

HALRIC Research Internship Programme

Internship Proposal

Project Title: Understanding Legumin-Legumin interactions with X-rays and Light Scattering

Name of Institution/Country: Lund University, Sweden

Name of internship provider: Davide Schirone, PostDoc

Contact details: davide.schirone@fkem1.lu.se

Proposed timeframe: 3-6 months (to be decided jointly with the candidate)

Application deadline: Open for applications from now until December 2025

Administrative contact person at the organisation: Maria Lovgren

Scientific research questions

Proteins are the most abundant biomacromolecules in living systems, functioning as natural smart materials. Structural proteins such as spider silk and butterfly wings exhibit remarkable mechanical properties that remain unmatched by synthetic alternatives. Despite advances in structural biology and recombinant protein production through microorganisms, replicating the self-assembly and functionality of natural protein-based materials remains a challenge. This limitation comes from an incomplete understanding of protein-protein interactions, particularly the short-range forces that drive quaternary structure formation. While polymer physics concepts such as phase behavior and Flory–Huggins theory provide useful frameworks, the role of hydrophobic and electrostatic interactions in protein self-assembly requires further elucidation.

This project focuses on Legumin, a storage protein ubiquitous in leguminous crops such as pea or lentils, which are an abundant and cost-effective source of plant-based food proteins. Legumin naturally assembles into a hexameric structure stabilized by a β -barrel motif. However, depending on pH, temperature, and salinity, it can also exist as trimeric or monomeric forms, suggesting a interesting variability of overall and specific attraction. Understanding the molecular mechanisms governing this equilibrium is key to developing legume-based biomaterials or more advanced food applications.

Experimental approach

The intern will systematically investigate the influence of physico-chemical factors (pH, temperature, and salt concentration) on Legumin's multimeric equilibrium, distinguishing the contributions of hydrophobic interactions and electrostatic forces. The project will employ a combination of biochemical and physical chemistry techniques, including chromatography, protein quantification assays, gel electrophoresis, and scattering methods (e.g., small angle X-ray and light scattering) to characterize protein-protein interactions.

Tasks of the intern

- Protein extraction from pea flour through well-established procedures;
- Protein reconstitution in different buffers via established protocols using Size Exclusion Chromatography;

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- Characterization of multimeric equilibria using automated parameter scans;
- Characterization of Legumin fractions with Small Angle X-rays and Light Scattering;
- Data Analysis.

General information about the work group, the university and the region

The intern will join a collaborative research group on biological soft matter at Lund University's Division of Physical Chemistry, led by Prof. F. Roosen-Runge. The group focuses on the structural and functional properties of biomacromolecules, employing advanced scattering techniques and biophysical characterization methods. The international team currently includes two PhD students and two PostDocs, promoting an interactive and supportive research environment.

Lund University is one of Scandinavia's leading research institutions, renowned for its strong interdisciplinary approach and international outlook. The Division of Physical Chemistry offers state-of-the-art facilities for biophysical research, and has a strong emphasis on research at large-scale infrastructures such as MAX IV and ESS.

Eligibility and qualification of the applicant.

Bachelor's or Master's students in Physics, Chemistry, Engineering, Food Science, or Materials Science. Interest in experimental research and physical chemistry is desirable.