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

# ir. Jonas DE ROOS

to obtain the degree of Doctor of Bioengineering Sciences

## Functional role of microorganisms and wooden barrels in lambic beer production

Promotor:

**Prof. Dr. ir. Luc De Vuyst**

The defence will take place on

**Friday, November 23, 2018, at 17 h**

in Auditorium D.0.07 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. S. BALLET (VUB, chairman)
Prof. Dr. J. WENDLAND (VUB, secretary)
Prof. Dr. ir. L. DE VUYST (VUB, promotor)
Prof. Dr. D. MAES (VUB, DBIT)
Prof. Dr. I. VAN BOCXLAER (VUB, DBIO)
Prof. Dr. P. VANDAMME (Ghent University)
Prof. Dr. E. SMID (Wageningen University, The Netherlands)

### Curriculum vitae

Jonas De Roos (°26/01/1991, Jette, Belgium) graduated from the Sint-Martinus school, Asse, Belgium, in 2009. He obtained his MSc degree in Bioengineering Sciences (Chemistry and Bioprocess Technology) from the Vrije Universiteit Brussel, Brussels, Belgium, in 2014. In October 2014, he started his PhD research at the research group of Industrial Microbiology and Food Biotechnology (IMDO-VUB) under the supervision of Prof. Dr. ir. L. De Vuyst. His research dealt with the microbial ecology of lambic beer production processes, in particular to unravel the functional role of the prevailing microorganisms and the use of wooden barrels during these processes. He is the first author of three peer-reviewed scientific papers. He gave three talks at international conferences and 11 oral presentations at several national conferences and research meetings.

### Abstract of the PhD research

Lambic beers are produced through the spontaneous microbial inoculation of wort, which initiates a long-lasting fermentation and maturation process that is carried out in wooden barrels and results in a noncarbonated sour-tasting beer. Lambic beers are traditionally produced in Belgium in the proximity of the Senne river valley. The unique and complex flavor of these beers originates from the metabolic activities of various yeasts, lactic acid bacteria (LAB), and acetic acid bacteria (AAB).

Despite the increasing attention for acidic beers worldwide, scientific data on these beers were rather limited. The present study contributed to a more objective management of future lambic brews by assessing different lambic beer production processes with a multiphasic approach, encompassing various microbiological and metabolomic analysis methods. It turned out that the AAB, which were not examined extensively in previous studies, were present during two major phases of the lambic beer production processes, which could be explained by differences in their adaptation towards carbohydrate- or ethanol-rich and acidic environments. Generally, the AAB were more prevalent and displayed a higher metabolic activity at the liquid/air interface of the wooden barrels. Further, it was revealed that changing physicochemical parameters and substrate and metabolite compositions of the fermenting wort and maturing beer caused several transitions between the occurring microbial species and installed the typical four-phase fermentation and maturation process. The wooden barrels used in the lambic beer productions were partly responsible for the restricted microbial diversity and limited batch-to-batch variability between different lambic brews by acting as an additional microbial inoculation source, besides the environmental air during the coolship step. Moreover, they seemed to play an important role during the fermentation and maturation processes by establishing optimal heat transfer and microoxygenation conditions. A shotgun metagenomic analysis confirmed the functional potential of the microorganisms present during lambic beer productions, with some of these properties directly impacting the flavor profile of lambic beers.