Identifying bioprotective cultures that extend the shelf life of dairy products

Duration: 2019–2021

Highlights

- The shelf life of dairy products such as pasteurized milk, yogurt and grated cheese is limited because undesirable microorganisms eventually develop and create unpleasant odours and tastes.
- In North America, 20% of dairy products are lost or wasted, mostly by consumers at the household level.
- A promising strategy to stop the development of food-altering microorganisms is to control their growth using bioprotective cultures. Bioprotective cultures extend the shelf life of foods by producing natural antimicrobial compounds that slow the growth of undesirable microorganisms.
- The effectiveness of bioprotective cultures depends on the exchanges between microorganisms. This project will characterize the interactions between bioprotective cultures and alteration microorganisms by developing new, systematic methods on a large scale.
- This biopreservation strategy aims to develop mixes of bioprotective cultures for specific dairy products to extend their shelf life and help reduce food waste.
- The development of a consortium requires a prior understanding of the compatibility of strains since the properties of the mix are not equal to the sum of its individual parts. This phenomenon can be explained by the microbial interactions that take place within the dairy matrix and modify the behaviour of strains.

Objectives

The main objective of this project is to characterize the interactions between bioprotective cultures and alteration microorganisms by developing new, systematic methods on a large scale.

More specifically, the objectives are to:

1) Develop high-throughput methods to screen microbial interactions in a solid culture media;
2) Map the interactions of reference strains and strains isolated from dairy products;
3) Develop a tool to select strain consortiums;
4) Validate the selection tool.

Results and potential benefits

Dairy farmers and processors must meet the quality standards required by consumers. These standards are very high when it comes to shelf life, particularly for yogurt and grated cheese. Unfortunately, dairy processors have no control over what happens to products once they arrive at the grocery store. The use of bioprotective cultures is a natural solution for processors to limit problems of this type by creating a complementary barrier without having to use chemical additives. Bioprotective strains can interact with starter cultures and the endogenous flora of the dairy matrix. To select compatible strains with optimal bioprotective activity, in vitro tests are necessary. This project therefore addresses the challenge of systematically developing new bioprotective consortiums at a low cost since developing bioprotective cultures with the current methods is expensive and labour-intensive. The high-throughput methods developed will make this process available to dairy processors. The project will also shed light on the behaviour of different lactic acid bacteria (LABs) in a community context. For example, we were able to measure the competitiveness or cooperation between these bacteria toward the endogenous microbiota of dairy products and other LABs. We observed that the social qualities of these bacteria vary from one strain to the next. For example, the strain *Lactococcus lactis cremoris* promotes the growth of endogenous isolates while reducing the growth rate of other LABs. Conversely, the strain *Lactobacillus pentosus* reduces the production of endogenous isolates to the benefit of LABs. In addition, our experimental design simulates the impact of an alteration of microbial diversity through the addition of a starter culture or bioprotective strain. Diversity, specifically uniformity in the proportions of different microorganisms, significantly influences the production and growth rate of the total community (including endogenous flora). This new understanding of the impact of different strains and the modulation of diversity on other microorganisms in the dairy environment may help optimize strategies for adding microbial cultures to feed.

Innovative aspect

- The methods developed within the high-throughput microbial interaction mapping platform can be used to characterize the performance of (new) strains in a community context and rapidly identify combinations demonstrating optimal technological or bioprotective activities (e.g. competitiveness, antifungal or anti-pseudomonas activity, etc).

Professional trained

One PhD student, **Amadou Ndiaye**, will begin in May 2019. He is developing an expertise in high throughput approaches, including mass data analysis. After graduating, he wanted to return to work in the food processing industry.

For further information

The research results will be able to be quickly transferred to the dairy industry through diverse means, including the STELA Colloquium, the Novalait Forum Techno and different scientific conferences. Results will also be shared with the METABIOLAC chair scientific committee. Other communications activities (articles and presentations) are planned for collaborating users.

Financial contributions

Special call for proposals in dairy production and processing (2016–2021):

- Natural Sciences and Engineering Research Council of Canada (NSERC)
- Quebec consortium for industrial bioprocess research and innovation (CRIBIQ)
- Novalait

Total budget: $186,311

Contact persons

Project supervisor:

Marie Filteau
Department of Food Sciences

Université Laval
2425 rue de l'Agriculture
Quebec City (QC) G1V 0A6

418 656-2131 ext. 404278
marie.filteau@fsaa.ulaval.ca

Contributor:

Ismail Fliss
Université Laval