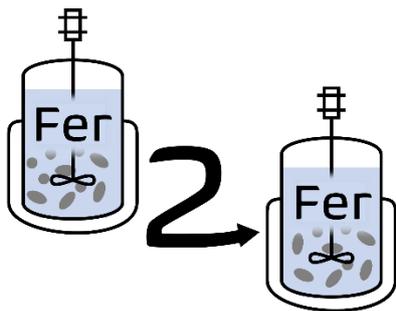


SUSTAINABLE VALORISATION OF FERMENTATION WASTE BY MICROBIAL METABOLIC MODELING AND EXTENSION OF FERMENTATION CASCADES

ANNUAL REPORT ON DISSEMINATION,
COMMUNICATON, MOBILITY AND TRAINING
ACTIVITIES, AND PROGRESS AND RISK MONITORING:
2022



*Prepared within the project “Sustainable valorisation of fermentation waste by microbial metabolic modeling and extension of fermentation cascades (Fer2Fer)”
(No. 1.1.1.2/VIAA/4/20/610)*

30.03.2022

The report is prepared within the project's work package no. 4.

The scientific objective of the project is to provide methodology leading towards an optimal, circular and efficient flow of Fermentation Waste (FerW) and side-streams from one fermentation process to others. This methodology would encompass an integrated FerW valorisation system where the contents of feedstock, its bioconversion efficiency, and the related environmental and economic effects are considered.

Results of the project: Four activities are planned in the project:

1. Evaluation of FerW streams,
2. Preparation of stoichiometric models for FerW fermentation,
3. Development and ranking of valorisation designs (VD),
4. Knowledge transfer, mobility and training.

The project will develop an innovative methodology for FerW valorisation. In addition (1) 2 scientific articles will be published in journals indexed in Scopus and Web of Science databases with a citation index of 50% of the industry average; (2) results will be presented at 2 international scientific conferences; and (3) the young researcher (postdoctoral student) will develop her competence in research, study, international mobility and networking activities for a total of at least 2 months, as well as develop her transferable skills.

Information about the project: Bioeconomy is a fast-growing field generating a range of bio-based products from biological feedstocks. A key enabler for bioeconomy is industrial fermentation (IF), which can be broadly defined as any process where microorganisms are used to transform biomass into useful products. These fermentation processes themselves create a diverse range of side-streams and waste, that could be valorised through anaerobic digestion, co-production of other products (e.g., biofuel and animal feed) or be used as feedstocks for subsequent fermentation cascades. This project will focus on methodology supporting decisions and evaluation of contents of various FerW as well as assessing the economic opportunities and constraints for further use of these FerW. Thus, the project focuses on sustainable growth of bioeconomy, paving way for predictive models to aid the design of more integrated bioconversion processes and biorefineries.

As a result of the project, the postdoctoral researcher will significantly improve her scientific, managerial and communication skills, which will help her achieve the status of an independent, mature researcher. The project will promote the development and implementation of the smart specialization strategy area "Knowledge-intensive bioeconomy" through more efficient use of resources (eco-innovative products, new technologies), innovation capacity building, knowledge base and human resources development (knowledge-intensive bioeconomy), innovation systems (eco-innovative products) and overcoming social, environmental, climate and energy challenges.

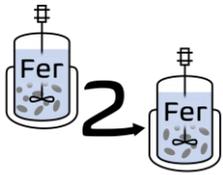
Project period: 01.03.2021 – 30.06.2023. (28 month)

Project costs: 104 071.24 EUR (98 867.67 EUR from EU as ERDF funding; 5 203.57 EUR – the share of the University of Latvia)

Source of funding: European Regional Development Fund Specific Objective 1.1.1 "Improve research and innovation capacity and the ability of Latvian research institutions to attract external funding, by investing in human capital and infrastructure" 1.1.1.2. measure "Post-doctoral Research Aid".

Project application selection round No.4.

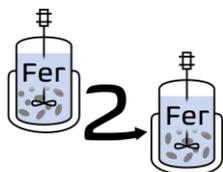
Project Leader: Researcher, Anna Stikane, PhD, anna.stikane@lu.lv



Sustainable valorisation of fermentation waste by
microbial metabolic modeling and extension of
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DISSEMINATION, EXPLOITATION AND COMMUNICATION ACTIVITIES

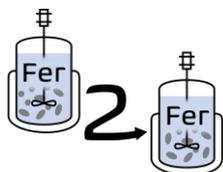
The project was started on 1st of March, 2021 during the global Covid-19 pandemic, which has influenced the dissemination and communication activities.

Two scientific articles have been envisaged to report the results of the project. In the second year the revision of the first article was concluded and the article was published in the journal [New Biotechnology](#) (ISSN 1871-6784, IF=5.079). This article (<https://doi.org/10.1016/j.nbt.2022.06.001>) looks at the resource potential of spent microbial biomass (SMB) as an organic, potentially valuable and increasingly available side stream of biotechnological production processes in the bioeconomy. In the second year of the project, scientific work was started to develop new modelling tools that could be applied to such complex fermentation substrates as SMB. The second article describing these results is currently under preparation.

The communication activities of the project include (1) participation in the international conference “International Conference for Young Scientists on Biorefinery Technologies and Products (BTechPro2022)”, with a talk *The resource potential of fermentation residues*, (2) a participation in the Early Career Researchers Symposium organised by the Society for Applied Microbiology (now renamed as Applied Microbiology International) with a poster presentation *A closer look on spent microbial biomass*. The poster presentation was awarded with a poster prize, (3) given a lecture for high school students at the summer camp Alfa2022 on the opportunities and innovations in the ecosystem of Biotechnology (title of the talk was *Īsi par biotehnoloģiju ekosistēmu*), and (4) a public talk at University of Latvia on *Catalysing sustainability: fermentation by-product evaluation with tools of metabolic modelling*.

The results of the project continue to be published in a dedicated section at the website of the University of Latvia, that informs visitors about the project’s aims, tasks and progress, while also providing links to all results published as an outcome of the project (information is provided in Latvian). Also, the website of the Computational Systems Biology Group holds a [section](#) dedicated to the project (information is provided in English). In addition, a project has been developed at ResearchGate, where periodic updates of the project’s progress are published.

At the beginning of the project, an information plate (A3 size) about the project and funding provider was placed in the premises of the University of Latvia – the House of Nature. The plate is being maintained for the whole project, thus informing employees and visitors of the House of Nature and acknowledging the funder of the research project.



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MOBILITY AND TRAINING ACTIVITIES

During the second year of the project the post-doctoral researcher went to several mobility visits to the United Kingdom and Netherlands.

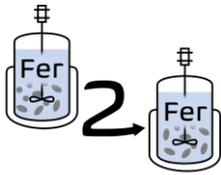
During the mobility to the United Kingdom the post-doctoral researcher visited Dr. Jon McKechnie and his group at the University of Nottingham. They had productive and fruitful knowledge exchange through various discussions and research workshops centring on the methodologies of Life-Cycle Assessment (LCA) and Techno-Economic Analysis (TEA) and how these can help with developing and guiding industrial process-development and policies shaping the sustainable transitions.

The postdoctoral researcher also went to a mobility to Technical University of Delft (Netherlands), where she visited *Dr Lotte Asveld*, *Prof Mark van Loosdrecht* and *Dr Rebecca González-Cabaleiro*. They had a productive knowledge exchange on the work and projects being undertaken at the University of Latvia and TU Delft as well as fruitful discussions on the various research challenges such as difficulties to recognise possible societal sustainability issues when developing new technologies and the challenges of creating an industrially relevant mathematical representation of metabolism with metabolic modelling techniques. This visit sparked a collaboration with *Dr Rebecca González-Cabaleiro* and a second mobility visit to Technical University of Delft, where they started working together to develop modelling tools for complex substrate uptake.

During the 2022 the postdoctoral researcher became an advisor for the first Latvian student team to the international Genetically Engineered Machine (iGEM) competition. This is the largest international competition and community of people working and developing synthetic biology and biotechnology. In addition, the post-doctoral researcher joined the iGEM judging team in person in this year's Jamboree, which allowed her to meet and share knowledge with other iGEM teams and the people mentoring and helping them to create the next generation of synthetic biology.

The post-doctoral researcher attended a virtual training course *Komericalizācija* (Commercialisation) run from 28th of February to 9th of March 2023 by a business coach Iveta Cīrule and Komerzizglītības centrs (KIC). The course allowed the post-doctoral researcher to learn in more details the importance of IP protection and main steps of business development. Thus, the course increased the professional knowledge and skills of post-doctoral researcher. This training was then followed on with a distance learning (DL) course *General DL Course on [Intellectual Property](#)* run by of the [WIPO Academy](#) and the Patent Office of the Republic of Latvia.

The post-doctoral researcher has participated in the training sessions on stoichiometric metabolic modelling as part of the *Biomodelling Spring* organised by the Computational Systems Biology Group, University of Latvia. Also, various national and international level workshops and events such as "From Research to Startup – First Steps" run by the Biocatalyst foundation. No certificates of attendance have been received, yet the post-doctoral researcher has used the vast opportunities provided by organizers of virtual events available during the pandemics.



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PROGRESS AND RISK MONITORING

During the second year of the project the work package #1 has been completed with a publication on the resource potential of fermentation waste in the [New Biotechnology](#) (ISSN 1871-6784, IF=5.079). In addition, the work package #2 has been completed with the completion of a local database of several industrially-relevant stoichiometric metabolic models.

The work to the remaining work package #3 is ongoing. Due to technical and scientific difficulties with different definitions of biomass components, data from various growth environments and difficulties to meaningfully incorporate a complex substrate into a metabolic model the preparation of the final publication has progressed slower than anticipated. To mitigate effects of these technical setbacks the post-doctoral researcher has discussed several options to modify the initial model designs and assumptions with her scientific-advisors and collaborators. As the result an updated plan for research is set in action for the final publication.

With the improving situation of the Covid-19 pandemic and travel restrictions, that limited mobility activities in the first year of the project, a higher emphasis was placed on fulfilling the project requirements for mobility and presentations in international conferences in the second year. These include conferences of BioTechPro, Society of Applied Microbiology annual event of the Early Career Researchers Symposium, as well as mobility visits to University of Nottingham and Technical University of Delft.

In conclusion, risk and progress monitoring has been performed on a regular basis to assess the progress of the project, correspondence with the project's timeline and evaluate the possible risks in coming phases of the project. The needed mitigation and contingency plans have been initiated and implemented by rescheduling some of the planned activities and deliverables.