



annual
report 

Novalait
Research Catalyst





Company Profile

A Strong Vision

Created by **Quebec dairy farmers** and **processors**, **Novalait** is accelerating the development of **scientific knowledge** and **skills** for the dairy industry of tomorrow.

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Conception and credit

Redaction: Novalait

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- Agropur coopérative laitière
- Centre de référence en agriculture et agroalimentaire du Québec
- Les Producteurs de lait du Québec
- Novalait
- Université Laval
- Julien Chamberland
- Sarah McPherson
- Elsa Vasseur

A unique business model

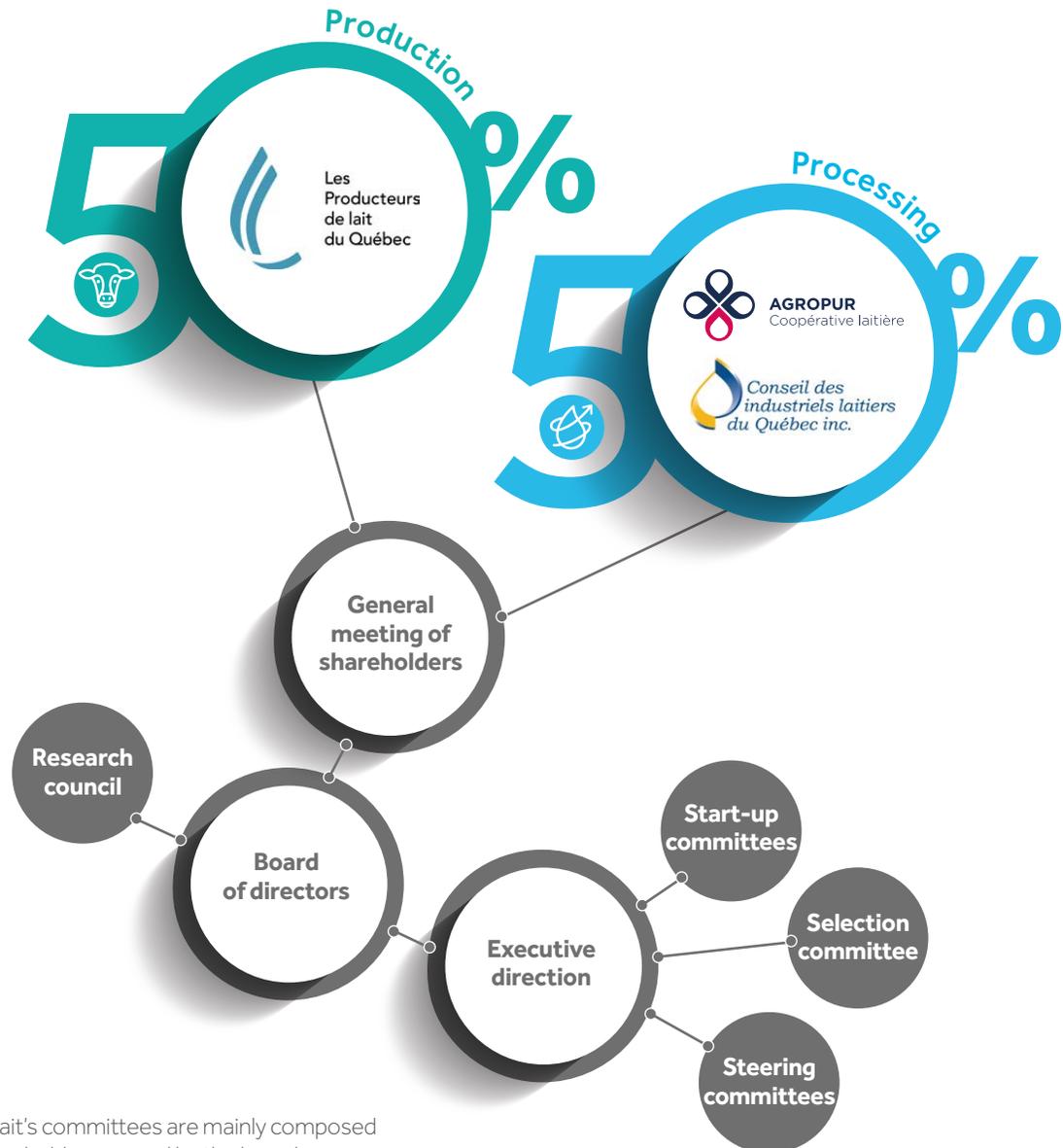
Novalait brings together all businesses that produce or process milk in Quebec – from small-scale cheese factories to family farms to multinational companies – making contributions to the research investment fund equivalent to €1.27/100 l of managed milk. They are represented within Novalait by three groups of shareholders. Les Producteurs de lait du Québec holds 50% of Novalait's shares. Agropur Cooperative, which represents dairy cooperatives, and the Conseil des industriels laitiers du Québec, which brings together private dairy processors, split the other half of Novalait's shares.

Calling upon the creativity and expertise of researchers from all disciplines and horizons, Novalait ensures that it meets its shareholders' research priorities. Novalait's committees evaluate the proposals received according to the potential for commercial opportunities and applications on farms and in plants. Novalait invests in the development and monitoring of the R&D projects selected. It collaborates with actors in the sector to valorize and transfer the research results. In everything it does, Novalait aims to optimize research benefits.

Novalait involves its shareholders in all of its activities, including:

- 
Establishing research priorities
- 
Selecting and monitoring projects
- 
Transferring research results

Shareholding and organizational structure



Novalait's committees are mainly composed of shareholders named by the board.

Board of directors 2018-2019

Novalait is governed by six experienced administrators who represent the three groups of Novalait shareholders.



President
Charles Langlois
Conseil des industriels
laitiers du Québec



Vice-president
Simon Robert
Agropur coopérative laitière



Administrator
Yvan Bastien
Les Producteurs de lait du Québec



Administrator
Michel Couture
Agropur coopérative laitière



Administrator
Geneviève Rainville
Les Producteurs de lait du Québec



Administrator
Dominique Mathieu
Conseil des industriels
laitiers du Québec

In fiscal year 2018-2019, Mr. Yvan Bastien replaced Mr. Alain Brassard in May 2019 as a director for Les Producteurs de lait du Québec.

Word from president

Novalait: A strategic asset for the dairy sector

In 2018–2019, actors in the dairy sector completed a strategic planning exercise. Research was identified as one of the best ways to tackle the dairy sector's future challenges. The strategy calls on Novalait to execute its action plan, and we take fulfilling our mission very seriously!

A new strategic plan for Novalait

At the same time as the dairy sector, Novalait completed its own strategic planning exercise. Novalait remains focused on its mission:

To ensure, through its leadership, knowledge and investments in research, the development and promotion of knowledge to stimulate innovation and foster the sustainable growth of Quebec's dairy industry.

In recent years, Novalait has increased its investments in research to reach its full operating capacity. Novalait demonstrated agility and creativity in generating a high leverage effect in a context of changing programs and government funding for research. Pursuing increased investments in Novalait's research will take sustainable, diversified funding, an issue that will be addressed as soon as the strategic plan is launched. It is now up to Quebec's dairy industry to set Novalait's next objectives.



Report from the executive director

Acknowledgements

To conclude, I would like to recognize the board of directors' commitment to Novalait's mission. Rigour guides our exchanges in a spirit of conviviality. I would like to thank Novalait's small yet dynamic team, exemplified by its mode of operating as a research catalyst.

Charles Langlois, President

Novalait increased its investments in research to reach its full operating capacity, and succeeded in generating a high leverage effect in a context of change. It is now up to Quebec's dairy industry to set Novalait's next objectives.

A vision for unprecedented investment

Thanks to payments resulting from the settlement of the dispute with the Canada Revenue Agency, Novalait has fully replenished its reserves. These funds serve as a guarantee of Novalait's commitments to R&D. Because Novalait maintained a development strategy despite the prevailing uncertainty and buttressed by an increased capacity for engagement, the board of directors authorized an unprecedented number of funding offers in 2018–2019. These research projects will be starting in the coming year once their financial arrangements have been finalized.

The key to a high leverage effect: renewing and diversifying partnerships

Novalait builds on its partnerships to generate the greatest amount of return possible on every dollar invested in research. In 2018–2019, Novalait renewed its collaboration with the Quebec consortium for industrial bioprocess research and innovation (CRIBIQ), resulting in the selection of five new projects.

The funding partner diversification strategy is beginning to come to fruition. With the signing of the Dairy Research Cluster agreements, Novalait has joined in on this major national initiative of the Dairy Farmers of Canada, in partnership with Lactanet. Within the framework of the cluster, Agriculture and Agri-Food Canada (AAFC) is once again contributing to funding research selected by Novalait, for the first time in more than five years. The agreement also brings AAFC scientists back into fold of actively searching for solutions for the dairy industry.

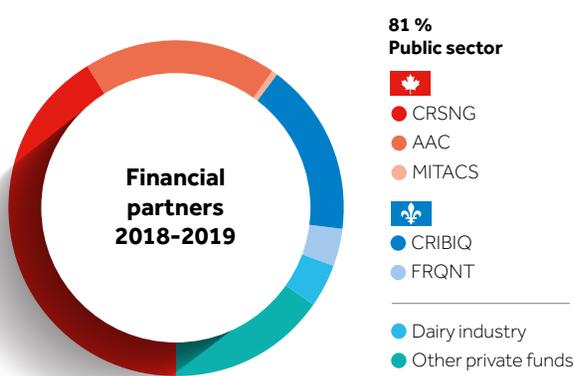
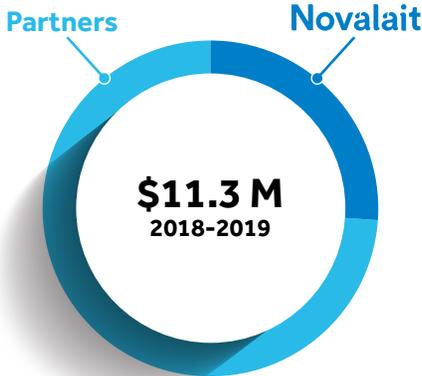
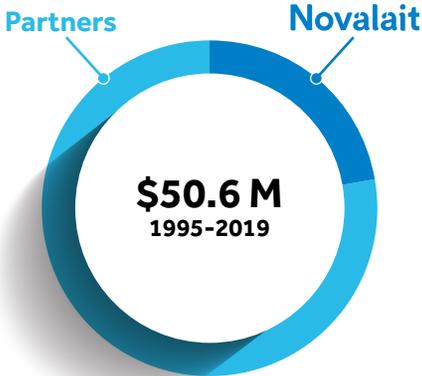
A small team in a large network

The annual reports highlight the incredible hive of activity behind Novalait's achievements. We would like to highlight the quality of the scientific teams that invent research protocols to generate solutions to the scientific challenges faced by the dairy industry. Novalait's projects all revolve around applied research, with many requiring dairy product samples or data collection at farms and plants. With the start of a number of new projects, Novalait has increased its requests to dairy companies to participate in research. Their answer is always an enthusiastic "yes!" In closing, the Novalait team relies on the expertise of its many committees to develop, select and guide research. It should be noted that these committees are mainly composed of industry representatives, all of whom are volunteers. Novalait could not fulfil its mission without them, and would like to express its deepest gratitude to them.

Élise Gosselin, CEO

Novalait would like to highlight the ingredients that are essential to its mission: an excellent network of researchers in search of solutions, actively involved dairy companies and the invaluable expertise of its committee members.

Novalait in numbers



R&D Overview 1995-2019

Since its creation in 1995, Novalait and its partners have invested \$50,6M in 126 research projects.

Portfolio 2018-2019

The current 18 projects and the three industrial research chairs in 2018-2019 totalized an investment of \$11,3M from Novalait and its partners.

Novalait's financial partners

Novalait maintains the performance of its leverage effect by renewing and diversifying its financing partnerships. In 2018-2019, two new partners, MITACS and Dairy Farmers of Ontario, contributed to Novalait's research. With the Dairy Research Cluster, Agriculture and Agri-Food Canada is making a remarkable comeback among Novalait's partners.

Committees' activities

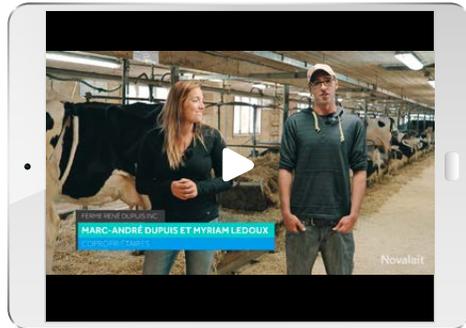
- 8** Boards of Directors
- 2** Selection committees
- 13** Steering committees for projects and chairs
- 20 +** Start-up committees for projects



Communications

Novalait.ca

4 new video-capsules



Managing bedding for more comfort
[View](#)



Fodder grass alternatives in the context of climate changes
[View](#)



Improving Cow comfort at L. Roy inc. Farm
[View](#)



Conference: Quality of stirred yogurt; stability and rheological properties
[View](#)

An overview of the results and benefits of projects supported by Novalait. Find out what dairy farmers and processors support as research in Quebec and their impacts on the farm or at the plant.

Increased visits to the site



visitors



pages viewed

Year	visitors	pages viewed
2015-2016	1448	8833
2016-2017	3152	14 063
2017-2018	4095	16 052
2018-2019	6103	13 755



Lait'Xpress

4 Newsletters to know everything about Novalait's activities

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Soon in English



Research

Newly launched projects

CRIBIQ–NOVALAIT's second call for proposals

This year, Novalait and the Quebec consortium for industrial bioprocess research and innovation (CRIBIQ) continued their collaboration to fund research projects responding to the priorities established by dairy farmers and processors. The following projects were retained following the second call for proposals.



Optimizing the efficiency of proteins in rations

Protein is the most expensive ingredient in rations fed to dairy cows. It constitutes 42% of feed costs. Moreover, more than 70% of this investment is excreted by the animals without even contributing to milk production. Dejections contain a large quantity of nitrogen, the base component of the amino acids that form proteins. A ration offering a better balance of amino acids would reduce nitrogen ingestion, which would lower feed costs without negatively affecting milk yield. In this project, researcher Christiano Côrtes plans to demonstrate that it is profitable to offer cows a more balanced diet when it comes to amino acids. After studying the practices being used on 12 commercial farms equipped with feed robots, he will test a ration optimized with nitrogen and compare it to a control ration. The exercise should lead to the development of feed strategies applicable to dairy farms.

More than a dozen farms will be participating in the project aiming to optimize the efficiency of proteins in rations.

Steering committees

Novalait has established steering committees made up of experts designated by Novalait's shareholders and knowledge transfer partners. The role of the steering committees is to monitor research progress and provide guidance. At the end of each project, they analyze the results obtained, determine the applications and potential benefits for dairy farms and plants, and recommend knowledge transfer strategies. Their ultimate goal: facilitate and accelerate the application of research results!



Increasing ecoefficiency by concentrating dairy fluids

Filtering milk by extracting water and concentrating the proteins aligns with the dairy sector's objective to improve ecoefficiency. To do so, baromembrane processes including reverse osmosis and ultrafiltration are used to produce a protein-rich concentrate, as well as a liquid co-product known as permeate. The residue from reverse osmosis presents a composition that is very close to water and can be used in dairy plants to reduce the consumption of potable water, whereas the permeate obtained through ultrafiltration contains lactose and mineral salts that make it difficult to use. This research, led by professor Yves Pouliot, aims to evaluate the ecoefficiency gains resulting from process optimization and milk concentration at the plant, and the impacts on cheese production and whey valorization. It will draw on the knowledge and simulation software recently developed by the NSERC-Novalait Industrial Research Chair on Process Efficiency in Dairy Technology.

Measuring the ecoefficiency gains resulting from milk concentration and the impacts on cheese production and whey valorization.



Identifying bioprotective cultures that extend the shelf life of dairy products

Who has never found a container of yogurt in the back of their refrigerator dotted with blue-green flecks, destined only for the trash? Dairy products have a limited shelf life due to undesirable microorganisms that develop and alter their taste. However, it may be possible to control the growth of these microorganisms by using bioprotective cultures. Bioprotective cultures produce natural antimicrobial compounds that can slow the appearance of bacteria, yeasts and mould, in addition to preventing the formation of compounds with unpleasant odours. Professor Marie Filteau is beginning to research how different bioprotective cultures interact with harmful microorganisms by applying new, systematic analysis methods on a large scale. Ultimately, her team aims to develop specific bioprotective culture blends to increase the shelf life of dairy products, thus helping to reduce food waste.

Developing specific bioprotective culture blends to increase the shelf life of dairy products, thus helping to reduce food waste.



Vitamins post-calving: a way to increase cow fertility?

After calving, dairy cows are less fertile for up to three months, particularly high-yielding cows. Why is this? This project examines whether a deficiency of vitamins A and D negatively affects fertilization. In spring, pastures rich in vitamins A and D increase cows' fertility levels, but few farms use the practice which is, however, known to affect reproductive performance. According to past studies, genes that depend on vitamin A are abnormally expressed 60 days post-calving. In this new research, professor Marc-André Sirard's team will examine if cows are more easily fertilized when they take a vitamin A and D supplement between the 50th and 90th day following calving. Blood tests on 48 cows will be used to establish their energy profiles at the time of vitamin supplementation and insemination. The supply of vitamins A and D has already been studied, but never during this key period in the reproduction cycle. This approach is based on the hypothesis is that the ovaries sense a seasonal effect and that a targeted supplement of vitamins reproduces the arrival of fresh pasture (vitamin A) in spring (vitamin D) and influences fertility.

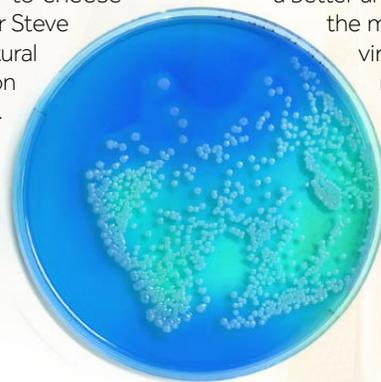
The research approach is based on the hypothesis that the ovaries sense a seasonal effect and that a targeted supplement of vitamins reproduces the arrival of fresh pasture (vitamin A) in spring (vitamin D) and influences fertility.

Contributing to a third dairy research cluster in Canada

Novalait has partnered with two Canadian organizations – Dairy Farmers of Canada, and Lactanet – to fund a third research cluster in the sector. The budget for the cluster totals \$16.5 million, with Agriculture and Agri-Food Canada contributing 70% and dairy partners contributing 30%. The funding will support 15 research projects. Two of the projects will address milk quality, a priority issue for Novalait due to its importance to farms and dairy plants.

Project 1 How do milk's natural microflora and composition contribute to cheese quality?

This project aims to understand why cheese made with milk collected in summer doesn't age as well as cheese produced in fall. Does the answer lay in the fluctuation of certain bacteria in the milk? This is the question that processors have been asking themselves for some time now. Variations in the composition of natural flora is a constant challenge for cheesemakers. This research aims to confirm the origin of the main sources of microorganisms that develop as cheddar and washed rind cheeses age. It will analyze their interactions with milk's natural antimicrobial system and determine their impact on cheese ageing. Lastly, it will identify the bacteria in milk that have either positive or negative effects on cheese texture. The study will consider milk concentration prior to cheese production. The team, led by researcher Steve Labrie, will paint a portrait of milk's natural microbiota throughout the production process, all the way to the ageing cellar. Eight artisanal and industrial cheesemakers are contributing to this project.



Project 2 Occurrence and impact of microbial biofilms on milk quality from farm to cheese vats

The microbiological quality of milk is a major asset in dairy product production and extending shelf life. Despite control measures established on farms and in plants, biofilms can form on equipment and tanks. Biofilms are communities of microorganisms that adhere to each other and attach to a surface to form a protective matrix that is difficult to remove. This research studies the origin, structure, composition and formation of biofilms, whether harmful or beneficial, on farms and at cheesemaking facilities. The research will result in recommendations on management and equipment sanitation practices for farmers and cheesemakers. Through the project, the team led by researcher Denis Roy aims to gain a better understanding of the interactions between the microbial communities present in this environment. They will sample biofilms at a number of sites at two cheesemaking facilities and 60 farms, recruited and divided equally between Quebec and Ontario.





Valorizing buttermilk

Buttermilk is a co-product of butter production obtained through the churning of cream, a process that breaks down the membrane of dairy fats. While butter consumption is on the rise in Quebec, buttermilk remains undervalued despite its potential as a high value-added bio-ingredient. The fragments of dairy fat membrane contained in buttermilk contain molecules that make it less suitable for cheesemaking. Separating the membrane components valorizes the non-fat solids in different dairy matrices to improve ecoefficiency. Such is the challenge that researcher Guillaume Brisson has set himself. He will be developing different strategies to separate the membrane in buttermilk by combining ultra-high-pressure homogenization, a continuous process that promotes protein aggregation, with baromembrane processes. The project aims to develop ecoefficient separation strategies to optimize buttermilk usage by valorizing its solids and extracting high value-added bio-ingredients.

Developing ecoefficient separation strategies to optimize buttermilk usage.

Canadian Dairy Commission Scholarship Program Seven award winners share \$276,667

The Canadian Dairy Commission has entrusted Novalait with management of its scholarship program in Quebec, representing a budget of \$500,000. A first call for proposals was launched in fall 2018. Novalait awarded scholarships to six master's students and one PhD student, for a total of \$276,667. The recipients of the first awards are:

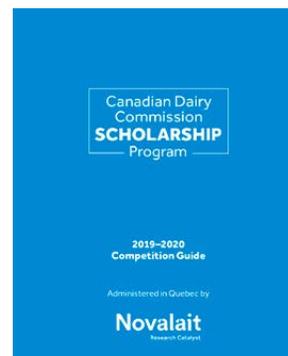


Dairy production scholarships

Samantha Bennett Université Sherbrooke	Determining the antimicrobial potential of bacteriocins in the treatment and prevention of bovine mastitis
Jean-Philippe Laroche Université Laval	Evaluating the potential of using more digestible alfalfa in rations for lactating cows
Catherine Lussier McGill University	Proposing sustainable solutions to ensure exercise for dairy cows in tie-stalls to meet their behavioural needs and environmental constraints
Annie Fréchette Université de Montréal (doctorat)	Impacts of recycled manure solids preparation methods on dairy cow health and milk quality

Dairy processing scholarships

Rachel Morin-Pelchat Université Laval	A study on the non-structural proteins in <i>Streptococcus thermophilus</i> bacteriophages using the CRISPR-Cas9 genome editing tool
Alice Perrault-Jolicoeur Université Laval	Characterizing the interactions between a <i>Lactococcus lactis</i> commercial strain and bacteriophages found in the cheesemaking industry
Nissa Niboucha Université Laval	Developing and characterizing dairy biofilms on stainless steel surfaces in a model pasteurization system



A second call for proposals was launched in fall 2019. The competition will result in the awarding of five to six scholarships to master's students.

Current research projects 2018–2019

Eighteen research projects and three industrial research chairs generated a substantial amount of research activity in 2018–2019. The projects currently underway are grouped according to the different partnerships developed by Novalait to fund them.

Partnership agreement for innovation in dairy production and processing NOVALAIT – FRQNT – MAPAQ [2011-2018]

2014-2018

-  **Systems biology applied to cheddar**
Sylvain Moineau, Université Laval
-  **Improving ecoefficiency in milk processing by optimizing the usage of milk components: the case of Greek yogurt**
Yves Pouliot, Université Laval

Partnership agreement for innovation in dairy production and processing – NOVALAIT – CRIBIQ – FRQNT [2015-2020]

2016-2019

-  **Pushing back the insemination of cows in metabolic stress to day 120: an idea to validate for the health and profitability of herds**
Marc-André Sirard, Université Laval
-  **Improving the history of health and fertility traits in dairy cattle**
Claude Robert, Université Laval
-  **Searching for the microflora of local milks and cheeses**
Steve Labrie, Université Laval

2017-2020

-  **Recycled manure bedding: recommendations for safe use to protect milk quality**
Simon Dufour, Université de Montréal
-  **Can milk analysis predict the level of well-being and health of dairy cows?**
Elsa Vasseur, McGill University

Special Call for Proposal – NOVALAIT – CRIBIQ [2016-2021]

2018-2021

-  **Using the fatty acid profile of milk to detect and prevent ruminal acidosis in cows**
Stéphanie Claveau, Agrinova
-  **Performance and behavior of dairy heifers according to their milk diet**
Édith Charbonneau, Université Laval
-  **Improving cows' protein diet through new models tested in Quebec**
Doris Pellerin, Université Laval
-  **The benefits of using new, more digestible alfalfa for Quebec's dairy farms**
Caroline Halde, Université Laval

2019-2022

-  **A targeted Treatment for post-partum infertility in dairy cows**
Marc-André Sirard, Université Laval
-  **Improving dairy processing ecoefficiency using an integrated approach to dairy fluid concentration**
Yves Pouliot, Université Laval
-  **Diet strategies to improve protein efficiency on Quebec dairy farms**
Cristiano Cortes, Agrinova
-  **Identifying bioprotective cultures that extend the shelf life of dairy products**
Marie Filteau, Université Laval
-  **Valorizing buttermilk more efficiently**
Guillaume Brisson, Université Laval

Dairy Research Cluster DFC – NOVALAIT – Lactanet – AAFC [2018-2023]

2018-2023

-  **How do milk's natural microflora and composition contribute to cheese quality?**
Steve Labrie, Université Laval
-  **Occurrence and impact of microbial biofilms on milk quality from farm to cheese vats**
Denis Roy, Université Laval

Industrial Research Chairs

2014-2019

-  **On Process Efficiency in Dairy Technology**
Yves Pouliot, Université Laval
Novalait 

2016-2021

-  **On Sustainable Life of Dairy Cattle**
Elsa Vasseur, McGill University
Novalait   
-  **In Metabolic Activity and the Functionality of Bioprotective Lactic Cultures**
Ismail Fliss, Université Laval



Results

This section presents the promising advances made through the five projects completed this year, and the work completed by the industrial research chairs.

Production

Selecting bulls for genetic diversity

For dairy cows, the traditional method of genetic selection has proven to be ineffective at transmitting health and fertility traits. An additional drawback is that it gradually homogenizes the genome since the most advantageous alleles increase the selection value. As a result, farmers choose individuals bearing identical copies of the genes, but new research could lead to modifications to these practices. When bulls have similar genetic values, which ones will transmit the greatest genetic diversity to their progeny with respect to health and fertility traits?

The team led by researcher Claude Robert genotyped 200 bulls using semen samples and then identified more than 900 zones of interest in their genome. They then tested an additional lot of 1,000 dairy cows to validate the regions of the genome related to health and fertility. Their work demonstrated that it is possible to increase the diversity of genes related to these traits without neglecting other traits such as milk production. The next step is to make the process more robust by applying it to a larger number of genotyped animals. Ultimately, farmers will be able to use a tool to select bulls so as to improve their health and fertility traits as a result of a higher level of genetic diversity.



Prolonging the voluntary waiting period between the time of birth and the next insemination to ensure that cows have regained their energy balance would help to prevent this type of negative “programming” of embryos.

Why delay cow insemination until day 120?

Epigenetics is an emerging scientific field that studies how the environment modifies genes that are inherited at conception. Researcher Marc-André Sirard explored the epigenetic effect of energy deficits in cows. Do cows that are “hungry” at the time of insemination give birth to females that are less efficient at producing milk? An energy deficit results in higher levels of β -Hydroxybutyric acid, or BHB, in the blood. Embryos from cows with high BHB levels were compared with embryos from mothers with low BHB levels. The embryos from high-BHB mothers presented a metabolic alteration that programmed them to store up reserves in anticipation of stressful conditions. Prolonging the voluntary waiting period between the time of birth and the next insemination to ensure that cows have regained their energy balance would help to prevent this type of negative “programming” of embryos.

The team aimed to validate the economic impact of pushing insemination back to 120 days post calving. It created three model farms based on data compiled by Lactanet over five years, including the number of lactations, annual production levels, time of first breeding and BHB levels in milk at the initial testing. The analysis revealed a slight decrease in production, but an increase in the milk’s fat and protein contents. In all three cases, delaying insemination had no effect on the net benefit. The follow-up to the project is to develop a decision-making tool to find the ideal timeframe for inseminating each cow based on their BHB levels.

Industrial Research Chair on Sustainable Life of Dairy Cattle

Optimizing cow comfort in tie-stalls to increase well-being; such is the mission of the Chair on the Sustainable Life of Dairy Cattle supervised by researcher Elsa Vasseur at McGill University. For the past four years, the research team has been working on adapting stall housing to attain this objective. Farmers, experts and students have all collaborated on determining best practices. Professor Vasseur has also trained more than thirty graduate students. Here are her latest research findings on improving cow well-being.



Installing a 3-inch metal tube as a bedding-keeper and raising the feeder.



Extension of the stall by adding a metal platform screwed on the gutter.

A focus on comfort

Housing quality plays a major role in cow well-being. What can be easily modified in stables to increase comfort? The research team compared the behaviour of cows in two groups, the first housed in a 188-cm (74-inch) stall, and the second housed in a 178-cm (70-inch) stall. For reference purposes, the current recommendation is 184 cm (72-inch) for cows with the profile of those under study. In both cases, the stall contained a generous

7 cm (3-inch) of straw, kept in place by a bedding keeper. All of the cows that presented injuries at the time of the study healed quickly, with injuries disappearing within a few weeks after trying their new housing, which confirms the protective role of the bedding. Cows that stayed in the longer stalls remained lying down for nearly one hour more than those kept in the shorter stalls. The research goes to show that housing animals in more comfortable spaces has beneficial effects that fast become evident.

In search of longevity

The chair also began addressing the issue of cow longevity. Which cows are more profitable over a lifetime? The most productive? The least sick or injured? Preliminary analysis of the production, health and ProAction's well-being databases revealed the indicators of lifetime profitability and longevity. Specifically, it makes it possible to evaluate the relevance of keeping a cow for an additional lactation, or to calculate the real losses to the cumulative profit resulting from mastitis or lameness. Based on these initial findings, the team is currently trying to show how cow well-being and longevity affect the farms' profitability. These associations will make it possible to identify the most profitable cows in a herd. Stay tuned for more!



To stay up-to-date on the chair's activities, subscribe to the blog cowlifemcgill.com or visit novalait.ca.



New video-capsule: Managing bedding for more comfort

Novalait has put together a video showcasing La Ferme René Dupuis, who has put the latest findings by the Industrial Research Chair on Sustainable Life of Dairy Cattle into application.

[Watch it here!](#)

“What’s interesting about Novalait is its focus on research that addresses the dairy industry’s interests. We have the opportunity to give our opinion and orient research. Novalait makes a large amount of scientific information available to industry players that they would otherwise not have access to. As an example, the Chair on Process Efficiency in Dairy Technology provided its initial findings on the use of membranes and cheese yields, which are useful to Saputo and the industry. What’s more, research on animal well-being aligns with our commitment to sustainable supplying since we care about how the milk that we use is produced. Lastly, the students that participate in projects generate indispensable dairy knowledge, in addition to forming the next generation of scientists that the industry will be able to count on.”

Richard Marier, Vice-President,
Technical Services,
Saputo Dairy Products Canada G.P.

Processing

Industrial Research Chair on Process Efficiency in Dairy Technology

Active until 2018–2019, the objective of the Chair on Process Efficiency in Dairy Technology was to develop an innovative industrial approach in the field. Its success is rooted in the fruitful exchanges between the research team and dairy processors, who have benefited from its significant findings.

Here is a brief overview the advances made by the chair within the past year.

Draining curd

A new technological tool was developed to make it easier to drain curd made from a reverse osmosis concentrate. Lowering the pH level reduces curd mineralization and increases drainage.

Generating water

Reverse osmosis is a concentration technique that reduces water consumption in plants. The chair applied the technique to skim milk, whey and ultrafiltration permeate in a water generation analysis. The ultrafiltration permeate presented the most efficient and economical solution to generating water since it doesn’t contain any protein, which creates better permeate flux and, as a result, removes a larger proportion of water.



“One of the most rewarding aspects of holding an industrial chair is getting results in the lab, transposing them to the industrial scale and knowing that it works.”

Yves Pouliot, chairholder

Washing membranes

The research measured how much successive chlorine washings influence the adhesion of spores to ultrafiltration membranes, which become rougher over time. Nevertheless, exposure to chlorine did not cause a measurable effect on roughness beyond the material’s normal wear and tear.

Assessing ecoefficiency

Many advances have been made on ecoefficiency evaluation software and improvements to its graphical user interface have given dairy companies the chance to test a demonstration version. Novalait hired a postdoctoral student to round out the software to meet industry interests.

1
New professor-
researcher
position –
Alain Doyen

10
Master’s
students
professionally
trained

3
PhDs
professionally
trained

10
Meetings between
researchers and
processors

+20
than
Scientific
articles

+50
than
Presentations



Metabiolac Industrial Research Chair in Metabolic Activity and the Functionality of Bioprotective Lactic Cultures

The mission of the Metabiolac Chair is to leverage the power of lactic acid bacteria whose antimicrobial or antifungal activities help fight certain pathogens. In the dairy sector, lactic acid bacteria serve to counter mastitis in cows and flora that alter dairy products. More than twenty graduate students helped develop new bacteriocin formulations and to demonstrate their effectiveness. Here is a short summary of the work completed in the chair's third year of research.

Lowering *Clostridium* levels in cheddar

The team identified and characterized strains of *Lactococcus lactis* that produce a bacteriocin known as nisin A, which prevents the development of harmful flora in cheese. It then developed a matrix to encapsulate nisin A to control its release into food. Tested on a large-scale batch, the encapsulated bacteriocin significantly reduced the population of *Clostridium tyrobutyricum*, the primary agent responsible for swelling in cheese. In addition, it did not interact with the -starters in the cheddar.

An alternative to antibiotics to counter bovine mastitis

The chair tested four bacteriocins out of 60 bacterial strains linked to clinical bovine mastitis. Among pediocin, bactofencin, nisin and reuterin, the latter two demonstrated promising inhibitory activity. The research team then produced and purified the substances on a larger scale to test them on cows. It is currently evaluating whether they are safe for use on the mammary gland. In the next stage of research, it will test their effectiveness at countering mastitis by administering them in areas of cows' udders that have become spontaneously infected.

A user-friendly tool for grouping bacteriocins

Selecting, isolating and characterizing such a large number of bacterial strains has resulted in a database containing a substantial amount of information relating to protective cultures and their antimicrobial activities. When new data is generated, the databank is immediately updated, making the databank a valuable tool for dairy processors looking to learn more about bacteriocins.

Cheddar – a “system” for study

Systems biology looks at interactions between the components of a living organism, all the way down to the molecular scale. It is specifically useful to understanding the impact of the network of microorganisms involved in cheddar production. Many factors influence cheddar quality, including the milk's microbiological composition and the effectiveness of lactic starters and bacteriophages. Researcher Sylvain Moineau wanted to verify if it was possible, using high-throughput sequencing, to track the evolution of the microbes and viruses that develop during the cheese production and ageing process.

The research team developed a method to detect these microorganisms in milk and cheese using commercial samples. They completed a number of sequences of the genome of the bacteria *Lactococcus lactis*, and then built a database containing genome sequences of the cheeses' microbiome. In addition, the team obtained metabolic profiles of the cheeses in the lab. A positive association exists between the metabolic profiles and the sensory analysis completed when classifying the cheddars once aged, indicating that metabolic profiles could one day complement classifiers' "sense of smell." The methods developed and knowledge gained through the project will be used to develop a predictive tool for cheese ageing.



Microflora of Quebec cheeses

Milk quality has a large influence on the production of fine cheeses. For several years now, Novalait has supported research on the role of microflora in fine cheese production. Within the microflora, a group of bacteria, yeasts and moulds interact to give cheeses their sensory properties and typicity. The microorganisms come either from the environment or lactic starters inoculated intentionally. It is possible to identify the microorganisms using new genomic techniques, but work remains to be done to determine their effects, whether positive or negative, on the ripening process.

Researcher Steve Labrie characterized the microflora that develops through the ripening of a number of fine cheeses by sequencing their genome and gaining an understanding of the role that the main microbial species play. Twenty-one cheesemakers participated in the project and provided cheese body samples and rinds from 49 cheeses. The team then characterized the microbial ecosystem of 16 of these cheeses by comparing two different years: 2015 and 2018.

The analyses revealed the persistence of certain species, regardless of the product or production year. A similarity index was used to measure consistency in cheese production, which generally proved very good between the two years. This suggests that cheesemaking processes are well controlled in Quebec. In addition, the comparisons allowed for the identification of microorganisms as indicators of quality. The research team identified three indigenous yeasts and characterized their aromatic compounds. As a next step, they will determine the potential contribution of each natural yeast strain to cheese typicity. Cheesemakers will be able to use these results to demonstrate their product's uniqueness in order to obtain a reserved designation.



Greek yogurt process efficiency: a matter of technology?

Ecoefficiency involves producing added-value products by reducing the resources used and environment impacts. Applying this principle to the production of Greek yogurt, which has seen rapid growth in consumption, is not easy, however. This is because the process generates a co-product, acidic whey, which is difficult to use and manage. Researcher Yves Pouliot decided to tackle the challenge within the context of Quebec.

He evaluated the environmental performance of three technologies used to manage acidic whey: centrifugation, fortification and ultrafiltration. Three dairy processing companies participated in the development of a life cycle analysis model, with surprising results. The factor that contributes the most to the environmental impacts of Greek yogurt is ... packaging! The best option for producing fat-free Greek yogurt containing 10% protein is centrifugation, followed by ultrafiltration and fortification.

The results also suggest that producing Greek yogurt using Canadian dairy proteins has a positive impact on this agri-food channel. By valorizing the skim milk that is co-produced through cream and butter production, producers avoid the energy-intensive drying process and the addition of non-fat solids.

The best option for producing fat-free Greek yogurt containing 10% protein is centrifugation, followed by ultrafiltration and fortification.



Impacts and benefits

Responding to the scientific and technological challenges

Novalait fosters the development of knowledge and skills through the research it funds. The professionals who receive training at the master's and PhD levels are a source of new talent ready to tackle the challenges that dairy companies face.

Concentrating milk ... and ingenuity!

During her master's degree, Iris Dussault-Chouinard sought to understand the mechanisms behind milk concentration in cheesemaking. As part of the Industrial Research Chair on Process Efficiency in Dairy Technology, at Université Laval, she aimed to improve the cheesemaking performance of reverse osmosis during the rennet coagulation phase. In the process, she learned rigorous work methods that she now applies in her current job.



Iris Dussault-Chouinard

Technical services specialist, Saputo

"As I completed my master's degree as part of the industrial research chair, I gained exposure to the real challenges faced by dairy processors, all while developing cutting-edge scientific knowledge. Managing a research project taught me skills that facilitated my integration into the workforce. I also learned a rigorous problem-solving method that I use every day in my work. I got so much out of my university education!"

From the lab to the plant

In professor Sylvain Moineau's lab, at Université Laval, Marie-Laurence Lemay shed light on the mystery surrounding the most abundant species of lactococcal bacteriophages in Quebec. Known as p2, the virus infects certain lactic acid bacteria. Within the framework of her PhD, the young professional identified a new protein from the microorganism. During her studies, she gained an understanding of fundamental genomic concepts and developed her ability to apply them to concrete cases, such as cheddar production.



Marie-Laurence Lemay

Microbiology specialist – innovation and product development, Agropur coopérative laitière

"During my graduate program, I studied a worldwide industry problem: viruses that negatively affect dairy fermentations. Even though I took a fundamental research approach to my work, it didn't prevent me from getting a job where I now do applied research. Working with a group like Novalait allowed me to expand my network and better understand the major issues facing dairy farmers and processors in Quebec."

Improving the agriculture of tomorrow

Catherine Chaput obtained her master's in the lab of Marc-André Simard, at Université Laval, where she studied the issue of the insemination of cows under metabolic stress. She demonstrated that the embryos of cows under stress present a significant metabolic alteration that justifies delaying the animals' insemination when experiencing an energy deficit. Parallel to these discoveries, she developed her critical thinking skills and exchanged with numerous professionals on issues facing the industry. Her objective: to improve agriculture and the future of research.



Catherine Chaput
RD assistant-coordinator, Jefo

“Pursuing graduate studies at Université Laval under Marc-André Simard’s supervision allowed me to deepen my scientific knowledge and my critical thinking skills. The experience gave me the chance to meet people from many different fields, all working toward the same goal: to improve agriculture and tomorrow’s research. It also gave me a better understanding of the issues in the industry and their impact on the different areas of agriculture. Due to the knowledge I gained during my master’s degree, I obtained a position on Jefo’s research and development team where I set to work developing nutritional solutions for a range of agricultural productions.”

A new dairy processing expert

Dairy production and processing companies appreciate having internationally renowned researchers in close proximity in order to address the industry’s scientific challenges. They can now leverage the knowledge of Guillaume Brisson, a recent hire in the Department of Food Sciences at Université Laval. The new assistant professor has given himself the task of understanding how food components interact, as well as modulate the structure of the food matrix and influence digestion such as the bioavailability of nutrients. He has extensive experience in the dairy sector as a result of his postdoctoral research completed in California and New Zealand. His research focused on whey, buttermilk and the physico-chemical and functional properties of milk powder.



Guillaume Brisson
Assistant professor, Université Laval

“Valorizing buttermilk is a major challenge ... The lipid fragments it contains are about the same size as casein micelles, proteins of interest, which makes it impossible to separate them using conventional baromembrane processes. The objective of my project is to develop original approaches with the creation of a size gradient between the two fractions in order to separate them. I hope that my work will result in a total valorization channel for buttermilk components to generate major economic benefits for the dairy sector.”

 To learn more about researcher Guillaume Brisson’s first project funded by Novalait, read “Valorizing buttermilk” on page 9.



Novalait extends its reach

Novalait values collaboration and is involved in numerous initiatives and committees to share its expertise in research and knowledge transfer.



During the **Quebec Dairy Cattle Symposium** in October 2018, Valérie Bélanger, knowledge transfer coordinator, presented the highlights from the poster session showcasing student researchers. Ms. Bélanger sits on the CRAAQ [Quebec Reference Center for Agriculture and Agri-food] dairy cattle committee.



As a member of the **Lactanet** Digital Transformation Committee, Ms. Gosselin collaborated with a number of other stakeholders on prioritizing the multiple and complex issues related to data management.



As a director of the **Quebec Dairy Technology Foundation**, Ms. Bélanger actively contributed to the third re-issue of the dairy technology and science manual.



At the AGM of the **Producteurs de lait du Québec** in April 2019, Élise Gosselin, CEO, delivered a presentation to dairy farmers on the impacts of their investments in research.



As a director of the **Quebec consortium for industrial bioprocess research and innovation** since 2016, Ms. Gosselin was named chair by the board.



In 2019, Ms. Gosselin joined the Board of Directors of the **Quebec Cheese Expertise Centre**.



Upcoming: 2020 Forum Techno

The Forum Techno is Novalait's must-attend event to learn about the latest research findings and discuss application opportunities on the farm and in the plant. To be held on June 1, 2020, at the Château Frontenac in Quebec City, the Forum Techno will open the *International Cheese Symposium*. For more information on the program for this exceptional event, [click here](#).

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