LeadENG project: Secondary Metabolites extraction and characterization from the halophyte Salicornia sp.

Supervisors:

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Background

One of the most important challenges of the 21st century is to meet the world's demand for sustainably produced biomass for both food and the growing bio-products sector. Increased use of fresh water for agriculture and loss of farmland due to salinity are related concerns. The most common halophyte "*Salicornia*" is grown commercially in the EU for its fresh tips. It is a halophyte plant and can grow on saline lands without requiring freshwater for irrigation.

The woody residue part of Salicornia has been investigated as a source of pharma- and nutraceutical products due to its high content of phytochemicals e.g. hydroxycinnamic acids (HCA), phenolic acids, flavonoids, and other bioactive secondary metabolites. To help increase *Salicornia* farming there is a wish to valorize these residues via biochemical and bioenergy production.

Salicornia extracts showed promising properties such as high antioxidant capacity, health benefits (in humans treated with *Salicornia* cream), and enhanced immune functions (in fish and shrimps feed with plant extracts). The extracts have also shown a strong antibacterial effect and even an efficient anticorrosion effect.

Today, there is a great gap in the mass balance when characterizing the plant extracts, showing that we can only identify a small fraction of the compounds present in the extracts. Literature on detailed chemical characterization of halophyte secondary metabolites is very sparse. A fundamental compound identification is needed using more complex analytical methods such as NMR and HPLC-MS. The extraction methods needs to be optimized and the optimized extracts examined for their bioactivity.

In this LeadENG project, student groups from Biotechnology (4th Semester BSc) and Energy Technology (2th semester MSc) will team up to investigate the beneficial effects of Salicornia further. The student groups will meet across campuses 2-3 times during the project period. One meeting will take place in Esbjerg, one in Aalborg, if the Faculty covers the travel costs. Eventual additional meetings can be held online.

Project Description for 4th Semester BSc Biotechnology (Main supervisor: Reinhard Wimmer):

In this project, we will extract different compounds from green biomass of Salicornia and test them for bioactivity. We will identify already known compounds by HPLC-MS and then purify 1-2 still unknown compounds. The compounds will be characterized by different analytical techniques and their structure will be determined by NMR spectroscopy. Their antimicrobial activity will be investigated using real-time microscopy.

There is a possibility for two different student groups – working on different *Salicornia* extracts.

Project Description for 2nd Semester MSc Energy Technology (Main supervisor: Mette Hedegaard Thomsen):

In this project, the students will look at optimization of the extraction and purification process for target compounds identified by the Biotechnology group. Preliminary data has shown significant amount of e.g. betaine in the green biomass of Salicornia sp. Betaine is a potential nutraceutical for humans and animals, which has been shown to improve digestion, build muscle mass, and decrease fat deposits. The project will include optimizing key biorefinery processes in the lab, and also use Super Pro Modelling to determine the best process set-up including utilization of the fiber part of the plant for e.g. biofuels.

Synergy

If time permits, Biotechnology students will measure the content of a few key metabolites in the extracts provided by the Energy Technology students to evaluate extraction methods.