

Advances in the production of high value products from microalgae: Current status and future prospectives

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Microalgae are a promising source for various high value products such as carotenoids, omega-3 and omega-6 PUFA. β -carotene from *Dunaliella salina*, and astaxanthin from *Haematococcus pluvialis*. Phycocyanin extracted from cyanobacteria has gained a major market share recently. Additional algal strains of industrial potential have been described for the production of high value products, or for biofuels production, and novel promising strains continue being described. Phototrophic production of algal biomass and bioproducts is considered 2 – 5 times more expensive than competing pathways both for high value products and bulk biomass. Recent advances in deciphering the genomes and transcriptomes of multiple high value algal species, and molecular pathways of carotenoid, lipid and PUFA biosynthesis in algae have recently been resolved. Therefore, progress in microalgae transformation and genetic engineering is now opening the way towards increasing production efficiencies for high value products, or for bulk biomass or biofuels production. Recent advances include enhanced production of LC-PUFA in engineered *Phaeodactylum* and *Nannochloropsis*, enhanced carotenoid biosynthesis in *Phaeodactylum* and *Haematococcus*, and enhanced oil accumulation and productivity in various engineered species. Encouraging progress has also been achieved in expressing high value proteins in several microalgae species. We will present major advances in understanding and engineering of microalgal high value and other metabolic pathways, demonstrating significant progress in developing competitive production pathways. Such technologies, supported by adequate biorefinery technologies and highly sustainable cultivation options can significantly contribute towards sustainable production of high value biochemicals, while also offering opportunities for increasing sustainable food and fuel supplies. Microalgae thus offer the unique opportunity to shifting significant agricultural production volumes into unproductive land using non-potable water, while reducing global resource depletion and pollution from unsustainable agriculture and fishery.

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