Leveraging lactic acid bacteria collection for new sustainable processes

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State of Art

Lactic acid bacteria (LAB) have a long history in industrial processes as food starters, biocontrol agents, and producers of high-value compounds. Studying large microbial strain collections and screening them through a new phenotype microarray approach presents new opportunities in natural product discovery and numerous applications of strains [1].
The present work will be focused on the obtainment of polyhydroxyalkanoates (PHAs) and poly-lactic acid (PLA), both involved in the bioplastic industry. Using suitable waste and by-products as raw materials and appropriate strains for microbial fermentation would reduce the manufacturing costs of biopolymers [2]. LAB are also known for their antibacterial activity [3]. The University of Parma Culture Collection (UPCC), composed of over 5000 strains, will be leveraged to explore the potential of bioresources herein preserved. A Statistical Design of Experiment (DoE) will be used to extract the maximum amount of information from limited experiments [4].

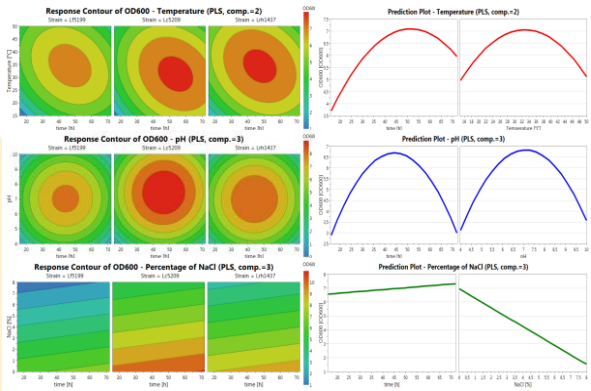
Aim of the Study

The aim of this PhD is to exploit a large microbial collection of Lactic Acid Bacteria for two relevant and emerging issues: bioplastic production and antimicrobial discovery.
After a preliminary characterization of LAB strains based on their genotypic and phenotypic features, a DoE will be used to screen strains and find out precursors of bioplastics, such as PHAs and PLA, and producers of antimicrobial compounds. The most performing strains selected will be used to explore their functionality on agrifood by-product based substrates. The results obtained will be useful to valorize the large microbial diversity collected in the UPCC and to develop innovative and sustainable processes by recovering agrifood waste.

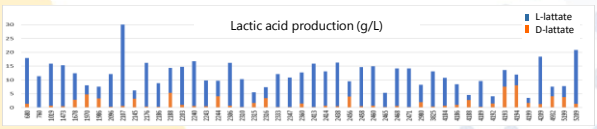
Activity \ Months	6	12	18	24
A1) Characterization and Primary Screening				
A2) Secondary Screening in Vitro				
A3) Secondary Screening in Situ				
A4) Writing and Editing				

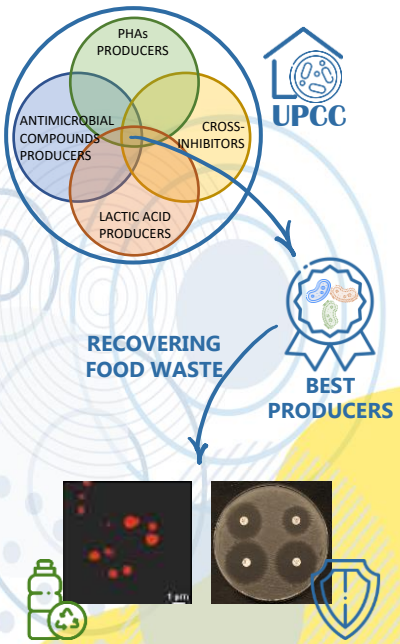
Preliminary Results – Caracterization

Different growth conditions (Temperature, pH, and salt concentration) was tested by using a DoE to reduce the number of experiments. The Response Contours show the behavior of single strains and allow us to establish optimal growing ranges for each of them. The Prediction Plot show the general trend of growth, suggesting us targeted arrays.



The optical isomers D- and L- of lactic acid were detected after enzymatic reaction.





References:
[1] Steele AD, Teijaro CN, Yang D & Shen B (2019). Leveraging a large microbial strain collection for natural product discovery. *J. Biol. Chem.* **294**(45): 16567-16576.
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[3] Ricci A, Bernini V, Maoloni A, Cirlini M, Galaverna G, Neviani E & Lazzi C (2019). Vegetable by-product lacto-fermentation as a new source of antimicrobial compounds. *Microorganisms* **7**(12): 607
[4] Wang Q, Wong CH, Chan HE, Lee WY & Zuo Z (2018). Statistical Design of Experiment (DoE) based development and optimization of DB213 in situ thermosensitive gel for intranasal delivery. *Int. J. Pharm.* **539**(1-2): 50-57.

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