

The PUFACHain project: a value chain from algal biomass to lipid-based products

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PUFACHain is a new European project that started in November 2013 and targets to substantiate the industrial development of sustainable high-value products from microalgae. To produce highly purified omega-3 fatty acids, a complete microalga-based process from feedstock production and harvesting to oil extraction and purification will be assembled from lab to demonstrative prototype level.

In a **biorefinery** concept, target of PUFACHain, a broad spectrum of biobased products like food, feed, materials, chemicals and energy carriers like fuels, biogas are produced concurrently and all fractions of the produced biomass are exploited.



The value chain's processes in highlights

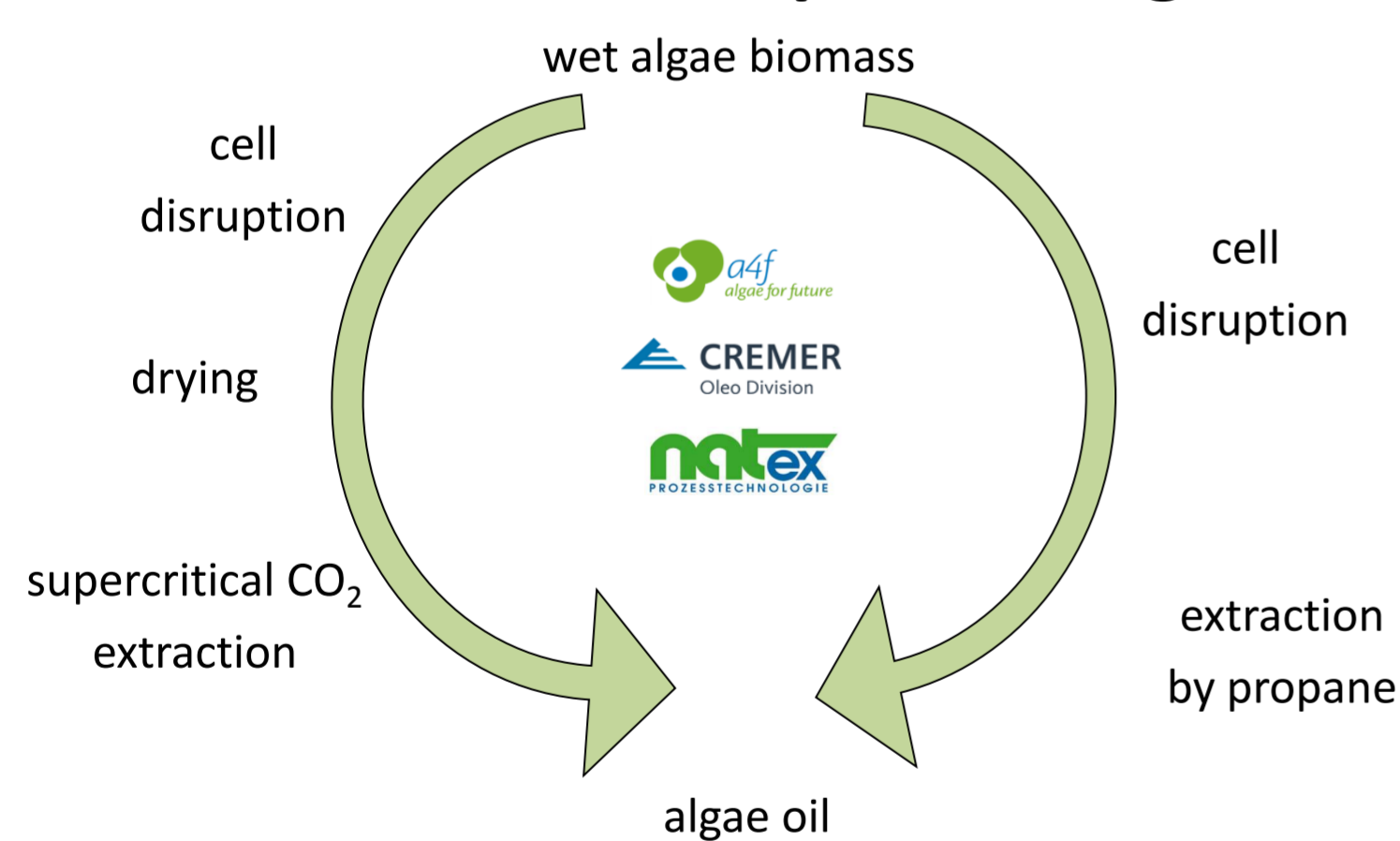
Biology

- two bioresources for microalgae provide a pre-selection of the wide **biodiversity** for testing and optimization of PUFA yield.
- the algae production with optima and tolerances towards high temperatures and light intensities, best suited for the cultivation in summer in Middle Europe, will rotate with **cryophilic or cryotolerant strains** isolated from Polar regions and adapted to low light and temperatures, which are well suited for growth in colder seasons.

Bioprocess engineering

- the selected algal strains will be cultivated at laboratory scale in order to determine the optimal cultivation conditions.
- a pilot unit will be engineered to achieve a scale-up of the cultures from the initial 10 l to 10.000 l. Highlights of this pilot plant will e.g. be an entirely new membrane-based filtration as well as a concept for the reuse of process water.
- the biomass produced will be harvested, concentrated, dried, stored, and shipped to partners for further processing.

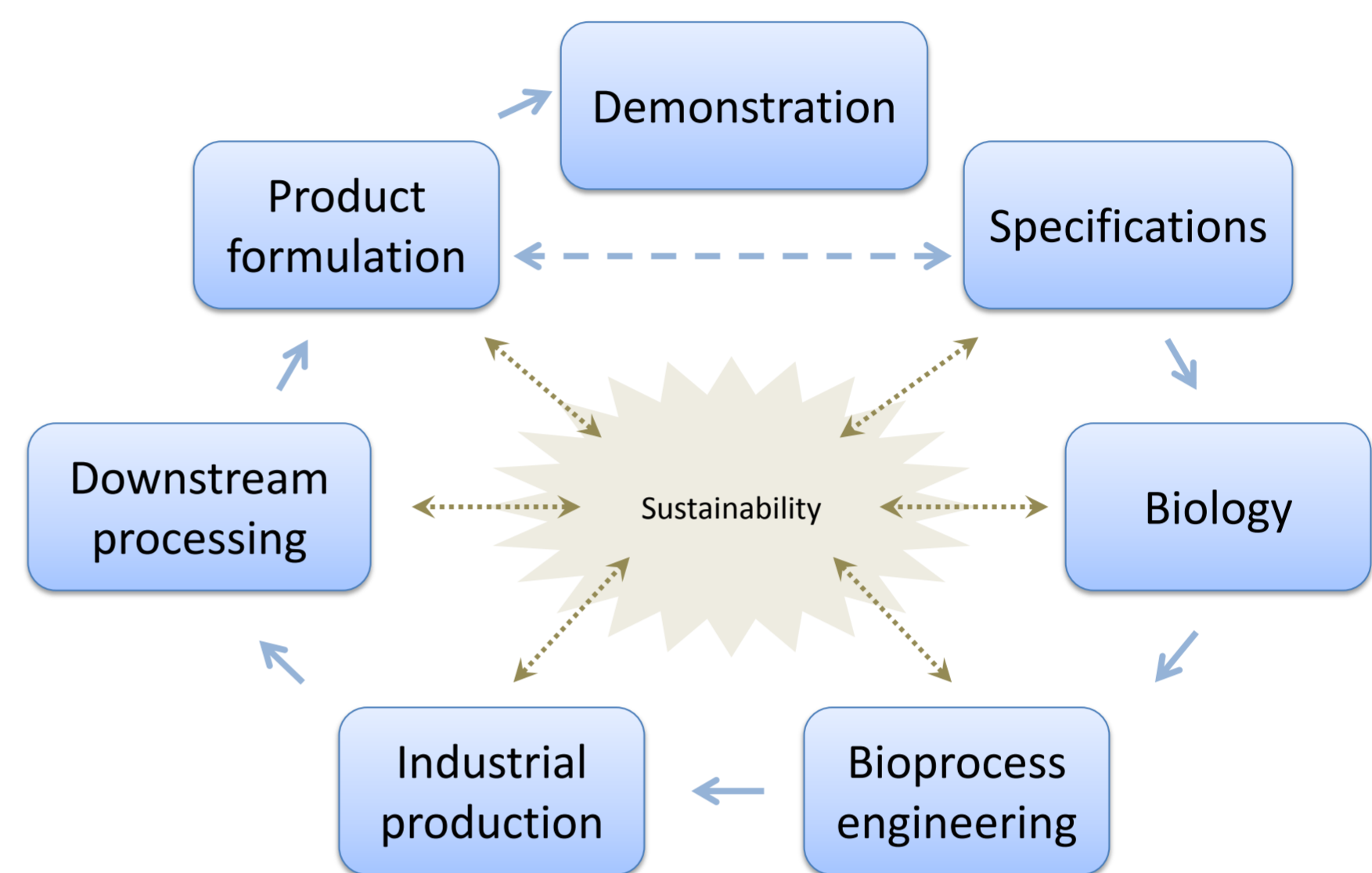
Downstream processing



PUFAs

- Omega-3 fatty acids, i.e. Poly Unsaturated Fatty Acids (PUFAs), in particular Docosahexaenoic (DHA) and Eicosapentaenoic (EPA) acid, are recognized as important players supporting human health (e.g. prevention and/or treatment of coronary heart diseases, cancer, diabetes; structural role in the nervous tissues of the brain and retina)
- PUFAs are present in large amounts in fish oil and cephalopods. But algae are the only form of life which can readily produce PUFAs directly using energy from the sun.
- With the upcoming shortages of environmental threats such as pollution of oceans as well as political worries in developing countries, the search for alternatives concerning a sustainable PUFA supply is renewed.
- microalgae are seen as a promising alternative: PUFA accumulation in algae is a response to stress (e.g. photodamage).

Value adding stages in the PUFACHain project



Downstream processing

- various extraction procedures will be used to reflect the sensitivity of the unsaturated fatty acids, i.e. for optimally producing high quality oils at lower costs.
- extraction using supercritical CO₂ after pelletizing the algae in culture to fine powder which will gain clear oil and defatted algae pellets. The latter may be further used as animal food in aqua cultures.
- for cell disruption various novel methods will be used, including cryogenic and steam jet technologies in addition to osmotic stress and ultrasonic cell disruption.
- the crude algal oil will be purified to gain highly purified and concentrated (> 98% pure) fatty acids employing a cascade of purification steps which include organic solvent extraction, fractionated crystallization and catalyzed hydrolysis.

Product formulation

- the crude algal oil needs to be characterised, based on previously defined criteria, i.e. free fatty acids
- evaluation of the most promising refining and separation technology
- removal of non-target fatty acids and preparation of various esters from DHA and EPA for the use in future products.

Sustainability

- the value chain's processes will also be critically evaluated for their sustainability, so that a commercial scale-up can be further developed.

Participants:

9 partners from 4 different countries, 6 companies, 3 research institutes



www.pufachain.eu

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