatment, restricted C-5 sugar utilization, metabolic trade-offs in co-production, and costly recovery processes.

This PhD project focuses on optimizing *H. mediterranei* as a next-generation microbial cell factory. The approach includes (i) developing green pretreatment techniques for efficient sugar recovery, (ii) integrating omics and genetic engineering to enhance PHBV and bacterioruberin synthesis, while fine-tuning HV content for improved material properties, (iii) designing bio-based extractions and developing morphology engineering strategies for streamlined downstream processing, and (iv) developing PHBV-bacterioruberin bio-composites with antioxidant properties.

This research aims to improve the efficiency of biopolymer and carotenoids production, expanding their potential for biomaterial and cosmeceutical applications.

References

1. Koller, M. Polyhydroxyalkanoate biosynthesis at the edge of water activitiy-haloarchaea as biopolyester factories. *Bioengineering* (2019)
2. Martínez-Espinosa, R. M. Halocins and C50 Carotenoids from Haloarchaea: Potential Natural Tools against Cancer. *Marine Drugs 2024, Vol. 22, Page 448* **22**, 448 (2024).
3. Chen, G. Q. & Jiang, X. R. Next generation industrial biotechnology based on extremophilic bacteria. *Curr Opin Biotechnol* **50**, 94–100 (2018).