WETENSCHAPPEN & BIO-INGENIEURSWETENSCHAPPEN

The Research Group of

Industrial Microbiology and Food Biotechnology (IMDO)

has the honour to invite you to the public PhD defence of

MSc. Andrea Comasio

to obtain the degree of Doctor of Bioengineering Sciences

Novel fermentation strategies and ingredients to produce innovative sourdoughs and breads

Promotor:

Prof. Dr. ir. Luc DE VUYST

The defence will take place on

Friday, August 30, 2019, at 17 h

in Auditorium D0.07 of the Campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel,
Pleinlaan 2, 1050 Elsene, and will be followed by a reception.

Members of the jury

Prof. Dr. ir. Geert ANGENON (VUB, chairman)
Prof. Dr. ir. Wim VERSÉES (VUB, secretary)
Prof. Dr. ir. Eveline PEETERS (VUB)
Prof. Dr. Steven BALLET (VUB)
Prof. Dr. Peter VANDAMME (Ghent University)
Dr. Delphine SICARD (INRA, France)
Prof. Dr. ir. Luc DE VUYST (VUB, promotor)

Curriculum vitae

Andrea Comasio (May 30, 1987, Chivasso, Italy) obtained his MSc degree in Food Science and Human Nutrition from the University of Milan (UNIMI), Italy, in 2013. After finishing his studies, he was visiting scientist at Lund University (Sweden) and worked thereafter at UNIMI in collaboration with a multinational food company. In May 2014, he started his PhD in the Research Group of Industrial Microbiology and Food Biotechnology (IMDO) of the Vrije Universiteit Brussel, under the supervision of Prof. Dr. ir. Luc De Vuyst, with the financial support of the Flanders' FOOD project INNOCEREAL II (Innovative fermentation strategies to accentuate aroma formation in bakery products). His research dealt with the microbial ecology of sourdoughs and the use of appropriate ingredients and/or starter cultures to improve the organoleptic properties of breads with sourdough. Andrea Comasio is first author of one and co-author of two scientific papers published in peer-reviewed international journals. He gave two talks at international conferences and seven oral presentations at several national conferences and research meetings.

Abstract of the PhD research

Sourdough is a mixture of flour and water that is fermented by heterogeneous communities of lactic acid bacteria (LAB) and yeasts that are naturally present or added as starter culture, in particular strains of LAB species. LAB are responsible for the acidification of the dough, whereas both LAB and yeasts contribute to flavour formation and dough leavening. Other microbial communities, such as acetic acid bacteria (AAB), can be present too.

Based on their inoculum, three different types of sourdough productions can be distinguished. Type 1 sourdough productions are carried out through spontaneous fermentations of flour-water mixtures based on backslopping. They are mainly produced as firm sourdoughs by households and bakeries. Traditional recipes often make use of a wide range of ingredients, such as yoghurt and fruits. Type 2 sourdough productions are one-step, prolonged fermentations of the flour-water mixtures that are initiated with a starter culture. They are typically produced at industrial scale. Type 3 sourdough productions are starter culture-initiated sourdough fermentations, followed by backslopping.

The present study investigated 17 Type 1 sourdoughs from different origins and unravelled a producer-dependent, broad, microbial species diversity, including AAB species, and independent of the flours used or the geographical location. The use of metagenomics, applied on four sourdoughs of an artisan bakery, opened new frontiers for a better understanding of the taxonomic structure of complex sourdough ecosystems.

Further, the study focused on both Type 2 and Type 3 sourdough productions, with the addition of daily ingredients, such as lemon juice (source of citrate) and apple juice (malate), and a dedicated citrate- and malate-positive LAB starter culture strain (*Lactobacillus crustorum* LMG 23699). An enhanced production of lactate (both with citrate and malate) and buttery aroma compounds (only with citrate) was made possible. The use of these innovative sourdoughs led to the production of aroma-enhanced breads too. Further, this study showed the potential for the use of lambic beer, replacing the water phase in a wheat-rye flour-water mixture, during Type 3 sourdough productions to produce innovative breads with a link to the Brussels' region (traditional production of *masteluin* and spontaneously fermented acidic beer).

Finally, this study showed that the use of strains of non-sourdough-specific bacterial species could be of interest to produce innovative sourdoughs, in particular regarding the use of dedicated strains of the acetic acid bacterium *Gluconobacter oxydans*, to have an impact on the colour (browning) of wheat-based breads.