



UMEÅ UNIVERSITET

GUARDIANS OF GREEN GOLD

**Exploring microalgal cell walls and their
significance in industrial processing**

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Akademisk avhandling

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Guardians of Green Gold: Exploring microalgal cell walls and their significance in industrial processing.

Abstract

Microalgae are a remarkable source of high-value compounds. They can rapidly and efficiently produce proteins, lipids, antioxidants, omega-3s, pigments and many other compounds that are of great interest to pharmaceutical, cosmetic, food, feed, and fuel industries. Their fast growth rate, lack of need for fertile land, and their ability to capture carbon more efficiently than higher plants, further highlights their immense potential.

However, microalgal cells are surrounded by a thick and robust cell wall that hampers the extraction of compounds of interest. Furthermore, the interaction of the cell wall with its environment greatly impacts algal harvesting. Despite their significant role in downstream processing, there is a lack of knowledge about algal cell walls, and specifically about their structure and composition. This thesis aimed to address this knowledge gap by studying the cell walls of various Nordic microalgal strains and their involvement in harvesting (**paper II**), extraction (**paper I**), and nutrient removal processes (**paper IV**). This research aims to mitigate the monetary and energetic costs that are currently hindering the microalgal industry from reaching its full potential.

This thesis shows that cell walls vary not only with the algal strain (**paper I**) but also with growth phases (**paper I**) and growth conditions (**paper III**). The plasticity of the cell wall means that its composition cannot be defined per se. However, this thesis describes methodologies and techniques that can be used for cell wall characterization and visualization for future researchers that would like to investigate the cell walls of their own algal strains under varying conditions. Characterization techniques used in this thesis include Fourier Transform Infrared Spectroscopy (FTIR), Cryogenic-X-ray photoelectron spectroscopy (Cryo-XPS), Transmission electron microscopy (TEM), Scanning electron microscopy (SEM) and Gas Chromatography- Mass spectrometry (GC-MS).

Keywords

Microalgae, cell wall, algal harvesting, compound extraction, cell wall composition, biotechnology, biochemistry

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