

“Extraction and purification of protein, lipids and hemicellulose sugars from green halophytes”



Extract obtained from the extraction of *Salicornia ramosissima* by cold water (#1) and the 3 cycles of subcritical water at pilot scale (#2, #3, #4)

"Stéphane Kohnen, within this four-year project, the CELABOR team is working on the topic "Extraction and purification of proteins, lipids and hemicellulose sugars from green halophytes". What is your main task within this topic?"

The main task of CELABOR in AQUACOMBINE project is to find an innovative protocol to obtain extracts concentrated in valuable compounds (mainly hydrocinnamic acids and flavonoids) from halophyte plants. The work mainly focused on lignified biomass but some trials on succulent biomass. This work could be split in 4 different tasks:

- The development of extraction processes considering the ecological and economic impacts of the processes, notably using subcritical water (hot and pressurized water)
- The development of the process of concentration of the produced extracts to obtain more efficient extracts for the targeted application
- The first scaling up stage of those processes to be able to treat a few kilograms of biomass.
- The characterisation of the extracts, mainly the quantification of the targeted secondary metabolites.



Subcritical water extraction pilot plant at the CELABOR facility





"What added value do you expect from the project?"

From CELABOR point of view, AQUACOMBINE project is a great challenge and a good opportunity to broaden our knowledge on secondary metabolites from a category of crops that we are not used to work with.

"The project has been running since October 2019 and will be completed by the end of September 2023. Which results have surprised you the most so far?"

The result that surprised me the most so far is probably the huge number of molecules identified as phenolic acids, polyphenols or flavonoids present in our extracts. In the beginning of the project, the idea was only to focus on about ten molecules called hydrocinammic acids, but our investigations showed that our extracts contain more than one hundred molecules that potentially should have valuable activities (antioxidant, anti-inflammatory, antimicrobial, anti-ageing...) for the applications in food/feed/cosmetics sectors. But every rose has its thorn: that great diversity of molecules makes the identification and the purification work more complex.

"AQUACOMBINE takes a circular approach to utilising all fractions of the halophyte plans. Why is this topic so important from your point of view and from CELABOR's point of view?"

CELABOR is involved in many national and European research projects dealing with the valorisation of biomasses: crops, side-streams from food industry or forest exploitation, algae, microorganisms, etc. We are convinced that those biomasses are parts of the solution to the major problems of our society concerning alternative resources for fuel, packaging, food, materials, etc. That is also the philosophy of the AQUACOMBINE project, and it is the reason why we directly wanted to be in its consortium. The idea of AQUACOMBINE is to use salt spoiled lands or salt marshes to grow halophytes that will produce specific molecules to fight salt stress. Those valuable compounds once extracted can be used as sustainable ingredients for the targeted application. Moreover, AQUACOMBINE is clearly engaged in the circular economy with two different loops: the loop dealing with water consumption and valorisation through aquaculture and the loop of the full valorisation of the plants after the extraction of valuable compounds.

"If you could wish for something for the project, what would that be and why would that be your wish?"

I wish the AQUACOMBINE project will be a demonstration step that could convince European Commission and large companies to invest in the solutions proposed by our project. The next step could be a flagship project with industrial investments to reach market and society to make our expectations on circular bioeconomy a reality.



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Stéphane KOHNEN holds a PhD in chemistry from Liège University with expertise in the study of natural antioxidant compounds, their in-vitro activities, and their influence on the oxidative stress processes from a biochemical point of view. Since joining CELABOR in 2008, Dr. KOHNEN has focused his activity on the extraction processes of high value-added molecules from sustainable biomass and, more precisely, on the environmentally friendly and innovative processes giving priority to a significant reduction in organic solvents use and energy consumption (subcritical water, supercritical CO₂, microwave, or ultrasound assisted processes). He has also developed skills in the pre- and post-treatment (hydrolysis, drying, fractionation) and in the characterization of the extracts (mainly GC analyses). He has been involved in various projects that have focused on biomass valorization, including the H2020 project AQUACOMBINE offering innovative solutions for the use and the valorization of halophyte plants in aquaponics.

“The work of Stéphane in AQUACOMBINE consortium will stop at the end of the year 2022. Starting from next January, Job TCHOUMTCHOUA will be in charge of AQUACOMBINE project for CELABOR.



Job works at Celabor since July 2018. He obtained his PhD in Pharmacognosy and Natural Products Chemistry at the School of Pharmacy of the University of Athens in 2016. After his PhD, he worked as postdoctoral researcher at two universities in France, The University of Reims Champagne Ardenne and The University of Picardy Jules Verne successively. These experiences enable him to enhance and deepen his know-how in the methods development for the analysis of complex matrices and the dereplication of secondary metabolites from diverse origins using LC-MS and NMR. At Celabor, he already managed several national and European projects including one BBI-H2020 as WP leader with a focus on the development of green extraction methods for the recovery of high added-values ingredients and the chemical characterization.”



Celabor is a Belgian scientific and technical center based in the Petit-Rechain industrial park near Verviers. Celabor is an SME offering scientific and technical support to companies in the field of agri-food (nutrition and extraction), packaging, environment, and textiles.

Celabor have 20 years of research experiences and has been involved in several EU and national projects and is eager to maintain its position at the cutting edge of scientific knowledge.

The “Food Technologies – Extraction” department of Celabor is equipped with a technological platform unique in Wallonia boasting an ExPROOF zone, a test hall constituted of pilot extraction equipment, a high performing laboratory, and an experienced multi-disciplinary team. This team is working on the development of extraction, fractionation, and purification processes with a “green” orientation (subcritical water and supercritical CO₂), the preparation



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of natural plant ingredients (polysaccharides, lipids and fatty acids, carotenoids, polyphenols, alkaloids, etc.) for the food supplements, cosmetics and phytotherapy markets. One of the major activities of the “Extraction” department is focused on the biomass valorization processes and recovery of primary and secondary metabolite from co-product and industrial agro-waste.



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