

## Towards Versatility of Aquatic Production Platforms: Unlocking the Value of Nordic Bioresources (NordAqua)



### Aims and objectives

NordAqua brings together 10 Nordic universities and research institutes along with 10 industrial and societal partners from Finland, Norway and Sweden. NordAqua aims at improvement and strengthening the algae-based blue bioeconomy, which in Nordic countries is still in its infancy. NordAqua focuses on the use of aquatic photosynthetic organisms to convert solar energy into energy-enriched carbon products with concomitant recycling of nutrients and removal of water pollutants. Main objectives of NordAqua are (i) to develop a value chain of activities for sustainable production by making use of the unique properties of aquatic photosynthetic organisms; (ii) to improve photosynthesis and develop synthetic biology tools for creating cell factories producing a diverse range of biofuels and fine chemicals; (iii) to create fruitful interactions with company partners to achieve efficient knowledge transfer to industry; (iv) interact with key players in society, including decision makers and the public to foster science-based decision making towards conceptual and solid frameworks for a blue bioeconomy.

### Progress towards the objectives

NordAqua has focused on screening and identification of the most efficient microalgae (including cyanobacteria) from Nordic culture collections to be used in removal of contaminants of emerging concern (pharmaceuticals and toxic metals) and for recycling nutrients from wastewaters, while concomitantly contributing to the sequestration of CO<sub>2</sub> and enhanced biomass production for blue biorefineries. Co-cultivation of microalgae and horticulture in hydroponic greenhouses is another focus for nutrient recovery and development of a sustainable and environmentally friendly aqua-(agri)culture production system. The consortium explores Nordic macro and microalgae as a source of natural high-value bioactive compounds - novel nutraceuticals and pharmaceuticals. To this end, the NordAqua consortium focuses on (i) detection of high-value phlorotannins, phenolic compounds, carotenoids and vitamins; (ii) revealing and characterization of the action mechanisms of antifungal glycolipopeptide; (iii) identification of novel and known natural UV-sunblocks from red algae and microalgae by making use of genome mining and screening of the culture collections. NordAqua cancer cluster identifies novel cyanobacterial products with anticancer bioactivity using human cancer cell lines. Downstream processes including extraction, fractionation and purification of target products are also ongoing activities in NordAqua.

NordAqua has also contributed to understanding the regulation of natural photosynthesis with an aim at enhancing the conversion efficiency of solar energy to biomass and/or targeted added-value products in micro and macroalgae. To this end, the consortium partners have also improved the immobilization technique of photosynthetic cells using natural and tailored polymeric matrices. The engineered thin-layer biofilms significantly enhance light utilization and decrease water usage of algae-based production systems. NordAqua has developed synthetic biology tools for model and newly identified promising Nordic microalgae in order to overcome limitations in cell metabolism and to introduce novel biosynthetic pathways for effective direct production of desired fine chemicals and biofuels.

NordAqua is establishing an open access database of Nordic culture collections (NORCCA, the Norwegian Culture Collection of Algae, HAMBI culture collection, University of Helsinki and Umea University culture collection) under the same umbrella. NordAqua heavily integrates entrepreneurship and promotes algae-

based blue bioeconomy by active involvement of both the private and public sectors, industry, consumers, end-users and high school teachers.

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