Fostering sustainable microalgae cultivation in Europe as a local source of alternative protein

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TAKE-HOME MESSAGES

- Sustainable microalgae production requires reduced reliance on fossil-fuel-based nitrogen and critical phosphorus resources.
- Market growth is constrained by high production costs, unfamiliar taste and texture for consumers, and limited presence in mainstream supermarkets.
- Policy support should encourage R&D investment for improved production efficiency, financial incentives for circular cultivation, and strategic public procurement to increase consumer acceptance and market visibility.

Introduction

Within the European Green Deal, the Farm to Fork strategy aims at creating a sustainable and resilient food system within the EU. As part of this effort, the strategy identifies **algae[1] as a vital alternative protein source**, with significant potential to enhance global food security and sustainability.

Algae present a promising solution as they grow in water, **eliminating the need for arable land**, they **do not require pesticides**, and can be cultivated using nutrient-rich side-streams from other industries, **reducing reliance on mineral fertilisers**.

Despite these advantages, **microalgae production in the EU remains limited**. Key barriers include **high initial investment costs**, an **underdeveloped market** for algal biomass, and a **heavy dependence on mineral fertilisers** due to the lack of recycled nutrient sources for cultivation[2].

To unlock the full potential of algae as a sustainable food source, **targeted support** is needed to foster industry growth, drive innovation, and create a viable market within Europe.

[1] Algae are a diverse group of organisms that perform photosynthesis and include macroalgae (seaweeds), microalgae, and cyanobacteria (also often referred to as microalgae).
[2] Only one commercial algae medium exists using recycled nutrients, produced by the company Varicon Aqua, in the UK.

Recycled nutrients suitable for microalgae cultivation

Several residual streams from agriculture and industrial activities are suitable for microalgae cultivation. However, when food production is targeted, food-grade streams should be prioritised. The list below highlights potential sources of recycled nutrients for microalgae cultivation with examples of implementation.

- By-products of whisky distillation: MiAlgae
- Food industry waste: Swedish Algae Factory
- Brewery waste streams: AlgaeBrew
- Dairy wastewater: NENUPHAR
- Winery wastewater: RedWine
- Fruit and vegetable processing wastewater: Life ALGAECAN
- Grass juice: Grass2Algae

Barriers to microalgae consumption in the EU

Although microalgae are recognized for their high protein content and low environmental footprint compared to other crops, their integration into the European food system remains limited.

A recent study examined EU Consumer habits regarding fishery and aquaculture products, including algae products[3]. While seaweed has gained some traction—primarily in sushi and wraps—**microalgae consumption remains limited**, mostly confined to dietary supplements.

Key barriers to broader adoption include, in order of importance:

- Lack of habit
- Unknown taste or smell
- Lack of easily available recipes
- Cost
- Reduced availability in local shops

In addition, the high level of requirements for food safety in Europe also reduces the price competitiveness of this product in comparison to microalgae obtained in other regions with less stringent requirements, which still make their way into European markets.

[3] https://europa.eu/eurobarometer/surveys/detail/3213

Policy Recommendations to Promote Microalgae in the EU

Call for integration of microalgae into National Protein Strategies and prioritization of associated R&D support

National and regional protein transition frameworks—such as the Flemish Protein Strategy[4]—should explicitly prioritise microalgae alongside other sustainable protein options. This includes establishing a national contact point or coordination office to support producers and entrepreneurs with access to regulatory guidance, technical expertise, certification schemes, and funding instruments.

In parallel, public investment in research and development should focus on reducing production costs, expanding product applications, and increasing market uptake. Priority areas include low-energy cultivation systems, nutrient recycling from agro-industrial waste streams (promoting end-of-waste criteria, when possible, under risk-based criteria), and innovations in food formulation that enable the integration of microalgae into familiar products such as snacks, sauces, and meat alternatives. Aligning strategic planning with technological advancement will help bridge the gap between innovation and market readiness.

Call for financial incentives for circular microalgae cultivation and industrial

To accelerate the adoption of sustainable microalgae production, financial instruments should target both producers and upstream partners engaged in circular practices. Cultivation systems that utilise residual nutrient streams—such as agro-industrial effluents—have shown promising results in projects like AlgaeBrew and Grass2Algae. These systems close nutrient loops and significantly reduce environmental impact, but remain cost-intensive and need to overcome legislative barriers in certain applications.

Targeted subsidies should be made available to support the operational costs of such circular cultivation models and the costs for obtaining legal permits and bio-product certification. At the same time, fiscal incentives (e.g., tax reductions or exemptions) can stimulate industrial symbiosis by encouraging upstream sectors, such as food processing or brewing, to supply nutrient-rich byproducts to algae producers. Together, these financial measures would help overcome initial economic barriers, reinforce regional circularity, and increase the commercial viability of microalgae-based food products.

Call for public engagement and strategic procurement to stimulate demand

Creating consumer demand is essential to scale microalgae production and normalise its role in European diets. Behavioural change can be supported through public awareness campaigns that emphasise both the health benefits—such as high-quality protein and omega-3 fatty acids—and the environmental advantages of microalgae, including low

[4] https://lv.vlaanderen.be/beleid/go4food-vlaamse-voedselstrategie/eiwitstrategie

land, water, and resource requirements. Effective outreach could include algae-themed cooking competitions, school tastings, and media content with chefs and nutrition experts.

Meanwhile, governments should leverage their role as market leaders by incorporating microalgae-based products into public food procurement—particularly in schools, hospitals, and official events. When aligned with existing sustainability criteria, strategic procurement not only increases visibility and acceptance but also sends a strong market signal, encouraging investment and fostering early-stage supply chain development.

Call for support of EU algae producers

Microalgae found in the European market are often produced outside of Europe, where less stringent food certification results in lower production costs, causing a market distortion in favour of non-European products. Financial support and incentives for starting algae production facilities through national Innovation Funds to minimize risk and capital costs can reduce this distortion.

Certification schemes highlighting the advantages of consuming a European product subjected to more stringent legal obligations are another possible approach to stimulate European production of microalgae.

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NUTRI-KNOW is a Horizon Europe project under the Coordination Support Action (CSA) framework that brings nutrient recovery research results to end-users in the market and policy. This project engages 12 EIP-AGRI operational groups from 4 EU member states: Spain, Belgium, Italy, and Ireland. Among them, the operational group Grass2Alage explores the potential of grass juice as a nutrient medium for microalgae cultivation, converting low-quality by-products into high-value alternative protein sources.

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