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

BSc. Sophia Jiyuan Zhang

to obtain the degree of Doctor of Bioengineering Sciences

Wet Coffee Processing: from Ecosystem Analysis to Starter Culture Development, a Metabolomic Approach

Promotor:

Prof. Dr. ir. Luc DE VUYST

The defence will take place on

Friday, April 26, 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. Steven BALLET (VUB, secretary)
Prof. Dr. Dominique MAES (VUB)
Prof. Dr. ir. Sebastiaan EELTINK (VUB)
Dr. ir. Guido VERNIEST (Johnson & Johnson)
Prof. Dr. Luca COCOLIN (Universidad degli Studi di Torino, Italië)
Prof. Dr. ir. Luc DE VUYST (VUB, promotor)

Curriculum vitae

Sophia Jiyuan Zhang (°January 1, 1991, Xi'an, China) obtained her Bachelor of Applied Science (First Class Honours) in Food Science and Technology from the National University of Singapore, Singapore, in 2013. After graduation, Sophia continued to work in Singapore at Nestlé R&D. In 2015, she started her PhD in the Research Group of Industrial Microbiology and Food Biotechnology of the Vrije Universiteit Brussel, under the supervision of Prof. Dr. ir. Luc De Vuyst. In the framework of a bilateral research agreement with the Nestlé Research Centre, Vers-chez-les-Blanc, Switzerland, Sophia has worked on multiple coffee plantations over the world to conduct coffee processing field experiments to study the metabolomics of the coffee post-harvest processing chain. The knowledge gained from studying these processes was then employed to develop functional starter cultures for coffee fermentation. Sophia Jiyuan Zhang is first author of two peer-reviewed scientific papers, and gave seven oral presentations at (inter)national scientific conferences and symposia.

Abstract of the PhD research

Every cup of coffee has its story. The entire coffee value chain backing our daily coffee contains a series of events, including post-harvest processing, roasting, and brewing. These events lead coffee from plantation to final beverage, and each of them plays an important role in the final cup quality.

Post-harvest processing is the step to convert freshly harvested coffee cherries to dried coffee seeds, *i.e.*, the green coffee beans. These are the raw materials for roasting, so that their chemical compositions are closely linked to the final cup quality. In recent years, the role of post-harvest processing is brought to the spotlight as a well-recognized factor to change and improve the cup quality. However, the corresponding mechanisms have always remained behind the curtains. Therefore, this study carried out a systematic and comprehensive investigation of coffee post-harvest processing through a metabolomic approach.

Various field experiments on coffee processing were conducted across different coffee varieties and geographical locations (Ecuador and China). At the same time, an extensive analytical platform was established and optimized, enabling a metabolomic study along the whole processing chain. In general, the post-harvest processing of coffee is a dynamic and complex process, during which microbial activities and endogenous bean metabolism take place concurrently and interfere with each other. It turned out that the activities performed by lactic acid bacteria were of great importance, together with the endogenous bean metabolism, such as anaerobic degradation and germination-like activities involving carbohydrates, organic acids, free amino acids and chlorogenic acids, under various abiotic stress factors (hypoxia or drought stress). Switching the processing methods or alternating the processing parameters could modify the metabolite compositions of the processing waters and (green) coffee beans, implying their impacts on both microbial activities and endogenous bean metabolism. For instance, the fermentation duration had a greater impact on the coffee quality, compared to the application of demucilaging instead of depulping of the coffee cherries or the application of a soaking step on the fermented and washed coffee beans. As a result, fine-tuning the processing parameters leaves a great margin for quality improvement, in particular the sensory profile of the brewed coffee.

Further, all this knowledge was implemented to develop a starter culture composed of lactic acid bacterial strains that could valorise the coffee fermentation step and enhance the coffee quality. Multiple coffee-autochthonous strains were selected and screened in a novel coffee mucilage simulation medium, and the candidate strains were implemented during small- and large-scale coffee processing trials in multiple plantations in Ecuador and Brazil with locally available coffee varieties. Based on the starter culture performance, the coffee bean composition, and the sensory quality of the brewed cup, this study narrowed down to two lactic acid bacteria starter culture formulations that could be used to ameliorate the coffee quality and enhance specific sensory notes in-cup.