From starter-assisted to fermentome-driven: a paradigm shift in sourdough fermentation

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Introduction

- sourdough fermentation is almost exclusively starter-assisted. Natural or commercial, defined or undefined, and single or mixed cultures may be used to start fermentation processes
- Sourdough ecosystem is colonized by complex meta-communities (fermentomes). The fermentome is a supra-entity whose supra-genome, under environmental pressure, expresses diverse supra-phenotypes
- The application of omics methodologies helps to further unravel sourdough fermentation processes.

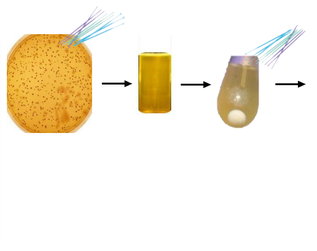
Aim

- To develop a new conceptual view of the socio-microbiology of sourdough fermentation, introducing the concept of fermentome
- To explain the metabolic networking among dominant and satellite members to build up very robust sourdoughs, which are resistant and resilient to overcome the most frequently occurring causes of disturbance and may guarantee the stability for long-time use.

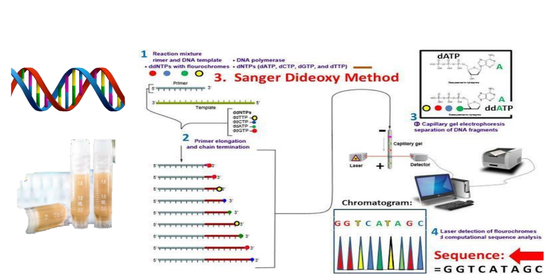
Materials and Methods

8 Sourdough samples from Puratos Sourdough Library

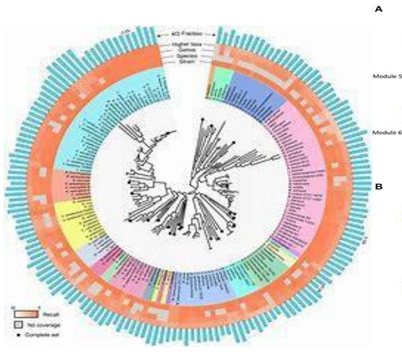
Culturomic analysis



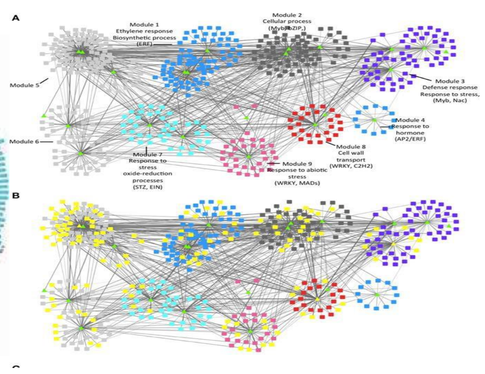
High-Throughput Sequencing of 16S rRNA and 26S rRNA Gene Amplicons



Metagenomic Analysis

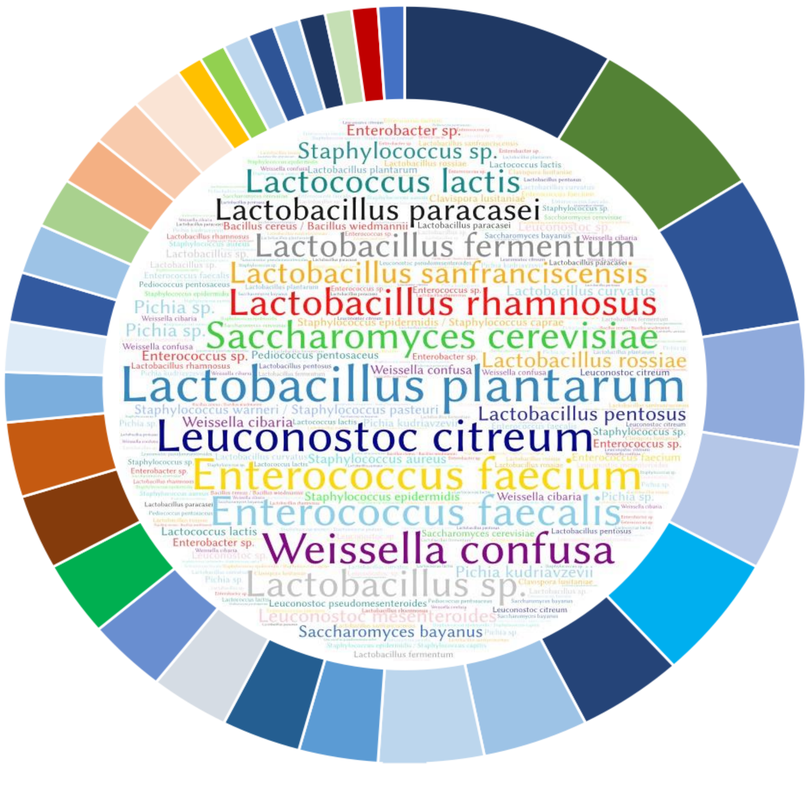


Metatranscriptomic Analysis



Metabolomic analysis

Results



Pie chart showing the identified species of lactic acid bacteria, other bacteria and yeast isolated from 8 sourdoughs. Word cloud represents species with font size depicting the species frequency.

- Based on metaomic data, the assembly of selected species showing a complementary metabolic ability against carbohydrates, peptides and amino acids resulted in a stable microbiota under sourdough ecosystem
- *L. plantarum*, *L. fermentum*, *P. pentosaceus*, *F. rossiae and S. cerevisiae* persisted for 30 days of refreshment when they were part of the composition of the sourdough
- Based on peptides and amino acid metabolisms, S. *epidermidis* could have a role in the first days of sourdough propagation
- If *S. cerevisiae* is used, *P. kudriavzevii* did not have a strong role on the sourdough ecosystem
- The metabolic stability during 30 days of sourdough propagation was also confirmed by metabolomic data

Outlook

From the comparison of all omics data, emerged a clear picture of the potential metabolic background vs. metabolisms expressed under sourdough conditions. The ecological fundaments retrieved will ensure the resilience sourdough-fermented doughs to various causes of disturbance. The results of this study will allow the industrial development of the most stable and performing mixture of microbes to drive the sourdough fermentation.