# Characterization and valorization of polysaccharides from microalgae

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## Introduction

Microalgae are unicellular autotrophic organisms that are cultivated and exploited to produce biofuel from lipids. Currently, two main problems are encountered: the high production cost and the low yield. To make the process profitable and to solve the first problem, it is necessary to exploit the non-energetic part of the microalgae and more particularly the polysaccharide fraction. The project thereby aims to produce, characterize and valorize these polysaccharides. The selected microalgae is *Spirulina Platensis*, a cyanobacterium belonging to the prokaryotic blue algae [1]

*Figure 1 : microalgae cultures*

Polysaccharide extraction from the spirulina biomass is currently being optimized. As a model polysaccharide, Alginate, a commercial polysaccharide (100000g/mol) extracted from macroalgae, has been selected for the present studies.

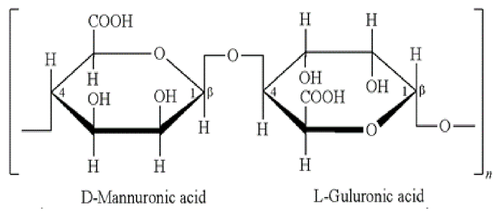


*Figure 2 : structure of alginate*

## Goals of the project and first results

### Production of oligosaccharides and polysaccharides

#### Oligosaccharides

They can be produced by organic synthesis or degradation of naturally occuring polysaccharides.
However, the synthesis of oligosaccharides is more complex than other polymers due to the numerous combinations, the anomericity and the configuration of the carbohydrates.
Since the past decades, differents producing methods of oligosaccharides by depolymerization have thereby been investigated [2],[3] such as chemical, physical or enzymatic degradation.
Green chemistry methods, particularly microwave treatments appear to be promising [4]

Experiment

Hydrolysis of alginate by microwave treatment at different pH, temperatures and reaction times. The best results are obtained for microwave treatment at 150°C at pH 5

#### Polysaccharides

Optimisation of the conventional method by using a physical method : ultrasound-assisted extraction in water.

### Valorization of oligosaccharides and polysaccharides

#### Oligosaccharides

Study of biologicals properties of oligosaccharides, particularly for biostimulation of plants [6]

#### Polysaccharides

Hydrogels formation by photopolymerization using stereolithography technology (3D printing) with different pourcentage of additives to enhance mechanicals properties of hydrogels [7]

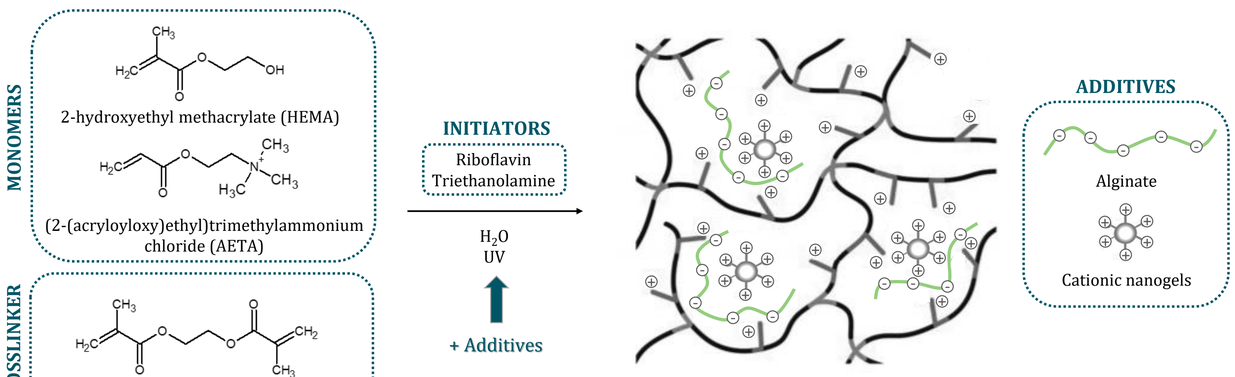


*Figure 6 : Hydrogel formation by photopolymerization*

### Characterization of oligosaccharides

#### Viscosimetric method

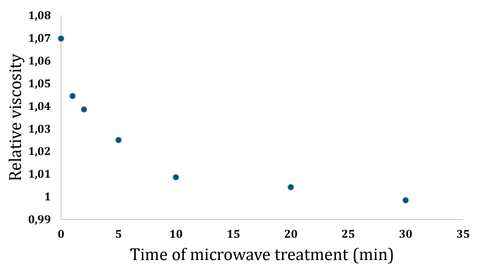


*Figure 3 : Evolution of viscosity over time after microwave treatment at 150°C*

The viscosity of each solution is measured by a capillary viscometer

We observe a decrease of the viscosity over time, which demonstrates that smaller molecules are present

#### Colorimetric method

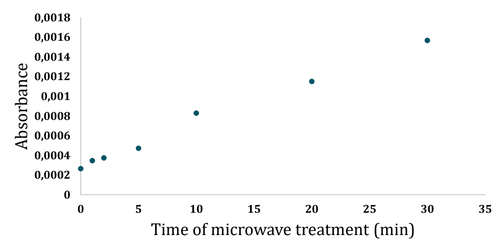


*Figure 4 : Evolution of absorbance over time after microwave treatment at 150°C*

Dosage of the reducing-end of saccharides by reaction with the Nelson reagent to form molybdenum blue, which presents a high absorbance at 595 nm [5]
We observe an increase of the absorbance over time, which confirms the hydrolysis efficiency.

#### Structural analyses : mass spectrometry

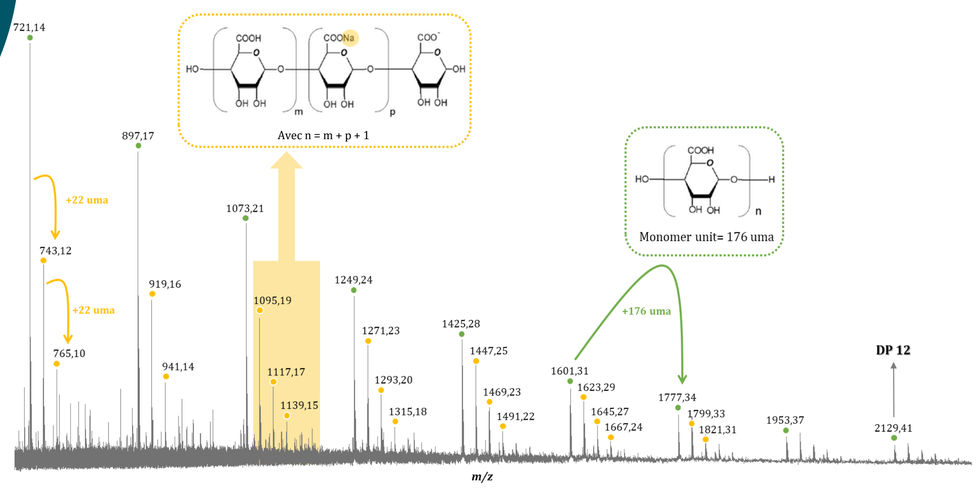


*Figure 5* : ESI-MS *of alginate treated at 150°C during 1 minutes*

#### ESI-MS : Electrospray ionization mass spectrometry

In negative mode from methanol

#### MALDI-MS : Matrix assisted laser desorption/ionization mass spectrometry

In positive mode with DHB/DMA as matrix
In negative mode with harmane as matrix

## Conclusion and outlook

Currently, we produced oligosaccharides by microwave treatment at 150°C in 1 minute from alginate in water. This method seems really promizing because no chemical reagents are required. The hydrolysis reaction is achieved in short reaction time. The hydrolysates are characterized by common methods, such as viscosimetry and reducing sugar analysis. ESI-MS measurements are clearly adding a great analytical values, when determining the composition and the structures of the oligosaccharide mixtures. GPC measurements are also in progress to have an information on the yield of oligosaccharides produced.
Those preliminary results pave the way to our further investigations that intend to prepare tailor-made oligosaccharidic mixtures starting from algae-derived polysaccharides for which no enzyme is to date identified for the production of oligosaccharides.

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