Occurrence and impact of microbial biofilms on milk quality from farm to cheese vats

Duration: 2018-2023

Highlights

- Bacteria and biofilms are an inherent risk in cheesemaking that must be managed on a continuous basis. Biofilms, protective cultures that form on cells, can either be beneficial or harmful and can contain infectious bacteria. As a result, identifying and controlling the formation of biofilms is critical to ensuring and maintaining milk quality.
- The project's objective is to study milk biofilms, from the farm to dairy plants.
- The parameters to be studied include the origin, structure and composition of biofilms, and whether they are harmful or beneficial.
- Sixty dairy farms located in Quebec and Ontario, two industrial cheesemakers and two artisanal cheesemakers will be sampled to characterize the biofilms on a farm-to-plant continuum.
- The research team will use bioreactors to study the formation of milk biofilms.
- Microorganisms from the biofilms that form will be isolated and identified, and the microbial communities found in the farms and dairy plants will be compared.
- Bioprotective cultures will be characterized with the aim of preventing and eliminating the biofilms.
- The project will result in recommendations on managing milk quality and sanitizing equipment, in addition to increasing our understanding of the beneficial biofilms associated with quality dairy products.

Objectives

The project's main objective is to gain a deeper understanding of the milk biofilms present from the farm to dairy plants.

Specifically, the research hypotheses are as follows:

1) Studying the ecology of biofilms from the farm to dairy plants will help determine the origin of the microorganisms that they contain and assess their impact on milk contamination;
2) A more complete characterization of dairy biofilms will allow for the development of quality control strategies;
3) Lactic acid bacteria can inhibit or promote the production of dairy biofilms.

Results and potential benefits

The initial findings will make it possible to compare the microbial communities involved in the formation of biofilms on farms and in dairy plants and generate knowledge of the impact of management practices on the appearance of biofilms. To date, it has been observed that there is a microbial biomass that adheres to farming equipment stronger than industrial cheesemaking equipment. This biomass is a complex ecosystem made up not just of bacteria, but also yeasts and moulds. Recommendations on milk quality management and equipment sanitation practices will also be issued to farmers and cheesemakers. In addition, a study on beneficial biofilms, both at the artisanal and industrial scales, will allow the sector to better characterize the microbial communities associated with product quality, including cheeses. Potential benefits:

- **Economic**
  - Reduced losses of milk and cheese related to biofilm contamination.
  - Production of higher quality dairy products.
  - Increased productivity due to targeted cleaning strategies.
- **Environmental**
  - Reduced losses of milk and cheese related to biofilm contamination.
  - Reduced use of chemical disinfectants and increased use of natural antimicrobials.
- **Social**
  - Consistent, high-quality dairy products.
  - Reduced presence of pathogens in dairy products.

Innovative aspects

- Study of the farm-to-plant continuum.
- More complete characterization of dairy biofilms due to advanced culturomics and high-throughput sequencing techniques.
- Use of natural antimicrobials to prevent or eliminate dairy biofilms.

Professionals trained

- **Samuel Jean**, MSc in Food Science, Université Laval and Agriculture and Agri-Food Canada; Farm management practices and agri-food microbiology
- **Carine Diarra**, MSc in Food Science, Université Laval; Parameters dictating biofilm formation
- **Jacob Vanderkoov**, MSC in Food Science, University of Guelph; Biofilm microbiology
- **Nissa Niboucha**, PhD in Food Science, Université Laval; Microbiology of biofilms in dairy processing
- **Coralie Goetz**, Postdoctoral fellow, Université Laval
- **Laila Ben Said**, Postdoctoral fellow, Université Laval
- **Alexandre Jules Kennang Ouamba**, Postdoctoral fellow, Université Laval
- **Mérilie Gagnon**, Postdoctoral fellow and Coordinator, Université Laval
- **Caroline Chénard**, Research professional, Université de Montréal

For further information

A technological workshop on the study of biofilms was organized for members of the Op+lait research group on October 28, 2020. When the initial results are available for transfer to dairy farmers, a popular science article will be published in the journals *Le producteur de lait québécois* and *Milk Producer*. Scientific articles will also be published in peer-reviewed journals. Other communications activities (articles, presentations and workshop) have been completed and are planned for collaborating users, including Novalait, Lactanet, Dairy Farmers of Ontario, and more. A presentation will also be given at Novalait's Forum Techno.

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