Oil production by the marine microalgae *Nannochloropsis* sp. F&M-M24 and *Tetraselmis suecica* F&M-M33

Paolo Bondioli a, Laura Della Bella a, Gabriele Rivolta a, Graziella Chini Zittelli b, Niccolò Bassi c, Liliana Rodolfi c,d,a, David Casini e, Matteo Prussi e, David Chiaramonti e, Mario R. Tredici d

a INNOVHUB–Stazioni Sperimentali per l’Industria - SSOG Division, Milan, Italy
b Istituto per lo Studio degli Ecosistemi, CNR, Florence, Italy
c Dipartimento di Biotecnologie Agrarie, University of Florence, Italy
d CREAR, Dipartimento di Energetica “Sergio Stecco”, University of Florence, Italy


**ABSTRACT**

*Nannochloropsis* sp. F&M-M24 and *Tetraselmis suecica* F&M-M33 were cultivated outdoors in Green Wall Panels under nutrient deficiency to stimulate oil synthesis. Under nitrogen deprivation, *Nannochloropsis* attained average biomass and lipid productivities of 9.9 and 6.5 g m⁻² day⁻¹, respectively. Starved *Tetraselmis* cultures achieved a biomass productivity of about 7.6 g m⁻² day⁻¹ and a lipid productivity of 1.7 g m⁻² day⁻¹. Lipids represented 39.1% and 68.5% of non-starved and starved *Nannochloropsis* biomass, respectively. Starvation did not increase lipid content in *Tetraselmis* biomass. Important differences in lipid classes and in fatty acid composition were observed under the different cultivation conditions for both microalgae.

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**1. Introduction**

Biodiesel is currently produced from oils and fats of vegetable or animal origin. Biodiesel is constituted of fatty acid methylesters (FAMEs) that are normally obtained by means of a simple alkali catalyzed chemical reaction, from triglycerides and methanol, with parallel production of glycerol as a by-product. The general balance of this process, starting from 100 kg of neutral fat, is approximately 100 kg of biodiesel and 10 kg of glycerol, with a parallel consumption of 10 kg of methanol. The demand of natural oils for biodiesel production is constantly raising in Europe and worldwide (Subramaniam et al., 2010). For this reason and in order to avoid the competition with the food market, research is today focusing on alternative renewable feedstocks for biodiesel production.

Microalgal biodiesel is technically feasible. However, algal biomass is, at present, largely too expensive to compete with petrodiesel. Besides, the energy balance of algal biomass production is still not sufficiently positive (Tredici, 2010).

Microalgae have been identified as a possible source of new generation biofuels since they do not compete with food and feed crops, attain higher oil yields than currently available agricultural crops, and can be cultivated in seawater on non-arable land (Greenwell et al., 2010; Tredici, 2010). During last years several research projects have been launched and numerous papers have been published on this subject (Amaro et al., 2011; Gouveia and Oliveira, 2009; Griffiths and Harrison, 2009; Huerlimann et al., 2010; Mutanda et al., 2011; Scott et al., 2010). Oil-rich algae (the so-called oleaginous species) can be grown either autotrophically or heterotrophically. In the first mode, carbon dioxide (or bicarbonate) is used as the sole carbon source, which is incorporated by means of the photosynthetic process, while in the second mainly organic molecules are used for growth. The photosynthetic process needs light to take place and hence algal cultivation must be carried out with artificial light or under sunlight, while the heterotrophic process can take place in classical fermenters. Despite the metabolic flexibility of microalgae and the impressive progress achieved in these years by algal biotechnology, a long way must still be run before microalgae might be exploited for commercial biofuel production (Tredici, 2010).

A first crucial point to be cleared is the maximum oil yield attainable with microalgae cultures. This is strictly dependent on the selected microorganism, the geographical location of the production plant and the culture conditions (Hu et al., 2008). According to Rodolfi et al. (2009) and Studt (2010), the potential oil yield of microalgae cultures is from 5 to 20 times that of oil