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Short Communication

An Analysis of the need of creating microalgae library for future global research

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An Analysis of the need of creating microalgae library for future global research

Studies on single cell creatures will be important for the development of the future technologies ranging from food, nutrients, pharmaceuticals, energy, to the environmental protection (greenhouse gas and more).

Algae have long been touted as a source of novel functional ingredients and bioactive compounds, and while great progress has been made in commercialising certain nutraceutical ingredients, there are many challenges ahead. In this special edition article we explore the situation for nutritional oils, alginates, and carotenoids extracted from algae.

Sustainability concerns regarding global fish stocks, together with ever-growing demand from the aquaculture industry have been key factors in driving the demand for alternative sources of the long chain polyunsaturated fatty acids (LC-PUFAs) eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Microalgae are the prime source of LC-PUFAs for fish and other organisms. Fish oils are abundant in both EPA and DHA because they reflect the trophic integration of diatom and flagellate type algae, which are rich in EPA and DHA respectively. Early production of algal sourced LC-PUFAs involved predominantly DHA. The principal species used were from either fermentation of Schizochytrium sp. or the heterotrophic Crypthecodinium cohnii. Other DHA-rich species include Thraustochytrium aggregatum and Ulkenia sp. Martek Biosciences (acquired by Royal DSM NV in 2011) developed commercial edible DHA from both the main algal sources mentioned above. One of Martek's proprietary products was demonstrated to have similar nutritional properties to cooked salmon. The company's DHASCO product, derived from C. cohnii, has a DHA content of over 40% and its safety and bioaccessibility has enabled its use in infant formula, baby foods, dietary supplements and pharmaceuticals.

EPA EPA-rich varieties include Phaeodactylum tricornutum, Nannochloropsis sp. and Monodus subterraneus. The former is a diatom which naturally contains around 30-40% EPA and is considered a viable source for scalable industrial production. Nannochloropsis' EPAcontent is also potentially high, although very dependent upon culturing conditions, while the light-dependency of the phototrophic Monodus subterraneus to achieve high EPA yield renders commercial development problematic. Commercial barriers The main barriers to the commercial EPA exploitation of microalgae have been the high cost of producing biomass plus the efficient extraction of valuable products. "The primary barrier has been stable production of EPA rich Nannochloropsis biomass at large scale (over 10 acres). For the last two years, we have focused on the use of agronomic practices such as crop protection and integrated pest management practices, fertilizer management, and water use as well as technology improvement, to stabilize and scale our open pond production. In addition, we have been working with technology partners to find more energy efficient, more sustainable harvesting and cultivation methods, including looking outside the algae industry for inspiration and innovation. This is what has allowed us to expand both at our Texas facility and in the partnership with Green Stream," commented Rebecca White, Vice President of operations at Qualitas Health, the Texas-based market leader in algal EPA production. Heterotrophic production, which uses a variety of carbon sources, is also an area of focus. The technique has enabled a 2-3 fold increase in LC-PUFA productivity versus autotrophic cultivation. Recent studies have focused on optimising production parameters to maximise yields. Key input variables are not only the different algae species themselves but also carbon source (and its concentration), culture temperature and culture mode (e.g. batch, fed-batch, etc.) Optimising the production environment has also been combined with another key development, the metabolic engineering of particularly algae strains to vary the ratio of DHA/ EPA. "Metabolic engineering means genetically engineering organisms to directly modulate (create, increase or optimize) expression of desired metabolites or to improve cellular processes," explained White. A recent example is the metabolic engineering of P. tricornutum, a species which naturally produces almost exclusively EPA, and only trace amounts of DHA. By injecting two additional genes, a strain of Ostreococcus tauri, which overexpresses delta-5 (Δ-5) saturase, and a glucose transporter gene, researchers have been able to produce a transgenic alga that produces substantial amounts of both DHA and EPA.

There are estimated 300,000 to 1 million different species of microalgae around the world. Companies and institutes had done a lot of studies on different land based microbials (fungi, yeast, and bacteria). There are hundreds of thousands of species collected and studied in various organizations. However, there are very little collections and research being done on microalgae. Lack of commercial interest is one of the key reasons, difficulties in collection process is another.

With growing population, it has become ever more evident that we need to rely more on these single cell creatures to help us function in a more efficient way in the future. More importantly, a lot of the species of microalgae might come from another planetary system which may help us understand more about our universe. These species can be found in cold artic water, highest mountain peak, hot volcanic environment, and even the deepest ocean trenches. Some of these studies may hold the answers to the questions we are facing today on this planet, some may even help us explore our new world in another planetary system tomorrow.