

UNLOCK

UNLOCK is a unique facility for research on mixed microbial communities, the first of its kind worldwide. UNLOCK is an experimental and data platform, enabling breakthrough research and knowledge sharing on natural and synthetic mixtures of microorganisms. Such microbial communities are of key importance at different scales in our society, ranging from individual-based health issues related to microbial communities inhabiting the human body, to global greenhouse gas (i.e. CH₄ and N₂O) emissions related to microbial activity. Herewith UNLOCK provides the means to analyse and solve some of the major societal challenges we are facing in the coming decades related to food production, health, environmental protection, climate change, and sustainable production of plug-in commodity chemicals.

Even though natural and man-made ecosystems are characterized by an enormous microbial diversity, research on microbial communities historically has been conducted with a very limited number of strains isolated from these ecosystems. It is generally accepted that by using this approach we have overlooked a major fraction of the microbial potential available in nature. Molecular, cultivation-independent methods have demonstrated that we have been able to isolate, study and use no more than 1% of the natural microbial diversity. Furthermore, biotechnological production processes currently rely heavily on pure cultures, with a single functionality. Mixed microbial communities inherently have interesting emergent properties, and we are running into the limits of what can be achieved with reductionist approaches because many of the key-microorganisms depend on symbiotic interactions and therefore are difficult to study and explore in isolation.

In light of these challenges, three major limitations exist in our current experimental procedures in research on microbial communities: (i) the lack of (medium to) high-throughput cultivation facilities for comparative analysis of microbial ecosystem development, (ii) the effective integration of these cultivation studies with molecular systems characterization, and (iii) the transparent and uniform storage and processing of the generated data. It is exactly these three limitations that UNLOCK will address, through enabling research on mixed microbial communities at an unprecedented scale and efficiency.

With UNLOCK, Wageningen University and Delft University of Technology have joined forces to integrate the expertise of the research groups involved in four complementary platforms. The first platform is the Biodiscovery platform located in Wageningen for high-throughput discovery and characterization of yet-uncultured microbes, specifically focusing on

fastidious anaerobes. The second platform in Wageningen, the modular bioreactor platform, is specifically suitable for investigating sustainable solutions for environmental challenges, such as degradation of (micro)pollutants, sustainable energy generation, and recovery of resources from complex waste streams. The third platform of UNLOCK is located in Delft and facilitates users to conduct dozens of high-resolution cultivation experiments in bioreactors in parallel for comparative analysis of how process variables affect system development. On-line analytical facilities and state-of-the-art liquid handling equipment enable high-resolution analysis of functional system development in time. Finally, the fourth platform, the FAIR-data platform also located in Wageningen, allows for data storage, data extraction and analysis of high-throughput data in a cloud-based infrastructure, the basic framework of which has been implemented in close cooperation with SURFsara through funding by the NWO GWI

Roadmap Bridge Program. The data generated will be FAIR (Findable, Accessible, Interoperable, Reusable) by design, enabling transparent procedures.

Owing to the smooth access procedure, the experimental hardware available, and the expertise of involved researchers, UNLOCK enables research that to date is considered too complex and too expensive for one researcher (or one research group) to conduct. Combining and exploring the fields of expertise of the UNLOCK research groups will boost the research community and strengthen the position of Dutch research in the fields of microbiology, microbial ecology, and bioprocess engineering. UNLOCK is open to excellence-driven users from Dutch universities, knowledge institutes and industries and beyond, placing them in the unique position to conduct research at unmet speed and resolution.