

# Optimisation de la bioproduction d'astaxanthine à partir de culture de microalgues psychrophiles

## Optimization of carotenoids bioaccumulation by psychrophilic microalgae culture

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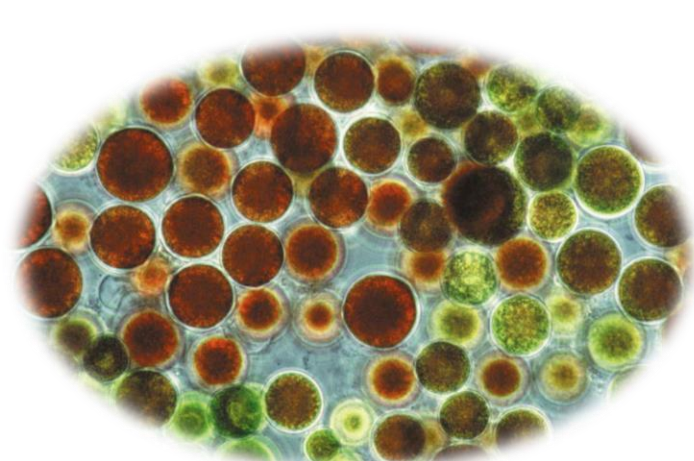
### 1. Thesis Context

#### Astaxanthin: properties, sources, and applications

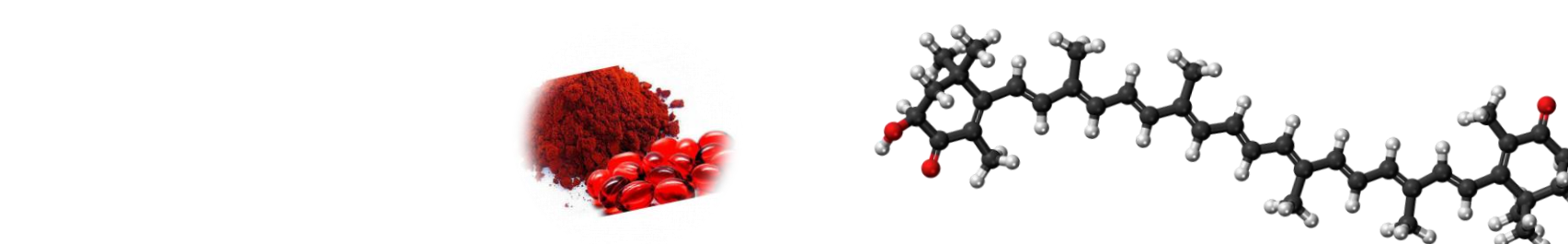
**Astaxanthin** represents **one of the key carotenoids** with the **highest antioxidant activity** and **monetary value** of the **natural form (2500 to 10,000 USD per kg)**. It offers a **wide range of applications** in various industries.



Natural sources



Microalgae such as the mesophilic *Haematococcus pluvialis*



Food colorant    Animal Feed    Cosmetics    Nutraceuticals

**Psychrophilic microalgae: a promising source of natural carotenoids [1]**

- Chlorophyceae
- Unicellular and **Phototrophic**
- Cells can **grow** between **2° to 18°C**

**Why working on these microalgae?**

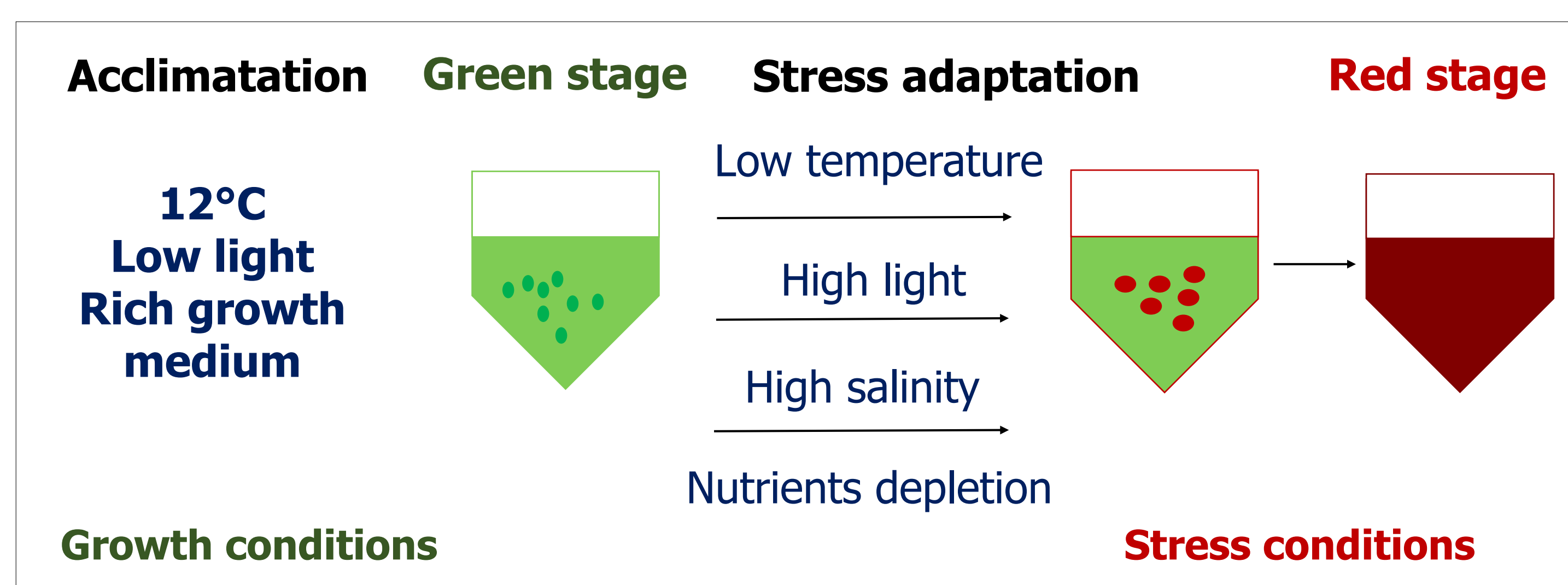
- Alternative **source of astaxanthin** and **secondary carotenoids**
- Thick **cell wall, robust cell**
- Well adapted to the Northern Europe climate**



Watermelon snow below the toe of the Lava Glacier, Mt. Garibaldi, BC. Photo: Casey Engstrom.

### 2. Materials and methods

#### Culture of psychrophilic microalgae via the two-step approach



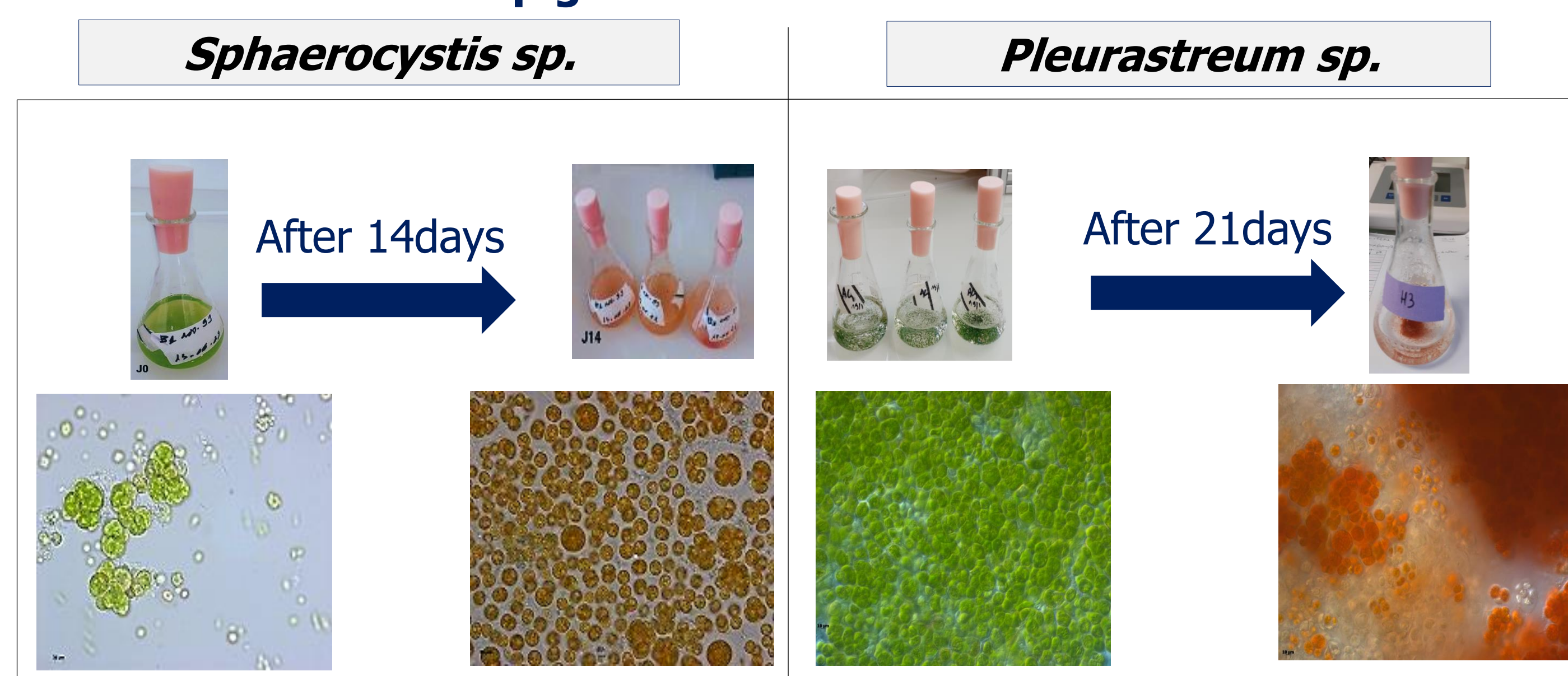
**Figure 1.** Culture of psychrophilic microalgae using the two-step approach [2]

**Table 1.** Experimental conditions culture of the two psychrophilic microalgae

Experimental conditions	<i>Sphaerocystis sp.</i> CCCRyo 100-99	<i>Pleurastrum sp.</i> CCCRyo 006-99
<b>Green-phase</b>	<b>14°C</b> <b>BBM-Medium</b> <b>1% CO<sub>2</sub></b>	<b>12°C</b> <b>BBM-Medium</b> <b>1 g/L NaHCO<sub>3</sub></b>
<b>Red-phase</b>	<ul style="list-style-type: none"> <li>• <b>Luminous stress : 500-600 μmol photons/m<sup>2</sup>/s</b></li> <li>• <b>Saline stress : 6g/L</b></li> <li>• <b>Azote and Phosphore deprivation</b></li> </ul>	

### 3. Results

#### Culture pigmentation and cells observation



**Figure 2.** *Sphaerocystis sp.* and *Pleurastrum sp.* in flasks and optical microscope pictures (400X).

**Table 2.** Pigment content of *Sphaerocystis sp.* extracts, depending on culture conditions (green and red-phase)

<i>Sphaerocystis sp.</i>	Pigment content (μg/mg DW)	
	Results	
<b>Green Phase</b>	Chlorophyll a	10.0
	Chlorophyll b	6.9
	<b>Total carotenoids</b>	<b>1.5</b>
<b>Red Phase</b>	Chlorophyll a	0.9
	Chlorophyll b	0.8
	<b>Total carotenoids</b>	<b>2.7</b>

### 4. Conclusion

The psychrophilic strains selected *Sphaerocystis sp.* and *Pleurastrum sp.* were successfully **acclimated** to our laboratory conditions for **growth** and for **accumulation of carotenoids** during a stress period. Results are promising because **both microalgae can accumulate secondary carotenoids of high interest like *Haematococcus pluvialis***. Work is still in progress on the **production of green and reddish biomass, microalgae pretreatment and pigments extraction** in order to optimize their productivity and recovery yield.

[1] Leya T, Rahn A, Lütz C and Remias D (2009). Response of arctic snow and permafrost algae to high light and nitrogen stress by changes in pigment composition and applied aspects for biotechnology. *FEMS Microbiology Ecology* 67(3), 432–443

[2] Aflalo C, Meshulam Y, Zarka A, Boussiba S (2007). On the relative efficiency of two- vs. one-stage production of astaxanthin by the green algae *Haematococcus pluvialis*. *Biotechnology and Bioengineering* 98(1), 300–5