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This is the author's manuscript

Original Citation:

Availability:

This version is available http://hdl.handle.net/2318/156691 since

Publisher:

SCI SCF

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12 October 2024

Non-conventional extractions and antioxidant properties evaluation of microalga *Spirulina maxima*

D. Garella[1], M. Giorgis[1], C. Cena[1], A. Di Stilo[1], E. Marini[*, 1]

[1] *Dipartimento di Scienza e Tecnologia del Farmaco, University of Turin, Via P. Giuria 9, 10125 Turin, Italy.*

(*) corresponding author: elisabetta.marini@unito.it

Keywords: Spirulina maxima, antioxidant activity, extraction, ultrasound, microwave

Free radical reactions, especially those with participation of oxidative elements, have been shown to be associated with damage on lipids, proteins, cell membranes and nucleic acids, ultimately resulting in various chronic diseases. In the last decades there has been an explosive interest in the use of antioxidant nutritional supplements. Several studies demonstrated that intake of some vitamins, minerals, and other food constituents may help to protect the body against many diseases, and that antioxidants exert their protective effect either preventing these diseases or decreasing their severity. In the search for new and alternative sources of antioxidants, extraction from microalgae has recently gained importance [1]. During the photosynthesis process microalgae generate molecular oxygen, which can reach locally high concentration levels and can be easily activated by ultraviolet radiation or heat from sunlight into toxic ROS. Microalgae, like plants, have developed protective mechanisms which consist in the production of antioxidant compounds able to minimize ROS concentration. The great biodiversity, the ease of cultivation and modulation of growth conditions are important factors that allow to count microalgae among the natural resources with high antioxidant potential. The blue green microalgae *Spirulina* species have been widely used as an excellent nutrient source for humans and animals due to their nutritional profile characterized by a high-protein content (55–65%), with all the essential aminoacids in perfect balance. *Spirulina* contains as well a whole spectrum of natural mixed carotene and xanthophyll phytopigments which, together with phycocyanin, seem to be related to its antioxidant activity. For all these properties *Spirulina* extracts are increasingly studied and used in the supplements industry.

Since microalgae are a complex matrix, it is important to find optimum extraction conditions for selective isolation of specific groups of compounds. The traditional extraction methods (maceration, Soxhlet and hydrodistillation) are energy intensive, with low yields and moderate selectivity, and require as well a long extraction time. Several innovative extraction methods have been successfully used in food and pharmaceutical applications for the extraction of bioactive compounds with beneficial results in terms of time, cost and yield [2]. The bioactive compounds intracellularly located, require the cell wall destruction for their extraction and this could be enhanced by the use of the so called non-conventional techniques. Most cell disruption methods developed for non-photosynthetic microorganisms can be applied to microalgae and cyanobacteria, e.g. microwave (MAE) and ultrasound assisted extraction (UAE). The shear forces created by the implosion of cavitation bubbles, which are in turn created by ultrasonic waves, disrupt plant tissues and facilitate extraction at room temperature. The easy scaling up of UAE, the safety aspects, the low energy consumption and the moderate investment required make this technique very attractive for industrial application [3].

The aim of this work is to find optimum extraction conditions, comparing several extracts of *Spirulina maxima,* in term of antioxidant activity. The extracts were obtained in different conditions of solvent polarity and with several techniques, either traditional or non-conventional (UAE and MAE). The antioxidant activity was determined with two different assays: Trolox Equivalent Antioxidant Capacity (TEAC) assay and the Oxygen Radical Absorbance Capacity (ORAC) assay, here reported for the first time for *Spirulina* extracts.

The authors acknowledge the Fondo Finanziamento Locale 2013 from University of Turin for finantial support and FiToLife (Turin) for providing microalgae material.

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