Development of antifungal ingredients leveraging antimicrobials from natural sources and an encapsulation process to maintain the quality of grated cheese

Duration: 2019-2022

Highlights

- Cheeses are an at-risk product with respect to contamination by undesirable moulds. To remedy this problem, natamycin is commonly used as an antifungal on the surface of whole and grated cheeses.
- However, consumers are increasingly concerned about the ingredients added to products, prompting companies to offer different alternatives that use natural antimicrobial extracts.
- It has been shown elsewhere in the world that a number of molecules from extracts of fruits, spices, plants, and algae have antifungal properties.
- Some Quebec algae extracts have antibacterial properties, but they are not documented.
- Several algae extracts have been produced (extracts of carrageenans, proteins, lectins, ethanolic extracts, terpenes) and their antifungal activity has been evaluated but no antifungal activity has been detected to date.
- Two arctic bacteria that show a broad spectrum of antifungal activity have also been isolated and the research team is attempting to identify the active antifungal molecule.
- Natural antifungal compounds of fruit and plant extracts have been selected and characterized and a formulation with synergistic extracts has been developed. Formulation stabilization studies are underway.

Objectives

The research hypothesis is that natural extracts (spices, fruits, algae, metabolites of arctic bacteria) contain antifungal compounds that can replace natamycin in grated cheese. To verify this hypothesis, the project has the following objectives:

- Prepare different natural extracts and test their antifungal activity;
- Purify and characterize antifungal molecules;
- Develop formulations containing synergistic compounds;
- Develop a method for stabilizing the formulations developed;
- Assess in situ the effectiveness of formulations to improve shelf life;
- Evaluate the sensory properties of coated cheeses;
- Assess the safety and toxicity of anti-fungal extracts derived from algae.

Results and potential benefits

The antifungal capacity of natural extracts (essential oils (EOs) and citrus extracts) against cheese-altering moulds has been determined and a formulation containing these synergistic extracts has been developed. Microfluidization of this formulation in the form of a nanoemulsion has been shown to be effective at ensuring its stability. The project will also reduce energy consumption and allow for the application of low-cost (physical) processes. The research team has also discovered two new antifungal molecules that are effective against a wide range of fungi. This may lead to the development of new products for the cheese industry.

The potential results and benefits of the project include the identification of a variety of new molecules from natural sources presenting antifungal properties in refined cheeses. Their effectiveness at inhibiting mould growth in grated cheese and extending its shelf life while maintaining its physicochemical and organoleptic quality may also be demonstrated.

Innovative aspects

- The characterization of natural extracts will explore several properties of spices, fruits, algae, and metabolites of arctic bacteria that have not been studied to date and may be of interest in food preservation.
- The use of encapsulation processes for natural bioactive compounds using a «clean label» approach is also an innovative approach to ensure the stability of the formulations developed and to optimize their bioactivity during processes and storage.

Professionals trained

- **Ghada Sassi**, Master's student in applied microbiology, INRS - Centre Armand-Frappier.
  - Expertise acquired: assessment of antimicrobial effectiveness; mastery of analytical processes and use of advanced technologies such as modelling, nanotechnology, encapsulation for the development of state-of-the-art technologies applied to food.
  - Professional interests: Research, design, and development of complex food formulations, elaboration of processes for the development of new technologies (etc.).
- **Adam Classen**, master's student, McGill University. Adam is responsible for co-culture experiments and is attempting to determine the molecular identity of new antifungal molecules.

For further information

Research results will be transferred to dairy industry partners at scientific meetings and communication activities such as the Novalait Forum Techno and the STELA Symposium. Results will also be presented at the annual conference of the Canadian Society of Microbiologists in 2021 and published in the following journals: *International Journal of Antimicrobial Agents*, *Int J. Food Microbiology*, *LWT Food Sc. Technol.* etc... These activities will be coordinated by the RITA Consortium management team.

Financial contributions

RITA Recherche Innovation Transformation Alimentaire: a consortium mandated by MAPAQ at McGill University in collaboration with CTAQ and MEI. Below is the total budget for the 13 activities of the RITA network.

Budget total : $2,765,828

Contact persons

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