

Life Cycle Assessment of High Added-Value Compounds Production with Microalgae

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Microalgae have found commercial applications as natural sources of valuable macromolecules, including carotenoids and long-chain polyunsaturated fatty acids. Natural carotenoids derivate from microorganisms as algae, bacteria and plants, have medicinal properties and are used for preventing human diseases and maintaining good health. The major types of carotenoids used commercially are astaxanthin, for its antioxidant properties and its bright red color, and β -carotene, which imparts a red-orange-yellow color to animal and food products. Synthetic carotenoids are less expensive to produce but are petrochemical derivate and this raises issues related to food safety and environmental pollution. Although the market is dominated by synthetic carotenoids, the demand for natural sources is growing. Microalgae are a good alternative to other natural sources because they do not require arable land and can produce a considerable amount of carotenoids when cultivated under specific conditions.

The EU project "Algae for a biomass applied to the production of added value compounds (ABACUS)" aims to develop a new algal biorefinery concept, based on the production of added value compounds from microalgae. The focus of the project is on terpenes for fragrances and carotenoids for nutraceuticals and cosmetics activities. For the sustainable design and development of the biorefinery concept, life cycle and techno-economic analysis of the processes are performed. The presented work covers the knowledge on the environmental aspects and on the optimization of the sustainability of the production process. Preliminary results, based on primary and secondary data will be presented and a first analysis of the environmental impact of the process provided. A sensitivity analysis will show to which degree the different stages of the process influence the results and if the impacts could be reduced by using different extraction technologies and energy sources. The goal and scope definition and the most important assumptions and choices, such as the definition of the product and its life cycle and the description of the system boundaries will be illustrated. A description of data quality will be provided in order to figure out the reliability of the results and give a proper interpretation of the outcome of the study.