SCIENCES & BIOENGINEERING SCIENCES

Research Group of
Transdisciplinary Agrifood Studies (TAFS)

has the honor to invite you to the public defence of the PhD thesis of

Yohanes Raditya Wardhana

to obtain the degree of Doctor of Bioengineering Sciences

Title of the PhD thesis:

Microbial diversity, stability, and functionality across sourdough production systems

Supervisor:
Prof. dr. ir. Frédéric Leroy (VUB)
Co-supervisor:
Prof. dr. ir. Luc De Vuyst

The defence will take place on
Friday, September 25, 2026 at 5 p.m.

VUB Etterbeek campus, Pleinlaan 2, Elsene,
Auditorium I.0.01

Members of the jury

Prof. dr. ir. Geert Angenon (VUB, chair)
Prof. dr. Bruno Pot (VUB)
Prof. dr. Debby Mangelings (VUB)
Prof. dr. ir. Mia Eeckhout (UGent)
Prof. dr. ir. Christophe Courtin (KU Leuven)

Curriculum vitae

Yohanes Raditya Wardhana studied at Wageningen University and Research, The Netherlands, and obtained a Master's degree in Food Technology. In February 2020, he started his PhD research in the Research Group of Industrial Microbiology and Food Biotechnology (IMDO) of the VUB, since renamed as Transdisciplinary Agrifood Studies (TAFS), under the supervision of Prof. dr. ir. Luc De Vuyst and Prof. dr. Frédéric Leroy, in the framework of the VLAIO/Flanders FOOD-ICON project SourDough and SourFun. He is co-author of six scientific papers published in peer-reviewed journals, among which two as first author.

Abstract of the PhD research

Sourdough is a fermented flour–water ecosystem in which lactic acid bacteria (LAB) and yeasts interact to shape its quality through acidification, leavening, and aroma formation. However, sourdough quality can vary considerably because microbial composition and activity are influenced by raw-material composition, propagation conditions, and starter-culture stability. Understanding how ecological factors such as minerals affect microbial dynamics, and how robust and functionally complementary starter cultures can be maintained, is therefore essential to enhance and stabilize sourdough quality.

Mineral-enriched spontaneous sourdough productions showed that minerals can act as ecological drivers and functional modulators of sourdough fermentation. Rather than fundamentally altering LAB succession, their effects were mainly reflected in yeast diversity and metabolic output, indicating that mineral composition can influence fermentation performance and product characteristics. Propagation experiments with mature Type 3 sourdoughs further showed that microbial stability depended strongly on the technological niche. The consortium of *Fructilactobacillus sanfranciscensis* and *Maudiozyma humilis* remained stable under short cold-storage intervals, whereas prolonged storage promoted ecological drift. Similarly, *Lactobacillus amylovorus* DCE 471 persisted only under weekly refreshments, while *Companilactobacillus paralimentarius* IMDO 1Mg105 remained competitive across flour types and refreshment regimes.

Finally, the repeated co-occurrence of *Coml. paralimentarius* IMDO 1Mg105 with an autochthonous *Saccharomyces cerevisiae* revealed a promising mixed-strain starter culture. Fermentations in wheat sourdough simulation medium showed complementary activities, with the LAB ensuring rapid acidification and broad substrate utilization and the yeast contributing alcoholic fermentation and aroma formation. Despite an amensalistic interaction, the coculture generated interaction-dependent esters with potential for aroma-oriented sourdough applications.

Overall, these results show how raw-material composition, propagation regime, microbial competitiveness, and metabolic complementarity jointly shape sourdough functionality and support the rational design of robust, aroma-active starter cultures for sourdough bread production.