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Advancing assessment of marine phytoplankton community structure and nutritional value from fatty acid profiles of cultured microalgae

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Abstract

The dual function of fatty acids as both biomarkers of phytoplankton community structure and proxies of their nutritional value is becoming increasingly recognized as a substantial complement to elemental stoichiometry studies in aquatic ecology and aquaculture. Despite information on fatty acid composition of marine microalgae being more abundant, phytoplankton fatty acid reviews as well as information on their nutritional quality and effects in food webs are far more frequent for freshwater species. Here, 683 fatty acid profiles of 115 genera of marine microalgae belonging to 17 classes from eight phyla and cultured under nonstressful conditions were compiled. Data analysis allowed establishment of fatty acid reference values that can be used to quantitatively determine marine phytoplankton community structure with an unprecedented descriptive level. Fatty acids also served to generate the first microalgae nutritional index adapted to requirements of consumers and their trophic upgrading capabilities. Fatty acid profile allowed taxonomically differentiating among marine microalgae within a group comprising 14 classes and the Bacillariophyta phylum. Phylogeny was the strongest driving force of fatty acid variation, whereas the marine or freshwater origin of microalgae contributed <1%. Nutritionally, marine microalgae were more homogeneously arranged at the phylum level, with the Dinophyta separately scoring the maximum nutritional value. The phylum Chlorophyta comprised strictly marine classes and other classes also present in freshwaters and showed the highest within-phylum nutritional quality variability. Such variability is relevant and recommends using specific taxonomic terminology for green lineage microalgae regarding their nutritional value.

Key words: fatty acid profile, marine phytoplankton, nutritional value, taxonomic arrangement, trophodynamics.

Introduction

Marine phytoplankton is the main trophic support in diverse aquatic ecosystems providing humans with both fishery and aquaculture resources. Such resources are rich in essential nutrients primarily produced by microalgae. The dependence of fisheries on phytoplankton primary production has been demonstrated (Chassot *et al.* 2010), and microalgae have been even considered as the main world aquaculture product due to their high production estimates in managed ponds where they are trophic support for different aquaculture products (Neori 2011). In any instance, primary production alone is a partial indicator for production in upper trophic levels, and recent findings pinpoint the need to complement such information with additional data on plankton quality and food web structure in order to achieve more robust predictions of fisheries yield (Friedland *et al.* 2012). Chlorophyll concentration has been traditionally used to estimate the potential of primary production. However, phytoplankton assemblages are highly diverse; they may exhibit very distinct digestibility and nutritional status, and some of them may even have the capacity to inhibit grazing activity (Irigoien *et al.* 2005). This variability applies to most aquatic environments and has therefore important consequences both for marine ecosystems management and aquaculture practises relying