

Wine pomace and Algae: a winning team

Carla Amarelo Santos

carla.santos@estbarreiro.ips.pt

Professora da Secção de Engenharia Química e Biológica
Escola Superior de Tecnologia do Barreiro/IPS

What are **microalgae**?

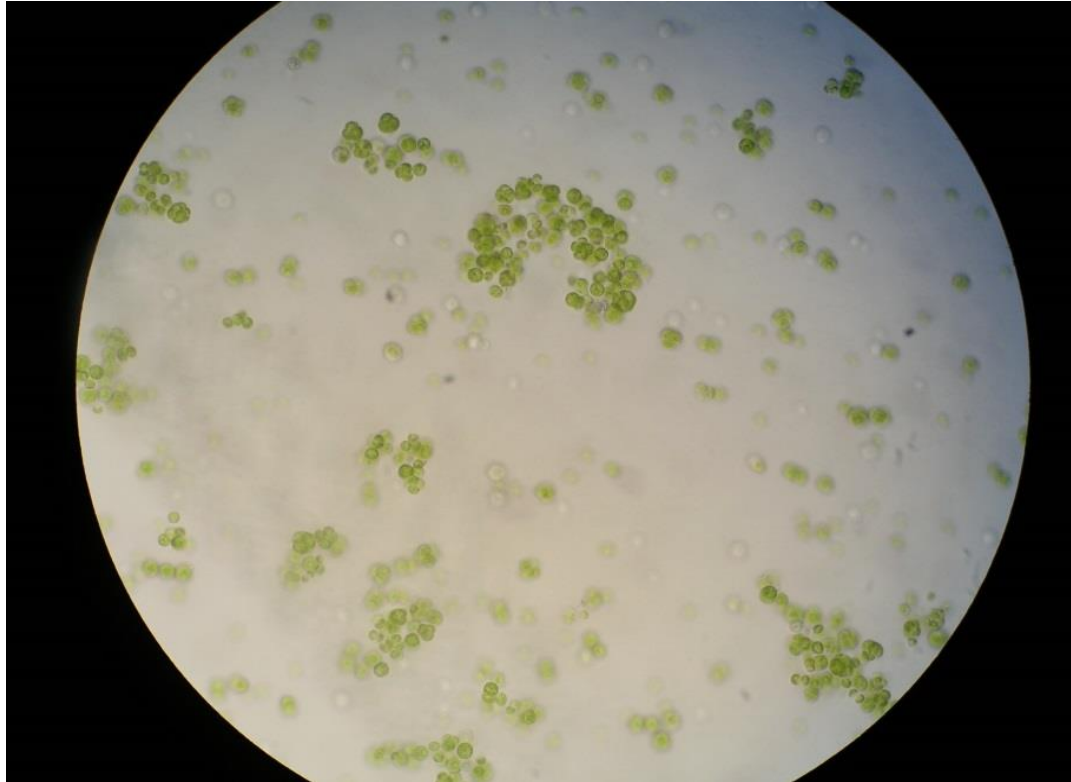


Azores lagoons

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

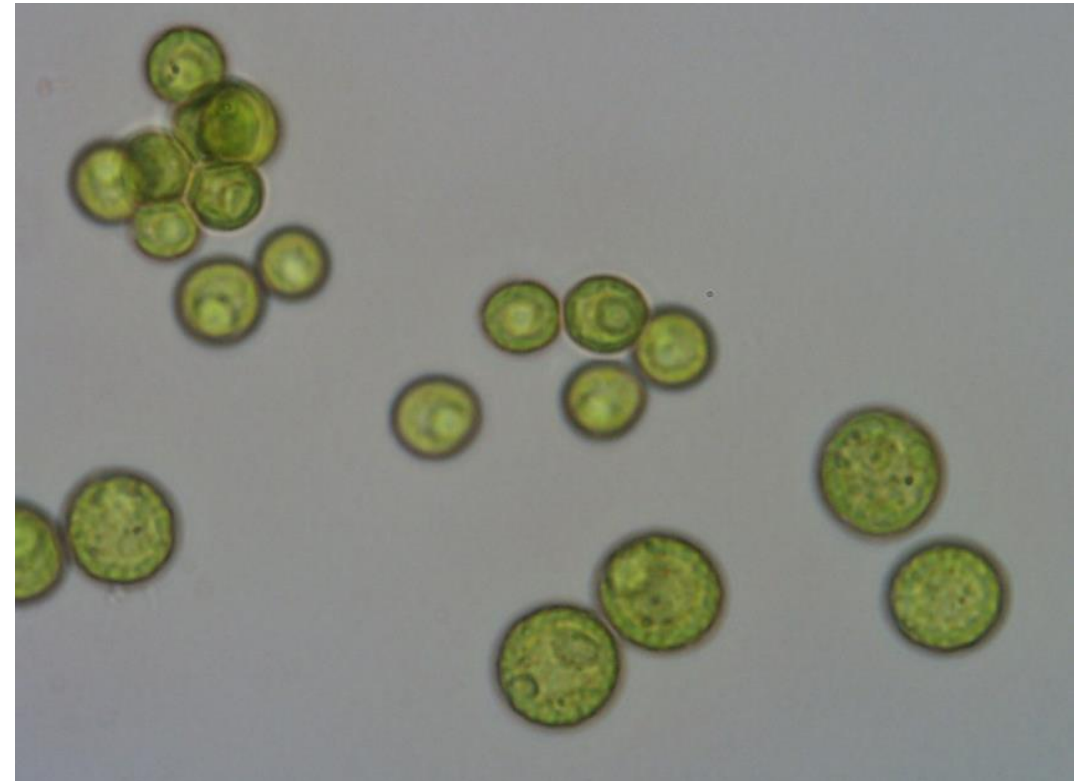
By Maros Mraz

Chlorella protothecoides



100 X

1 drop watched at the microscope



1000 X

Cultivation mode

Photoautotrophic: **photosynthesis**

Carbon dioxide + water + **solar energy** → glucose + oxygen



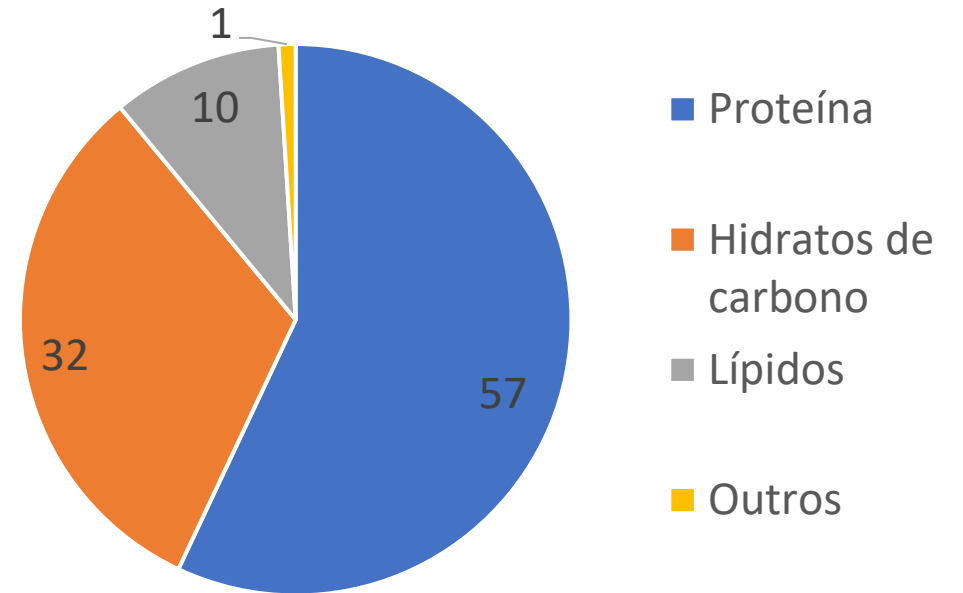
Heterotrophic: **respiration**

glucose + oxygen → carbon dioxide + water + **solar energy**



Microalgae content

	Average content
Protein	57 %
Carbohydrates	32 %
Lipids	10 %
Others	1 %



Carotenoids (0,2 %): beta-carotene (provitamin A), astaxanthin, lutein.

Minerals

What are **microalgae** used for?

- ✓ Human nutrition
- ✓ Aquaculture and Animal Nutrition
- ✓ Cosmetics and pharma
- ✓ Biofuels (Biodiesel)
- ✓ Wastewater treatment
- ✓ Soils fertilization
- ✓ Carbon dioxide (CO₂) fixation

Feed ingredient for animals

Feed manufacturer:

“A product with such a high protein content (57%) is very interesting to formulate feed.

The use of algae may have a functional interest because of the advantage modulation of the immune system, antioxidant effect, supplier of omega 3, vitamins, minerals.”

Formulation Engineer at DIN



By Ana Alves

What we do to grow **microalgae**?

1 mL



100 mL



Microalga seed in Petri dishes

Erlenmeyer flask cultivation

Liquid culture media containing **NPK, light** and **CO₂**

Scale up

1 L



3 L



30 L × n



Bubble
columns

Tubular
photobioreactor

Photobioreactor

Heterotrophic growth

100mL



3L



Microalga
seed

Erlenmeyer
cultivation

Bench
Fermenter

Big Scale
Fermenter

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

Comparing

	Fotoautotrophic	Heterotrophic
Biomass	6 g L ⁻¹	80 g L ⁻¹
Productivity	0.4 g L ⁻¹ d ⁻¹	5.8 g L ⁻¹ d ⁻¹

A large, conical pile of bright yellow, granular powder is centered on a white surface. The powder has a fine, porous texture. In the background, a blurred laboratory setting is visible, including a glass beaker, a white electrical outlet, and some cables.

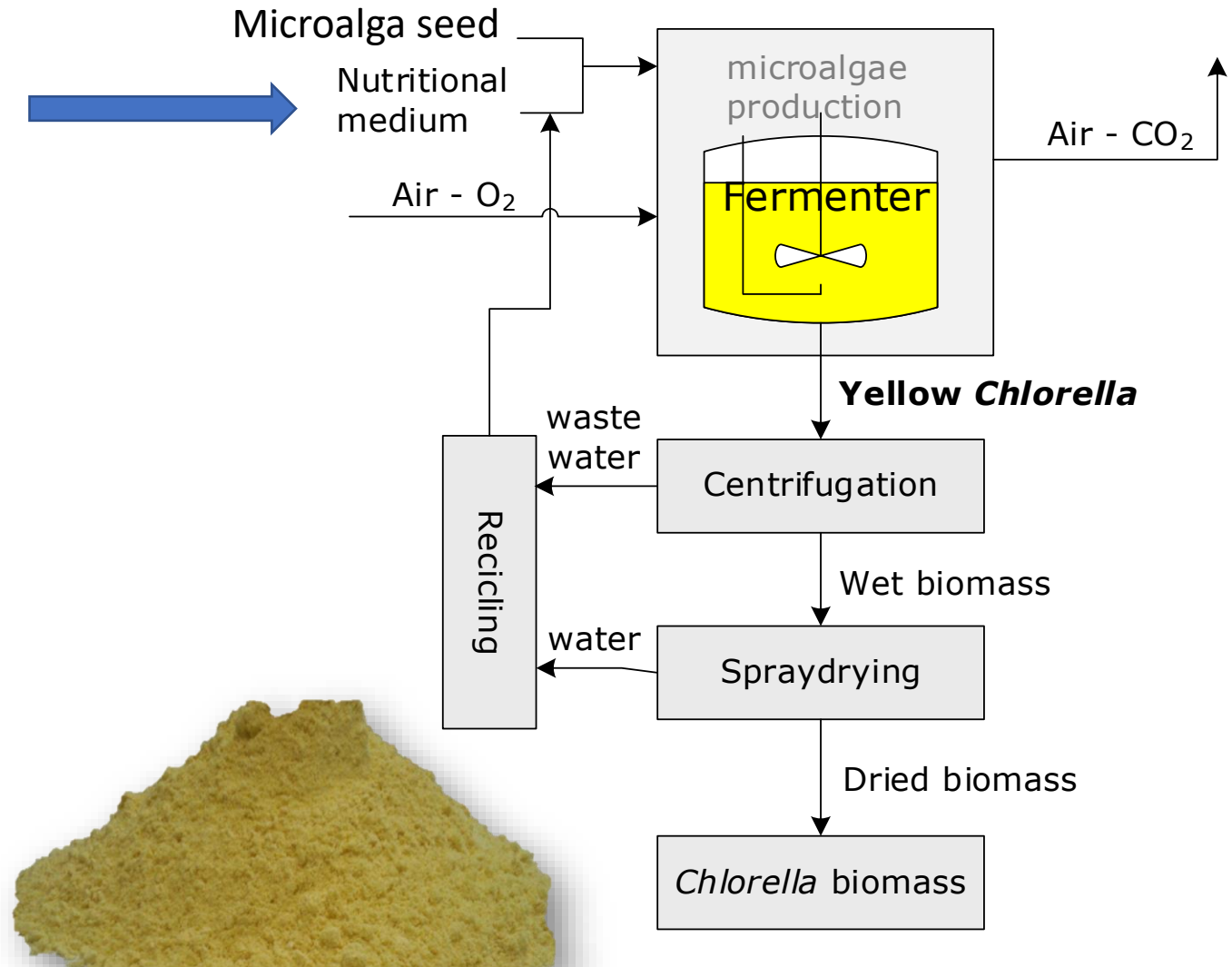
Spraydriered *Yellow Chlorella*

Protein rich microalgae production flow chart

Nutritional media with organic source of carbon

20% production costs

Economic sources of culture media



Agri-food wastes

Research Project at Biological and Chemical Engineering
E.S.T. Barreiro, IPS in 2019

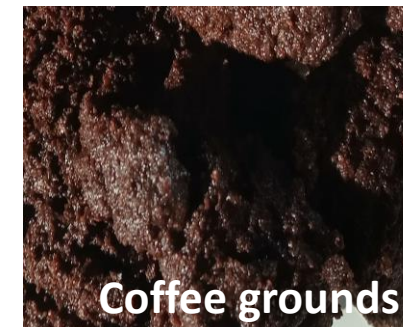
1. Viticulture and wine making industry (AVIPE)



2. Tomato industry (FIT)



3. Coffee grounds (Bar – ESTBarreiro)



Agri-wine wastes

1. Viticulture and wine making industry (AVIPE)



Grape pomace is 15 -17% of the total volume of wine produced
10.5 – 13.1 Mton of grape pomace in the world annually.

Wine Lees represent 2–6% of the total volume of wine produced



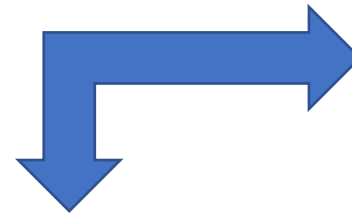
Pre-treatment



Moscatel grape pomace (AVIPE)

1 kg of grape pomace

↓
Hydrothermal processing followed by filtration



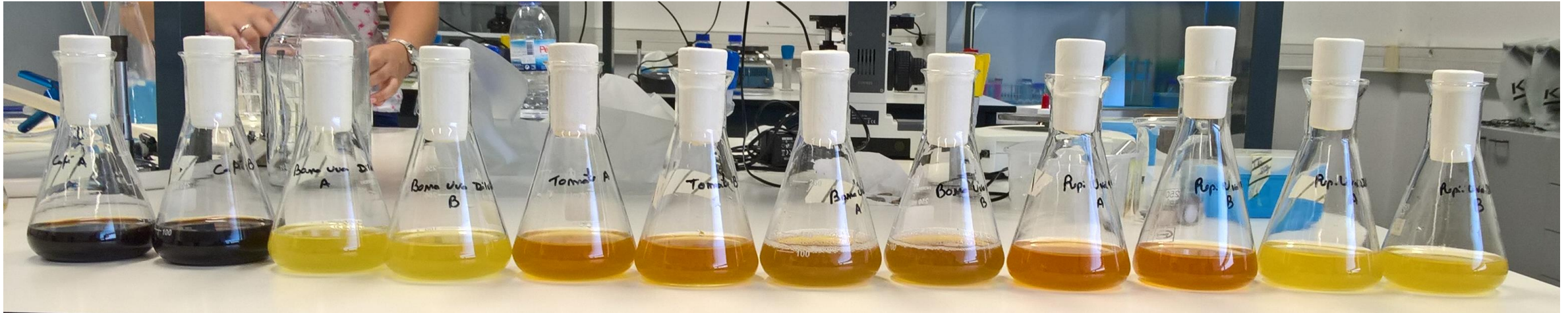
13% Nutritional liquid Substrate



87% mass next study

Trial of nutritional liquid substrates for microalgae growth

Started trial small scale 100 mL



Coffee grounds

Grape lees diluted

Tomate pomace

Grape lees

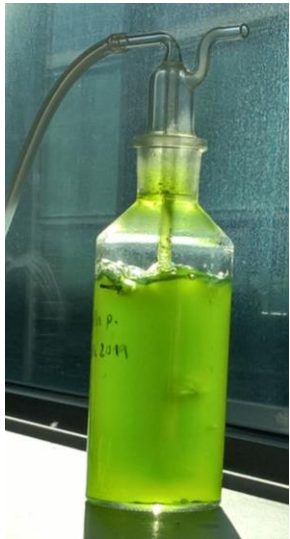
Grape pomace

Grape pomace diluted

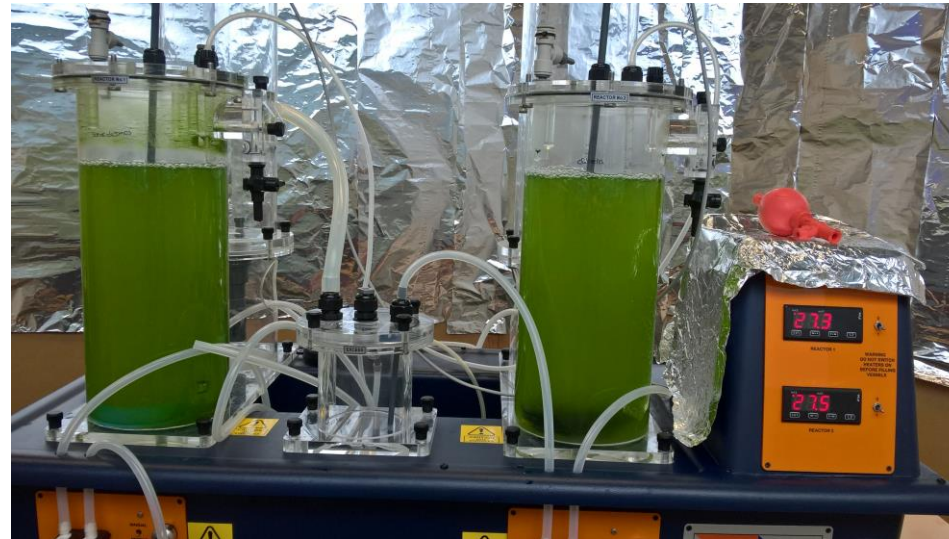
Master thesis of David Sousa 2019



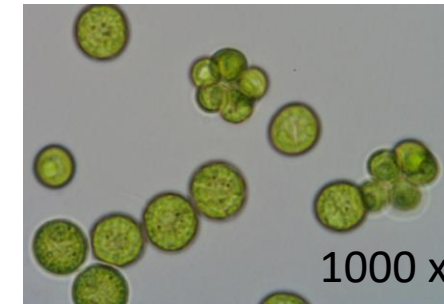
Trial of nutritional liquid substrates for microalgae growth



400 mL

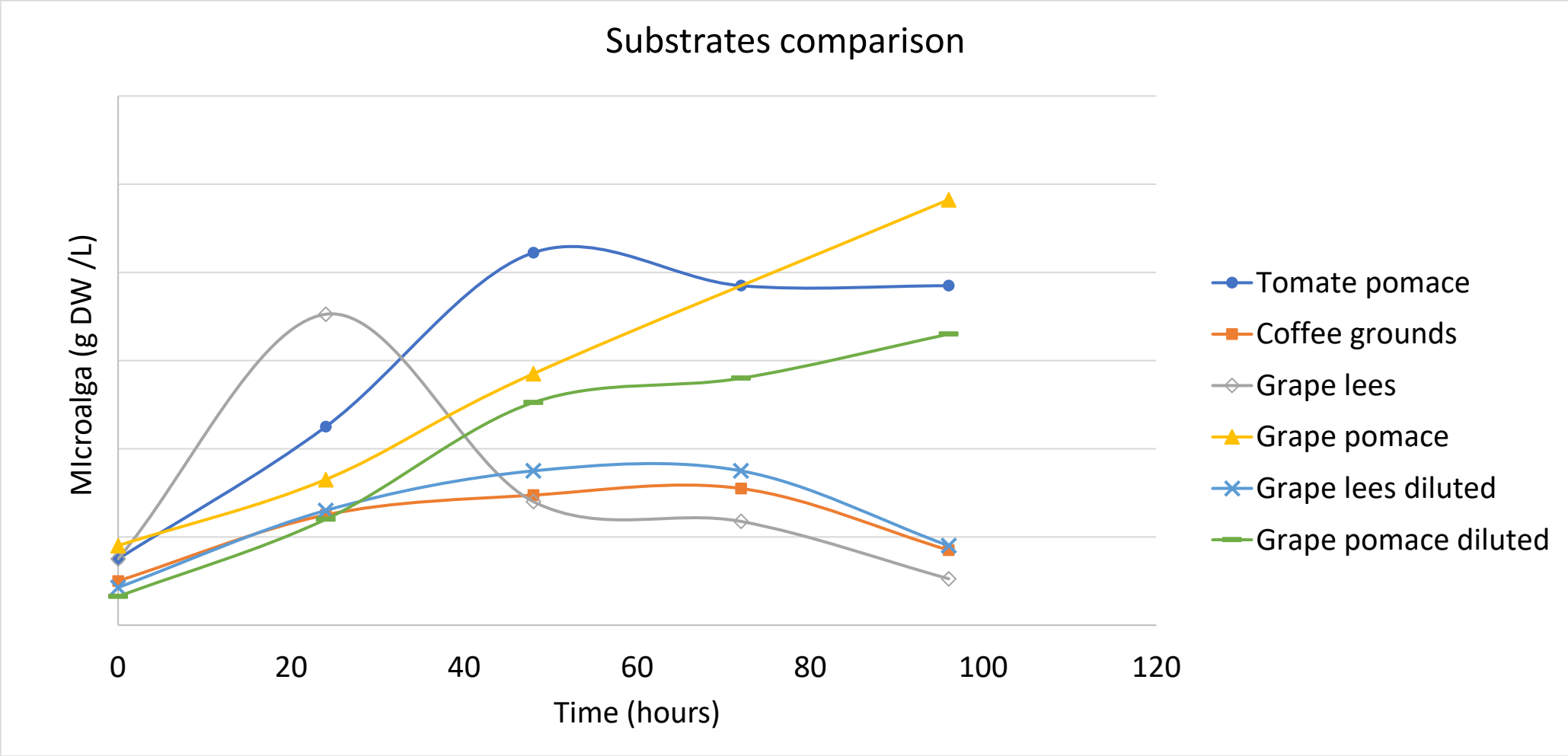


4 L



In the photoautotrophic growth the liquid substrates applied was much lower.

Results (2019)



Results (2019)

	Pomace tomate	Coffee grounds	Wine lees dilluted	Wine lees	Grape pomace dilluted	Grape pomace
Glucose (g/L)	5,89	1,34	0,38	1,32	13,44	49,39

Future work:

the combination of all tested liquid substrates,
that will improve productivity.

ProteAlgaFeed

sustainable microalgae cultivation to obtain protein-rich biomass

Thanks to AVIPE for all the agri-wine by-products provided for this work!

<https://www.estbarreiro.ips.pt/>

carla.santos@estbarreiro.ips.pt

Thank you all for your attention!

