Boost algae supply chain applying holistic up- and downstream processes

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Abstract

The principle objective of NewAlgae is the interdisciplinary development of innovative up- and downstream algae processing based on electroporation stress induction during cultivation, gentle extraction, advanced characterisation of techno-functional protein properties and further translation into the development of new product applications. Scientific focus of NewAlgae elucidates influence of nanosecond pulsed electrical fields (nsPEF) on protein biomass production as well as potential alterations in the protein composition of the algae. A model strain with GRAS status, *Arthrospira platensis*, is utilised for phototrophic cultivation. This will i) deliver technological insights on boosted cultivation, detailed characterisation of functional and bulk proteins from algae and ii) offer solutions to industry for the exploitation of algae as an alternative source of high added value proteins for human nutrition. Therefore, NewAlgae supports the way towards global food security by technology driven innovations and concrete product applications.

Research plan

As global protein consumption will significantly increase by 2054, alternative protein sources are of growing interest to guarantee food security. Within the alternative protein landscape algae protein is of increasing importance due to its protein quality and quantity.

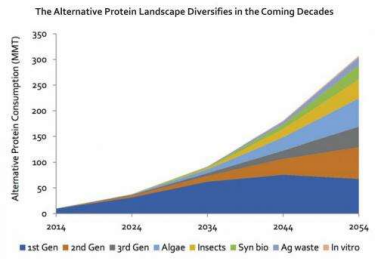

Fig 1.: Alternative protein landscape, Lux Research Report 2016

As algae can grow photoautotrophic they bear a huge potential to secure food security with a limited resource input. They grow on non-arable land, have a high biomass productivity and can uptake CO_2.

Fig 2.: *A. platensis* cultivation on a rooftop in Bangkok, Energaia 2013

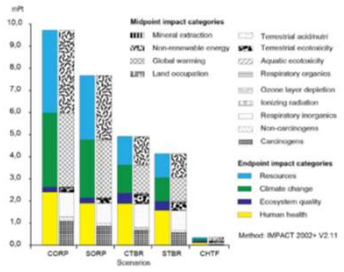

Figure 2: Comparison of microalgae cultivation technologies with end-point impact categories: FU1 – 1kg of fresh microalgae biomass; mPt – milipoints (ecopoints, 1 kPt is equal to the annual impact of one European citizen); CORP – open raceway pond cultivation of *C. vulgaris*; SORP – open raceway pond cultivation of *A. platensis*; CTBR – tubular photobioreactor cultivation of *C. vulgaris*; STBR – tubular photobioreactor cultivation of *A. platensis*; CHTF – heterotrophic fermenter cultivation of *C. vulgaris* [1].

However, photoautotrophic cultivation can up to date not compete with a heterotrophic cultivation [1]. To overcome this aspect NewAlgae incorporates a novel cultivation concept based on cell stimulation with nanosecond pulsed electric fields (nsPEF) [2].

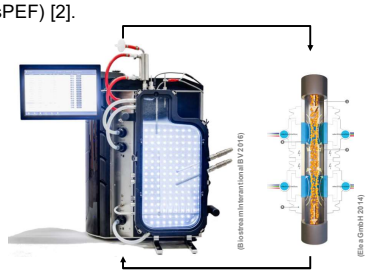

Fig 4.: Novel photobioreactor nsPEF cultivation concept, developed in the Laboratory of Sustainable Food Processing at ETH

By this novel cultivation system the efficiency can be increased and therefore a first step towards a more sustainable photoautotrophic cultivation can be achieved.

References

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2. Eing, C. J., Bonnet, S., Pacher, M., Puchta, H., & Frey, W. (2009). Effects of nanosecond pulsed electric field exposure on Arabidopsis thaliana. *IEEE Transactions on Dielectrics and Electrical Insulation*, *16*(5), 1322–1328.

Food System Relevance

Algae, bearing large amounts of proteins (up to 70% of dry matter), can serve as an enormous biological protein source. They enable food production concepts considerably more sustainable than the existing value chains as they could grow on infertile land with a high biomass productivity, by using combustion gas as CO_2 source to generate a wide range of material and energetic products with an almost 100% fertilizers use efficiency.

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