

## CD – Anti-*Pseudomonas* dairy microbiome engineering

### 1. Project description

The United Nations Environment Programme (UNEP) estimates that 913 million tons of food were wasted in 2019, representing 17% of the total food available. The reasons for this massive loss of food are diverse, but in the food industry microbial spoilage, which affects the organoleptic quality of the product (appearance, texture, taste and aroma), plays a major role.

In the dairy sector, the application of low temperatures can extend the shelf life. However, these conditions can favor the growth of psychrotrophic opportunistic bacteria. These unwanted microorganisms can cause visible and invisible spoilage that significantly reduces the quality and shelf life of dairy products.

Among these spoilage micro-organisms, bacteria of the genus *Pseudomonas* cause the appearance of defects such as gelation, creaming and/or bitterness in certain dairy products. These phenomena result from the production of proteolytic and lipolytic enzymes with high resistance to heat treatment. The ability of certain strains of *Pseudomonas* to produce pigments that cause undesirable colouring of foods is also a source of spoilage in cheeses.

In this context, biopreservation appears to be a promising solution to reduce these undesirable effects. Biopreservation is a process based on the use of microorganisms (as protective cultures) and/or their metabolites to inhibit the growth or reduce the survival of unwanted microorganisms in food. This technology could be advantageously used to inhibit *Pseudomonas* in food and thus reduce the food waste associated with these spoilage microorganisms. However, preliminary work in the laboratory has shown that dairy products can be colonised by a wide variety of *Pseudomonas*. This diversity of target microorganisms complicates the approach to engineering biopreservation systems.

The objective of the project is to design an ecological engineering approach of biopreservation systems targeting *Pseudomonas* in dairy products. The project is organised in three tasks: (1) study of the diversity of *Pseudomonas* of dairy origin, (2) ecology of competitive interactions between *Pseudomonas* and microorganisms of the dairy microbiota, and (3) selection of microbial systems able to inhibit the growth of *Pseudomonas* in dairy products.

This project will use omics methods (genome analysis by genomics, analysis of microbial communities by metabarcoding), high-throughput phenotyping methods (monitoring of model ecosystems using automata), as well as the use of a micro-dairy for milk processing.

### 2. Profile of the PhD student

We are looking for a candidate with a strong background in microbiology and microbial ecology. Knowledge of dairy technology, biochemistry and molecular biology will be appreciated as well as skills in data analysis (statistics and R programming language). The ability to communicate in English, both orally and in writing, will be essential for the completion of the project. Knowledge and practice of the French language will be useful for everyday life in France. Above all, we are looking for a motivated and dynamic student who is willing to work in a team.

### 3. The position

The PhD contract will start on 1 October 2023 for 3 years with a gross salary of 2044.12€ per month (funding acquired). The work will take place at LIBio in collaboration with other research teams in Brazil and Italy (with possible travel to partner laboratories).

The PhD student will be supervised by:

- Anne-Marie Revol-Junelles: thesis director, expert on *Pseudomonas*,
- Marcia Leyva Salas: thesis co-director, proximity management and expert on *Pseudomonas* and dairy ecosystems,
- Frédéric Borges: team leader and referent for the analysis of data produced at high throughput.

The doctoral student will be part of a team of 10 members, providing close supervision. The many opportunities for formal and informal scientific exchanges will allow the student to develop his/her critical mind, to enrich his/her scientific approach as well as his/her project management skills. He/she will also have the opportunity to enhance his/her skills by participating in the realisation of the laboratory's projects, the team's policy being to encourage the association of collaborators as co-authors on publications as much as possible.

The doctoral student will have the opportunity to teach at ENSAIA or the Faculty of Sciences of the University of Lorraine.

He/she will participate in training courses offered by the doctoral school (SIReNA) and may also participate in internal training workshops at LIBio in data analysis, genomics and metabarcoding. Other training courses may be planned according to needs.

### 4. The laboratory

The Biomolecule Engineering Laboratory (LIBio) is a Research Unit (UR 4367) of the University of Lorraine, housed within the Ecole Nationale Supérieure d'Agronomie et des Industries Alimentaires (ENSAIA), in Vandœuvre-lès-Nancy.

The laboratory's management is based on an ISO 9001 certified Quality Management System. This certification serves the governance of the laboratory, in line with the scientific strategy, and enables the implementation of research projects to be optimised. The certification covers the areas of laboratory leadership and management, the design and implementation of research projects, the reception of students and doctoral candidates, and training through research.

The project of the LIBio is to meet the societal and economic challenges of (1) managing natural resources by using agro-resources for food and non-food purposes, and (2) improving human health by providing safe and functional foods.

LIBio is a recognised laboratory in the dairy sector. Reference laboratory of the CNIEL (Centre National Interprofessionnel de l'Industrie Laitière) since 1985, LIBio collaborates closely with many industrial dairy groups (Nestlé, Lactalis, Savencia, Ingredia, Union Laitière de la Meuse, Fromagerie de la Meix, Euroserum, Compagnie des Fromages et RichesMonts).

Its location within the ENSAIA and its thematic proximity with the educational program of the school allow for the implementation of cooperative actions between the laboratory and the school, particularly in

the form of student projects. These links with the school also ensure a strong anchorage in the socio-economic world thanks to the alumni network and exchanges with companies contributing to the training of engineers.

The ENSAIA is equipped with a technological hall including a micro-dairy and an experimental agronomic platform (La Bouzule). This farm produces milk and raw milk cheese marketed under the brand name "Fromage de Chèvre de la Bouzule". These facilities will be available for research activities in the framework of this thesis project.

## 5. Nancy, university town

LIBio is located in Vandoeuvre-lès-Nancy, in the immediate vicinity of Nancy city centre.

With nearly 50,000 students, Nancy, a city of 105,000 inhabitants (258,000 for the Greater Nancy area), is the 5th largest university city in France in terms of student population density.

Nancy is 1.5 hours from Paris and less than 1 hour from Strasbourg by TGV.

It is also a cross-border city near Luxembourg, Belgium and Germany. Nancy-Metz airport is located 20 minutes from the heart of the city and Luxembourg airport is 1 hour 50 minutes away.

Renowned for its Place Stanislas, a UNESCO World Heritage Site, Nancy is distinguished by its cultural infrastructure and its heritage of the Renaissance, the Age of Enlightenment and the "Ecole de Nancy" art movement that spread throughout Europe in the early 20th century.

The CROUS university residences ([www.crous-nancy-metz.fr](http://www.crous-nancy-metz.fr)) and shared accommodation are very popular with students.

The university offers a program of more than 70 activities, the SUAPS Brabois sports complex is located 10 minutes' walk from the laboratory.

## 6. Application

The application file must include the following documents:

- Resume,
- Letter of motivation,
- Grades obtained for the degree conferring the Master's degree and copy of the diploma if available,
- Two letters of recommendation from the Head of the training course and the tutor of the end-of-studies internship,
- Tangible elements on the initiation to research (research paper, publication, ...).

Applications should be sent by e-mail to:

Anne-Marie Revol-Junelles: [anne-marie.revol@univ-lorraine.fr](mailto:anne-marie.revol@univ-lorraine.fr)

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