



# METABIOLAC Industrial Research Chair in metabolic activity and the functionality of bioprotective lactic cultures

Duration: 2016 – 2021

## Highlights

- Market trends limit resorting to traditional microbiological barriers (e.g., chemical additives) to ensure food quality and safety.
- The discovery of new generations of natural and safer antimicrobials represent one of the most promising approaches.
- As part of this project, unique lactic acid bacterial strains with antibacterial and antifungal properties against pathogenic strains or spoilage strains in fermented dairy products were isolated and characterized.
- Two bioprotective and biocompatible lactic acid bacterial consortia that could be used to produce and conserve Cheddar cheese were developed.
- Natural ingredients with synergistic antimicrobial compounds produced by bioprotective lactic cultures were also developed.
- Technological processes were developed for the production and long-term stabilization of bioprotective cultures and functional ingredients.
- Capsules and hydrogels with antimicrobial activities for conserving fermented dairy products or cleaning work surfaces and equipment were developed.
- These results will constitute the first proof-of-concept of the application of natural bioactive compounds in food production and processing.

## Objectives

The general objective is to develop knowledge and expertise relating to the isolation, identification and characterization of lactic acid bacteria exhibiting antimicrobial activity with a high potential for use as a bioprotective agent. Our specific objectives in dairy sector are:

- To conduct *in vitro* and *in vivo* evaluations of the potential of new, natural antimicrobial-based products produced by lactic acid bacteria as an alternative to antibiotics in the prevention and treatment of sub-clinical and clinical mastitis in dairy cows.
- To develop an environmentally friendly approach based on the use of bioprotective lactic acid bacterial cultures or their metabolites for the positive modulation of microbial ecosystems in milk and dairy products and for controlling undesirable flora in these products. The impact of such an approach on the quality and safety of these products will be evaluated.

## Results and potential benefits

Protective cultures and metabolites demonstrating unique antibacterial and antifungal activity: Several bioprotective lactic acid bacterial strains were identified and selected for their antibacterial or antifungal activity against pathogenic flora and spoilage flora in fermented dairy products. Some of these strains demonstrated an ability to inhibit the growth of moulds frequently isolated in cheese (*Penicillium chrysogenum*) or a spoilage strain in dairy products such as *Clostridium tyrobutyricum*, which is responsible for the butyric swelling of cheese. Six strains of *Lactobacillus reuteri* that produce reuterin, a broad-spectrum aldehyde that can inhibit the growth of moulds in yogourt, were isolated. The purified reuterin obtained demonstrated strong fungicidal activity as well as antibacterial activity against pathogenic strains resistant to some antibiotics. In parallel, a fermentation and spray-drying process for the production of natural bioingredients, concentration and long-term stabilization of culture environments containing selected protective strains and their metabolites was developed.

Galenic food-grade forms for the protection and controlled release of bacterial cultures or their metabolites: Capsules for protecting protective cultures and metabolites with antibacterial and antifungal activity and gradually releasing them in food were developed and characterized. Their effectiveness as bioconserving agents was demonstrated in Cheddar cheese, grated Mozzarella cheese and stirred yogourt type models.

In the mid-term, this work will help improve the safety of dairy products through the use of natural products and will help reduce losses related with their downgrading.



## Professionals trained

Training of skilled workers in the field of milk and dairy product quality and safety.

**Laurent Dallaire** and **Léo Daviaud** completed their master's project as part of the chair. Additionally, a master's student and four PhD students are currently working on their research projects:

**Hélène Pilote-Fortin**, master student

**Liya Zhang**, doctoral student

**Hebatoallah Hassan**, doctoral student

**Samira Soltani**, doctoral student

**Sabrine Naïmi**, doctoral student

## For further information

- Presentation of the results at Novalait's Forum Techno and annual meeting as well as Agropur's annual scientific meeting.
- Presentation of posters at national and international conferences.
- Publishing of scientific articles in *Food Control*, *Frontiers in Chemistry*, *Frontiers in Microbiology* and *Probiotics and Antimicrobial Proteins*.
- Patenting.
- Development of a spin-off (Laboratoire Innodal) by a chair student for the production of large-scale bioprotective cultures.
- Tests aiming to scale up reuterin production were completed. The scaling up is scheduled for 2019.
- Signing of an agreement with a company to conduct research on the bioprotective activities of the *Carnobacterium divergens* M35 strain (approved by Health Canada as a new food additive) in fermented dairy products.
- Tests for scaling up four bioprotective cultures were completed by a ferment company.

## Financial contributions

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Industrial Partners are:

- Biena
- Cascades
- La Coop Fédérée
- Fumoir Grizzly
- Novalait
- Olymel
- Sani-Marc

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