

## Project TAČR – SIGMA DC2

PigmenTech: Innovative refinement of microalgae biomass (*Haematococcus pluvialis*) for bioactive pigments via countercurrent separation

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The production of natural pigments such as lutein, canthaxanthin and astaxanthins usually requires various natural sources and complex extraction processes. The microalgae *Haematococcus pluvialis*, which contains all three pigments, offers a unique opportunity for a more efficient and integrated production process. Despite its potential, *H. pluvialis* is mainly sold as microalgae powder and oleoresin/extract and offers limited market value. Although these extracts contain the target pigments with a high safety profile and are approved for human use, they also contain high proportion of lipids bound to unhealthy fatty acids — an often overlooked drawback. The underutilization of *H. pluvialis* highlights a missed opportunity to diversify the commercial supply of pigments from a single microalgae source and underlines the need for a selective separation approach. However, the complex distribution of pigments in *H. pluvialis*, due to their different polarity profiles, has hindered the simultaneous commercial production of these valuable compounds.

To overcome this challenge, PigmenTech — a joint research and development initiative of Algatech-MBU and the company Aveflor a.s. supported by a TAČR grant (2024-2025) — aims to revolutionize the separation process. PigmenTech is developing an advanced broad-spectrum chromatographic process based on countercurrent separation (CCS) to extract lutein, canthaxanthin and astaxanthin esters simultaneously. This innovative method creates a high-resolution two-phase system that can generate a variable polarity gradient through systematic modifications. This enables the simultaneous generation of multiple elution systems in CCS and provides a comprehensive chromatographic scanning range without compromising the hydrodynamics of the separation process. The new process will be transferred to the industrial partner for scaling up to a TRL7 pilot level, followed by optimization for industrial production. This initiative will establish a new model for the commercial production of *H. pluvialis* pigments, significantly improving both the efficiency and marketability of these valuable bioactive compounds. It will also pave the way for the development of new products through multi-pigments formulation approach.