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[Article], 2008, 80 (5), 1574-1581
DOI: 10.1021/ac702196z

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Jons Dik, Koen Janssens, Geert Van Der Snickt, Luuk van der Loeff, Karen Riekers, and Marine Cotte
[Article], 2008, 80 (16), 6436-6442
DOI: 10.1021/ac800965g

Water Analysis: Emerging Contaminants and Current Issues
Susan D. Richardson
[Review], 2007, 79 (12), 4295-4324
DOI: 10.1021/ac070719q

Electrochemical Sensors
Benjamin J. Privett, Jae Ho Shin, and Mark H. Schoenfish
[Review], 2008, 80 (12), 4499-4517
DOI: 10.1021/ac8007219

Rapid Prototyping of Microfluidic Systems in Polydimethylsiloxane
David C. Duffy, I. Cooper McDonald, Olivier J. A. Schueler, and George M. Whitesides
[Article], 1998, 70 (23), 4974-4984
DOI: 10.1021/ac980656z

Micro Total Analysis Systems: Latest Achievements
Jonathan West, Marco Becker, Sven Tombrink, and Andreas Manz
[Review], 2008, 80 (12), 4403-4419
DOI: 10.1021/ac800680j

Cancer Cell Targeting Using Multiple Aptamers Conjugated on Nanorods
Yu-Fen Hsiao, Huan-Tsung Chang, and Weihong Tan
[Accelerated Article], 2008, 80 (3), 567-572
DOI: 10.1021/ac702322j

Colorimetric Method for Determination of Sugars and Related Substances
Michel DuBois, K. A. Gilles, J. K. Hamilton, P. A. Rebers, and Fred. Smith
[Article], 1956, 28 (3), 350-356
DOI: 10.1021/ac60111a017

Gold Nanoparticle-Based Colorimetric Assay for the Direct Detection of Cancerous Cells
Colin D. Medley, Joshua E. Smith, Zhiwen Tang, Yanrong Wu, Suwussa Bamrungsap, and Weihong Tan
[Article], 2008, 80 (4), 1067-1072
DOI: 10.1021/ac702037y

Fiber-Optic Chemical Sensors and Biosensors
Otto S. Wolfbeis
[Review], 2008, 80 (12), 4269-4283
DOI: 10.1021/ac800473b

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Innovative Natural Functional Ingredients from Microalgae

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Nowadays, a wide variety of compounds such as polyphenols, polyunsaturated fatty acids (PUFA), or phytosterols obtained, for example, from wine, fish byproducts, or plants are employed to prepare new functional foods. However, unexplored natural sources of bioactive ingredients are gaining much attention since they can lead to the discovery of new compounds or bioactivities. Microalgae have been proposed as an interesting, almost unlimited, natural source in the search for novel natural functional ingredients, and several works have shown the possibility to find bioactive compounds in these organisms. Some advantages can be associated with the study of microalgae such as their huge diversity, the possibility of being used as natural reactors at controlled conditions, and their ability to produce active secondary metabolites to defend themselves from adverse or extreme conditions. In this contribution, an exhaustive revision is presented involving the research for innovative functional food ingredients from microalgae. The most interesting results in this promising field are discussed including new species composition and bioactivity and new processing and extraction methods. Moreover, the future research trends are critically commented.

KEYWORDS: Microalgae; functional foods; extraction; antioxidant

INTRODUCTION

In the last years, there has been a growing interest in functional food development because of the beneficial health effects that it can promote (1). The rising demand on such foods can be typically explained by the increasing costs of healthcare, the steady enhancement in life expectancy, and the desire of older people to improve their health quality (2).

Functional food was born as a new concept in Japan at the beginning of the 1980s, as a means to protect the health of the consumers and to reduce the high health costs derived from a high population with high life expectancies (3). In 1993, the Ministry of Health and Welfare established a policy for "Foods for Specified Health Uses" (FOSHU) by which health claims of some selected functional foods were legally permitted and regulated (4). In the United States, the Food and Drug Administration (FDA) has accepted a correlation between some nutrients in the diet and the possibility to prevent several diseases when "the totality of publicly available scientific evidence, and where there is substantial agreement among qualified experts that the claims were supported by the evidence" (5). On the other hand, in Europe, a working group coordinated by the European Section of the International Life Science Institute (ILSI) and supported by the European Commission was created in the second half of the 1990s to promote the action FULOSE (Functional Food Science in Europe, under the IV Framework Program) (6). This particular action's aim was to stimulate the scientific study on functional food.

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Besides, from this project, a standard definition for functional food was agreed. Namely, a food can be regarded as "functional" if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either an improved state of health and well-being and/or a reduction of the risk of disease (7–10). Moreover, the novel functional food must remain the same as the original food (not in the form of pills or capsules, for instance), and it has to be demonstrated that it can cause its effects in amounts that can be normally expected to be consumed in a regular diet (5). In this sense, from the research carried out in the past decade, the European Regulation (CE) 1924/2006 about functional foods (approved in December 2006 by the European Union; regulation of the European Parliament and of the Council, of December 20, 2006, relative to the nutritional declarations and of healthy properties in the food) was derived. In this regulation, the nutritional allegations and/or healthy properties of the new products are regulated, including their presentation, labeling, and promotion.

From a food science point of view, a particular action of a functional food is derived from one or more functional ingredients. The functional food can be classified depending on the type of food or depending on the type of the functional compound employed. This type of classification is shown in Table 1. As can be observed, there are a wide range of compounds and beneficial activities that have already been described to develop new functional products. Therefore, because the demand on functional food is continuously increasing, there is a need to find new adequate functional ingredients to be employed by the food