

From waste to resource: sustainable protocols to develop health and cosmetic products from hops leave

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INTRODUCTION

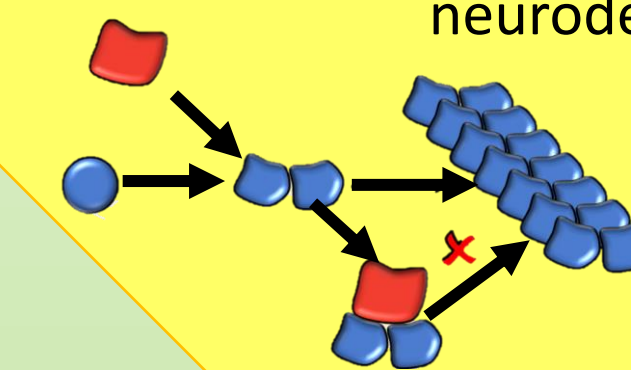
The potential of the hop plant has been considered wide from ages, but research and an extensive experimental work is required to test its efficiency, and to properly deliver its components.

The main idea of this project is to exploit the bioactive compounds extracted from the waste of the hop plant: the leaves, which are not used for commercial aims and are often burned after the harvest.

It is hence crucial to understand how to optimize the extraction of bioactive compounds and to make possible their use in different kind of products.



Contains compounds able to interfere with the amyloid fibrillation process, the cause of the most important neurodegenerative diseases.



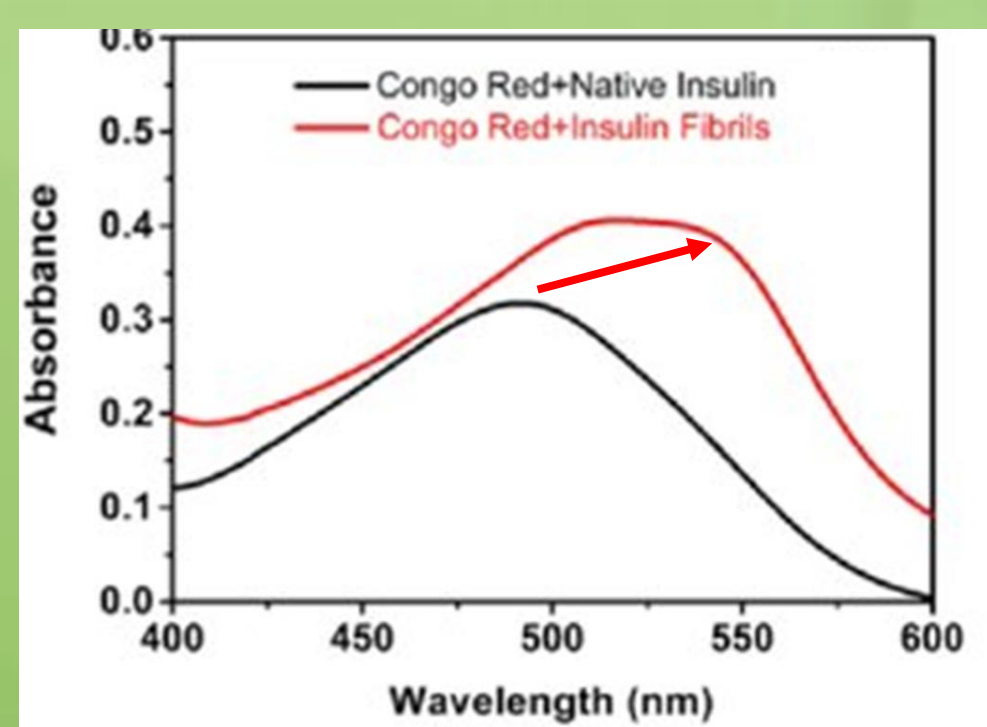
Contains several principles that have been shown to have antibacterial and antiviral properties



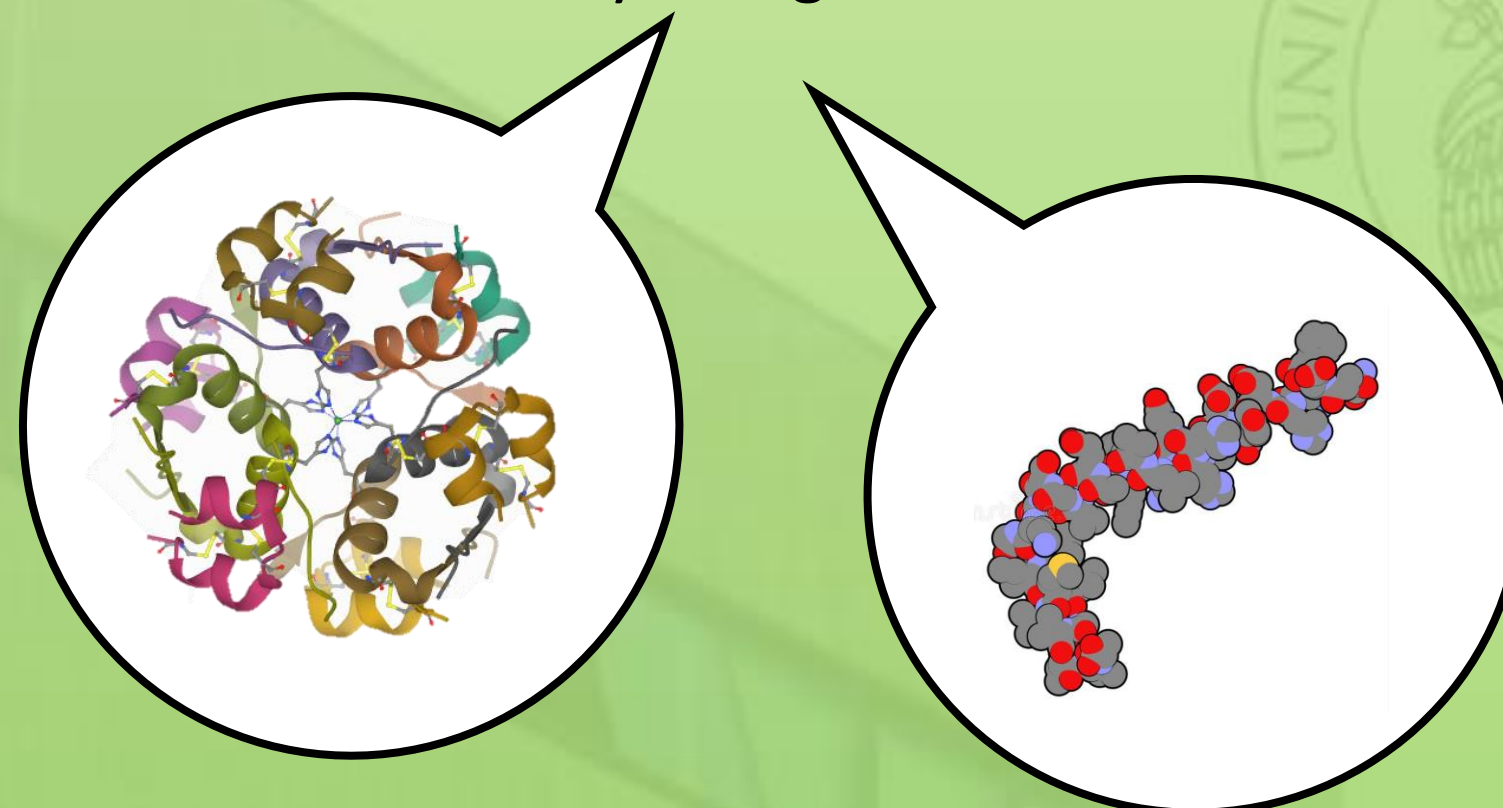
The aim is to evaluate the biological activity of the functional groups present in hops: evaluate the antioxidant properties, the antimicrobial capacities, and the influence on amyloid aggregation.

MATERIALS AND METHODS

UV-Visible absorption spectrophotometry, using Congo Red as a probe, monitors the formation of β -structures¹, characteristic of amyloid fibers, in presence of hop extracts and of single hop compounds.

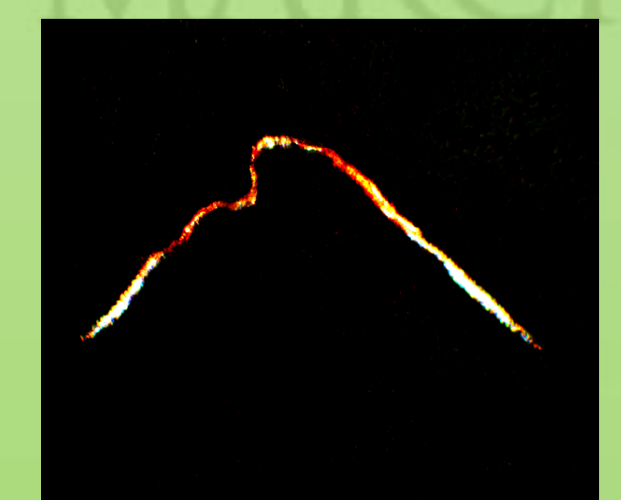


The first proteins proposed for this investigation are **human insulin** and **amyloid beta peptide**: both of them are related to amyloidogenic diseases.



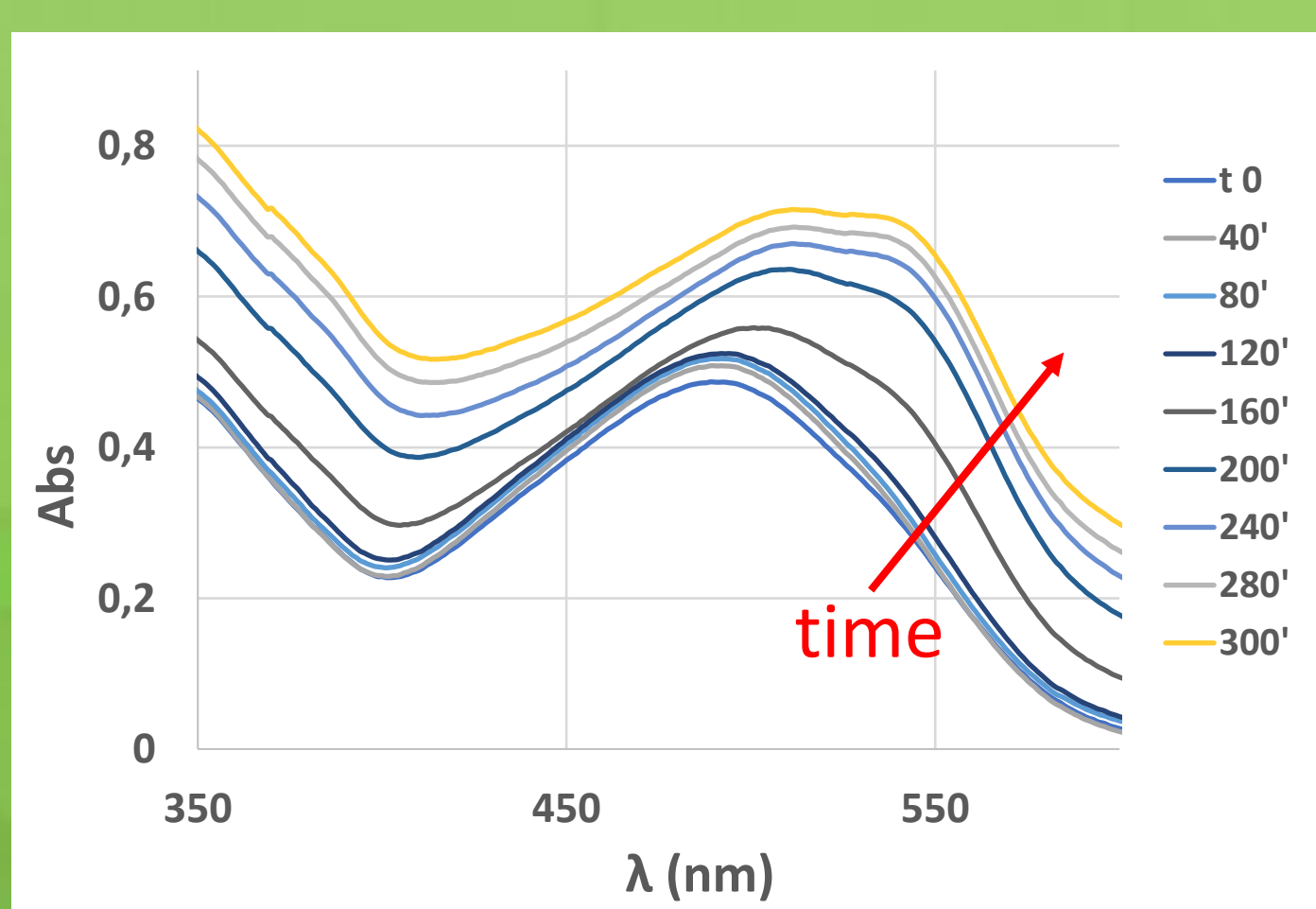
The **microcolony counting system** on Petri will evaluate the antimicrobial activity of hop leaves extracts against the most common food pathogens such as Salmonella, Listeria monocytogenes, Escherichia coli and others.

Further experiments will be performed: **Dynamic Light Scattering (DLS)**, **Small Angle X-ray scattering (SAXS)**², and **Atomic Force Microscopy (AFM)** techniques will help us to verify the size and structural morphology of protein aggregates.



FIRST RESULTS

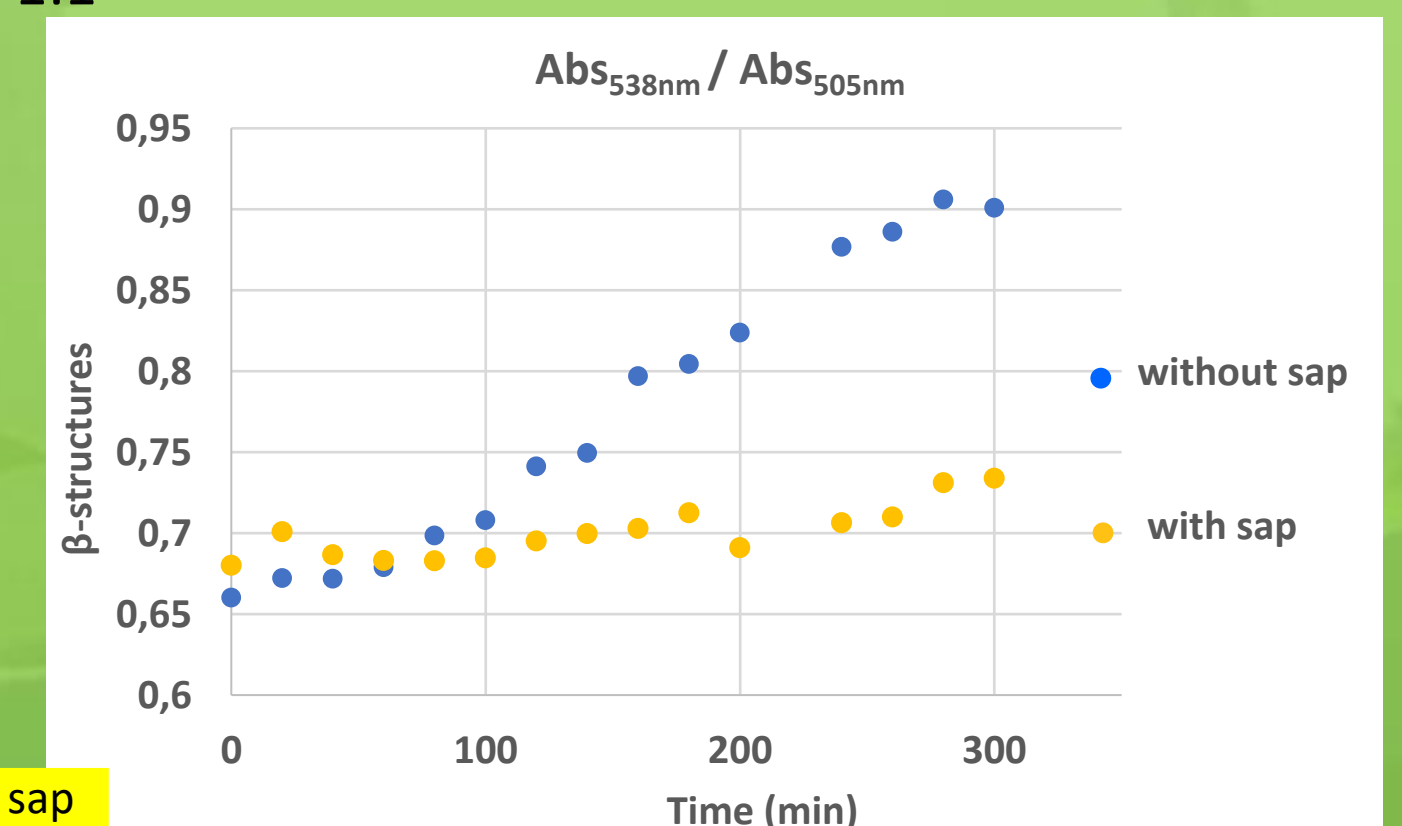
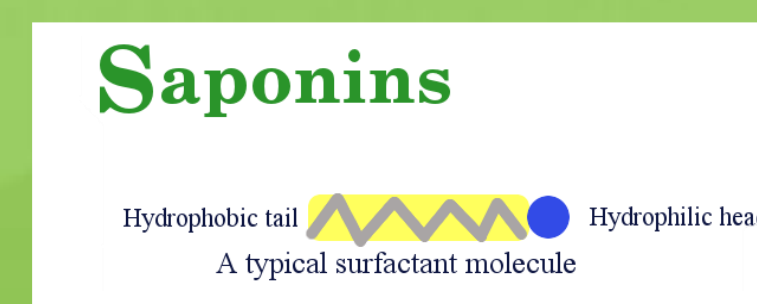
Congo Red is a dye used in microscopy for amyloidosis staining. It binds to the beta structures producing a shift of the absorbance peak in the measurements to the spectrophotometer.



Absorption Spectroscopy curves obtained for human insulin in phosphate buffer 50mM, pH 7,4 at 37°C, and at gentle agitation.

Insulin fibrillation tests have recently begun after adding saponins, contained in hop leaf extracts, to test their anti-amyloid efficacy.

Data obtained for human insulin in phosphate buffer 50 mM, pH 7,4 at 37° C in agitation, molar ratio insulin-saponins 1:1



Data show the influence of saponins on fibrillation, blocking or reducing the final formation of amyloid aggregates.

PERSPECTIVE

The aim of this project is to vehiculate benefic compounds present in waste, hop leaves, into different kind of products.

The **antibacterial and antimicrobial properties** of hop extracts, obtained by different methods, will be obtained.

Further results concerning the extracts will arise from their use for **contrasting protein amyloidogenic aggregation**. Both extracts alone and extracts in drug delivery systems will be tested on proteins in solution. These results will contribute to the development of pharmaceutical strategies against AD.

The biomass of hops can be a **precious resource for the pharmaceutical and nutraceutical industries**, for this reason it is good to investigate its potential, in order to also be able to propose a circular economy model.