Microalgae Metabolic Induction: An Original Way to Design Cosmetic Ingredients

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Abstract

Microalgae are involved in numerous industrial fields and gain importance in cosmetic ingredients and food supplement markets due to their interesting chemical composition. Indeed, the broad microalgae diversity is a source of wide natural compounds like proteins, vitamins and minerals. Microalgae are easily cultivated compared to seaweeds.

The metabolic induction concept lies in managing and modifying the culture parameters triggering microalgae physiological adjustments towards high added value targeted metabolites over-expression or accumulation. For instance, we have modified the fatty acid composition of Porphyridium cruentum oil towards eicosapentaenoic acid (EPA) accumulation.

Based on metabolic induction technical mastery, our company has developed a product line:

- Cicatrol® – An antioxidant, anti-ageing and pro-healing active ingredient
- Biomin® – Oligoelement-rich *Spirulina platensis* food supplement
- O^+ Gold Microalgae Extract® – Cosmetic gold-rich *Tetraselmis suecica* extract.

Introduction

Algae are among the earth's most important natural resources. In evolutionary terms, algae have existed for 3.8 billion years. They are considered to be one of the first organism groups to colonise the earth and have a broad habitat range. In their natural environment, they produce more than 60% of the oxygen on the planet through photosynthesis. Microalgae are extremely efficient solar energy converters and they can produce a great variety of metabolites. This capacity and their ubiquitous distribution have led to their exploitation for a diverse range of purposes.

What are microalgae?

Microalgae history as a staple in the human diet is unique. There is evidence that the Aztecs used biomass in the early sixteenth century. It was harvested from lakes in Mexico and reduced into small bricks. Likewise, dried microalgae have been used as food by the Kanembu tribe on the shores of Lake Chad in Central Africa.

All microscopic algae, usually unicellular or filamentous, are called microalgae, although this term is not related to taxonomy. By some estimates there are more than 30,000 different microalgae species. Microalgae are unicellular or multicellular photosynthetic micro-organisms divided into two taxons: prokaryotes and eukaryotes (see Figure 1 overleaf).

Prokaryote microalgae are constituted by cyanobacteria. 7500 cyanobacteria species have been described but only 200 are distinct and 75% are marine. However, *Spirulina platensis*, one of the most widespread microalgae on the market, grows in fresh water.

Eukaryote microalgae are all microscopic organisms among the three algae groups: red, brown and green. The main difference between prokaryote and eukaryote relies on the lack or presence of a cell nucleus.

This broad phylogenic microalgae diversity is a source of wide chemical varieties.

Photosynthetic machinery is embedded into folds of the cell membrane, containing photosynthetic pigments. The main pigments are chlorophylls, carotenoids and xanthophylls. Beside these, cyanobacteria and some Rhodophyceae contain phycocyanin, allophycocyanin and phycoerythrin acting as light harvesting antennae.

Microalgae present a very interesting nutritional composition because of their high content in proteins, vitamins and minerals. For example, *Spirulina platensis* contains 3 to 4 times more proteins than seaweed.

Regarding the lipid composition, some microalgae present a high lipid content compared to seaweed. Nevertheless, their lipid metabolism is oriented to long chain omega-3