Proposition de stage 2026-2027
Internship Proposal 2026-2027

Laboratoires d'accueil / *Host Institutions :*

- Institut Parisien de Chimie Moléculaire (IPCM, Sorbonne Université), Equipe Chimie des Polymères https://ipcm.fr/en/en-research/en-presentation-ecp-group/
- Laboratoire d'Archéologie Moléculaire et Structural (LAMS, Sorbonne Université) http://www.umr-lams.fr/

Lieu de stage / *Internship adress* :
Campus Pierre et Marie Curie, 4 place Jussieu 75005 PARIS – France

Equipe d'encadrement / *Internship supervisors :*
Nathan Ferrandin-Schoffel (IPCM), nathan.ferrandin-schoffel@sorbonne-universite.fr
Patrice Castignolles (IPCM), patrice.castignolles@sorbonne-universite.fr
Lucie Arberet (LAMS), lucie.arberet@sorbonne-universite.fr

Période de stage / *Internship period* : 6 months from January/February 2027
Gratification / *Stipend* : Statutory internship gratuity (approximately €680/month)

Profil du/de la candidat(e) / *Candidate profile :*
The ideal candidate will be enrolled in a Master 2 program (or equivalent, for instance last year of engineering school) in Analytical Chemistry, Molecular Chemistry, or Polymer Chemistry. Selection will be based on the following criteria:
- Familiarity with chromatographic techniques and NMR spectroscopy
- Proficiency in scientific English and good technical writing skills
- Familiarity with polymer structural characterization techniques
- Experience with biopolymers and a commitment to cultural heritage will be considered a plus

Depending on the motivation and skills of the selected candidate, an application for a doctoral fellowship may be submitted during the project, in order to extend it into research on the life cycle of tannins, following a more global approach. This is a particularly competitive process, and selected applications typically present an excellent academic record.

6. Procédure de candidature / Application process
Applications (CV, cover letter, and Master 1 transcript or equivalent) should be sent to Nathan Ferrandin-Schoffel, Lucie Arberet, and Patrice Castignolles.

Titre / *Title*

Extraction and chemical analysis of natural tannins

Projet scientifique du stage (1 à 2 pages) / *Internship scientific Project (1 to 2 pages)* :

1. Contexte de l'étude / *Background*

Tannins, polyphenols abundant in many plants, are attracting growing interest, both for their applications in dyeing and vegetable tanning and for the prospects of obtaining natural raw materials for the production of biobased materials. Tannins are derived from a wide variety of plant sources, such as gallnuts, tara pods, myrobalan fruits, tea leaves, certain barks, as well as the peels and seeds of many fruits. Their abundance in the plant world and in certain waste streams makes them a major challenge, both academic and industrial, yet one that remains largely unexplored within the framework of the materials life cycle: from the extraction of tannins to their depolymerization into phenolic monomers, up to their valorization for the synthesis of sustainable materials.
In this context, a scientific partnership has emerged at Sorbonne Université, bringing together two complementary areas of expertise and making it possible to gather, cross, and deepen the many sources of knowledge on tannins and the appropriate analytical chemistry techniques: biopolymers through the Polymer Chemistry Team (ECP) of the IPCM, and dye-related molecules through the LAMS.

2. Description du projet / *Description of the project*

This internship is part of a broader research effort on the life cycle of tannins (Figure 1), and follows on from recent studies conducted by the partnership on the analysis of commercially available tannin extracts. Building on this acquired knowledge, the project will focus here on the **extraction of tannins from plant-based raw materials**. The student will take part in the development of extraction protocols in line with the principles of green chemistry, to be adapted according to the various available sources and the nature of the tannins they contain (in particular hydrolysable and condensed tannins). **The raw materials and extracts will be characterized by various analytical techniques** available within the ECP and the LAMS (NMR, liquid chromatography, mass spectrometry, capillary electrophoresis), not only qualitatively but also quantitatively. Indeed, the determination of tannin compositions and molar masses depends on their solubility properties at the molecular scale, a gap in the literature where analyses are commonly performed on samples that are soluble at the macroscopic scale. This is why the project will also aim to deepen the knowledge of the **molecular solubility properties of tannins** (quantitative NMR).
The results obtained will fall within one of the key steps of the tannin life cycle, namely their extraction, and will open up new avenues for their valorization, both for the study of their depolymerization and for the synthesis of biobased materials.

3. Techniques ou méthodes utilisées / *Specific techniques or methods*

- NMR (Nuclear Magnetic Resonance)
- Liquid chromatography: HPLC-DAD, HPLC-MS
- MALDI-MS (Matrix Assisted Laser Desorption Ionization – Mass Spectrometry)
- CE (Capillary Electrophoresis)

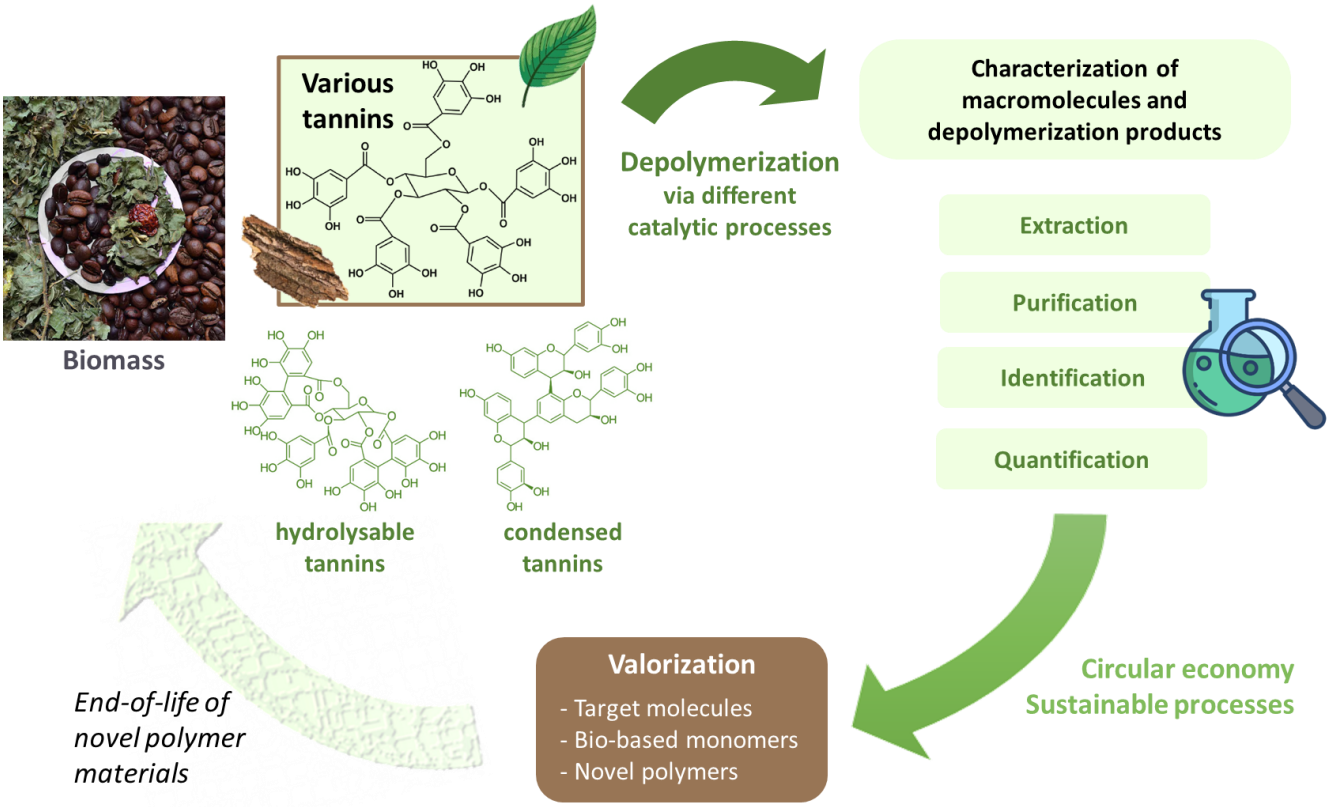

Figure 1. Illustration of tannin extraction, depolymerization, and characterization for their valorization

4. Références / *References*

Romani, A. et al. Analysis of condensed and hydrolysable tannins from commercial plant extracts. J. Pharm. Biomed. Anal. 41, 415–420 (2006).

Das, A. K., Islam, Md. N., Faruk, Md. O., Ashaduzzaman, Md. & Dungani, R. Review on tannins: Extraction processes, applications and possibilities. South Afr. J. Bot. 135, 58–70 (2020).

Ben Abda, E. et al. Bark tannins: Extraction methods, characterization, and reactivity. Ind. Crops Prod. 235, 121745 (2025).