ISGC 2022

N°1497 / PC
TOPIC(s) : Alternative solvents

Switchable solvents in the extraction of linear diterpenes from macroalgae Bifurcaria bifurcata

AUTHORS

Samuel PATINHA / UNIVERSIDADE DE AVEIRO, CAMPUS UNIVERSITÁRIO SANTIAGO, AVEIRO
Armando J.D. SILVESTRE / UNIVERSIDADE DE AVEIRO, CAMPUS UNIVERSITÁRIO SANTIAGO, AVEIRO
Helena ABREU / ALGAPLUS, ÍLHAVO, AVEIRO
Silvia M. ROCHA / UNIVERSIDADE DE AVEIRO, CAMPUS UNIVERSITÁRIO SANTIAGO, AVEIRO
Sónia A. O. SANTOS / UNIVERSIDADE DE AVEIRO, CAMPUS UNIVERSITÁRIO SANTIAGO, AVEIRO

PURPOSE OF THE ABSTRACT

One of the challenges in the development of green and sustainable extraction methodologies is solvent recovery from the extracts and its subsequent reuse in the extraction step. In fact, the obtention of dried extracts usually require energy consumption for the subsequent reuse of extraction solvent (via distillation or evaporation). A promising alternative approach to the conventional extraction methods is the use of switchable hydrophilicity solvents (SHS) [1]. These solvents, mainly tertiary and secondary amines, can switch reversibly between a water miscible form and another that forms a biphasic system with water. SHS can be easily switched between the hydrophilic and hydrophobic forms in aqueous solutions for instance by adding or removing CO2 for a short period of time or by adding a specific reagent. This type of solvents open doors to a new approach to extract valuable compounds from complex biomass sources given that they can be used both for extraction and separation steps depending on the nature of the extracted compounds. Besides this, SHS can be easily reused, present low volatility and less amount of solvents is required in comparison to conventional extractions, embracing some points from the principles of green chemistry [2] towards more sustainable and greener extraction processes. SHS have been particularly exploited in the extraction of lipids from microalgae. However, there is a lack of studies exploiting these solvents in the extraction of bioactive components from narural sources. So far, SHS is not known to have been applied to macroalgae nor in the extraction of linear diterpenes from that source.

The lipophilic fraction of macroalgae has been recognized for having interesting bioactive compounds. Linear diterpenes (LD) are quite exclusive compounds found in a few brown macroalgae families, for instance in Sargassaceae, and notably in Bifurcaria bifurcata [3]. These compounds have been associated with anti-inflammatory, antiproliferative and antimicrobial properties making them very promising for nutraceutical or pharmaceutical applications.

In this work, SHS were used for the first time to extract valuable bioactive compounds from macroalgae. More specifically, linear diterpenes were successfully extracted from macroalgae B. bifurcata using a tertiary amine, N,N-Dimethylcyclohexylamine (DMCHA). Extracts were qualitatively and quantitatively analysed by gas chromatography-mass spectrometry (GC-MS) and compared with extracts obtained with conventional solvents.

This work was developed within the scope of the projects CICECO-Aveiro Institute of Materials (UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020) and LAQV-REQUIMTE (UIDB/50006/2020 and UIDP/50006/2020), financed by national funds through the FCT/MCTES; co-financing, when adequate, by FEDER under the PT2020 Partnership Agreement. Acknowledgements are also due to FCT/MCTES for the PhD grants to S.P. (SFRH/BD/148555/2019).

FIGURES

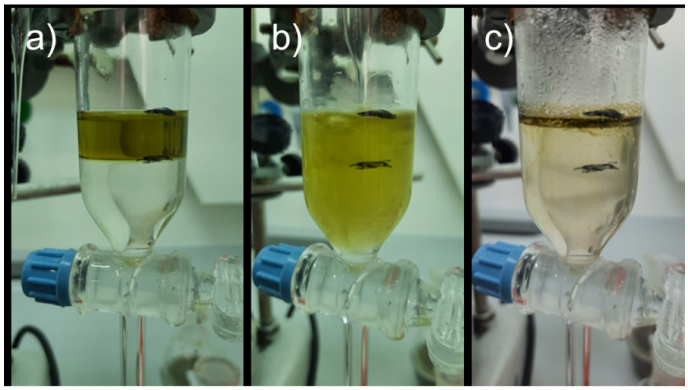

FIGURE 1

LD extraction from B. bifurcata using DMCHA

LD extraction from B. bifurcata using DMCHA. a) DMCHA/ water biphasic system (extract dissolved in DMCHA). b) Extract in the DMCHA+water monophasic system during CO2 bubbling. c) Lipid layer (top), DMCHA+water monophasic system (bottom).

FIGURE 2

KEYWORDS

Switchable hydrophilicity solvents (SHS) | Linear diterpenes | Bifurcaria bifurcata | Bioactive compounds extraction

BIBLIOGRAPHY

[1]. Jessop, P.G.; Phan, L.; Carrier, A.; Robinson, S.; Dürr, C.J.; Harjani, J.R. A solvent having switchable hydrophilicity. Green Chem. 2010, 12, 809-814.

[2]. Anastas, P.; Eghbali, N. Green Chemistry: Principles and Practice. Chem. Soc. Rev. 2010, 39, 301-312.

[3]. Pais, A.C.S.; Saraiva, J.A.; Rocha, S.M.; Silvestre, A.J.D.; Santos, S.A.O. Current research on the bioprospection of linear diterpenes from Bifurcaria bifurcata: From extraction methodologies to possible applications. Mar. Drugs 2019, 17.