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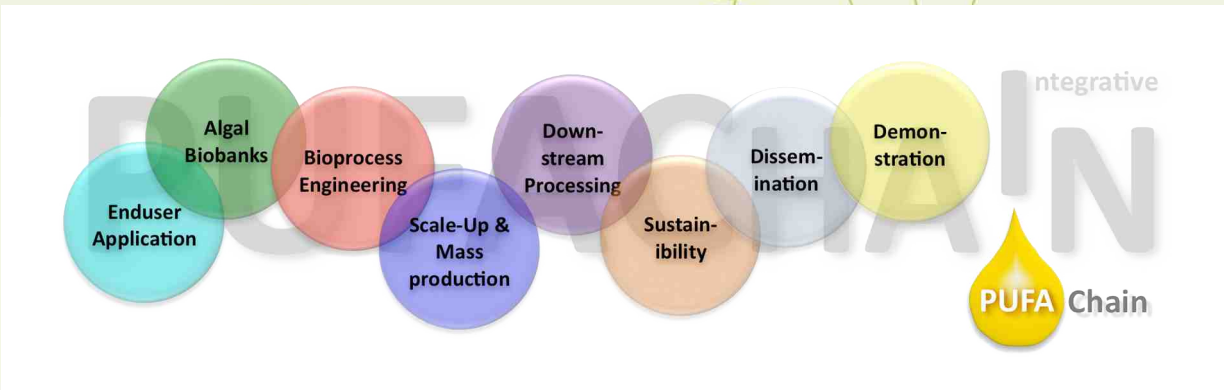
NEWS



PUFAChain: The Value Chain from Microalgae to PUFA

PUFA Chain

The Value Chain from Microalgae to PUFA

Introduction

In this Issue

SEVENTH FRAMEWORK PROGRAMME

The overall goal of the project PUFAChain is to develop a robust scientific and technological basis for substantiating strategic and technical decisions for the industrial development of high value products from algae. This shall contribute to develop this new and sustainable resource for market. The concept of the proposal is strictly oriented to the value chain of microalgae. Starting at the very end of the value chain the proposal picks up a distinct application of high market relevance. The main application targeted with this project is the use of high purified omega 3 fatty acids (DHA/EPA) as building blocks in modern oleo-chemistry to gain high value products for nutrition and pharmaceutical applications.

These applications will define specifications that propagate backwards along the various value- adding stages of the value chain. These stages include the downstream technologies of harvest, disruption, extraction and purification, the cultivation technology, and the biology at the beginning of the complete process. So, the aim of this project is to realise a specific exemplary value chain, develop the technical interfaces between the different value adding stages and investigate the still open research aspects at every single stage while simultaneously addressing the needs of the value chain as a whole. Finally, an integrated process, combining all technical steps, will be implemented for demonstration. A comprehensive and holistic sustainability approach will complement the scientific and commercial advances on each value-adding stage. A consortium of 6 companies and 3 research institutes will integrate state of the art science and technologies in order to assemble a complete process from algae production and harvesting to oil extraction and purification. Innovative technologies will be combined taking advantage of a complementary partnership with the best available expertise in this sector in Europe. These processes will be evaluated for their sustainability and scaled-up from lab to demonstrative prototype level.

The Value Chain from Microalgae to PUFA

Project Progress

Research and Development:

For the realisation of the proposed Algae Crop Rotation (ACR) principle, additional cryophilic strains have been screened to determine the fatty acid content. Meanwhile, intensive tests have been performed to determine the optimal growth conditions for the previously selected microalgae strains with high fatty acid contents. These tests were performed in labscale photobioreactors and on gradient tables to simulate various temperature and light conditions. As a result of these tests, 7 strains with high temperature and light optima and 8 strains with low temperature and light optima could be identified. In addition, the composition of the ideal culture media composition for best growth results was determined and tested on 13 strains. At both partners, UGOE and Fraunhofer, the cryopreservation of promising algae strains has been successfully started.

Cryopreservation of microalgae strains.

At partner A4F, 6 of the 12 strains available have been tested at pilot scale and biomass was extracted from 3 of these strains. In total, over 30 pilot scale trials with more than 1,200 cultivation days have been performed. The goal was to gather the necessary data for comparison of biomass and productivity of the the different strains. In this context, tests regarding culture media optimisation, mechanical stress and cultivation temperature influences were performed. For the industrial production, different configurations were tested to determine the ideal scale-up concept for tubular photobioreactors. Regarding the filtration, new hollow fibre membranes have been developed by partner MAHLE. According to the preliminary test results, these fibres could be a promising step in algae harvesting. To confirm this, they will now be tested in dedicated trials on the A4F site. For the cell disruption, a methodology for lipid extraction has been developed and disruption methods for the individual algae strains were determined. In parallel, further extraction experiments for the algae crude oil were performed by NTX. Due to the currently limited amount of available biomass (upscaling still in progress), more significant results are expected for the last project year.

For the final product formulation, reliable analytical methods have been established. In this context, a variety of enzymes has been screened and tested at an experimental set-up. With more biomass available, these tests will soon be extended, especially with regards to EPA/DHA isolation.

Spray-dried biomass, two-phases extract and exhaust biomass.

Dissemination Activities:

An article has been prepared and will soon be published in the European IMPACT magazine. In addition, a poster has been presented on the 3rd Algae Europe conference in Madrid, Spain and project partner IFEU held a presentation on sustainability aspects at this conference.

3rd General Assembly Meeting

Date: 4th – 6th October 2016 Location: Lelystad, Netherlands

The third PUFAChain General Assembly Meeting took place between the 4th and the 6th October 2016 at the premises of PUFAChain partner DLO in Lelystad, Netherlands.
After a short welcome round, the partners started right away with the presentation and discussion of the latest findings. At IOI, the algae screening is still ongoing, however, at this stage, the focus shifted from the detection and determination of fatty acids towards optimisation methods for higher yields. While the best strains for summer cultivation are already well defined, more analysis work is still needed for winter algae. In this context, partners UGOE and Fraunhofer performed extensive experiments to separate all identified algae into two groups: strains for high temperatures and light intensities and strains for low temperatures and light intensities. In the discussion it was decided to test a new promising strain at cold temperatures in Lisbon. In addition, further research was conducted to determine the influence of growth media on the yield. It was revealed, that for each algae strain, individual composition of the growth medium is advisable. Due to some unforeseen delays in the upscaling of the selected microalgae strains, especially the partners in downstream processing were short on biomass to perform extensive tests. Therefore, a plan was developed by the partners on how to produce relevant amounts of biomass and, in this context, tasks and priorities for the upcoming project months were determined. Afterwards, the project management reported present issues and upcoming activities. In this context, the partners decided on preliminary dates and locations for the next two project meetings.

In the afternoon of the second day, the partners got a comprehensive tour and insight into the diverse activities of Wageningen University, with a special focus in the algae and microalgae research.
At the morning of the third day, the partners had the opportunity to discuss with a representative of a large industrial company focussed on oils and fats about future possibilities and industrial applications of the PUFAChain research results. The remainder of the third and last day was dedicated to the sustainability assessment, with a specific focus on the SWOT analysis. In this context, an analysis of the consumer market was performed and the outcomes were discussed in detail. In addition, the progress of the Life Cycle Costing and Life Cycle Analysis were presented by partners DLO and IFEU.

To conclude the anual meeting, follow-up possibilities for the PUFAChain project were discussed and first interesting topics and aspects for a future collaboration could be defined.

Newsflash

Valensa commercialises algae-based immune health ingredients

US company Valensa announced a collaboration with Algal Scientific Corporation to commercialise PureAlgal™ ingredients in the human health and nutrition market. The products are based on dried non-GMO microalgae *Euglena gracilis* and purified beta-1,3-glucan. Following successful in-vitro pilot studies, Valensa plans to develop a full-scale clinical study for to verify the immune health support of these ingredients early in 2017.

Realisation of a small-scale AlgaePARC on the isle of Bonaire

Wageningen University & Research and the Council of International Education and Exchange join forces to build a small-scale algae pilot on the isle of Bonaire. The purpose of this pilot is to study how algae production can best be realised. Constant temperature and lots of sun make Bonaire an excellent location for growing algae. In addition, the realisation of an algae production might help Bonaire to diversify and reduce the dependency on tourism.

Fermentalg starts production of DHA

French company Fermentalg started production of first batches of microalgae oil that is naturally rich in DHA. After production was launched by Fermentalg partner ARD, the oil is recently the process of refinement and will soon be delivered to first pilot users.

Coppens launches new algae products for the aquaculture sector production

The successful collaboration of the two feed companies Coppens International and Alltech Technologies resulted in several new products for the aquatic product range of Coppens. Very interested is Coppens' ForPlus, an algae-based replacement of fish oil containing high levels of DHA.

Algae for a healthy world

The European consortium "Algae for a healthy world" has been formed by the seven partners AINIA, the Centre for Biological Research (CSIC-CIB), Endesa, Mar Cristal Marilum, Neoalgae Micro Seaweed Products, Novatec and the University of Cádiz. The purpose of this multi-disciplinary consortium is the production of biocompounds with food applications from microalgae. It will focus on the development of necessary biotechnological tools for the improvement and optimisation of biomass production, and the further studying of pigments and other value added fractions from various microalgae. The results of the project will be validated at the Endesa microalgae pilot facility in Carboneras (Almería) to demonstrate the uses of microalgae and extracts of interest therefrom in the food sector.

Event Watch

Alga Europe

Date: 13th - 15th December 2016 **Location:** Madrid, Spain

From the 13th to the 15th December 2016, the 3rd annual Alga Europe Conference took place in Madrid, Spain. Alga Europe is a joint event organised by the European Algae Biomass Association (EABA), the European Commission and the DLG Benelux. This year, 230 delegates from 32 different countries could be welcomed to the conference. In 9 sessions with 58 speakers, the latest developments in the world of micro and macro algae were presented and discussed. The topics of the nine sessions were:

- Research and industrial applications worldwide
- Scientific innovation potential in Europe
- Genetically improved and GMO algae for high value products and commodities
- Innovative processes for high value products
- Breakout to commercialisation: "Algae Cluster" and other "Lighthouse" projects
- Value chains in commercialisation: EU biorefinery and added-value products
- Biofuels, chemicals, wastewater treatment, and greenhouse gas reduction
- Novel foods and animal feed
- Algae cultivation: from laboratory to commercial plants and marketing in Europe

The next Alga Europe Congress will be from the 5th - 7th December 2017 in Berlin, Germany. For further information please visit: www.algaecongress.com

Consortium

GEORG-AUGUST-UNIVERSITY GOETTINGEN

The University of Goettingen is known for outstanding quality in several research areas and deeply anchored interdisciplinarity within natural and life sciences. The SAG, Culture Collection of Algae at the University, is among the three largest algal service culture collections in the world and a most comprehensive resource of micro algal cultures. It is supporting research in biotechnology and biodiversity through ex situ conservation of algae and expert knowledge on identifying and isolating. In addition to the characterization of and the provision of the partners with algae strains, the University of Goettingen also holds the role as overall project coordinator. These administrative tasks will be performed by the dedicated EU-Office of the University.

A4F Algae for Future

The Portuguese company A4F Algae for Future, S.A. is a spin-out from Necton S.A., dedicated to the development and delivering of bioengineering projects for the industrial production of microalgae. A4F develops microalgae production units in high-emitting industries for CO_2 mitigation. The Prototype Unit, implemented on a cement plant (SECIL) was the first set of tubular photobioreactor systems, from cell to biomass, on a scale that established "proof of concept". It has evolved into Algafarm – a 1 ha microalgae production unit as a joint project between SECIL and A4F – which is already commercialising Chlorella for the food and feed industries. A4F proposes an innovative approach through a gradual scale-up, to maximize performance of each process. Within the project PUFAChain, A4F is coordinating two work packages and will be mainly responsible for the bioprocess engineering and the industrial scale.

MAHLE INNOWA

MAHLE InnoWa GmbH is a specialist in the development and application of membrane technologies in various application fields. Through the production of capillary membranes for micro and ultrafiltration that are built into module housing with filter areas ranging from 0.1 m^2 to 60 m^2, a variety of applications can be covered. This comprises e.g. a large selection of hollow fibre membranes with different dimensions and cut-offs, point-of-use and point-of-entry systems for water filtration, systems and modules for the crossflow-filtration of wine and fruit juice, as well as the possibility of customer specific filter system design. In PUFAChain MAHLE is responsible for a new integrated membrane based filtration and the reuse of process water.

Consortium

NATEX PROZESSTECHNOLOGIE

NATEX has gathered experience in supercritical fluid extraction technology for more than 25 years, predominantly in process development, plant design and the operation of CO_2-extraction plants. Nowadays the company is well established as a specialist in supercritical fluid extraction technology and can offer its clients a "one stop shop" covering process development for new applications of CO_2 processes, scale-up and design of industrial plants as well as manufacturing of main components, erection and start-up. NATEX will lead the work package involving the downstream processing and will investigate algae biomass in its liquid extraction and supercritical fluid technology.

IOI OLEO

IOI OLEO (formerly Cremer OLEO) is the German branch of IOI Oleochemicals Division of the globally active IOI Group. IOI Oleo produces raw materials based on vegetable origin like fatty acids, glycerol, and esters up to structured lipids. With a strong commitment to R&D the company provides its customers with state-of-the art tailor-made oleochemical solutions. The broad product range contains individual solutions for pharmaceutical excipients as well as oleochemical based active pharmaceutical ingredients for enteral and parenteral formulations. Apart from their role as scientific project coordinator, IOI OLEO is the lead of the working packages responsible for purification of crude algae oil as well as final product preparation.

FRAUNHOFER INSTITUTE FOR CELL THERAPY AND IMMUNOLOGY

The Fraunhofer Institute for Cell Therapy and Immunology with its Branch Bioanalytics and Bioprocesses (IZI-BB) offers solutions in the areas of biomedical engineering, biotechnology, environmental control systems and material testing, as well as industrial process automation for food, chemical and pharmaceutical industry. Its Extremophile Research & Biobank CCCryo group studies cold-adapted snow and permafrost algae. Aims of the group's applied research are the use of algal strains for production of high quality substances and development of product-optimised photobioreactors for high purity algal mass production and the extraction of high-value metabolites for health and cosmetics. Within the project, the Fraunhofer IZI-BB acts as provider of well characterised algal strains.

Consortium

INSTITUTE FOR ENERGY AND ENVIRONMENTAL RESEARCH

Founded in 1978, the ifeu – Institut für Energie- und Umweltforschung Heidelberg – GmbH is a private independent non-profit organisation for environmental research and consulting. IFEU has an extensive track record in areas such as waste management and packaging materials, transport & mobility, renewable energies and energy efficiency as well as food and bio-based systems. IFEU is especially renowned for its expertise (>20 years) in the field of life cycle assessment (LCA), environmental impact assessment (EIA), and integrated life cycle sustainability assessment (ILC-SA). At European level, IFEU is involved in a number of projects on bio-based products. In the project PUFAchain, IFEU will lead and perform in the work package focusing on the integrated assessment of sustainability.

STICHTING DIENST LANDBOUWKUNDIG ONDERZOEK

Wageningen University and Research Centre (Wageningen UR) is a collaboration between Wageningen University and the specialised former research institutes (Stichting Dienst Landbouwkundig Onderzoek - DLO) from the Dutch Ministry of Agriculture. This combination of knowledge and experience enables Wageningen UR to contribute actively to solving scientific, social and commercial problems in the field of life sciences and natural resources. DLO embodies strategic and fundamental research as well as applied research in which researchers are operating in close co-operation with farmers, companies and governments. The main tasks for DLO in the project concerns the assessment of the economics and social sustainability.

EURA

EurA has been established in 1999. As an innovation service provider the company advises more than 800 medium-sized companies in Germany, covering all industrial sectors. EurA mainly focuses on consulting and assisting companies in national and European R&D projects. This comprises the entire innovation process, including the generation of promising ideas, the search for suitable partners, the establishment of the project consortium, the technical and administrative coordination of the project as well as the project controlling. Within the project PUFAChain, the company will act as assistance of the project coordinator and will furthermore be responsible for the dissemination activities.

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EurA AG
Max-Eyth-Str. 2
73479 Ellwangen, Germany
Phone: +49 7961 9256-229

Project Coordinator:

Georg-August-University Goettingen
Wilhelmsplatz 1
37073 Goettingen, Germany

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