

GREEN PARTICAPATION, GREEN EUROPE

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A11- Potential of microalgae in the fight against climate change

13-14.05.2025

Introduction to Microalgae as an Alternative Solution



Funded by the European Union

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Overview of Microalgae Species with High Nutritional Value

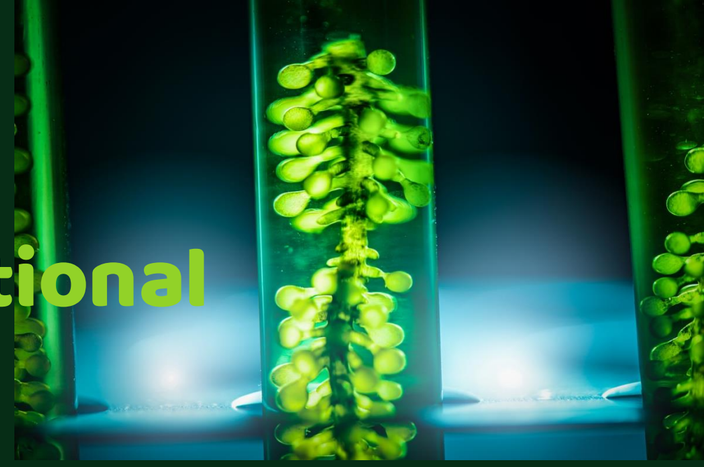
What are Microalgae?

Microalgae are unicellular, photosynthetic microorganisms that thrive in aquatic environments.

They are considered "functional foods" due to their dense nutritional profiles, including:

- High protein content (40–70% dry weight)
- Essential amino acids
- Omega-3 and omega-6 fatty acids
- Vitamins (A, B12, C, E)
- Antioxidants (carotenoids, chlorophylls)
- Minerals (iron, magnesium, zinc)

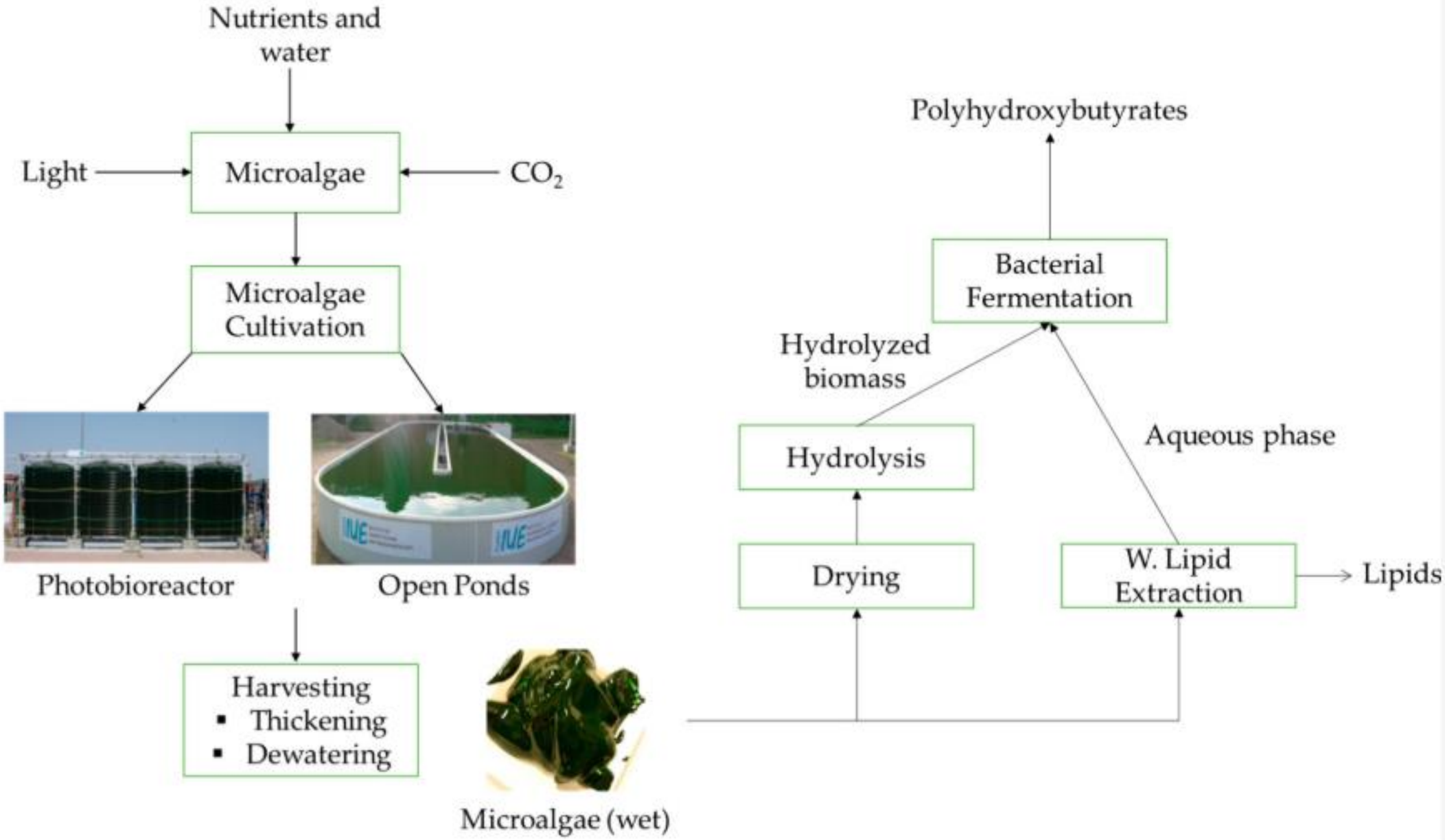


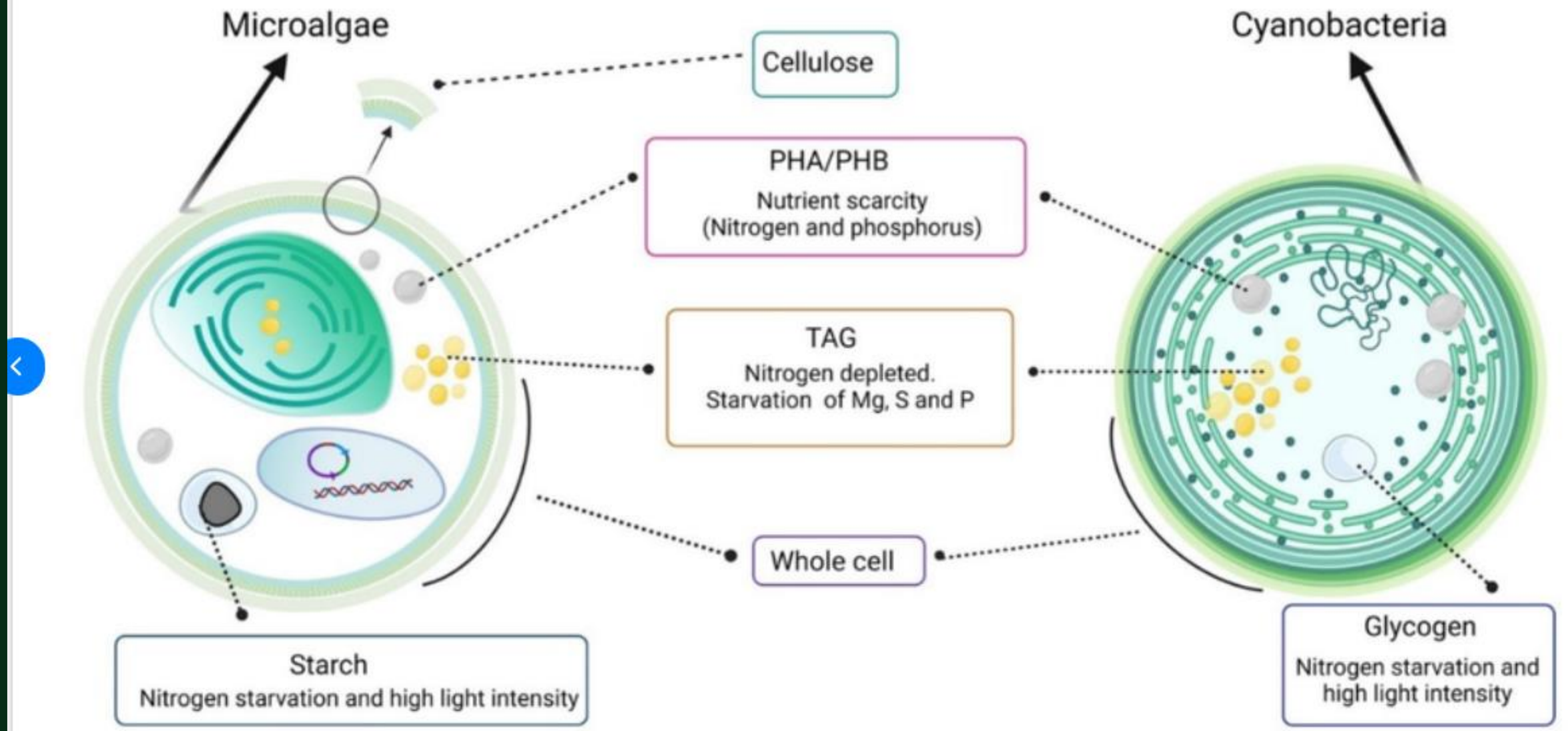


Key Microalgae Species of Nutritional Importance

- Spirulina (Arthrospira platensis): Known for its high protein (up to 70%), B vitamins, and antioxidant phycocyanin. Often used in dietary supplements.
- Chlorella vulgaris: Rich in chlorophyll, iron, and omega-3s, supporting immune health and detoxification.
- Dunaliella salina: An exceptional source of beta-carotene, a potent antioxidant.
- Nannochloropsis spp.: Valued for its high EPA (eicosapentaenoic acid) omega-3 content, used in aquaculture feeds and supplements.

Figure 7. Bioplastic production from microalgae [1].





Microalgae and cyanobacteria components used for bioplastic production. PHA: polyhydroxyalkanoates, PHB: polyhydroxybutyrate, TAG: triacylglycerol. Created with BioRender.com (accessed on 10 September 2022).

Question



Why are microalgae considered “superfoods” in human nutrition?

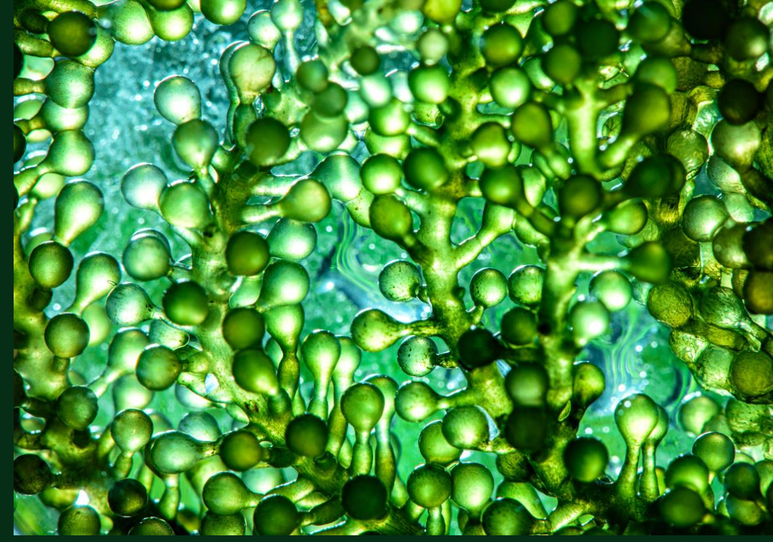
A) Only used as fish feed

B) Rich in essential proteins, omega-3s, vitamins, and antioxidants

C) They grow very slowly

D) They are artificially synthesized in labs

Role of Microalgae in Sustainable Agriculture and Food Production



Microalgae in Sustainable Agriculture

- **Biofertilizers and Biostimulants:**

Microalgae enhance plant growth, improve nutrient uptake, and increase stress resistance through bioactive compounds. This reduces reliance on chemical fertilizers.

- **Wastewater Treatment and Carbon Capture:**

Microalgae utilize nitrogen and phosphorus from wastewater, simultaneously cleaning the water and capturing CO_2 through photosynthesis.

- **Animal Feed and Aquaculture:**

Microalgae-based feeds can replace traditional fishmeal, reducing environmental impact while maintaining high nutritional standards in aquaculture.

Advantages of Microalgae in Agri-food Systems

- High biomass productivity per area
- No competition with arable land
- Minimal freshwater requirements
- Carbon-neutral or negative production cycles



Microalgae: Addressing Global Food Security and Climate Change

Food Security Implications

With the global population expected to reach 9.7 billion by 2050, microalgae are emerging as a viable alternative protein source, alleviating the pressure on land and water resources.

Climate Mitigation Potential

- CO_2 absorption capacity (up to 2 kg CO_2 per kg of dry biomass)
- Reduction in methane emissions when used as livestock feed additive
- Integration into circular bioeconomy models

Current Innovations and Future Trends

- Bioplastic Production:

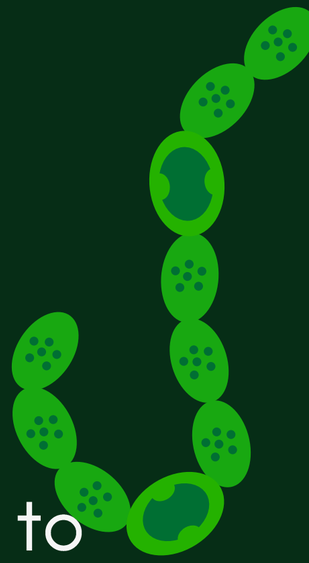
Microalgae-derived bioplastics offer biodegradable alternatives to petroleum-based plastics, contributing to waste reduction and circular economy.

- Nutraceuticals and Functional Foods:

Microalgae are being incorporated into functional foods (smoothies, protein bars) for their health benefits.

- Synthetic Biology & Algae Biofactories:

Engineering microalgae for tailored bioactive compounds, vitamins, or pharmaceuticals.





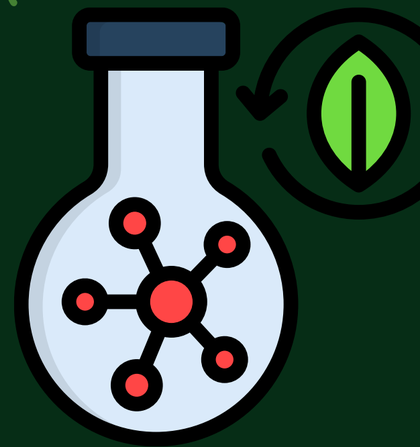
Global examples



1. NREL (USA):
   - Techno-economic models of microalgae-based biofuels
   - “Microalgae Biofuels Production Pathways” report (2022)
   - https://www.nrel.gov



2. European Algae Biomass Association (EABA):
   - Sustainable algae production and industrial applications in Europe
   - Horizon 2020 projects: ALG-AD, Photofuel
   - https://www.eaba-association.org



3. FAO (2023):
   - Comprehensive analysis of microalgae in food security and animal feed
   - https://www.fao.org

Examples from Turkiye

1. TÜBİTAK MAM:
   - Microalgae-based biodiesel production projects
   - Wastewater treatment using algal biotechnology

2. Ege University (Faculty of Fisheries):
   - Algal-based fish feed formulations
   - Spirulina and Chlorella cultivation under Turkish conditions

3. METU Biotechnology Center:
   - Photobioreactor design and optimization
   - R&D projects on algae-based bioplastics in Türkiye



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THANK YOU FOR YOUR ATTENTION!

Any questions?

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