SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Microbiology (MICR)

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

Radwa Moanis

to obtain the degree of Doctor of Bioengineering Sciences

Title of the PhD thesis:

Tracking polyhydroxyalkanoate biosynthesis in thermophilic bacteria

Promotor:
Prof. dr. ir. Eveline Peeters

The defence will take place on

Wednesday, July 3, 2024 at 5 p.m. in Auditorium D.2.01

The defence can also be followed through a live stream: https://shorturl.at/CFy2G

Members of the jury

Prof. dr. ir. Damya Laoui (VUB, chair)
Prof. dr. Charles Van der Henst (VUB, secretary)
Dr. Fatma Demir (VUB)
Dr. Heleen De Wever (VITO)
Prof. dr. ing. Stanislav Obruča (Brno University of Technology, Czech Republic)

Curriculum vitae

Radwa Moanis obtained her Master's degree in Microbiology from Alexandria University, Egypt. She started as a teaching assistant of Microbiology in the Faculty of Science, Damanhour University in Egypt. In 2018 she joined MICR at VUB as a PhD student through a fellowship from the Egyptian government under the supervision of Prof. dr. ir. Eveline Peeters.
Radwa's research focused on the production of PHA (bioplastics) from thermophilic bacteria.
During her PhD, she presented her work in several (inter)national conferences, (co)authored 2 publications and supervised 4 master students.

Abstract of the PhD research

Petroleum-based conventional plastics are essential materials in our daily lives. However, despite their importance, their production and end-of-life fates negatively affect our environment. Polyhydroxyalkanoates (PHA) are one of the most promising solutions to solve this dilemma, as they are microbially produced biobased and biodegradable polymers that can act as a green alternative to conventional plastics. The physicochemical features of PHAs are comparable to polypropylene. They are produced by diverse prokaryotes in response to nutritional or environmental stress conditions and stored as intracellular granules. Regardless of the interesting features of PHAs, high production costs currently stand as an obstacle that hinders their large-scale production and commercialization. The use of thermophiles, microorganisms growing optimally at high temperature ranges, for PHA production can help in improving cost efficiency on an industrial scale. This is achieved by lowered operational costs of cooling and sterilization.
In this PhD study, I delved into the ability of thermophiles to synthesize and accumulate PHAs, thereby exploring the underlying genetic machinery. Several thermophilic bacterial strains were selected for investigation, encompassing a wide temperature range. Their abilities to accumulate PHAs in response to different nutritional and stress conditions were studied. Five approaches of analysis were employed to unveil the PHA production potential and machinery of thermophiles throughout this study: bioinformatics analysis, growth analysis, chemical analysis of the extracted PHA polymers, proteomic analysis of PHA granules-attached proteins and transcriptomic analysis upon growth in different nutritional growth media to study the metabolic fluxes in these conditions.
The results pointed to the presence of a harsh temperature limit above which the PHA accumulation ability becomes very scarce to almost absent in extreme thermophiles and hyperthermophiles. In contrast, at lower temperature ranges I described a novel thermotolerant PHA producer, *Paracoccus kondratievae* (42-47°C), to produce poly-3-hydroxybutyrate upon growth on glycerol. In addition, the moderate thermophilic bacterium *Caldimonas thermodepolymerans* (50-55°C) was found to be able to accumulate PHA copolymers with enhanced physical properties upon changing growth conditions. A tight interconnected relation was observed between the exposure to stress conditions, gene regulation and PHA production.
In conclusion, this PhD work succeeded in shedding light on the ability of thermophiles to biosynthesize PHAs, and in this way, it can be considered as an important step in paving the way to utilize thermophilic strains as microbial cell factories for PHA production.