

Polyunsaturated fatty acid composition of three Antarctic macro-algae extracted by conventional and microwave-assisted methods

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Abstract

This work shows the conventional and microwave-assisted extraction of fatty acids in three sub-Antarctic macro-algae.

Introduction

Macro-algae are a polyphyletic group of organisms divided in Rhodophyta, Ochrophyta and Chlorophyta according to their dynamic taxonomy. They are known to be a renewable source of many valuable compounds such as steroids, polysaccharides, lipids and others. Lipids extracted from sub-Antarctic algae usually have a higher content of mono- and poly-unsaturated fatty acids (FAs) so the species living in this kind of environment can be able to thrive the extreme adverse conditions of temperature and geographic isolation.¹ Polyunsaturated fatty acids are of special nutraceutical and pharmaceutical importance since n-3 and n-6 FAs cannot be synthesized by humans, and are related to the prevention of neurological, inflammatory, cancerous diseases, and more.² Among fatty acids solvent-extraction based procedures, microwaves can be potentially used to reduce reaction times and simplify the experiment with safety.³ Continuing our research for alternative methodologies in organic chemistry⁴, the objective of this work was to determine the composition of fatty acids of three sub-Antarctic macro-algae and compare the efficiency of conventional and microwave-assisted extraction methods.

Results and Discussion

The studied algae were *Curdiea racovitzae*, *Georgiella confluens* and *Adenocystis utricularis*. Extraction of 1g of algal biomass followed the Bligh & Dyer conventional method with a reaction time of 30 min. at 25°C, whereas the microwave-assisted extraction was performed on a Discover Reactor for 5 min at 50 °C. The converted fatty acid methyl esters were analyzed by GC-FID. A total of 23 fatty acids were detected, of which 7 were saturated, 3 were monounsaturated and 8 were polyunsaturated. As it can be seen in **Table 1**, two out of three algae were constituted of more than 70% of PUFAs, the majority of that being of ω -3 and ω -6 for all samples,

which are considered essential fatty acids. Also, the ratio of ω -6/ ω -3 was lower than 5:1, as recommended.⁵ The fatty acid profile for both extraction methods was similar, in which the percentage of FAs extracted by microwave were very approximate or higher than the conventional technique. This shows that even though heating was used in the microwave, the fatty acids are not degraded or negatively affected by it, and yet the reaction time is considerably reduced.

Table 1. Percentage of fatty acids in the assessed macro-algae.

Algae	<i>Curdiea racovitzae</i>		<i>Georgiella confluens</i>		<i>Adenocystis utricularis</i>	
	Conv.	MW	Conv.	MW	Conv.	MW
C18:2n6	3,9	2,2	7,7	10,3	10,5	10,8
C18:3n6	0,9	2,1	-	-	0,9	0,9
C18:3n3	-	-	2,63	3,1	10,9	10,5
C20:2	1,2	1,2	2,4	2,8	16,6	16,4
C20:3n6	2,2	1,9	-	-	0,6	0,6
C20:4n6	12,5	11,4	1,4	3,7	8,3	8,0
C20:5n3	51,0	51,3	12,3	9,3	31,4	30,2
C22:2	1,2	1,2	-	-	1,8	1,7
Σ SFA	18,9	20,3	43,4	42,9	12,6	14,4
Σ MUFA	8,1	7,7	31,1	27,9	6,2	6,5
Σ PUFA	72,9	71,3	26,4	29,2	81,0	79,1

– not detected

Conclusions

It could be concluded that, as expected, the studied algae have a predominance of polyunsaturated fatty acids in their composition probably because of the low-temperatures influence of the region where they are found. Fortunately, these compounds are often associated with many health benefits. Also, the use of microwave-assisted extraction has shown to be a satisfactory method that can be used as a short-time alternative to other extraction procedures.

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