



Bacteriocins: A natural approach to controlling thermotolerant bacteria in silage

Duration: 2021-2024

Highlights

- Sporulated thermotolerant bacteria in silage is one of the major problems the dairy industry faces. These bacteria can be found in fermented dairy products, causing major defects in taste and texture, and considerable economic losses.
- In this project, various natural ingredients derived from lactic bacteria bacteriocins will be developed, characterized, and tested for their effectiveness in controlling *Clostridium* bacteria in silage.
- Different *Clostridium* species have already been isolated and characterized from butyric silage on four farms in Quebec.
- Processes have been developed for the production and purification of reuterin, pediocin, bactofercin, and nisin, four antimicrobials produced by lactic bacteria. The inhibitory activity against *Clostridium* of these bacteriocins will be evaluated *in vitro* and in model silos.
- The proposed approach in this project will be a promising new strategy for controlling thermotolerant bacteria in silage and preventing the contamination of dairy products and their associated losses.

Objectives

- Isolate and characterize *Clostridium* strains from silage produced in Quebec.
- Produce and purify various lactic acid bacteria bacteriocins, namely, nisin A, nisin Z, pediocin, bactofercin and reuterin.
- Evaluate the *in vitro* inhibitory activity of different bacteriocins alone or in combination against different *Clostridium* isolates.
- Demonstrate the inhibitory activity of bacteriocin formulations against *Clostridium* and measure their impacts on silage quality and stability.

Results and potential benefits

This project will generate unique scientific data on the potential of natural antimicrobial compounds (bacteriocins) in controlling undesirable flora in silage. Such products meet a critical need of dairy farmers and processors, where controlling the microbiological quality of silage and forage milk has become a major issue because of thermotolerant bacteria. A unique collection of *Clostridium* isolates was collected from silage. The characterization of these strains will help to better understand their role in the alteration of Quebec-produced silage and fermented dairy products. Processes will be developed for the production and purification of various natural antimicrobials (reuterin, pediocin, and nisin). Their inhibitory activities against *Clostridium* isolates will be determined *in vitro* as well as in silage.

The development of these antimicrobial ingredients will control the thermotolerant bacteria in silage and thus reduce the economic losses associated with undesirable fermentations, which affect up to 12% of the silage produced. It would also improve the productivity of dairy cattle and provide better milk with a higher microbiological quality. Among other things, reducing the incidence of butyric sporulate bacteria would reduce the taste and texture defects caused by these bacteria and thus limit the economic losses resulting from them.



Innovative aspects

- The project takes an original approach based on the use of natural, high-value-added food-grade antimicrobial compounds.
- The antimicrobial activity of these compounds, alone or in synergistic combinations, against non-sporulated and sporulated thermophilic bacteria will be characterized and demonstrated *in vitro* under real conditions of silage production. Particular attention will be given to the *Clostridium* genus, with a focus on *C. tyrobutyricum*.
- The proposed approach to improving the nutritional quality of silage can also be applied in other stages of the milk and dairy production chain.

Professional trained

- **Liya Zhang** is currently a postdoctoral fellow for the project.
- A PhD student, **Vahideh Vahdatmanesh**, was recruited. She will begin her doctoral studies in the near future. A master's student will also be recruited for the various tests on silage.

Expertise developed (student concerned):

- Methods for the isolation and characterization of *Clostridium* isolates from silage (L. Zhang)
- Methods for the production and purification of natural compounds with anti-*Clostridium* activity (L. Zhang and Vahideh Vahdatmanesh)
- Silage tests (Vahideh Vahdatmanesh and master's student)

For further information

- Presentation of the results at the Forum Techno and at the Novalait annual meeting
- Poster sessions at national and international conferences
- Writing of scientific articles by team members

Financial contributions

- Novalait
- CRIBIQ
- NSERC Alliance

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