



Microalgae Strain Catalogue

The University of Manchester

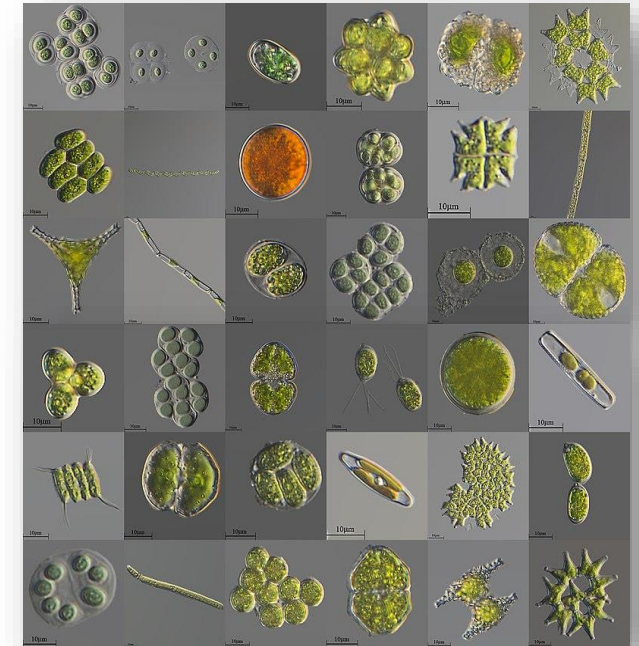
Gonzalo M. Figueroa-Torres, Elisabeth Bermejo-Padilla, Jon Pittman, Constantinos Theodoropoulos



EnhanceMicroAlgae project

- **WP7 – Knowledge; research and development; towards value applications.**
Provide SMEs with protocols for the reliable bulk growth of microalgae of contrasting types to yield protein-rich or carbohydrate/lipid rich biomass. This will support food industries and also production of fine chemicals.

✓ **WP7 - Action 1: Publicly accessible microalgae screening.**
On-line database containing information about microalgal strains of potential interest for commercial applications.





Microalgae Strain Catalogue: publicly accessible microalgae tool

Polysaccharides

Human nutrition
Functional food
Pharmaceutical and
therapeutical applications
Source of energy

Pigments

Cosmetics
Human nutrition
Feed
Pharmaceutical and
therapeutical applications



Proteins

Human nutrition
Functional food

Lipids

Pharmaceutical and
therapeutical applications
Aquaculture
Source of energy

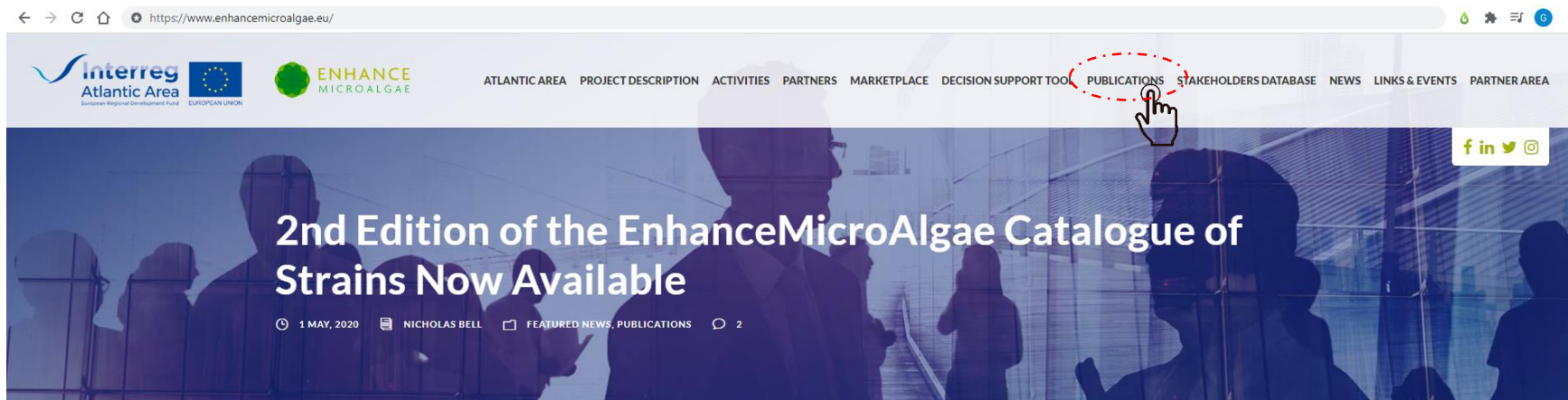
Bioactive Compounds

Antibiotic/antiviral
Antitumor
Diagnostic agents



Microalgae strain catalogue

Available in the EMA website within the project [publications](#):



Authors:

Gonzalo M. Figueroa-Torres, Elisabeth Bermejo-Padilla, Jon K. Pittman, Constantinos Theodoropoulos

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Strain characterisation and literature survey to develop the microalgae strain catalogue

Strains evaluated include:

Anabaena cylindrica

Arthrospira platensis

Botryococcus braunii

Chlorella vulgaris

Dunaliella salina

Dunaliella tertiolecta

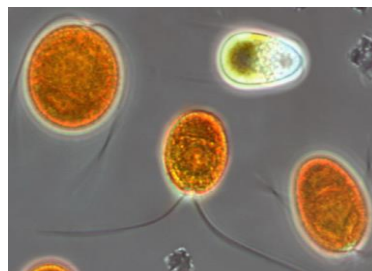
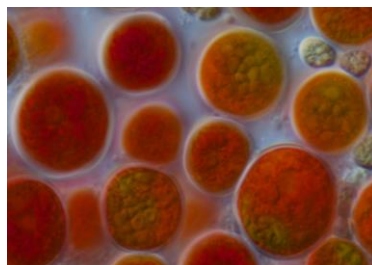
Haematococcus pluvialis


Microcystis sp.

Nannochloropsis oculata

Oscillatoria sp.

Phaeodactylum tricornutum

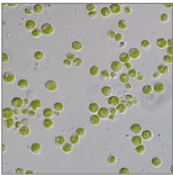




**Micro
catal**

A strain selection
cultivation and
added-value

8. *Chlorella sorokiniana*



A eukaryotic
growth rate
supplement
mixotrophic
show a broad
45°C ³⁰.

Commonly
UTEX 1230 ³¹

Cultivation characteristics

Strain	Cultivation Conditions
UTEX 1230 ³²	System: PBR Medium: 3N-BBM Temperature: 22°C Light: 150 µmol/m ² /s, 16h L: 8h D
IBVF 211-32 ³¹	System: 2 L stirred tank reactor (STR) Medium: Sueoka medium Carbon source: CO ₂ , and acetate Temperature: 25°C Light: 100 µmol/m ² /s, Continuous light
UTEX 1602 ³²	System: 250 mL flasks Medium: Kuhl medium Carbon source: 1 % CO ₂ , glucose Temperature: 25°C Light: 100 µmol/m ² /s, Continuous light
UTEX 2805 ³³	System: 250 mL flasks Medium: synthetic medium Temperature: 27°C Light: 60 µmol/m ² /s, L:D cycle nd

Biomass characteristics

Biomass composition	Element composition	Pigments	Fatty acids
56% protein ² 22% lipid 17% carbohydrate	46% C ² 2% N C/N ratio 21	32.4 mg/g total chlorophyll ² 1.2 mg/g beta- carotene 7.1 mg/g lutein	C16:0 22.0% ² C16:1 4.3% C16:2 11.5% C16:3 5.1% C18:0 3.5% C18:1 11.3% C18:2 31.1% C18:3 9.1% other 2.1% ---
6.65% lipids (on CO ₂) ³² 31.58% lipids (on glucose) 40% lipids ³¹			C16:0 20.99% ³² C16:1 5.56% C16:2 4.82% C18:0 0.33% C18:1 2.95% C18:2 13.79% C18:3 33.31%

Additional biomass considerations:

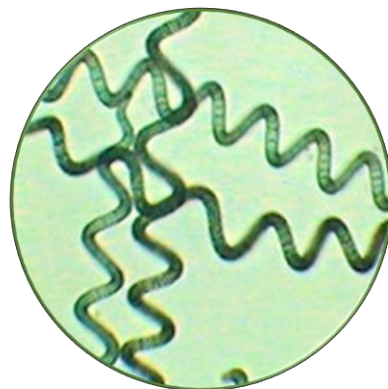
Supplementation of glucose as a carbon source can increase cell density, biomass production and total lipid yield but decreases protein abundance and chlorophyll biosynthesis ²⁵.



Some of the most promising microalgae species at a commercial level included in the Strain Catalogue 1st edition

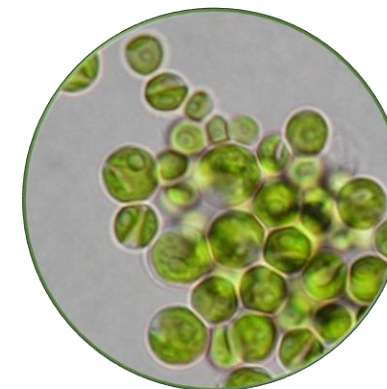
Arthrospira platensis

- It grows best at a high pH (9-11) and temperatures (35-37 °C).
- **Rich in proteins and pigments** (phycocyanin).
- Chemical composition:
46–71% protein;
8-16% carbohydrate;
4-9% lipids.
- Areas of application: food and nutritional supplement; cosmetics.



Chlorella vulgaris

- Robust growth.
- **Rich in proteins and lipids.**
- Chemical composition:
11–58% protein;
12-28% carbohydrate;
2-46% lipids.
- Areas of application: food, nutritional supplement; feed; biofuel.

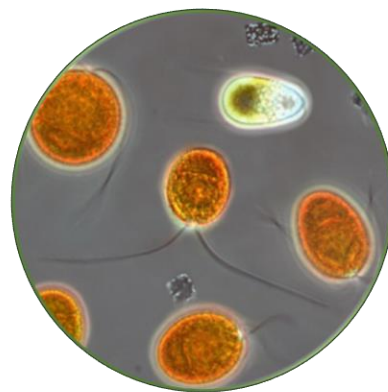




Some of the most promising microalgae for commercial applications included in the Strain Catalogue 1st edition

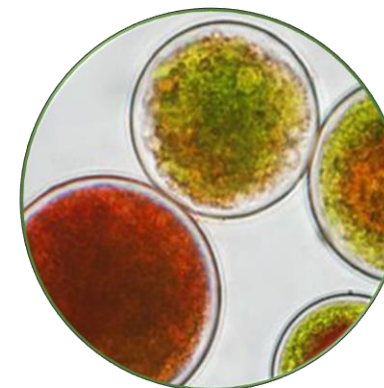
Dunaliella salina

- It is extremely salt-tolerant.
- Potential as β -carotene producer (up to 14% of dry biomass).
- Chemical composition:
49–57% protein;
4–32% carbohydrate;
6–8% lipids.
- Areas of application: food and nutritional supplement; feed; cosmetics.



Haematococcus pluvialis

- It is considered as the best natural source of astaxanthin.
- Chemical composition:
Protein: 29–45% (green stage);
17–25% (red stage);
Carbohydrate: 15–17% (green stage);
36–40% (red stage);
Lipids: 20–25% (green stage);
32–37% (red stage).
- Areas of application: food, nutritional supplement; aquaculture; cosmetics.

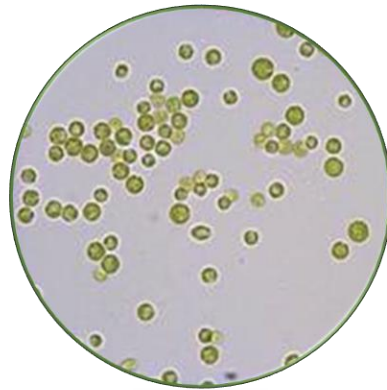




Some of the most promising microalgae for commercial applications included in the Strain Catalogue 1st edition

Nannochloropsis oculata

- It is widely distributed in oceans worldwide.
- Rich in polyunsaturated fatty acids.
- Chemical composition:
40-49% protein;
6-10% carbohydrate;
30-33% lipids.
- Areas of application: nutritional supplement; food for larval and juvenile marine fish; biofuel.



Phaeodactylum tricornutum

- It is a marine diatom strain with ability to produce high yields of fatty acids.
- Chemical composition:
Protein: 33-42%;
Carbohydrate: 9-24%;
Lipids: 26-34%.
- Areas of application: food, nutritional supplement; feeds; biofuel.





Update of the Strain Catalogue including 10 more microalgae strains.

Strains include in the 2nd Edition:

Auxenochlorella protothecoides

Chaetoceros calcitrans

Chamydomonas reinhardtii

Chromochloris zofingiensis

Isochrysis galbana

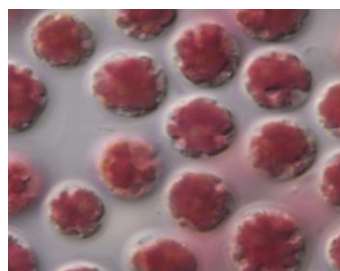



Porphyridium purpureum

Rhodomonas sp.

Scenedesmus obliquus

Scenedesmus quadricauda

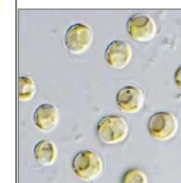
Tetraselmis subcordiformis

Microalgae strain catalogue

A strain selection guide for microalgae users:
cultivation and chemical characteristics for high
added-value products

14. *Isochrysis galbana*



A eukaryotic marine microalga which is a species of Haptophyta. For its good nutritive characteristics (especially in relation to polyunsaturated fatty-acid composition), is of substantial interest in aquaculture ⁶². It is also investigated for its high amount of fucoxanthin ⁶¹.

Cultivation characteristics

Strain	Cultivation Conditions	Mean biomass productivity (g/L/d)	Maximum productivity (g/L/d)	Maximum production (g/L)
nd ⁶² from Marine Microalgae Research Center, Ocean University of China	System: Erlenmeyer flasks Medium: f/2 Temperature: 23°C Light: 4.0 mW/cm ² , 16 h L: 8 h D	nd	nd	1.69x10 ⁷ cells/mL (500 µmol/L phosphorous)
nd ⁶³ Aquatic Research Laboratory at Isfahan University of Technology, Isfahan, Iran	System: 10 L carboys Medium: Walne's medium Temperature: 25°C Light: 80 µmol/m ² /s, 12 h L: 12 h D	nd	nd	1.55x10 ⁷ cells/mL (144mg/L nitrogen)

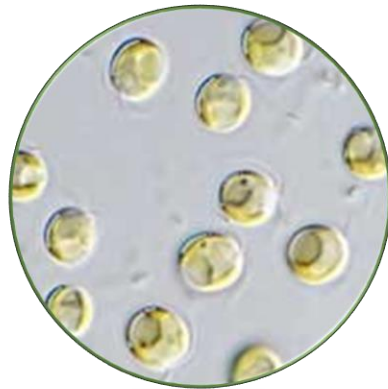




Some of the most promising microalgae for commercial applications included in the 2nd edition

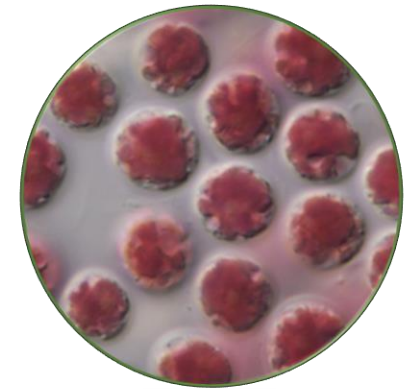
Isochrysis galbana

- Rich in polyunsaturated fatty acids.
- It produces high content of docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA).
- Chemical composition:
30–36% protein;
33–40% carbohydrate;
30% lipids.
- Areas of application: animal nutrition, aquaculture; biofuel.



Porphyridium purpureum

- It is a source of phycobiliproteins, sulphated EPS and polyunsaturated fatty acids.
- Chemical composition:
Protein: 28–39%;
Carbohydrate: 40–57%;
Lipids: 9–14%.
- Areas of application: food, nutraceuticals; pharmaceuticals; cosmetics.





Some of the most promising microalgae for commercial applications included in the 2nd edition

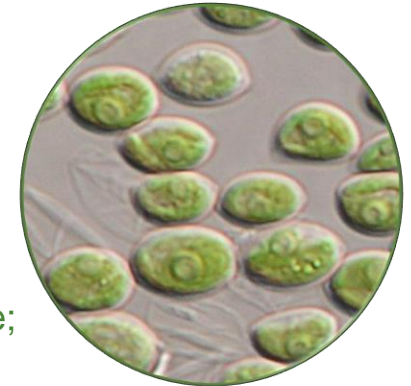
Rhodomonas sp.

- It is an important source of eicosapentaenoic acid (EPA) and docosahexaenoic acid DHA.
- Chemical composition:
35–55% protein;
4-8% carbohydrate;
18-39% lipids.
- Areas of application: aquaculture.



Scenedesmus obliquus

- It is one of the most widely used lipid-producing microalga.
- Chemical composition:
Protein: 30–37%;
Carbohydrate: 20-38%;
Lipids: 20-37%.
- Areas of application: aquaculture;
human nutrition; biofuel.





The catalogue includes:

- A compilation of growth media recipes for microalgae.
 - Artificial Seawater (ASW) medium
 - Blue-Green medium (BG11)
 - Bold's Basal Medium (BBM) and 3N-BBM
 - Chu 13 medium (Modified)
 - Conway medium
 - Detmer medium (DM) modified
 - f/2 medium
 - f/2+Si (Guillard's medium for diatoms)
 - Jaworski's Medium (JM)
 - Kuhl medium
 - SOT medium
 - Sueoka medium
 - Walne's medium
 - Zarrouk medium
- Culture collections.

A.2. Blue-Green medium (BG11)

Mix stock solutions and bring to 1 L; adjust pH to 7.1 (with NaOH or HCl).

BG11 medium components and concentrations¹⁰³

Component	Stock solution g per 500 mL dH ₂ O	Quantity used for medium
NaNO ₃	75	10 mL
K ₂ HPO ₄	2	10 mL
MgSO ₄ ·7H ₂ O	3.75	10 mL
CaCl ₂ ·2 H ₂ O	1.80	10 mL
Citric acid	0.3	10 mL
Ammonium ferric citrate green	0.3	10 mL
EDTA·Na ₂	0.05	10 mL
Na ₂ CO ₃	1	10 mL
Trace metals solution	See recipe below	1 mL

Trace metals solution (also known as A5 + Co Trace metals solution)¹⁰³

Component	Stock solution qty per litre dH ₂ O
H ₃ BO ₃	2.860 g
MnCl ₂ ·4H ₂ O	1.810 g
ZnSO ₄ ·7H ₂ O	0.220 g
CuSO ₄ ·5H ₂ O	0.08 g
Na ₂ MoO ₄ ·2H ₂ O	0.39 g
Co(NO ₃) ₂ ·6H ₂ O	0.05 g



A.7. f/2 medium

This is a seawater medium, prepared by bringing up the final volume to 1 L with filtered natural seawater. Adjust pH to 8 with 1 M NaOH or HCl.

f/2 medium components and concentrations¹⁰³

Component	Stock solution qty per 1 L dH ₂ O	Quantity used for medium
NaNO ₃	75 g	1 mL
NaH ₂ PO ₄ ·H ₂ O	5.65 g	1 mL
Trace metals solution	See recipe below	1 mL
Vitamins solution	See recipe below	1 mL

f/2 trace metals solution¹⁰³

Component	Stock solution qty per L dH ₂ O
Na ₂ EDTA	4.16 g
FeCl ₃ ·6H ₂ O	3.15 g
CuSO ₄ ·5H ₂ O	0.01 g
ZnSO ₄ ·7H ₂ O	0.022 g
CoCl ₂ ·6H ₂ O	0.01 g
MnCl ₂ ·4H ₂ O	0.18 g
Na ₂ MoO ₄ ·2H ₂ O	0.006 g

Vitamins solution¹⁰³ (filter-sterilise and store frozen).

Component	Stock solution Qty per L ⁻¹ dH ₂ O
Cyanocobalamin (Vitamin B ₁₂)	0.0005 g
Thiamine HCl (Vitamin B ₁)	0.1 g
Biotin	0.0005 g

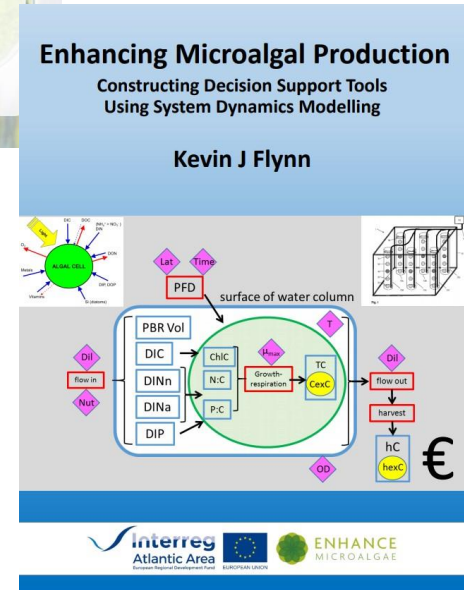




What's next ... ?

Microalgae Strain Catalogue 3rd edition:

- **Expanded information** of the current microalgae strains.
- Addition of **new microalgae species**.
- **Link the catalogue** with the **EMA virtual tools** to support researchers and SMEs with microalgae production and sector development.



Remember to connect with us on social media!



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Thank you



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