Influence of moderate electric fields on the performance of agar's extraction from *Gracilaria sp.*

C.M.R. Rocha(1), G.S. Matos, R.F.S. Gonçalves, R.N. Pereira, J.A. Teixeira

CEB - Centre of Biological Engineering, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal.

(1) cmrochainv@gmail.com

Introduction

Seaweeds are important marine resources in Portugal, being mostly applied in the hydrocolloids industry or as food. Emerging applications include the production of high added-value bioactive compounds.

Seaweed polysaccharides are water-soluble biopolymers and have a linear backbone composed of sugar units conjugated to form complex structures. The –OH groups, predominant in the polymeric chains can establish intra- and intermolecular hydrogen bonds which are excellent functional tools for gel and/or film-formation.

Agar is extracted mainly from red seaweeds from Gelidiales and Gracilariales (in which group *Gracilaria sp.* are included). In the case of agar from *Gracilaria sp.*, normally with inferior commercial characteristics, the functional properties are usually enhanced by an alkali pre-treatment that modifies the L-galactose-6-sulphate units into 3,6-anhydro-α-L-galactose residues.

Traditional hot water extraction is a tedious process, requires high solvent and energy consumptions and generates large amounts of waste creating the need for greener and more efficient technologies. The main objective of this work is to evaluate the influence of different electric fields intensity in the performance of the agar's extraction from *Gracilaria sp*. in terms of yield, extraction time and extract's quality.

Experimental

Seaweeds were purchased from AlgaPlus (Ílhavo, Portugal). Physicochemical characterization of the dried seaweeds and final extracts included proximate analyses (moisture, proteins, lipids, total sugars, fibres, total phenolics and ashes content), monosaccharides' profile (through HPLC), and trace elements (minerals and metals, through IPC), sulphate content, gel strength and thermal behaviour (gelling and melting temperatures through rheological measurements). Different extractions were made at 85 °C for 2 h, with controlled conductivity, and different electric fields intensity (starting from 0, for comparison purposes). The mixtures were filtered with a filter cloth and agar was recovered by a freeze-thawing process. Finally agar was washed, dehydrated with ethanol 96 % and dried at 60 °C overnight. Statistical analysis was made using the data analysis software Statistica version 10.0 (StatSoft, Inc, Tulsa, OK, USA).

Results and Discussion

Overall, electric fields do not appear to have a significant effect in agar's extraction yield, composition, gel strength and gelling temperature. However, the melting temperature in one set of samples was significantly higher with the presence of electric fields. Furthermore, these samples were highly viscous at high temperatures and very difficult to flow (similar to the starch or globular protein behaviour). This behaviour could come either from a chemical reaction promoted by the electric field (the use of high frequencies could help preventing this) or by components other than agar present in the extract (e.g. protein).

Conclusions -

Electric fields can be used as an alternative source of energy for heating in the agar's extraction process without impairing yield and agar's main functional properties, in the tested operational range. However, the use of high frequencies and a deeper analysis of other extracts components should be considered in further studies. Nevertheless, as electric fields heating is energetically more efficient than traditional heating, this can represent major savings and reduced environmental impact for the extraction process.