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Microalgae as a Key Source of Omega-3 Poly Unsaturated Fatty Acids (PUFAs)

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The production of functional foods gained importance nowadays due to the market demand for the dietary supplementary products which represents the pursuit of the healthier life. Omega-3 became popular among these products because of its various health benefits. The only major source supplying omega-3 is fish resources. Due to the reduction of fish stocks and increasing demands there is a need for an alternate source for omega-3 oil. In this regard microalgal source could be a potential source for sustainable omega-3 oil production because of their capacity to yield high biomass and accumulate high content of polyunsaturated fatty acids (PUFA) in their cells. Thraustochytrids are unicellular heterotrophic microalgae which accumulate high levels of lipids as triacylglycerols, with a high content of the long-chain omega-3 fatty acid docosahexaenoic acid (DHA). Thraustochytrid based DHA-rich oil was first commercialized by the U.S. company OmegaTech, which later was acquired by Martek and is now a part of DSM (Aasen *et al.*, 2016).

Constraints with the existing sources

Overexploitation of fish stocks for the oil production caused significant level of reduction in the fish resources. Other concerns such as presence of mercury and polychlorinated biphenyls (PCBs) contaminations, odor and low stability, variation in oil quality with respect to fishing season, location and climatic changes. The wild fish capture has generated environmental, ethical and economic problems, which may not support the growing demand for omega-3 oils since wild capture is the most prevalent source of the seafoods and products.

Thraustochytrids as sustainable omega-3 source

Sustainable production of omega-3 oil from thraustochytrids is depicted in the above cycle. Sustainability should be ensured in every step when thraustochytrids are used as a source for large scale production of omega-3 products. Sustainability is the ability to be remain productive without compromising the ecological balance. The sustainability cycle starts from the natural ecosystem from where the organisms are isolated, laboratory cell cultivation, industrial production, separation and purification process and the development of omega-3 rich products for human and aquaculture. Thus, the cycle should enable these organisms to reach the natural ecosystem again. Industrial processes such as oil extraction, refining and packaging involved in the oil production should be environmentally safe (Colonia *et al.*, 2020).

Examples of biomass, lipid and DHA yields in different stains

Thraustochytrids stains vary in the biomass, lipid and DHA accumulation. Lipid accumulation is maximum in the strain *Thraustochytrium* sp. ONC-T18 (4 days) and the percent DHA accumulation is maximum in the strain *Thraustochytrium* sp. 20892 (4 days).

Some example strains with their biomass, lipid and DHA yields are as follows:

Organism	Biomass (g/L)	% lipids in biomass	% DHA in lipids	DHA (g/L)
Schizochytriumlimacinum SR21	48.0	77.5	35.6	13.3
*Thraustochytrium*sp. ONC-T18	28.0	81.7	31.5	4.6
*Thraustochytrium*sp. 20892	6.1	15.2	53.1	0.7
Thraustochytrid strain 12B	31.0	57.8	43.1	6.8
Thraustochytriumroseum ATCC 28210	17.1	25	50.0	2.1

Commercial products developed from industries

1. DSM

Life'sDHA® and Life's™OMEGA are the DHA rich products developed for human consumption and DHAgold™ for animal feed. These products were developed from the *Schizochytrium* sp.

2. Veramaris

Veramaris algal algal oil is produced to meet the salmon aquaculture feed requirement to replace the fish oil developed from capture fishes with the aim of contributing to the Global Goals for Sustainable Development.

3. Fermentalg

DHA ORIGINS 400®, DHA ORIGINS 510® and DHA ORIGINS 550® are the products of Fementalg developed with varying DHA concentrations.

4. Nutrinova

DHAid™ (DHActive) is a Nutrinova's product from *Ulkenia* sp. with 35–40% DHA as main PUFA.

Conclusion

Omega-3 rich oils produced from Thraustochytrids serves as sustainable alternate source to meet the expected global demand of more than 135,500 tons in 2025. Multiple commercial products can be developed from thraustochytrids such as DHA rich oil, biodiesel and other terpenoid compounds. Isolation and development of new strains by genome editing for increased lipid production increases the market potential of food, feed and pharmaceutical industries. Genetic engineering approaches can be used for the artificial control over the expression levels of desired genes required for the production of lipids.

References

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