Demonstration of Innovative Functional food production systems based on more sustainable value chains of marine and freshwater raw materials for conscientious EU consumers

NOVAFOODIES

2.0 Processing techniques of marine and algae products in the context of sustainability

2.3 Benefits of algae and algae extracts

Funded by the European Union

This project has received funding from the European Union under Grant Agreement N° 101084180.

Main objective

- Get an overview of the health benefits of algae and algae extracts and their benefits for One Health

Learning outcomes

- Know different substances contributing to the health benefits of algae and algae extracts
- Explain the social, environmental and human health benefits and/or drawbacks of the use of algae extracts

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Agenda

Benefits

- Nutritional and health benefits
- Economic benefits
- Ecological benefits
- Societal benefits

Drawbacks

- Legals aspects
- Safety aspects
- Food safety hazards

- Group exercise – Product availability

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Main differences of Micro- and Macroalgae

- Based on cellular structure there are
  - **Macroalgae** (seaweeds): multicellular aquatic plants
  - **Microalgae**: single-celled (photosynthetic, microscopic eukaryotic organism)
- Higher protein content in microalgae (60 to 70% dry weight) (vs. 20 to 30% dry weight in macroalgae)
- Both macro and microalgae are/provide:
  - nutrient-dense
  - essential amino acids
  - bioactive compounds

→ Promising solutions to the growing demand for sustainable protein source

M. Maghimaa et al.

Table 2
Comparison of nutritional content of microalgae and macroalgae.

Nutrient	Microalgae	Macroalgae	References
Protein	High (up to 60–70 % dry weight)	Moderate (upto 20–30 % dry weight)	[107]
Lipid	Moderate (upto 10–20 % dry weight), rich in omega-3 fatty acids (eg., DHA, EPA)	Low in fat, minimal omega-3 fatty acids	[108]
Carbohydrate	Low to moderate, primarily in the form of polysaccharides (10–25 % dry weight)	Moderate to high, containing dietary fibers and polysaccharides (30–60 % dry weight)	[40]
Vitamins	Rich in vitamin B12, B6, E and K	Rich in vitamin A, C, E and K; Moderate in vitamin B	[109]
Minerals	High in iron, calcium, magnesium	High in iodine, calcium, magnesium, potassium, iron	[110]
Antioxidants	Contain chlorophyll, phycocyanin and beta carotene	Contain fucoxanthin, beta carotene and polyphenols	[111]
Bioactive compounds	Phycocyanin, polysaccharides and peptides with antioxidant and anti-inflammatory properties	Fucoxanthin, alginates and laminarin, which have antioxidant and anti-inflammatory effects	[13]
Fibre	Low in insoluble fibers, rich in polysaccharides	High in dietary fibers, including soluble fibers like alginate	[112]

Maghimaa, et al. (2025)

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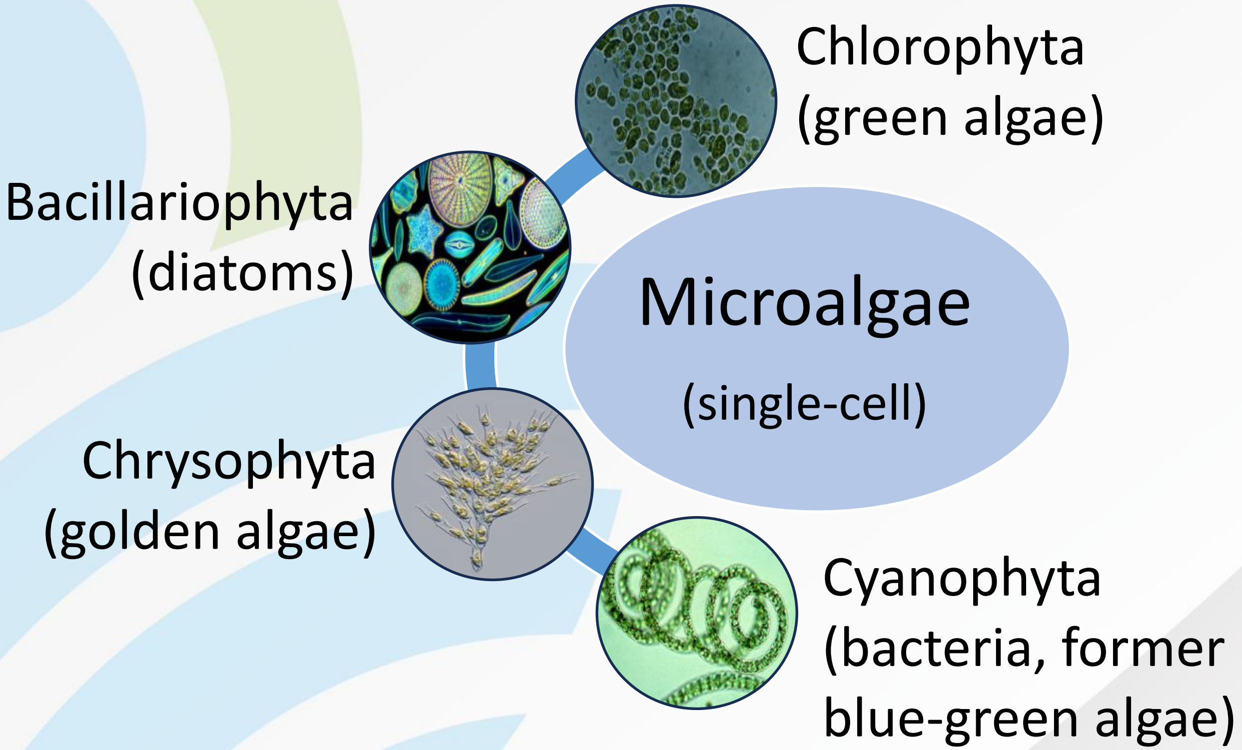
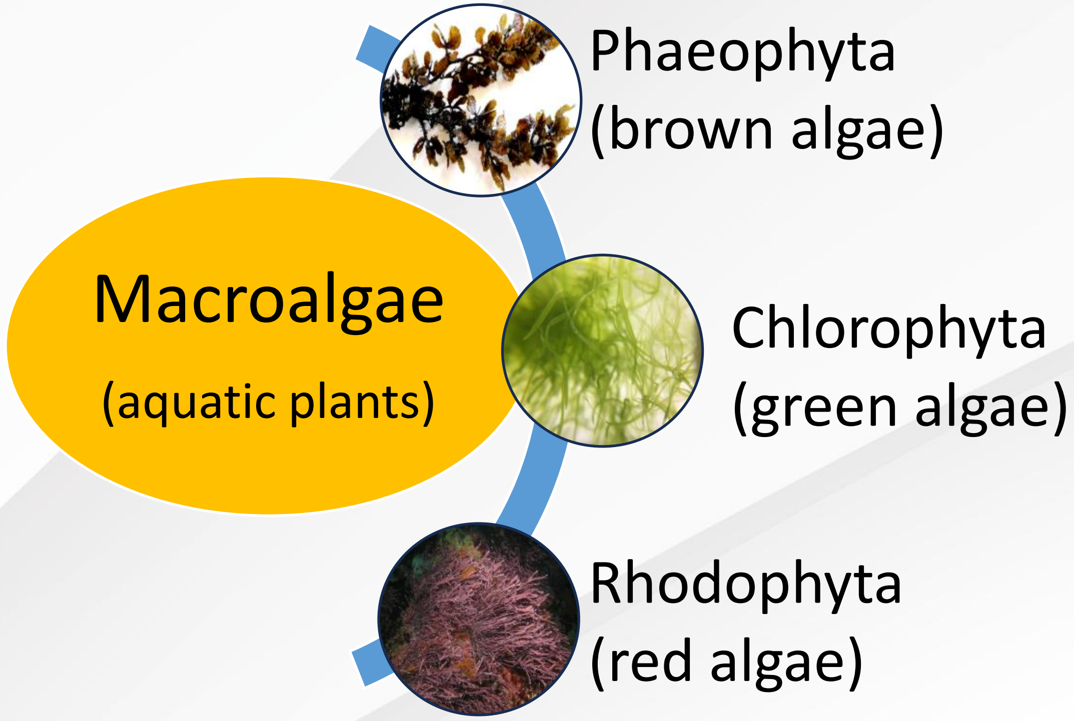
Algae Classification





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Opportunities

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Opportunities in different fields

- Nutritional and Health benefits
- Economic benefits
- Ecologic benefits
- Societal benefits

Field	Opportunities
Food and Feed	• Functional food and feed • Protein substitution • Natural food additives
Therapeutics and Pharmaceutics	• Bioactive secondary metabolites • Antioxidant, anti-aging and anti-inflammatory additives
Cosmetics	• Anti-aging formulations • Lenitive lotions for inflamed and/or damaged skin
Bioenergy	• Biofuels and Bioenergy • Bioethanol, Biomethane • Biogas, Biohydrogen
Biotechnology	• Waste water treatment • Fertiliser • Packaging

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Examples of already in use algae

- Agar-Agar
- Supplementation and nutraceutical (e.g. omega-3, ulvans)
- Gelling, stabilizing or binding agents
- Alginate-matrix for microorganism protection (alginate-immobilized yeast cell)
- Feed for aquatic animals
- Development of algae plastics → food wrapping
- Pigments: Astaxanthin, fucoxanthin, phycocyanin, lutein…

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Benefits

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What benefits of micro- and macroalgae can you think of?

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Nutritional and Health benefits

- Functional food and feed
- Dietary supplements
  - Macro- and micronutrients

➢ For individual diets and public food security

- Food additives
  - Antioxidant (dyes), antimicrobial substances

➢ For food production

- Medicinal and therapeutical application
  - Secondary metabolites
  - Anti-inflammatory, antimicrobial, anti-tumoral drugs

➢ For cosmetics and therapeuticals

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Health benefits

Macronutrients

- Polysaccharides with healthy properties (ulvan, fucoidan…)
- Proteins with high biological value
- Fatty acids (Omega-3 and -6 polyunsaturated fatty acid (PUFA) (ALA, EPA, DHA))
- (Low sugar content)

Micronutrients

- Vitamins
- Minerals
- Antioxidants
- Phenolic compounds

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Main effects of macro- and micronutrients (oral intake)

- Energy, functionality and structure
- Enzymes, hormones and production of other substances important for growth and development and health.

→ Strong immune system in humans and animals

→ Improved Public Health

→ Improved animal welfare

→ One Health!

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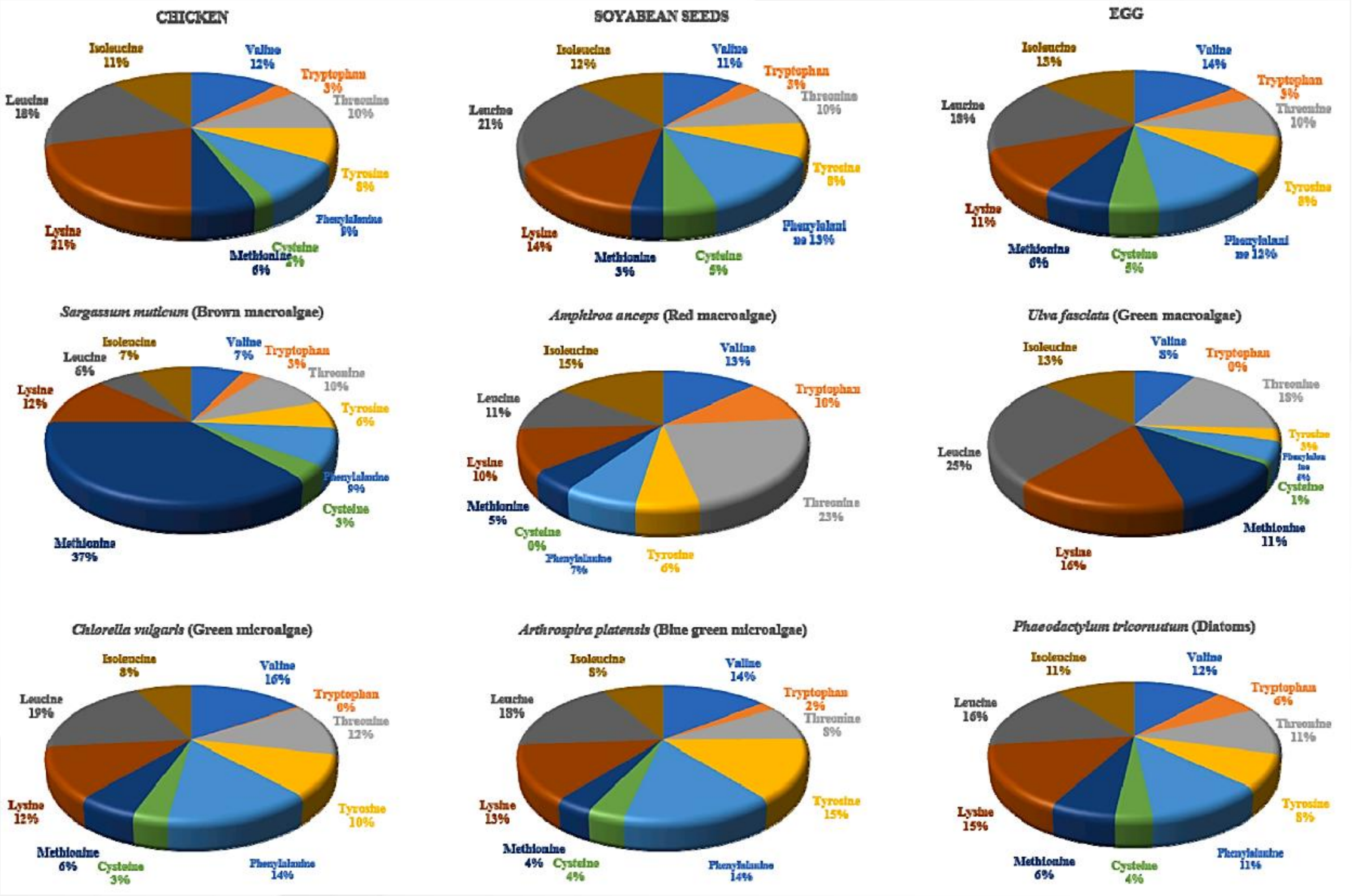
Protein profile of micro- and macroalgae

- Wide range of proteins with different structure and molecular weight
- Rich in essential and non-essential amino acids
- Highest protein content in
  - Microalgae: cyanophyta
    - up to 70% dry weight
  - Macroalgae: *Rhodophyta* (red algae)
    comprehensive amino acid profile, containing all essential amino acids
    → excellent nutritional source
    - protein up to 47% of dry weight



Amino acid profile of chicken, soyabean seeds, egg, macroalgae and microalgae. (Thakur et al. 2024)

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Amino acid profile of micro- and macroalgae

The protein levels are subject to various influences:

- Environmental factors: water temperature, wave force, and light intensity
- Seasonal changes
- Habitat and depth of the seaweed areas

Important industry aspects (solubility and denaturation):

- Amphoteric properties
- Algae proteins tend to have a rather low pH value
- Salt concentration and conditions at which a protein denatures
  → irreversible loss of three-dimensional structure
- High amount of acidic AA → lead to acidic isoelectric points
  (isoelectric precipitation of proteins is broadly used in the industry)

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Protein, bioavailability and meat alternatives

- To know the quality of the dietary protein, its EAA content and its digestibility need to be taken into account.
- Applications of protein from macro and microalgae
  - Protein source or incorporated in food products
    → e.g. dried, powdered, processed to supplements, meat substitution, extruded products, specific extracts, …
  - Food colorant (various pigments in different colours, phycocyanin, Phycoerythrin)
  - Emulsifying and foaming agent
  - Other protein types: e.g. lectin (a glycoprotein)
    → bio peptide with antibacterial, antiviral, and anti-influenza properties, …
- Limited research has been done on the quality of proteins derived from algae proteins (e.g. digestibility)

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Fatty acids - Omega-3 and -6

- Fatty acids in general are essential for body functionality
  - Skin
  - Respiratory and circulatory systems
  - Brain and vital organs
- Especially the precursors for HUFAs
  - Linoleic Acid (LA) and
  - Alpha-Linolenic Acid (ALA)

Highly Unsaturated Fatty Acids (HUFAs)
… extensively found in plants

- Omega-3 and Omega-6 are particularly important for:
  - Cell structure and functionality, mammalian cell membranes
  - Neural transmission and retinal development in humans

  → *Key role of reducing inflammation*

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Human Health Benefits of Omega HUFAs

- Necessary for good health!
  - Reduction of inflammation: due to improvement of cell membrane fluidity and joint mobility
  - Key functionality in cells: eicosanoids, enzyme-modulation, gene-expression

- Deficiency can lead to:
  - Cardiovascular and coronary heart disease
  - Raised stroke risk
  - Psychological problems

Recommendation – daily intake		
Fatty acid	Energy [%]	[mg/d]
LA	2	
ALA	0.7	
EPA/DHA combined		500

Recommendation of ISSFAL

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Sources of omega-3 and omega-6

- Exclusively photosynthetic plants
  - **ALA** HUFA (precursor) primarily in terrestrial plants
  - **LA** Omega-3 EPA and DHA exclusively in the marine environment
    → Photosynthetic microalgae

- Today ~ 80% of total Omega-type HUFA supply stems from *Engraulis ringens*

- Other (promising) alternatives:
  - Marine algae
  - Krill
  - Fungi (in particular the yeast *Yarrowia lipolytica)*
  - And genetically modified organisms (mostly terrestrial oil-seed plants)

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Bioactive potential in terms of antioxidant and anti-aging properties

Due to limited research digestibility poses a challenge.

However, research allowed identification of promising
- new antioxidants and antimicrobials
- anti-tumoral drugs
- anti-aging formulations and anti-inflammatory properties
- scavenge OH and NO radicals
- partial rescue of macrophages from cell death (H2O2-induced RAW 264.7)
- abate intracellular ROS (reactive oxygen species) production
- inhibition of LPS-induced inflammatory mediators

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Bioactive potential in terms of antioxidant and anti-aging properties

- Application already as
  - →pharmaceuticals
  - →cosmetics, cosmetic lenitive lotions for inflamed/damaged skin
  - →functional foods (bioactive peptides, lipids and carbohydrates)
  - →food additives; colorant, stabiliser, antimicrobial agent, …

- Future research and exploration is needed to increase
  - desirable sensory attributes
  - scalability of products
  - Cost-effective production methods

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Mineral and vitamin profile of seaweeds

- Varies between species
- Vitamins: A, C, E, B complexes
- Minerals: Na, Mg, P, K, I, Fe, Zn

Table 4. Mineral composition of seaweeds compared to whole foods

Food Type	Calcium	Potassium	Magnesium	Sodium	Copper	Iron	Iodine	Zinc
Seaweed								
(mg/100 g wet weight)*								
Ascophyllum nodosum	575.0	765.0	225.0	1173.8	0.8	14.9	18.2	NA
Laminaria digitata	364.7	2013.2	403.5	624.6	0.3	45.6	70.0	1.6
Himanthalia elongata	30.0	1351.4	90.1	600.6	0.1	5.0	10.7	1.7
Undaria pinnatifida	112.3	62.4	78.7	448.7	0.2	3.9	3.9	0.3
Porphyra umbilicalis	34.2	302.2	108.3	119.7	0.1	5.2	1.3	0.7
Palmaria palmata	148.8	1169.6	97.6	255.2	0.4	12.8	10.2	0.3
Chondrus crispus	373.8	827.5	573.8	1572.5	0.1	6.6	6.1	NA
Ulva spp.	325.0	245.0	465.0	340.0	0.3	15.3	1.6	0.9
Enteromorpha spp.	104.0	351.1	455.1	52.0	0.1	22.2	97.9	1.2
Whole food								
(mg/100 g weight)†								
Brown rice	110.0	1160.0	520.0	28.0	1.3	12.9	NA	16.2
Whole milk	115.0	140.0	11.0	55.0	Tr	0.1	15.0	0.4
Cheddar cheese	720.0	77.0	25.0	670.0	0.0	0.3	39.0	2.3
Sirloin steak	9.0	260.0	16.0	49.0	0.1	1.6	6.0	3.1
Lentils green and brown	71.0	940.0	110.0	12.0	1.0	11.1	NA	3.9
Spinach	170.0	500.0	54.0	140.0	0.0	2.1	2.0	0.7
Bananas	6.0	400.0	34.0	1.0	0.1	0.3	8.0	0.2
Brazil nut	170.0	660.0	410.0	3.0	1.8	2.5	20.0	4.2
Peanuts	60.0	670.0	210.0	2.0	1.0	2.5	20.0	3.5

*Values for seaweeds from the Institut de Phytonutrition (2004).[15]
†Values for whole foods from McCance et al. (1993).[16]
Abbreviations: NA, no data available; Tr, trace.

Table 7. Vitamin composition of seaweeds

Seaweed	B1	B2	B3	B6	B8	B9	C	E	B12†
	Vitamin (mg per 8 g dry portion)*								
Ascophyllum nodosum	0.216	0.058	0.000	0.001	0.001	3.648	0.654	0.029	0.131
Laminaria digitata	0.011	0.011	4.896	0.513	0.513	0.000	2.842	0.275	0.495
Undaria pinnatifida	0.403	0.936	7.198	0.259	0.015	0.528	14.779	1.392	0.345
Porphyra umbilicalis	0.077	0.274	0.761	0.119	NA	1.003	12.885	0.114	0.769
Palmaria palmata	0.024	0.080	0.800	0.002	0.002	0.021	5.520	1.296	1.840
Ulva spp.	0.060	0.030	8.000	NA	NA	0.012	10.000	NA	6.300

*Values from the Institut de Phytonutrition (2004).[15]
†Values expressed in µg/100 g wet weight.
Abbreviation: NA, no data available.

Table 5. Mineral contents of seaweeds as compared with reference nutrient intake (RNI) values

Seaweed	Calcium*		Potassium*		Magnesium*		Sodium*		Copper*		Iron*		Iodine*	
	mg/8 g	% RNI	mg/8 g	% RNI	mg/8 g	% RNI	mg/8 g	% RNI	mg/8 g	% RNI	mg/8 g	% RNI	mg/8 g	% RNI
Ascophyllum nodosum	184	26.4	244.8	7	72	24	375.6	23.4	0.3	22	4.7	54	5.8	4100
Laminaria digitata	176.8	25.5	976	27.8	195.6	65.2	302.8	18.9	0.14	12	22.1	254	34	24250
Himanthalia elongata	8	1.1	360	10.4	24	8	160	10	0.03	2.5	1.3	15.1	2.8	2030
Undaria pinnatifida	93.6	13.3	52	1.5	65.6	21.8	374	23.3	0.16	14	3.26	37	3.2	2300
Porphyra umbilicalis	24	3.4	212	6	76	25.3	84	5.25	0.07	6	3.7	42	0.94	670
Palmaria palmata	74.4	10.6	584.8	16.7	48.8	16.2	127.6	8	0.2	16	6.4	74	5.1	3650
Chondrus crispus	119.6	17	264.8	7.5	183.6	61.2	503.2	31.4	0.03	2.5	2.1	24	1.9	1400
Ulva spp.	260	37.1	196	5.6	372	124	272	17	0.25	21	12.2	140	1.3	920
Enteromorpha spp.	64	9.1	216	6.1	280	93	32	2	0.06	5	13.7	157	60.3	43030

*Values from the Committee on Medical Aspects of Food and Nutrition Policy (1991)[12] and the Institut de Phytonutrition (2004).[15]

Economic benefits

- Easy use in various products for human or animal consumption
  - E.g. in fish feed as prebiotics or in human food in a diversity of Novel Foods
- Cost efficient production (of macro algae) and rising market potential
- Integrable into other production systems (e.g. fish farms) IMTA aquaculture
- Local and sustainable feed material production (alternative protein sources) that is less depended on the global market.
- New antioxidants and antimicrobials → food additives for safe food

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Ecological benefits

- Reduction of methane emission, compared to other feed production
- Eutrophication control
- Lower impact in combination with other production cultures
- Production based on feedstock and liquid wastes (revaluation!)
- Waste reduction/recycling (circular economy)

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Societal benefits

- Higher diversification of food products
- Availability, accessibility and affordability of safe foods
- Macroalgae farming enhances rural economies and small-scale farming
- Job preservation and food security
- *“Research in the quest of* natural and safe antioxidative agents *from aquatic organisms to replace synthetic antioxidants, some of which have been restricted due to their carcinogenicity.” - La Fuente et al. (2020)*

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Drawbacks and challenges

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What challenges in the implementation of micro- and macroalgae can you think of?

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Legal and safety aspects

Regulation of **novel foods**, to ensure safety of algae, extracts and products

- contaminants and allergens
- hazards due to production methods and processing conditions
- different storage requirements

Control of **production and transport** due to hazard of invasive species

… it is important to protect native habitats and maintain a healthy and functional ecosystem

Rules for high-efficient monocultures (endangering natural ecosystems)

… as on land, monocultures bear risks of spreading diseases, displace native species, disrupt the functionality of ecosystems, … → ecological/ economic/ financial/ societal risks

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Safety aspects

- Contaminants
- Allergens and toxins
- Iodine

Generally;

→ Very high variability in contaminants

→ All types of environmental contamination can end up in marine organisms

→ Higher concentration in dried products

… and typical contaminations

- Heavy metals
- Ammonium
- Biotoxins
- Dioxin
- Pesticides
- Pathogenes, spores, toxins
- 5-Hydroxymethylfurfural
- Acrylamid
- PAH (thermal treatment marker)

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Food safety hazards

Hazards from growing, harvesting, transporting and processing

- Accumulation of heavy metals (chemical hazards)
  → Regulation (EC) No 2023/915 for ML in foodstuffs
  But **no specific EU regulations** for toxic metals (except Nickel) in seaweeds for human consumption, but French Recommendations available
  (CSHPF01/1990, AFSSA 04/2009)
- Biological hazards
  Biotoxins and microbial contamination, Allergens?
- Physical hazards
  Sand, stones, plastic, metal pieces, …

	Algae (vegetables or condiments) French recommendations [mg/kg dry weight]	Algae (vegetables or condiments) EU regulation [mg/kg]	Food supplements (EU) 2023/912 [mg/kg product]
Inorganic arsenic (As)	3		
Cadmium (Cd)	0,5		3
Mercury (Hg)	0,1		0,1
Lead (Pb)	5		3
Tin (Sn)	5		
Iodine (I)	2000	20*	
Nickel (Ni)		30 (40 for Wakame)**	

*In 2006 the Scientific Committee for food established an upper limit for iodine intake of 600 µg/day for adults and of 200 µg a day for children of 1-3 years. It indicated that the ingestion of iodine-rich algal products, particularly dried products, can lead to dangerously excessive iodine intakes, if such products contain more than 20 mg iodine/kg dry matter and the exposed population lives in an area of endemic iodine deficiency ((EU) 2018/464)
**For dry seaweed the maximum level applies to the product as placed on the market. For fresh seaweed the maximum level applies after washing and separating the edible part. For fresh seaweed the maximum level applies on a dry matter basis. ((EU)2024/1987)

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Diverse analysis of algae biomass, Vigo, Spain

- ANFACO-CECOPESCA

Key facts

Field of Work	Focus	Video
Analysis of algae biomass	Functional properties Food safety hazards Nutritional profile	ANFACO CYTMA

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Group exercise

Will there be more products available in the future?

What could it depend on, and will consumers accept these new products?

- Form groups of 4-5 people
- Discuss opportunities and benefits of algae and algae extracts. Consider drawbacks and especially consumer acceptance!
- Afterwards: One person per group gives a short summary of the collected input

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Time for your presentations!

- Do you think there will be more products in the future?
- What are challenges in consumer acceptance?
- In your opinion, what will be most challenging in the spread of algae-based products in Europe?

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Literature

- Centre d’etude de valorisation des algues. Edible seaweed and microalgae – Regulatory status in France and Europe. Last update: 07.01.2025
- Circuncisão, A. R., Catarino, M. D., Cardoso, S. M., & Silva, A. M. S. (2018). Minerals from Macroalgae Origin: Health Benefits and Risks for Consumers. *Marine Drugs*, *16*(11), 400. https://doi.org/10.3390/md16110400
- Cozmuta, L. M., Nicula, C., Peter, A., Apjok, R., Jastrzębska, A., & Cozmuta, A. M. (2022). Insights into the fermentation process of fresh and frozen dough bread made with alginate-immobilized S. cerevisiae yeast cells. *Journal of Cereal Science*, *107*, 103516. https://doi.org/10.1016/j.jcs.2022.103516
- Da Rosa, M. D. H., Alves, C. J., Santos, F. N. D., De Souza, A. O., Da Rosa Zavareze, E., Pinto, E., Noseda, M. D., Ramos, D., & De Pereira, C. M. P. (2023). Macroalgae and microalgae biomass as feedstock for products applied to bioenergy and food industry: A Brief review. *Energies*, *16*(4), 1820. https://doi.org/10.3390/en16041820
- De La Fuente, G., Fontana, M., Asnaghi, V., Chiantore, M., Mirata, S., Salis, A., Damonte, G., & Scarfì, S. (2020). The Remarkable Antioxidant and Anti-Inflammatory Potential of the Extracts of the Brown Alga Cystoseira amentacea var. stricta. *Marine Drugs*, *19*(1), 2. https://doi.org/10.3390/md19010002
- Del Mondo, A., Smerilli, A., Sané, E., Sansone, C., & Brunet, C. (2020). Challenging microalgal vitamins for human health. *Microbial Cell Factories*, *19*(1). https://doi.org/10.1186/s12934-020-01459-1
- Garrido, M. J. C., Fajardo, P., Piñeiro, E. C., Martínez, M. A., Farabegoli, F., & Vilariño, J. M. (2020). Microalgae: A new source of healthy ingredients. Antioxidant and antimicrobial properties and incorporation as a functional ingredient for cheese making. *Proceedings of the Nutrition Society*, *79*(OCE2). https://doi.org/10.1017/s0029665120005273
- Hall, J. R., Albert, G., Twigg, I. M., Baltar, F., Hepburn, C. D., & Martin, G. (2022). The production of dissolved organic carbon by macroalgae and its consumption by marine bacteria: Implications for coastal ecosystems. *Frontiers in Marine Science*, *9*. https://doi.org/10.3389/fmars.2022.934229
- *Intake of PUFA in healthy adults*. (2004). ISSFAL. Retrieved July 1, 2025, from https://www.issfal.org/statement-3
- Kotta, J., Raudsepp, U., Szava-Kovats, R., Aps, R., Armoskaite, A., Barda, I., Bergström, P., Futter, M., Gröndahl, F., Hargrave, M., Jakubowska, M., Jänes, H., Kaasik, A., Kraufvelin, P., Kovaltchouk, N., Krost, P., Kulikowski, T., Kõivupuu, A., Kotta, I., . . . Barboza, F. R. (2022). Assessing the potential for sea-based macroalgae cultivation and its application for nutrient removal in the Baltic Sea. *The Science of the Total Environment*, *839*, 156230. https://doi.org/10.1016/j.scitotenv.2022.156230

Funded by the European Union

This project has received funding from the European Union under Grant Agreement N° 101084180.

Literature

- Maghimaa, M., Sagadevan, S., Fatimah, I., Lett, J. A., & Garg, S. (2025). Exploring algal diversity for enhanced nutrition: Implications for human health and sustainability. *Algal Research*, *86*, 103907. https://doi.org/10.1016/j.algal.2025.103907
- O'Higgins, L. (2014). *Use of algal and other non-fish oils in refined edible products*. Scottish Aquaculture Research Forum (SARF). ISBN: 978-1-907266-59-1.
- O'Higgins, L., & Hamed, I. (2024). Attached Biofilm cultivation (ABC) of mixotrophic microalgae for the sustainable supply of innovative new bioproducts. In *Springer eBooks* (pp. 229–244). https://doi.org/10.1007/978-3-031-43969-8_18
- *One Health - Overview*. (2025, June 16). European Commission. https://health.ec.europa.eu/one-health/overview_en
- Reynolds, D., Caminiti, J., Edmundson, S., Gao, S., Wick, M., & Huesemann, M. (2022). Seaweed proteins are nutritionally valuable components in the human diet. *American Journal of Clinical Nutrition*, *116*(4), 855–861. https://doi.org/10.1093/ajcn/nqac190
- Rumin, J., Martins, J., Cruz, J., Vasconcelos, V., Grünewald, C. F., Flynn, K. J., Sabin, A., Paredes, M., Conde, E., Vilarino, J., Ferreira, M., Farabegoli, F., Fajardo, P., Chapela, M., & Picot, L. (2018). EnhanceMicroalgae: An European Interregional Project Stimulating Research, Innovation, Industrial Development and Transnational Cooperation within the Atlantic Area Microalgae Sector. *Journal of Oceanography and Marine Research*, *06*(03). https://doi.org/10.4172/2572-3103.1000182
- Thakur, A., Sharma, D., Saini, R., Suhag, R., & Thakur, D. (2024). Cultivating blue food proteins: Innovating next-generation ingredients from macro and microalgae. *Biocatalysis and Agricultural Biotechnology*, *60*, 103278. https://doi.org/10.1016/j.bcab.2024.103278
- Thum, G., Cappai, M. G., Bochert, R., Schubert, H., & Wolf, P. (2022). Nutrient Profile of Baltic Coastal Red Algae (Delesseria sanguinea), Baltic Blue Mussel (Mytilus spp.) and King Ragworm (Alitta virens) as Potential Feed Material in the Diet of Rainbow Trout (Oncorhynchus mykiss Walbaum, 1792): A Preliminary Assessment. *Agriculture*, *12*(2), 196. https://doi.org/10.3390/agriculture12020196
- Tretiak, S., Schwoerbel, J., Bosse, R., Buck, B. H., Enders, I., Henjes, J., Hoffmann, D., Reimold, F., & Hofmann, L. C. (2021). Optimizing antioxidant activity in Agarophyton vermiculophyllum for functional packaging. *Algal Research*, *54*, 102232. https://doi.org/10.1016/j.algal.2021.102232
- Zhang, B., Wang, L., Riddicka, B., Li, R., Able, J., Boakye-Boaten, N., & Shahbazi, A. (2016). Sustainable production of algal biomass and biofuels using swine wastewater in North Carolina, US. *Sustainability*, *8*(5), 477. https://doi.org/10.3390/su8050477

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