# Bio Base Europe Pilot Plant vzw – Stage-Internship (master/bachelor degree)

## Below is a list of topics for which we have internship vacancies as of August 2024

**TOPIC 1 - Process development and scale-up for the fermentative production of L-lactic acid from 2G feedstocks (Interns selected - Closed)**

In the framework of the Flemish FUCATIL project, this research will focus on the sustainable production of bio based L-lactic acid (L-LA), starting from second-generation (2G) feedstocks such as old paper and cardboard. An efficient production process for L-LA will be developed that goes far beyond the state of the art. An engineered industrial yeast strain will be used which efficiently produces L-LA by anaerobic fermentation. Yet, to obtain an industrially competitive process, advanced fermentation development and fine-tuning is key. Therefore, this internship aims to investigate different fermentation strategies, including batch, fed-batch, continuous with or without cell recycle, and to optimize the most important process parameters such as pH, temperature, aeration and medium composition.

Besides this, the sustainable and economical recovery of purified LA presents the principal challenge in fermentative LA production today. Therefore, in situ product recovery (ISPR) will be assessed as an innovative strategy to improve the fermentation performance and efficiently obtain purified LA. Different techniques will be investigated, including (reactive) extraction, enzymatic esterification, and adsorption to specific resins. Then, the integrated production and isolation of high-purity L-LA will be fine-tuned and scaled up to industrially relevant scale (150 L). [PDB, EU]

**TOPIC 3 - Cultivation of industrial high-value biomass with enhanced viability (interns already selected - not available anymore)**

The commercial interest in functional foods that contain live microorganisms, also named probiotics, has been steadily increasing over the past decade. While lactic acid bacteria have become a fixed value in the dairy industry, the wide use of yeast biomass in foods and nutritional supplements is well-known. This has forced the creation and optimisation of industrial high-value biomass production processes, where innovative technologies are continuously being developed. Indeed, the efficient production of high-value biomass with high cell viability and

minimal contamination remains a major challenge up to date.

This research project aims to develop state-of-the-art cultivation strategies to tackle these challenges. Firstly, this involves high cell-density cultivation, where high amounts of biomass are produced by using advanced feeding strategies and close monitoring and control of process parameters such as temperature, pH, oxygen supply and nutrient availability. Secondly, the accumulation of stress metabolites will be induced to prepare the cells for drying later in the process. For this, stress conditions will be imposed in the final stage of fermentation, such as nutrient starvation, osmotic shock or thermal shock. Thirdly, advanced downstream processing (DSP) techniques such as centrifugation, cross-flow filtration and decantation will be evaluated to prepare high-value biomass products while maintaining high quality and cell viability. Finally, the developed global production process will be taken to the next level, where scale-up to 150 L pilot scale will take place alongside experienced engineers. [PDB, EU]

**TOPIC 4 - Process modelling, optimization and techno-economic evaluation for the fermentative production and purification of L-lactic acid**

**(Available from August 2024)**

The industrial production of renewable chemicals and materials through fermentation presents an excellent case of a sustainable biorefinery concept that can boost the transition towards a circular bio economy while reducing the dependency on fossil resources. Yet, this relies on the availability of low-cost feedstocks, the efficiency, scalability and sustainability of the various process steps, as well as the final yield and market potential of the obtained target products. This research will focus on the sustainable production of bio based L-lactic acid, using engineered industrial yeast strains in advanced fermentation processes. Here, the efficient and economical recovery of purified LA presents the principal challenge in fermentative LA production today. Various state-of-the-art purification techniques will hence be considered, including (ion exchange) resin adsorption, solvent extraction and membrane filtration.

Yet, to get a clear view on the economic and industrial feasibility of these innovative production routes towards bio based L-lactic acid, and to identify the most promising strategy, the different fermentation and downstream purification processes will be modelled using the SuperPro Designer software, and a comprehensive and in-depth techno-economic assessment (TEA) will be conducted. The latter will comprise technical (performance) and economic (cost) considerations of each process step, as well as a thorough sensitivity analysis, while being applicable from an early TRL level up to full industrial scale. This will allow to compare various production approaches and technologies and to benchmark these against current fossil-based processes to produce L-lactic acid. From a broader point of view, this will also assist the chemical industry in Flanders to implement novel sustainable processes and ultimately, in their transition towards a true bio economy.

This internship takes place at Bio Base Europe Pilot Plant (BBEPP), a non-profit SME that assists companies and research groups to bridge the gap between laboratory research and industrial implementation of their innovations. BBEPP is equipped with all process and analytical tools which allow to perform high-quality research in an industrial environment. [EU, ST]

For this internship knowledge and experience in SuperPro Designer is required.

**TOPIC 6 - Developing a yeast cultivation and propagation strategy for the production of biofuels from MSW (Interns already selected - not available anymore)**

The development of a fermentative production process of isobutanol from paper and cardboard waste comprises three main steps:
1. The saccharification of cardboard to glucose and xylose using a special enzyme cocktail;
2. The propagation of an engineered S. cerevisiae strain up to a very high cell density culture;
3. The fermentation of the saccharified cardboard to isobutanol using the freshly propagated yeast culture.
In situ product recovery (ISPR) of isobutanol during the fermentation will be required to keep the isobutanol below its toxicity concentration.

This internship will mainly focus on the development of a yeast propagation on 7L bioreactor scale, aiming to improve yields and to minimize the overall cost prize. However, the saccharification will also be further improved at lab scale and different ISPR methods will be further explored. [CVC]

**TOPIC 11** - **Development of fermentation process to convert 2G feedstocks into acetic acid with 100% carbon conversion efficiency. (Available from August 2024)**

In the framework of Flemish AC2GEN project, this research focusses on the production of bio based acetic acid (AA) using anaerobic bacteria (acetogens), starting from second generation feedstocks. Acetic acid serves as a versatile commodity chemical with a variety of applications in both chemical and biotech industries. Acetogens have a diverse metabolism, with advantages such as pathways which allow conversion of all saccharides, including hexoses, pentoses, di-,tri-, oligo- and polysaccharides, into AA, 100% carbon efficiency of sugars to AA, hydrolytic capabilities, resistance to and even degradation of typical inhibitors, and more.

These characteristics have the potential to significantly increase the carbon efficiency on 2G feedstocks, beyond that of other biochemical pathways.

The first goal of this internship is to screen a variety of commercially available acetogenic strains and evaluate their performance to convert 2G sugars into AA. The best performing strains will be cultivated on real 2G hydrolysates, containing mixtures of 2G sugars, as well as typical inhibitors such as hydroxymethylfurfural. Analytical procedures such as HPLC and HPAEC will be used to follow up the consumptions of the substrates, as well as the accumulation of the target product and other metabolites. Then, the acetogenic fermentation process will be thoroughly studied in bioreactors, and optimized in terms of carbon efficiency and productivity.

The screening and identification of promising strains will be executed using serum bottles, to increase the experimental throughput, while the in-depth optimization of the fermentation process will be executed in bioreactors. To this end, batch fermentations will be performed in BBEPPâ€™s state-of-the-art 4x1L bioreactors, and the process will be scaled-up to 10L scale. The practical work will be executed at BBEPP, in collaboration with a team of experienced engineers. (NP)

**TOPIC 13 - Marine enzymes: production and industrial applications**

**(Available from December 2024)**

Project: Enzymares

Enzymes are remarkable biological catalysts, playing a key role towards a sustainable economy. They are widely used in industrial applications and their demand is continuously increasing. Biodiversity has been explored in the search for novel enzymes. The marine habitats, characterized by diverse and extreme conditions, host an amazing, unique and vast source of biodiscovery. The enzymes produced by marine organisms possess unique features, as they can withstand high salt concentrations, a broad range of temperature, pressure, pH, organic solvents and surfactants. Therefore, marine enzymes constitute a group of exceptional biocatalysts, often suitable for a variety of industrial applications.

In the framework of the Flemish ENZYMARES project, this research will focus on the production and applications of industrially relevant enzymes, obtained from marine organisms. Fermentative processes will be developed and optimized in advanced and automated bioreactors up to 10L scale. Further research will focus on the development and optimization of downstream processes for enzyme recovery, concentration and formulation. Finally, the performance and application potential of the newly produced enzymes will be evaluated. To this end, different enzymatic conversion reactions will be assessed, optimized and compared to benchmark industrial processes.

This internship takes place at Bio Base Europe Pilot Plant (BBEPP), a non-profit SME that assists companies and research groups to bridge the gap between laboratory research and industrial implementation of their innovations. BBEPP is equipped with all process and analytical tools are available to perform high-quality research in an industrial environment.

**TOPIC 14 - Plastic-degrading enzymes for sustainable development (Available from October 2024)**

Project: REPurpose

Plastic waste build-up in the environment is an enormous ecological challenge. Biocatalytic depolymerization mediated by enzymes has emerged as an efficient and sustainable strategy for plastic treatment and recycling. A variety of plastic-degrading enzymes have been discovered from microbial sources. Meanwhile, protein engineering has been exploited to modify and improve enzymes performances.

This research project will focus on the sustainable production and use of enzymes that depolymerise plastic wastes. In a first stage, fermentative processes will be developed and optimized on lab scale, using advanced and automated bioreactors. Enzyme production will be followed by downstream processing (DSP). Different state-of-the-art techniques for cell disruption, enzyme separation and purification will be tested and further optimized. Then, a depolymerization process, which employs the plastic-degrading enzymes produced, will be assessed. Research will focus on finding the optimized reaction conditions for obtaining monomeric and oligomeric fractions suitable for further re-polymerization into clean recycled plastic. The final aim of this project is to develop a sustainable, efficient and scalable enzymatic process that enables to transform plastic wastes into new polymer building blocks.

This internship frames within the EU-funded REPurpose project () and takes place at Bio Base Europe Pilot Plant (BBEPP), a non-profit SME that assists companies and research groups to bridge the gap between laboratory research and industrial

implementation of their innovations. BBEPP is equipped with all process and analytical tools are available to perform high-quality research in an industrial environment.

**TOPIC 17 - Development and Scale-Up of Sustainable Downstream Processing Strategies for SAF Precursors (Available from January 2025)**

The pursuit of Sustainable Aviation Fuel (SAF) has become a cornerstone of the transition towards a greener aviation industry. As part of this overarching goal, this research focuses on the development and scale-up of innovative downstream processing (DSP) strategies for the sustainable recovery and purification of SAF precursors. These strategies aim to enhance industrial relevance while minimizing environmental impact.

The specific objectives of this internship position include:

Development of Sustainable DSP Strategies: Innovate and optimize downstream processes to recover SAF intermediates with a focus on sustainability. This involves designing and testing various DSP techniques to maximize recovery efficiency.

Evaluation of Technologies and Process Conditions: Assess multiple DSP technologies and operational conditions to determine their performance in terms of recovery rates, energy consumption, and material requirements. This step is crucial for identifying the most effective and sustainable methods.

Benchmarking Green Solvents: Compare the use of green solvents against traditional extraction systems. This involves evaluating the efficacy, cost, and environmental impact of green solvents in the DSP of SAF precursors.

Solvent Recycling for Process Intensification: Investigate the feasibility of recycling solvents within the DSP framework to enhance process efficiency and industrial viability. This includes optimizing conditions for solvent reuse without compromising recovery performance.

This research will be conducted at Bio Base Europe Pilot Plant (BBEPP), a leading institution known for bridging the gap between laboratory research and industrial application. BBEPP is equipped with advanced process and analytical tools that will facilitate high-quality research in an industrial environment.

**TOPIC 18 - Hybrid Process Development for Upcycling Mixed Plastic Waste into High-Value Dicarboxylic Acids (Available from January 2025)**

The HYBRID project aims to address two major challenges: the incineration of difficult-to-recycle plastic waste, leading to CO2 emissions, and the fossil-based production virgin plastics from long-chain dicarboxylic acid (DCA) monomers. By integrating pyrolysis, biological funneling, fermentation, and advanced product recovery techniques, the project seeks to convert mixed plastic waste with over 70% polyolefins into high-value DCAs, critical for producing nylon-type polymers, polyesters, lubricants, and plasticizers.

This internship, part of the HYBRID project, focuses on upcycling MPW into DCAs using a yeast-based fermentation platform. Key tasks include:

1. **Fermentation Process Development**:
    - Investigate and optimize fermentation behavior of engineered yeast strains with varying alkane feedstocks.

- Enhance productivity target and substrate yields of alkanes to LcDCAs at bioreactor level.

2. **Biphasic Fermentation**:
    - Develop a biphasic process with in situ product recovery for maximal resource recycling.
    - Optimize organic phase composition to balance extraction capacity and biocompatibility with yeast.
    - Ensure >90% product recovery and <5% feedstock loss through advanced extraction techniques.
3. **Process Integration and Scale-Up**:
    - Transfer and evaluate the integrated process at bioreactor scale.
    - Collaborate with engineers to scale up the optimized process.

This internship at Bio Base Europe Pilot Plant (BBEPP) offers hands-on experience in fermentation and down-stream purification technologies and supports the transition to a circular bio economy. All experimental work will be performed in the industrial environment of BBEPP using state-of-the-art equipment, in cooperation with a team of experienced professionals. Your work will contribute to the Flemish-funded HYBRID project, crucial for further development and industrial scale-up.

**TOPIC 19 - Development and scale-up of the fermentation and downstream processing to produce ENA protein nanofibrils, a precursor for sustainable textile materials. (Available from September 2024)**

Project: HIPProFib

A novel class of protein nanofibrils (ENAs, ENdospore Appendages) was discovered, showing promising properties regarding chemical and tensile durability. These are produced in bacterial fermentations, and protein engineering enables the introduction of new functionalities. These ENAs can be further processed to obtain an engineerable textile material, called â€œsporesilkâ€. Apart from a completely new type of textile material, this offers a possible alternative to fossil-based textile materials used today, bringing a more sustainable variant.

In framework of the project HiPProFib (High Performance Protein Fiber materials), the objective is to develop an industrially relevant fermentation process where ENAs are recombinantly produced in a cost-efficient way. Within this internship, different fermentation parameters, media compositions, feed rate strategies, use of second-generation feedstocks, â€¦ will be investigated. Following the production of the ENAs, it is key to purify this product. Within this internship, the first steps towards a challenging product purification will be investigated. The aim is to obtain ENA protein nanofibrils sustainably, without compromising their intrinsic characteristics. This purified product will subsequently be used by the project partners in a process called wet spinning, creating textile materials or â€œsporesilksâ€.

This internship will take place at Bio Base Europe Pilot Plant, a leading institution known for bridging the gap between laboratory research and industrial application. BBEPP is a state-of-the-art facility, with a wide and flexible range of

modular unit operations to enable high-quality research.

**ONDERWERP 20: Bachelor stage QA (open)**

*Welke stage kunnen wij jou aanbieden?*

**Je zal kunnen meewerken aan de optimalisatie van het BBEPP kwaliteit managementsysteem voor de voedselveilige productie van innovatieve voedingsingrediÃ«nten vervaardigd uit industriÃ«le biotechnologie.**

- Je helpt mee met de implementatie van software modules voor kwaliteits- en voedselveiligheid management systemen.
- De focus zal hierbij liggen op de creatie en het beheer/onderhouden van het document management systeem en de HACCP databases.
- Je helpt mee met het verder uitbouwen van ons leverancierskwaliteitssysteem.
- Je voert administratieve ondersteunende taken uit in kader van de kwaliteits- en voedselveiligheid management systemen.
- Je werkt samen met en onder leiding van QA.

*Jouw profiel?*

- Je werkt georganiseerd, zelfstandig, nauwgezet en pragmatisch. Je hebt oog voor detail.
- Kwaliteit nastreven is voor jou prioritair
- Je bent leergierig en streeft constant naar verbetering en vernieuwing.
- Je bent vlot meertalig in Nederlands en Engels.
- Je stage kadert binnen een opleiding agro- en biotechnologie of voeding- en dieetkunde

*Ons aanbod?*

We bieden een dynamische, internationale en innovatieve werkomgeving en een volledige leerervaring, waarbij je begeleid wordt door ervaren werknemers.

Je werkt vanuit de Bio Base Europe Pilot Plant, gelegen in de haven van Gent, waardoor je je steentje kan bijdragen tot een meer duurzame samenleving en de bio-economie.

De stageduur hangt af van de topics, maar minimaal 3 maanden.

# Which student profile do we require?

**Requirements are:**

- You are studying for a degree in bio-engineering or related (bioprocessing, chemistry, biotechnology, cell- and gene technology) for the master internship.
- You are studying for a bachelor degree (agro- en biotechnologie of voeding- en dieetkunde) for the bachelor internship.
- Some experience with bacterial, yeast or fungal hosts is an asset

- Some relevant experience with biocatalytic processes for the production of chemicals, food ingredients or cosmetics is an asset
- The duration of your internship is at least 6 months.

## What do we offer?

We offer a dynamic, international and young working environment and a full learning experience. You are based at the Bio Base Europe Pilot Plant, situated in the port of Ghent in Belgium.

The internship runs for a minimum of 6 months fulltime to preferably a whole academy year fulltime.

https://www.bbeu.org/