Algae oil vs Fish oil

Life cycle assessment of fish oil substitute produced by microalgae using food waste

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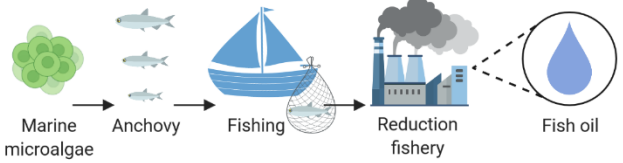
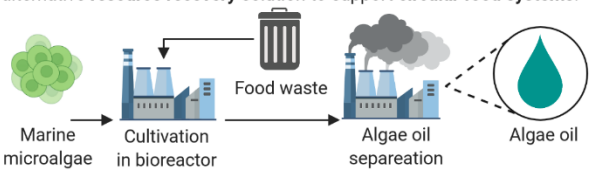
FISH OIL

Aquaculture is one of the fastest growing food-producing sectors globally, and each year about **1 million ton fish oil**, rich in the essential fatty acid Omega-3, is produced to support the global population with nutritious food and DHA. However, the fish oil industry is highly dependent on fossil energy and marine raw materials, which leads to **depletion of natural resources** and **ecosystems** as the global demand for fish increases.



ALGAE OIL

In aquatic ecosystems, **DHA is naturally produced by microalgae** and accumulated in fish via the food web. Research shows that heterotrophic microalgae can be cultivated in bioreactors using *volatile fatty acids* (VFA) derived from food waste as primary carbon feedstock. This solution would **lower the demand for fish** needed for fish oil, and is also an alternative **resource recovery** solution to support **circular food systems**.



FOOD WASTE

About **1.3 billion tons of food** is wasted globally each year. Some of this waste is re-used in anaerobic digestion to produce **biogas** for energy. However, multiple **high-value products** can be produced alongside traditional biogas. Recovering and re-using these resources could **reduce** the overall environmental impact caused by the food system.

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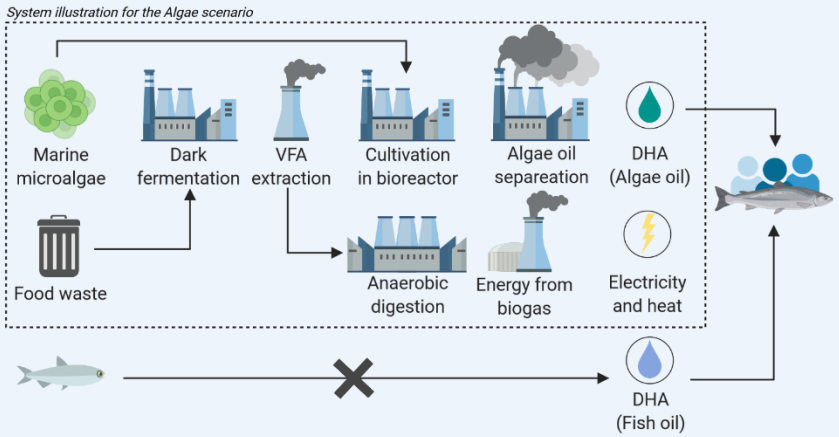
FOOD FROM WASTE

System illustration for the Algae scenario



New production methods, with **lower environmental impact**, are urgently required within aquaculture and food waste management. One solution with a high **sustainability potential** is to gain DHA directly from the marine primary producers, namely microalgae. Feeding algae VFA obtained from food waste to produce an algae oil rich in DHA, could provide **multiple benefits** in comparison to traditional fish oil, especially since biogas can be produced alongside. However, assessing and evaluating the environmental implications of new technologies is crucial to ensure that new solutions also support **future sustainability**.

Life cycle assessment (LCA) is a systematic method to gain a holistic quantification of the **total environmental impact** during a product's life cycle. This study aimed to evaluate the future potential of DHA produced from algae with a primary carbon feedstock from food waste, by assessing and **comparing** the environmental impact to that of DHA produced from Peruvian anchovy oil. A quantitative assessment of the environmental impact and the potential **effects on biodiversity** was included to provide a vital dimension of aquaculture and food waste valorisation to policymakers, the research community, and the industry.

ENVIRONMENTAL IMPACT

The results show that producing DHA via algae oil using VFA from food waste holds a promising sustainability potential as it infers lower impact considering global warming, acidification and land use compared to fish oil.

Table 1. Environmental impact per 1 ton DHA

	Global warming kg CO_2eq	Terrestrial acidification kg SO_2eq	Freshwater eutrophication kg Peq	Land use m^2a crop eq
Algae scenario	-5.2×10^4	3.5×10^3	-9.4×10^1	2.7×10^3
Fish scenario	-1.5×10^4	3.9×10^3	-9.7×10^1	3.2×10^3

BIODIVERSITY LOSS

Biodiversity refers to the variability among all living organisms and is **essential for life on Earth**. As natural systems and species are dependent on each other, damaged ecosystem quality or loss of even a small number of species could lead irreversible consequenses. Even though established LCA methods can **not fully account** for the total impact on biodiversity, the result from this study show that DHA from heterotrophic algae inferred **lower Ecosystem damage** compared to DHA from Peruvian anchovy. The aspect of ecosystem quality is important to consider, especially in systems dependent on biotic resourses.

WHATS NEXT?

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