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Comparison of microalgal biomass profiles as novel functional ingredient for food products

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ABSTRACT

Microalgae are one of the most promising sources for new food and functional food products, and can be used to enhance the nutritional value of foods, due to their well-balanced chemical composition. Knowing their physicochemical characteristics is fundamental for the selection of the most suitable microalgae to specific food technology applications and consequently successful novel foods development.
The aim of this study is to screen the chemical composition (e.g., proteins, pigments, fatty acids) and thermogravimetry properties of five microalgae species with potential application in the food industry: *Chlorella vulgaris* (green and carotenogenic), *Haematococcus pluvialis* (carotenogenic), *Spirulina maxima*, *Diacronema vlkianum* and *Isochrysis galbana*. *C. green* and *S. maxima* presented high protein (38% and 44%, respectively), low fat content (5% and 4%, respectively). The carotenogenic *C. vulgaris* and *H. pluvialis* showed a higher carotenoid content, higher fat, low protein and better resistance to thermal treatment. *D. vlkianum* and *I. galbana* presented high protein (38–40%) and fat (18–24%) contents with PUFA's ω3, mainly EPA and DHA. Finally, the results from microalgae chemical and thermal analysis were grouped and correlated through Principal Components Analysis (PCA) in order to determine which variables better define and differentiate them.

1. Introduction

Microalgae can use solar energy efficiently to transform wastewater, surplus CO_2 and possibly some additional nutrients into a green biomass rich in lipids, sugars, proteins, carbohydrates and other valuable organic compounds. These microorganisms convert inorganic substances such as carbon, nitrogen, phosphorus, sulfur, iron and trace elements into organic matter such as green, blue-green, red, brown and other color biomass.

Microalgae are a potentially great source of natural compounds, which could be used as functional ingredients [1]. There is a large number of available microalgae species, and knowledge of the chemical composition is mandatory as a first step in a screening methodology, since it will help to target valuable compounds, pigments, antioxidants, polyunsaturated fatty acids (PUFAs), etc., in the studied microalga.

As with any higher plant, the chemical composition of algae is not an intrinsic constant factor but varies over a wide range. Environmental factors, such as temperature, salinity, illumination, pH-value, mineral content, CO_2 supply, population density, growth phase and physiological status, can greatly modify chemical composition [2]. Most of the environmental parameters vary according to season, and the changes in ecological conditions can stimulate or inhibit the biosynthesis of several nutrients. Hence the growing conditions could be optimized to maximize the production for the biomolecules of interest. Because algae must adapt rapidly to the new environmental conditions in order to survive, they produce a great variety of secondary (biologically active) metabolites, with structures which cannot be found in other organisms [1].

The addition of microalgal biomass to food products is an interesting tool for providing nutritional supplementation with biologically active compounds (*e.g.*, antioxidants, PUFA-ω3), besides coloring purposes. Accordingly, the selection of microalgae species with balanced nutritional profiles is fundamental for successful novel foods development. A detailed physicochemical characterization of the microalgae is an essential stage that will allow determining which algae are best suited for different applications and purposes.

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