Production of omega-3-rich microalgae oil as a functional food additive from the complete utilization of tuber discards

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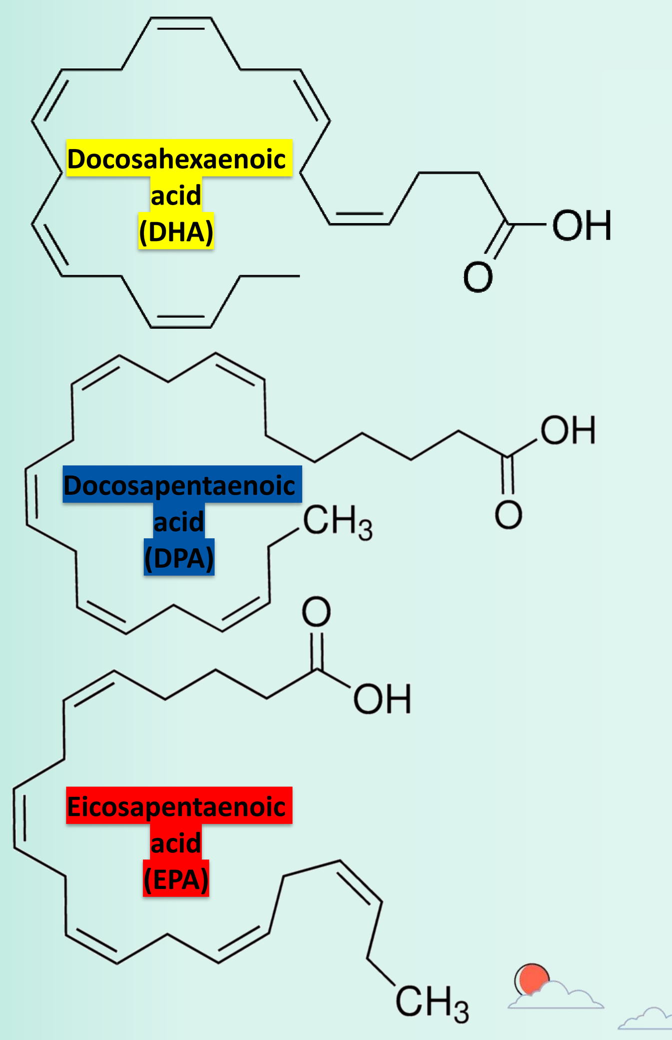
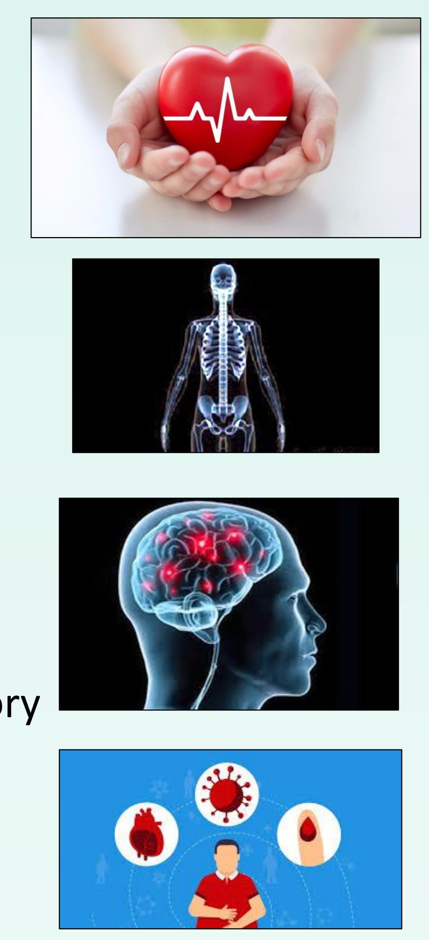
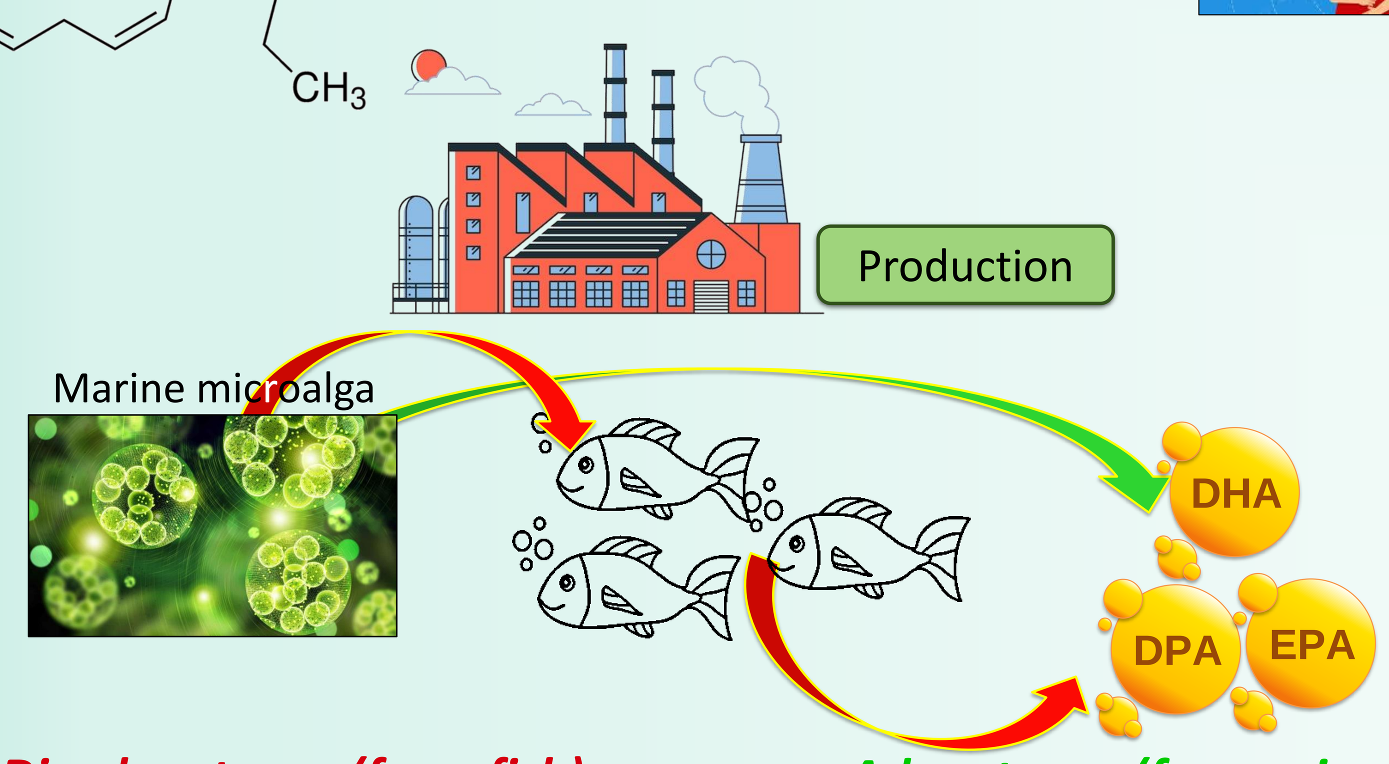
INTRODUCTION



Benefits ω-3

- Cardioprotective
- Antiinflammatory
- Antithrombotic
- Antiarrhythmic
- Anticancer
- Neuroprotective
- Antidepressant
- immunomodulatory





Disadvantages (from fish)

- Low DHA yield (< 50% w/w).
- Fish odor.
- Low DHA stability.
- Overfishing.
- Highly season dependence.
- Marine pollutants content (dioxins, methylmercury, polychlorinated biphenyls, metals).

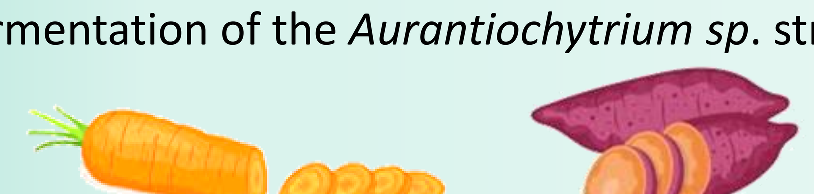
Advantages (from microalga)

- ✓ High purity.
- ✓ Good sensorial characteristics of final product.
- ✓ Use of natural and renewable discards.
- ✓ Toxins or pollutants absence.
- ✓ Low cost in fermentation process.

GOALS

Mean Goal

The purpose was to investigate the regional waste of carrot and sweet potato as a carbon source to replace glucose as the traditionally used carbon source for fermentation of the *Aurantiochytrium sp*. strain.



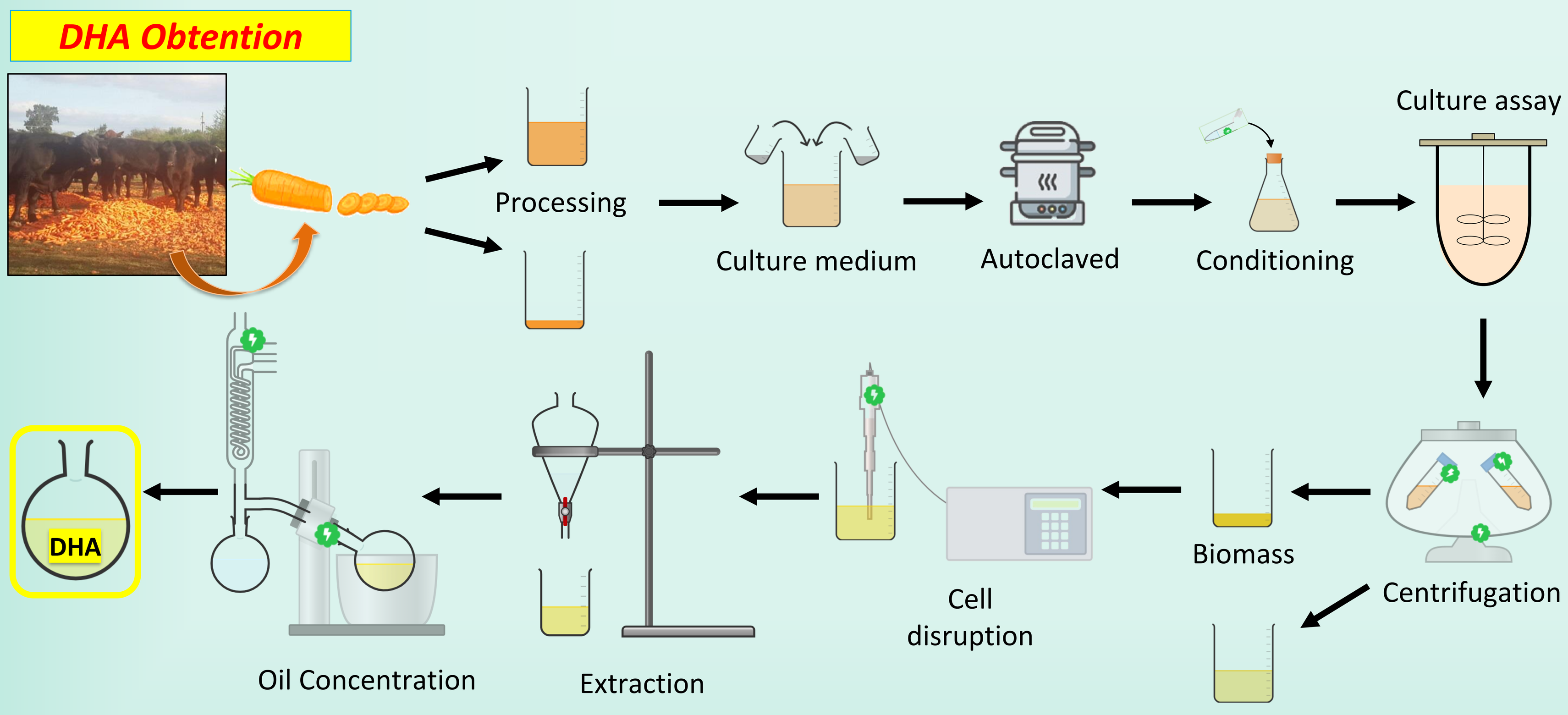
Carrots *Sweet potatoes*

- Sacarose
- Glucose
- Fructose

- Maltose
- Glucose
- Galactose

METHODOLOGY

DHA Obtention



Processing: decanted, filtered, and high speed centrifuged (DFH)

RESULTS

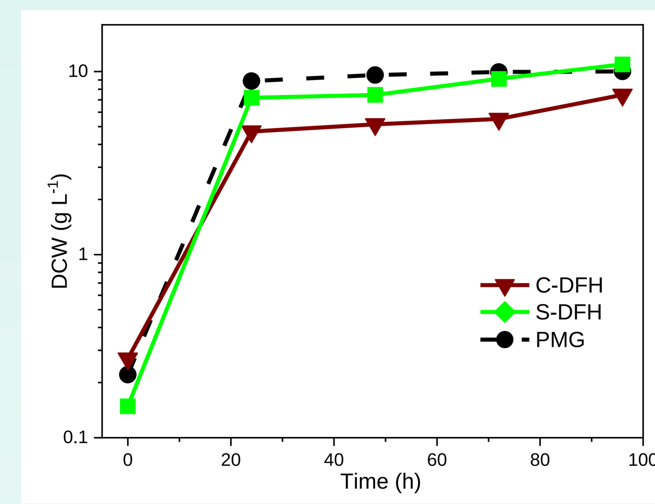


Figure 1. Cell concentration curves of *Aurantiochytrium* sp. cultures in 250 mL batch shake flasks with 100 mL and media prepared with juices of carrots (C-DFH) and sweet potatoes (S-DFH), tested at 150 rpm and 28 ± 2 °C for 96 h.

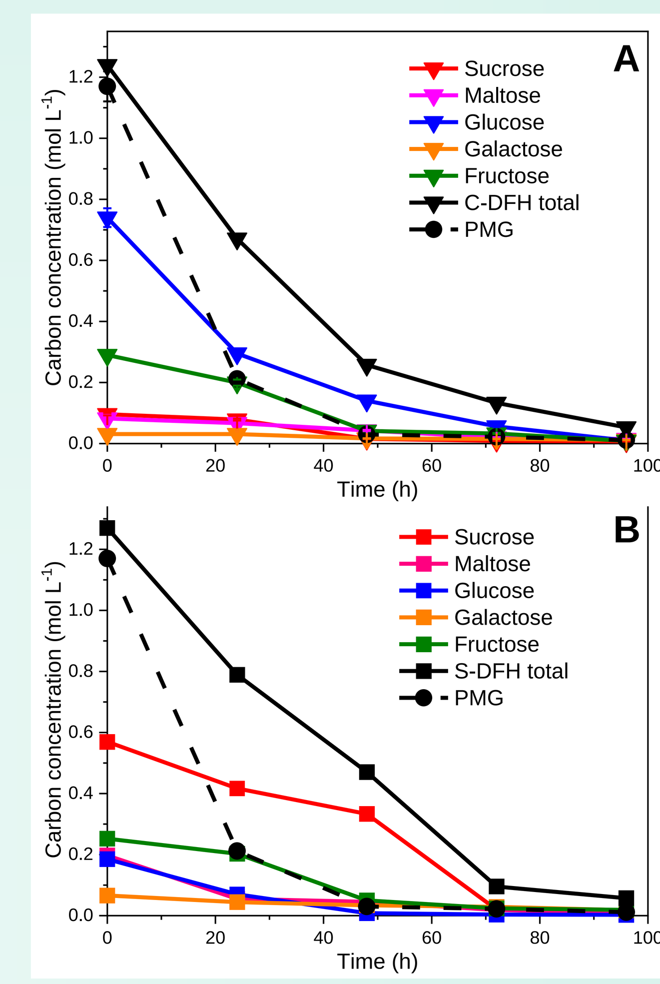


Figure 2. Sugar consumption profiles of *Auranthiocrytum* sp. cultures in 250 mL batch shake flasks with 100 Ml. A) C-DFH, B) S-DFH.

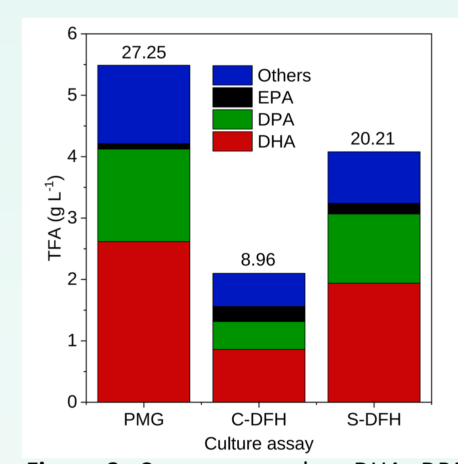


Figure 3. C_{TFA}, expressed as DHA, DPA, EPA and others fatty acids concentration, obtained in *Aurantiochytrium* sp. cultures in 250 mL batch shake flasks with 100 mL. Numbers over each bar correspond to P_{DHA} (mg L^{-1} h^{-1}) for each culture strategy.

Biomass, substrate, lipids, and yields parameters obtained during fermentation with *Aurantiochytrium* sp.

Parameter	96 h		
	PMG	C-DFH	S-DFH
μ (h^{-1})	0.72	0.63	0.78
DCW (g L^{-1})	10.01	7.46	10.81
S_R (mg L^{-1} h^{-1})	362.50	368.56	367.67
C_{TFA} (g L^{-1})	5.49	2.10	4.08
C_{PUFA} (g L^{-1})	4.21	1.56	3.24
C_{DHA} (g L^{-1})	2.62	0.86	1.94
P_{DHA} (mg L^{-1} h^{-1})	27.25	8.96	20.21
$Y_{X/S}$ (g g^{-1})	0.30	0.22	0.32

SUSTAINABILITY GOALS AND PRINCIPLES OF GREEN CHEMISTRY

Sustainability goals:

- ✓ Improves nutrition by providing a sustainable source of omega-3 fatty acids, essential for human health.
- ✓ Fatty acids (ω-3) are associated with cardiovascular and brain health benefits.
- ✓ Uses agro-industrial waste as a carbon source, reduces waste and promotes sustainable resource use.
- ✓ Reduces dependency on traditional sources such as fishing, thereby reducing over-exploitation of the oceans and its carbon footprint.
- ✓ Provides an alternative to fish oil, helping to conserve marine ecosystems by reducing the impact on marine species.

Principles of green chemistry:

1. Uses agro-industrial waste as a raw material, reducing waste generation.
4. Produces compounds that are beneficial to human health without creating hazardous by-products.
6. Biotechnological processes are often carried out at moderate temperatures and pressures, reducing energy consumption.
7. Microalgae is a renewable and sustainable resource compared to fossil or fish-based resources.
8. Avoids unnecessary intermediate steps by using a direct approach to omega-3 synthesis.

CONCLUSIONS

- ✓ S-DFH medium presented better results than C-DFH medium, with higher values of specific growth rate, biomass, and sugar consumption, which makes it an ideal methodology for obtaining a culture medium to be used in industrial-scale fermentation.
- ✓ The filter pressed technology could be used to remove even more of the microfibrils and to achieve even better results. The results presented here (C-DFH and S-DFH) could be extrapolated to the filter pressed. This opens the possibility of a potential scalability and industrial feasibility of this processing medium for obtaining culture media.