

SCIENTIFIC REPORTS



OPEN

The green microalga *Tetraselmis suecica* reduces oxidative stress and induces repairing mechanisms in human cells

Received: 21 December 2015

Accepted: 04 November 2016

Published: 24 January 2017

Clementina Sansone¹, Christian Galasso^{1,2}, Ida Orefice¹, Genoveffa Nuzzo³, Elvira Luongo³, Adele Cutignano³, Giovanna Romano¹, Christophe Brunet¹, Angelo Fontana³, Francesco Esposito¹ & Adrianna Ianora¹

Green microalgae contain many active pigments such as carotenoids having antioxidant and protective activity on human cells. Here we investigate the biological activity of an ethanol/water extract of the marine green microalga *Tetraselmis suecica* containing high levels of carotenoids such as the xanthophylls lutein, violaxanthin, neoxanthin, antheraxanthin and loroxanthin esters. This extract has a strong antioxidant and repairing activity in the human lung cancer cell line (A549) as shown by the increased expression of dehydrocholesterol reductase-24 (DHCR24) and prostaglandin reductase 1 (PTGR1) genes and proteins. The extract also reduces prostaglandin E₂ (PGE₂) levels in cells damaged by H₂O₂ and has tissue repairing effects on reconstructed human epidermal tissue cells (EpiDerm™) indicating a potential cosmeceutical activity of this microalgal species.

Reactive oxygen species (ROS) have been linked to the pathogenesis of several human diseases such as atherosclerosis, diabetes mellitus, chronic inflammation, neurodegenerative disorders and many types of cancers. ROS species can be partially neutralized by antioxidant compounds that can reduce the risk of many diseases related to oxidative stress¹. Hence, consumer preference for natural products is increasing the interest in finding new antioxidants from natural sources because synthetic products can cause potential long term toxic effects². Most, if not all, commercially available natural antioxidants are derived from terrestrial plants (e.g. rosemary, tea, coffee, grape seeds, tomato and cocoa). Many of these antioxidants are carotenoids that are a class of more than 700 naturally occurring pigments synthesized by plants, algae, and photosynthetic bacteria. Carotenoids are known to be potent physical and chemical quenchers of singlet oxygen (¹O₂) and scavengers of other reactive oxygen species (ROS). However, the exact mechanisms underlying the protective function and specific molecular targets of carotenoids *in vivo* and *in vitro* are still poorly understood³.

Tetraselmis suecica is a marine green microalga belonging to the class Chlorophyceae, widely used in aquaculture for the feeding of mollusks and crustacean larvae⁴ and as a probiotic in fish⁵. *T. suecica* is rich in vitamin E, carotenoids, chlorophyll, and tocopherols⁶ and has been suggested as a food supplement in human and animal diets⁷. The total pigment extract from *T. suecica* has been patented for its ability to enhance dermal pigmentation, reduce psoriasis lesions and increase hair growth⁷. Here we investigate the potential biotechnological application of this species studying the protective role at molecular level on human anaplastic cells and tissues. To this aim, we characterize the pigment content of an ethanol/water extract of *T. suecica* and investigate the antioxidant and protective effects of this extract against oxidative damage. We show that this extract has a strong antioxidant and cell repairing activity in a human lung cancer cell line (A549), an *in-vitro* model that is often used to study antioxidant effects⁸. In particular, this total extract targets the expression of dehydrocholesterol reductase-24 (DHCR24) and prostaglandin reductase 2 (PTGR2) genes and proteins, and reduces the levels of prostaglandin E₂ (PGE₂).

¹Integrative Marine Ecology Department, Stazione Zoologica Anton Dohrn, Villa Comunale, Naples 80121, Italy.

²University of Naples "Federico II", Department of Veterinary Medicine and Animal Production, Via Federico Delpino 1, Naples 80137, Italy. ³Bio-Organic Chemistry Unit, Institute of Biomolecular Chemistry-CNR, Via Campi Flegrei 34, Pozzuoli, Naples 80078, Italy. Correspondence and requests for materials should be addressed to C.S. (email: clementina.sansone@szn.it)