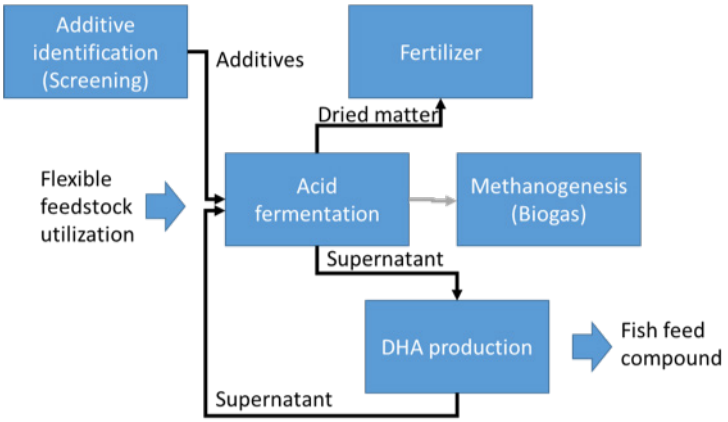
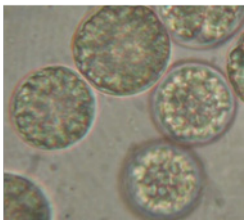
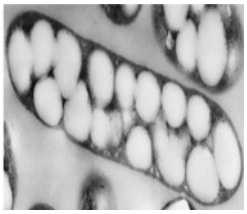
PASS-BIO

PLUG FLOW REACTOR –BASED ACID FERMENTATION FOR SMALL-SCALE BIOREFINERIES







1° Call:	2017
Project period:	03/2018 – 02/2021
Topic:	Optimization of acid fermentation by means of automated parallel enzyme screening, enzyme addition, gradient monitoring and polarizability measurements, scale up and demonstration of carboxylic acids as products for single-cell fatty acid and biopolymer production
Keywords:	Enzyme screening, gradient monitoring, plug-flow based acid fermentation
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Project partners:	Technische Universität Berlin (TUB), **Germany**, Natural Resources Institute Finland (Luke), **Finland**, Ecole Centrale de Lille (ECL), **France**.
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Website:	faccesurplus.org/research-projects-2nd-call/pass-bio

FACCE SURPLUS
SUSTAINABLE AND RESILIENT AGRICULTURE FOR FOOD AND NON-FOOD SYSTEMS

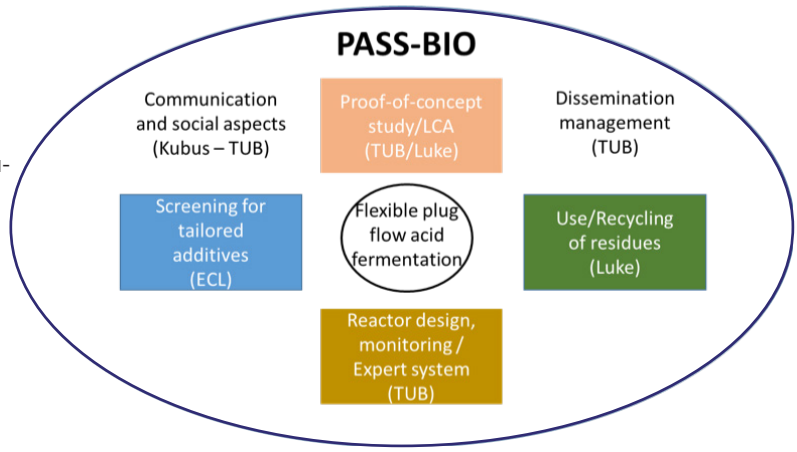
PASS-BIO
plug-flow acid fermentation

BACKGROUND

The utilization of biomass in bioprocesses is often limited to a few carbon sources, otherwise operators fear process instabilities or reduced yields. This situation hinders drastically the applicability of flexible and adopted feedstock utilization in many regions. Nevertheless, if a great variety of residues shall be considered as feedstock, usually rather undefined digestion processes are applied. These processes are considerably robust and allow the utilization of "poor" substrate, as it is already performed for biogas production for many years. Acid fermentation has a great potential to use any undefined feedstock mixtures and convert it to building blocks, which then are converted to products of higher value. It is proposed that acid fermentation can be performed very efficiently in plug flow bioreactors. By the addition of additives, especially enzymes, which are identified in automated screening, the application of gradient measurements along the plug-flow reactor, and polarizabilty measurements to assess the activity of microorganisms in several parts of the plug flow bioreactor, a robust process shall be achieved.

OBJECTIVE

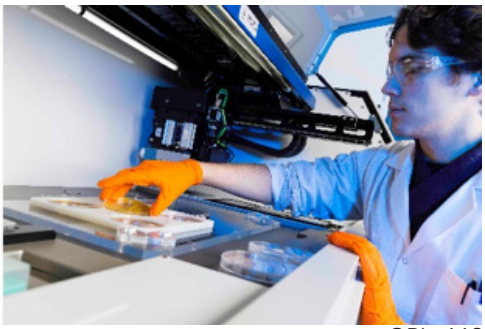
- Screening system for optimized enzyme addition depending on the feedstock;
- Cheap and easy-to-operate plug-flow type digester;
- Monitoring of gradients for real-time process optimization and flexible operation
- Development of an expert system to achieve lower risks of severe process failures;
- Thin slurry (recirculate) separation and suitable sterilization for the application as feedstock in a polyunsaturated fatty acid production process based on heterotrophic microalgae and proof-of-concept.



METHODOLOGY

Screening of bacteria and fungi in automated cultivation platforms with several feedstock sources; evaluation of the impact of fungal and bacterial enzymes on fermentations performances; scale-down of industrial plug-flow reactors and implementation of sensors at various residence times; installation of an expert system to react to disturbances and process inefficiencies, which are examined under flexible feedstock utilization; transfer to a pilot scale as proof-of-concept study; lab-scale separation of carboxylic acids and utilization as substrate for docosahexaenoic acid production with heterotrophic algae.

Microorganisms diversityselection



QPix 460

Submerged fermentations

BioLector

RESULTS AND KEY FINDINGS

- Methodology to rapidly identify enzymes and enzymatic cocktails to support feedstock degradation. A microbioreactor (BioLector®) will be used to to test the ability of selected microorganisms for feedstock degredation. The most suitable enzymatic cocktail is used for further biomass valoriztion in lab scale and pilot scale.
- Robust plug-flow based acid fermentation with and expert system is implemented for gradient-based process control,
- Scale up, economic and ecologic evaluation of the concept if coupled to single-cell oil production as case study is conducted.
- Proof-of-concept in an eco-village for public demonstration.