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# E3UDRES2

Engaged and Entrepreneurial European University as
Driver for European Smart and Sustainable Regions

## HOW CAN WE PRODUCE HEALTHIER FOOD WITH MICROALGAE AS A SUSTAINABLE RESOURCE

**7 MARCH TO 30 MAY 2023**

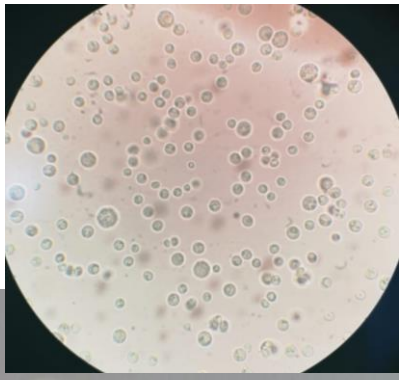
**Carla Santos**

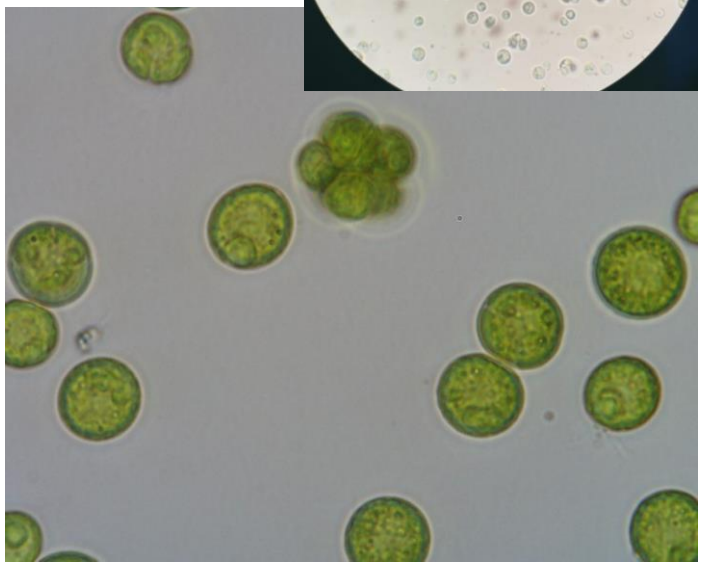
*Educational Entrepreneur*

*carla.santos@estbarreiro.ips.pt*

## Academic background:

1. Degree in Biotechnology, from Instituto Superior Técnico in Lisbon, 1994
2. Master in Food Science, from Lisbon Technical University 1997
3. PhD in Environmental Engineering from Instituto Superior Técnico at Lisbon University, Portugal, 2014.





## Scientific researcher in microalga cultivation:

- *Dunaliella salina*, to obtain beta-carotene (1995 - 1997)
- Cyanobacteria to capture carbon dioxide (1999 – 2000)
- *Chlorella protothecoides* for biodiesel production (2008 -2014)

## Professor of Biotechnology at Instituto Politécnico de Setúbal

- since 2016

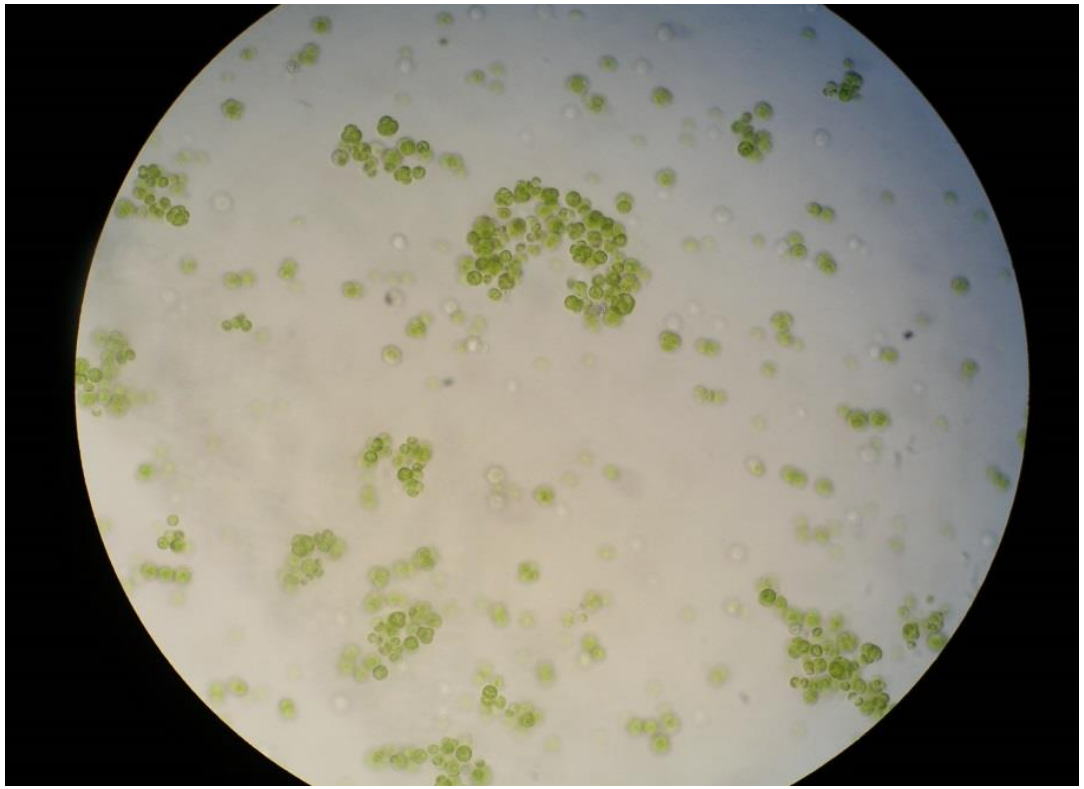
# What are **microalgae**?

Azores lagoons

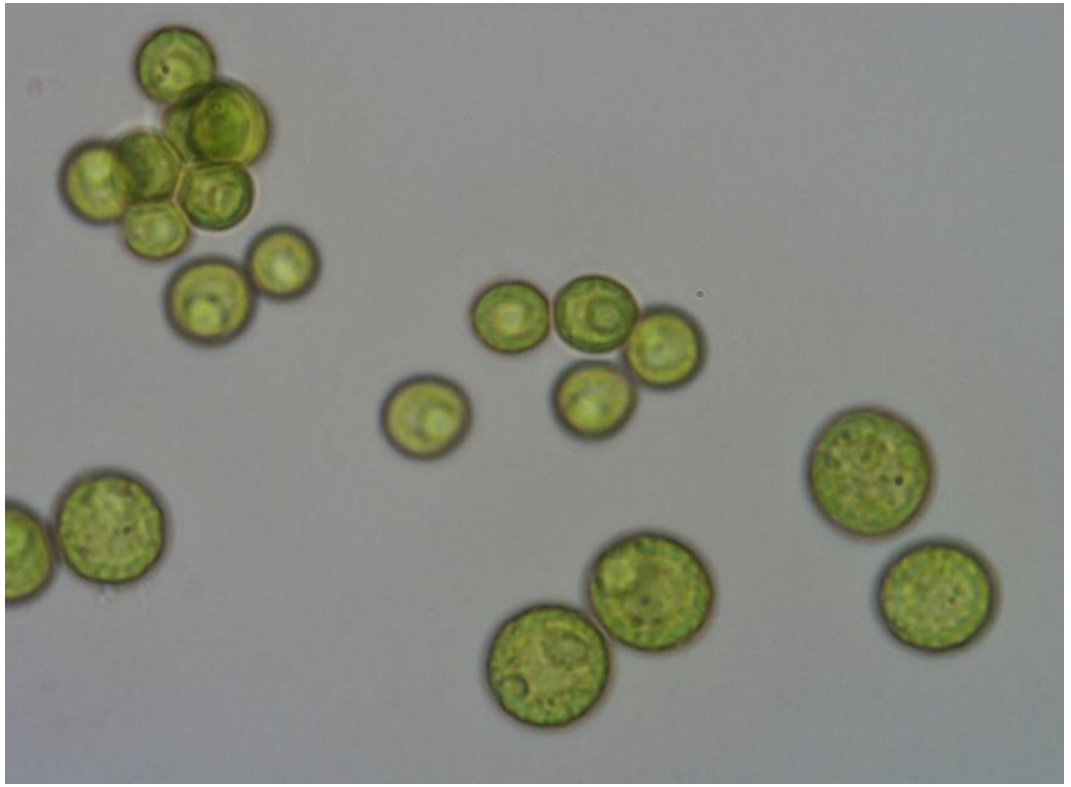
By Maros Mraz

**Unicellular microorganisms**
**Shapes, size, colours**
**Photosynthesis or respiration**
**35.000 known species**
**Water and salty habitat**

1 drop of culture watched at the microscope



100 X



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How microalgae get energy to live?

Photoautotrophic: **photosynthesis**

Carbon dioxide + water + solar energy→ glucose + oxygen

6 $\mathbf{CO_2}$ + 6 $H_2O$ + solar energy → $\mathbf{C_6H_{12}O_6}$ + 6 $\mathbf{O_2}$

Heterotrophic: **respiration**

glucose + oxygen → carbon dioxide + water + energy

$\mathbf{C_6H_{12}O_6}$ + 6 $\mathbf{O_2}$ → 6 $\mathbf{CO_2}$ + 6 $H_2O$ + energy

# How do we grow **microalgae**?

**1 mL**

**100 mL**

Microalga seed in Petri dishes → Erlenmeyer flask cultivation

Liquid culture media containing **NPK, light** and **$CO_2$**

# Scale up

**1 L**

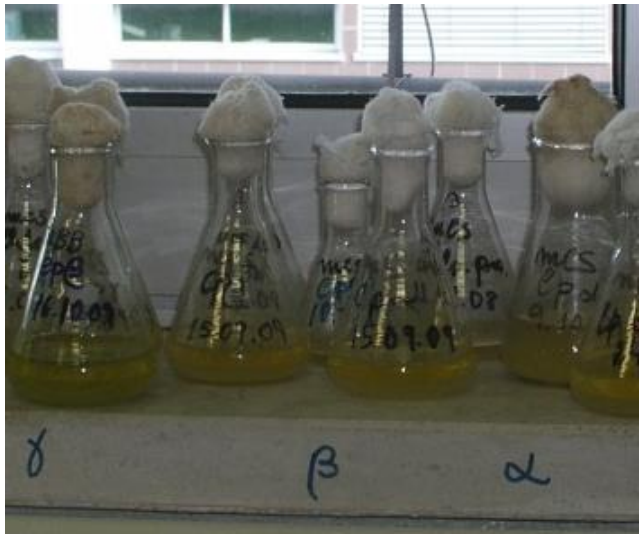
**3 L**

**30 L × n**

Bubble columns → Tubular photobioreactor → Photobioreactor

# **Hetero**trophic growth

100**mL**



3**L**

Microalga seed → Erlenmeyer cultivation → Bench Fermenter → Big Scale Fermenter

Cultivation media must have an organic carbon source: **glucose**, no light

## WHAT ARE MICROALGAE USED FOR?

- ✓Human nutrition
- ✓Aquaculture and Animal Nutrition
- ✓Cosmetics and pharma
- ✓Biofuels (Biodiesel)
- ✓Bioplastics
- ✓Wastewater treatment
- ✓Soil fertilization
- ✓Carbon dioxide ($CO_2$) fixation

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# RESEARCH AT ESTBARREIRO – IPS:

*Chlorella* growing in bioreactors

Is a

Sustainable production of biomass

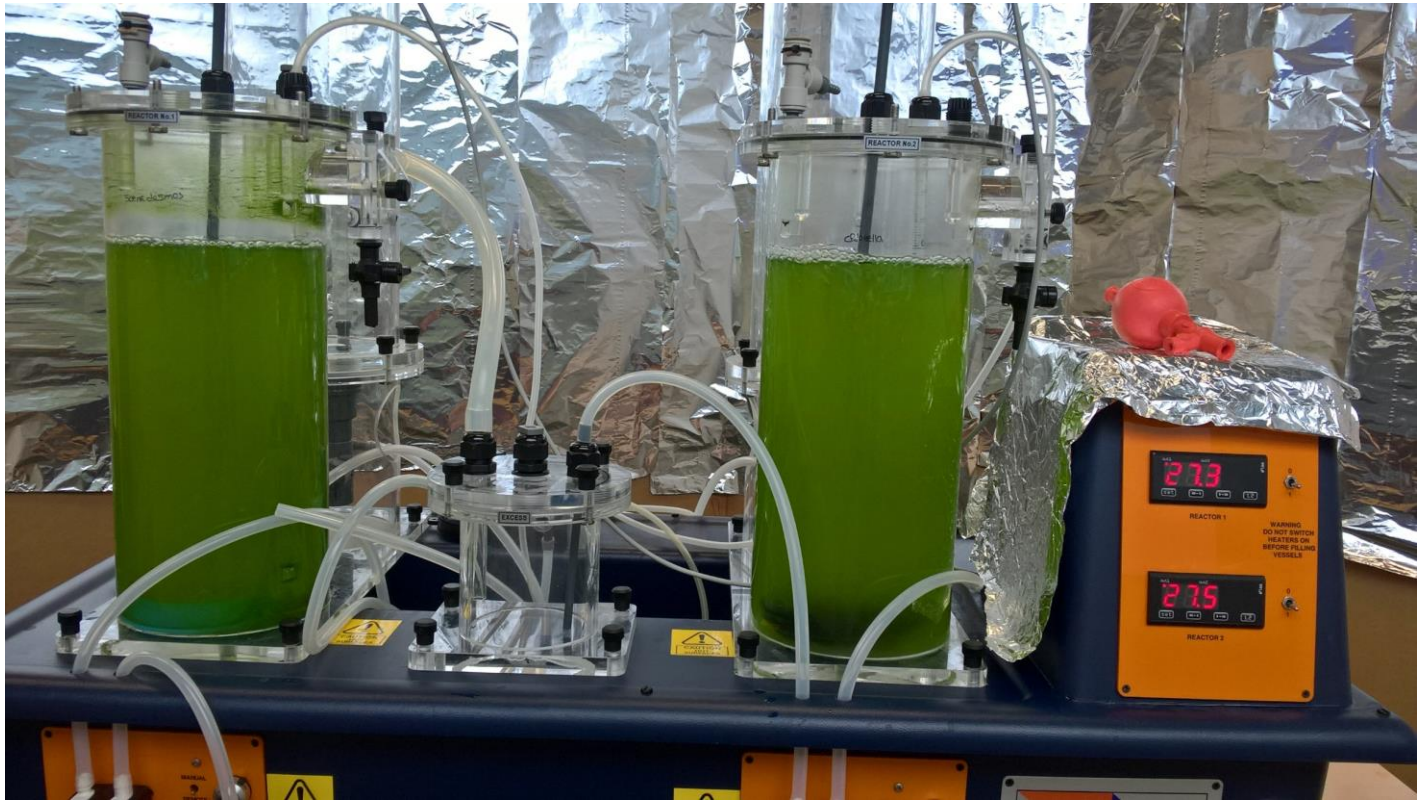
To

Make food or Feed

and

capture carbon dioxide

NewAlgaFeed (2018)



## PROTEALGAFEED PROJECT:

- The project aims to reduce the production costs by using agro-industrial wastes as nutritional media to grow microalgae.
- Grape pomace is a waste from grape processing into wine or juice, and it is estimated that 20% of the total grape weight is grape pomace, which represents a challenging waste disposal problem for the winery industry.
- 10.5 – 13.1 Mton of grape pomace in the world annually
- **Grape pomace** is 15 -17% of the total volume of wine produced
- Grape pomace composition:

| Water 27% | garpe skins 25% | grape stalks 25% | grape seeds 23% |
|---|---|---|---|

## RESEARCH AT ESTBARREIRO – IPS:

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### Wine producers

Moscatel grape pomace.

### Tomato industry

Tomato pomace

# ProteAlgaFeed

sustainable microalgae cultivation
to obtain
protein-rich biomass

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## RESEARCH AT ESTBARREIRO – IPS:

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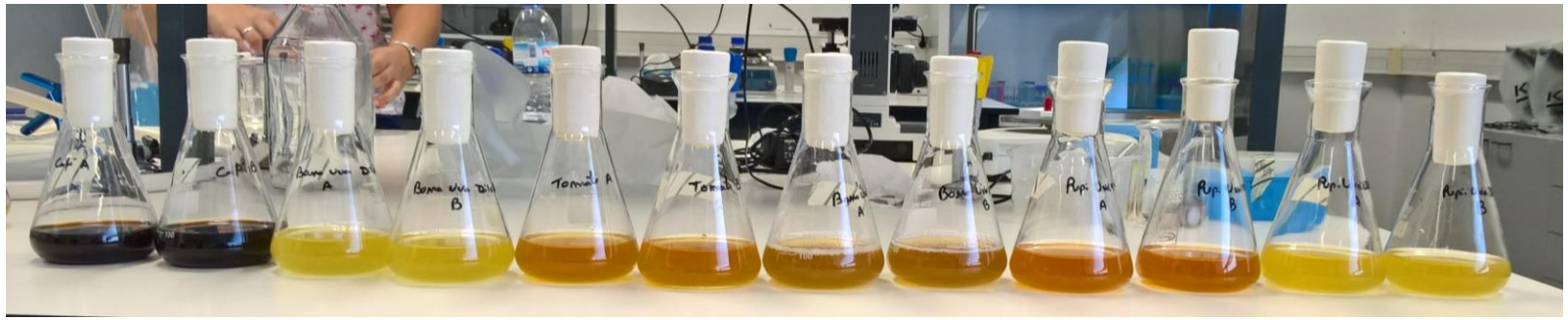
**Nutritional liquid**

**To grow microalgae**

ProteAlgaFeed

sustainable microalgae
cultivation
to obtain
protein-rich biomass



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# ProteAlgaFeed

sustainable microalgae cultivation
to obtain protein-rich biomass

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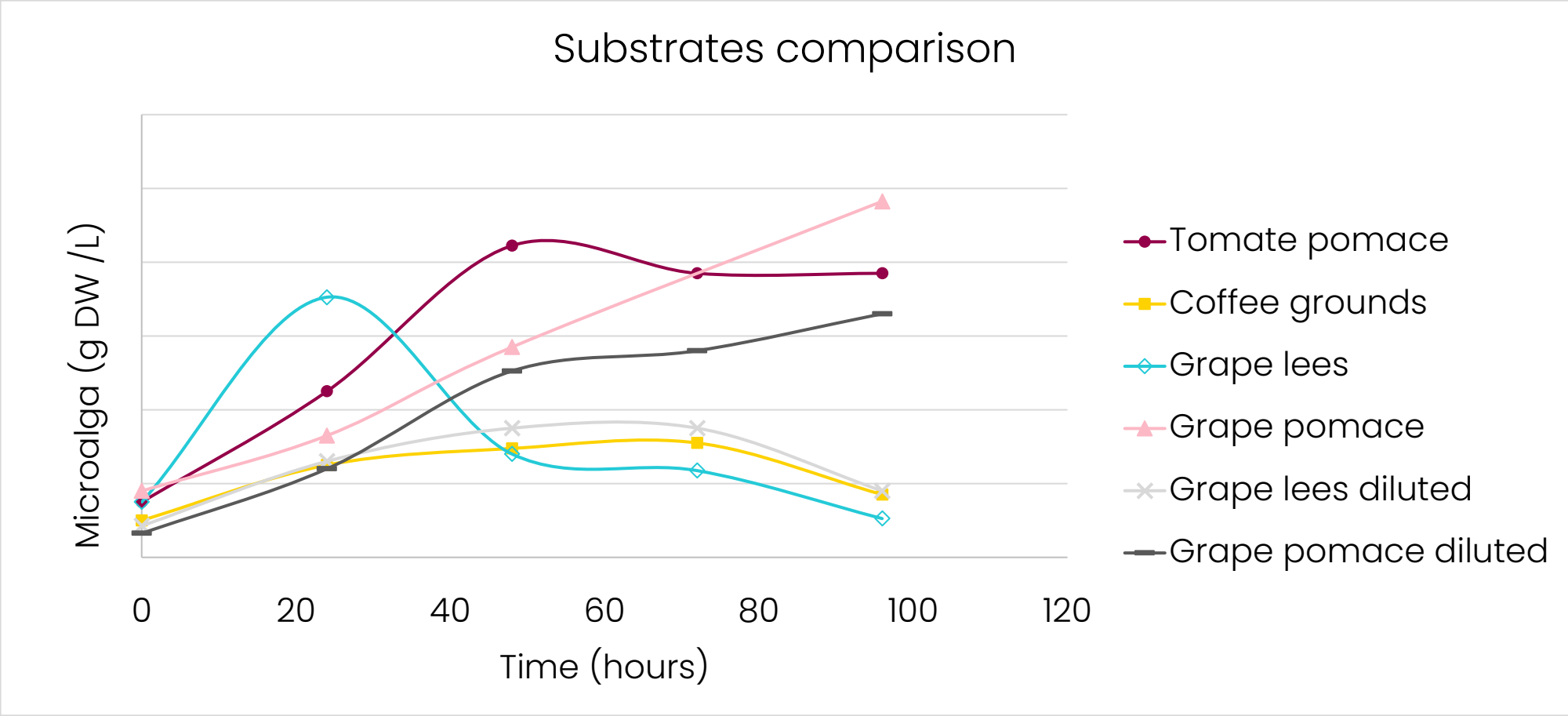
## Results

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## What do we need?

- Nutrients like:
  - Nitrate
  - Phospate
  - Trace minerals
- Water
- Transparent container
- Sun light
- Carbon dioxide
- Microalga seed

# Wine industry

AVIPE
Associação de Viticultores do Concelho de Palmela

https://en.avipe.pt/


The Association of Wine Growers of the Municipality of Palmela

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# Agro-industrial wastes


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## How can we produce healthier food with microalgae as a sustainable resource

7 March to 30 May 2023
17h CET Tuesdays

**Carla A. Santos, Monica Costa, Nataliia Rudenko**


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