DRIVING INNOVATION AND COMPETITIVENESS IN THE U.S. DAIRY SECTOR THROUGH STRATEGIC RESEARCH

Dairy Management Inc. (DMI)
Product Research-Ongoing Projects

DAIRY MANAGEMENT INC.™

DMI

Dairy Management Inc.™ (DMI) is funded by America's dairy farmers, as well as dairy importers. Created to help increase sales and demand for dairy products, DMI and its related organizations work to increase demand for dairy through research, education and innovation, and to build trust in dairy foods, farms and businesses.

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DMI DAIRY PRODUCTS RESEARCH ANNUAL FUNDING:

Each year, DMI Dairy Products Research organizes a public call for proposals through National Dairy Council which is the science arm of DMI:

http://researchsubmission.nationaldairycouncil.org/Pages/Home.aspx

The goal of this program is to fund research projects at various dairy research centers and other universities and research centers to create scientific knowledge that results in the development of innovative dairy products and ingredients.

OUR RESEARCH FUNDING IS TARGETED TO ADDRESS THE FOLLOWING FOCUS AREAS:

CHEESE AND CULTURED DAIRY:
Enhance cheese and cultured dairy opportunities in domestic and export markets.

MILK POWDERS:
Enable the U.S. to be a preferred supplier of milk powders (SMP/NDM/WMP) by developing the knowledge to consistently produce powders that exceed customer specifications.

MILK AND WHEY INGREDIENTS AND FRACTIONS:
Increase utilization of milk/whey proteins and other fractions and ensure that dairy proteins remain the protein ingredient of choice for food formulators.

CO-PRODUCTS:
Improve quality, performance, and increase utilization of co-products.

FLUID MILK AND BEVERAGES:
Drive incremental growth in dairy beverages.

DISCOVERY:
Cutting edge research that leverages a new or emerging technology to keep the U.S. dairy industry at the forefront of innovation.

FOOD SAFETY:
Control of food safety risks in dairy foods and/or dairy processing environments.

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DAIRY MANAGEMENT INC.
Rosemont, IL

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APPLICATION OF A PREDICTIVE TOOL ON MILK QUALITY AND RIPENING CONDITIONS TO REDUCE THE INCIDENCE OF BIOGENIC AMINES IN CHEESE

ANTICIPATED COMPLETION: *2026*

INVESTIGATORS

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OBJECTIVE

Biogenic amines (BA) are microbially produced nitrogenated organic compounds often found in ripened cheeses that are associated with flavor and gas defects, as well as potential toxicological reactions on consumers with high sensitivity. BA incidence in cheese is primarily produced by bacteria via amino acid decarboxylation during cheese ripening. In this work, an advanced molecular tool will be developed to predict the production potential of two BAs, histamine (His) and tyramine (Tyr). This research will quantify their levels in cheese milk, as well as in cheeses immediately after manufacture and during ripening. The prediction models will be then applied and validated in various scales of production (i.e., pilot plant scale, and a commercial facility). This tool can help cheesemakers reduce BA incidence in ripened cheese by adjusting ripening conditions.

BENEFIT TO INDUSTRY/FARMER

This project will have a direct impact on the quality of ripened cheeses and therefore a reduction in cheese being downgraded. We anticipate that targeted quantification of defect-causing bacteria in milk and cheeses after manufacture will have the potential to prevent a variety of cheese defects. We anticipate that this method can potentially be applied to prevent the incidence of other BA and help improve the quality and safety of cheese, therefore increasing trust in the dairy industry.

DEVELOPING A DAIRY-BASED ANTIFUNGAL INGREDIENT FOR USE IN THE CHEESE INDUSTRY

ANTICIPATED COMPLETION: *2025*

INVESTIGATORS

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OBJECTIVE

Food spoilage by fungal contamination is responsible for waste generation and great economic losses. Fungal contamination not only affects the appearance, texture, and flavor of food products, including cheese, but it can also generate certain compounds (mycotoxins) that can have serious and long-term health effects on consumers. Fungal contamination with cheese is commonly treated with a variety of methods such as modified packaging, preservatives, and bioprotective cultures, but recently, consumers are requiring natural and "clean label" ingredients in their foods. The objective of this project is to use components from whey proteins to create consumer-friendly and natural preservatives that meet consumer's needs.

BENEFIT TO INDUSTRY/FARMER

This project aims to reduce the incidence of cheese rejection from manufacturers, converters, retailers, and consumers. The proposed "clean label" dairy-based ingredient developed from this study will be enriched in bioactive peptides with antifungal properties that can be applied on the surface of cheeses to prevent and control most fungal contamination.

DEVELOPMENT OF PREDICTING MODELS FOR SHREDDABILITY OF CHEDDAR CHEESE USING WEAR BEHAVIOR AND MECHANICAL PROPERTIES

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

Cheddar cheese is commonly sliced or shredded for various applications in culinary dishes and restaurant services. During the process of slicing or shredding, problems such as wear phenomena often occur where cheese sticks to the moving parts of machinery or crumbles during high-speed operations. This type of wear accounts for significant material and economic loss to manufacturers. The objective of this project is to develop predictive models that provide an objective way to assess the machinability of Cheddar cheese based on controllable factors such as cheese age, composition, and temperature of operation.

BENEFIT TO INDUSTRY/FARMER

This project will provide manufacturers with empirical models to help predict the wear behaviors of cheese when sliced or shredded under high-speed conditions. These models can be used for a variety of operations such as judging the machinability of cheese, reworking the cheese into process cheese formulations, evaluating new cheese formulas, and changing processing conditions to reduce waste.

RELEVANT PUBLICATIONS

Sharma, Prateek. 2022. ADSA Foundation Scholar Award: Materials science approach to the study of mechanical and diffusion properties in cheese. J Dairy Sci. 105(6):4711-4721.

Pace, N., Verma, A., Mayank, Parhi, A., Sharma, P., 2024. The utility of a slice defect score method in understanding factors impacting the sliceability of commercial Cheddar cheese blocks. International Dairy Journal 151, 105865.

EFFECT OF SHRED DIMENSIONS ON FUNCTIONALITY AND CONSUMER ACCEPTANCE OF LOW MOISTURE MOZZARELLA CHEESE (LMPS)

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

Mozzarella cheese is widely used as a pizza topping because of its texture, melting, and stretching characteristics. The optimum shredding conditions of Mozzarella cheese depends on its manufacturing conditions, physicochemical properties, and its age, which can all affect its melt and stretch performance on pizza. The objective of this project is to conduct a survey of the existing quality of Mozzarella shreds available in the market, and study the different shred cuts, their properties under a controlled MAP environment, refrigeration, and freezing/thawing conditions, and examine the performance of each type on pizza.

BENEFIT TO INDUSTRY/FARMER

This project will help cheese manufacturers understand which properties of LMPS mozzarella they can control or manipulate to achieve the optimal machinability and performance of this ingredient for end users. This improved performance will help drive sales of LMPS.

RELEVANT PUBLICATIONS

Modi, Z and P. Salunke. 2024. Impact of maturity level and geometric cuts of natural cheese on processed cheese product functionality. International Dairy Journal 156: 105981.

FERMENTATION 2.0 EXPANDING DAIRY MARKET

ANTICIPATED COMPLETION: *2027*

INVESTIGATOR

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OBJECTIVE

This research will use Fermentation 2.0 platforms to enable the expression of calf, goat, and sheep lipases in yeast, thus creating enzymes that would be Kosher and Halal compliant. Once successful enzyme expression has been achieved, each lipase will be purified and characterized. Then, there will be a comparison of the fatty acid production profile of bovine milk fat treated with each individual lipase, as well as combinations, to that of commercially available animal-derived lipases. This research would thus develop novel tools that could then be leveraged by US cheese manufacturers to expand their markets and increase the demand for US Dairy.

BENEFIT TO INDUSTRY/FARMER

A large portion of the world's population eat Kosher and Halal foods. These populations represent important markets for US dairy export, particularly for cheese and dairy snacks. Because many lipases used in the dairy industry for cheese flavor are not derived in Kosher or Halal compliant manners, many US cheeses and other foods that use cheese flavors cannot be sold to these markets. This project would develop and demonstrate that yeast produced animal lipase platforms can deliver Kosher/Halal compliant tools that deliver the equivalent functionality to animal-sourced lipases, thus empowering US dairy foods processors to compete in these critical markets and increase the demand for US dairy.

IMPROVED QUALITY OF BLOCK RINDLESS SWISS CHEESE

ANTICIPATED COMPLETION: *2025*

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OBJECTIVE

Due to its slightly lower fat, and its naturally low sodium content, Swiss cheese is attractive to the USDA's School Lunch Program. Converters have stated that there are significant issues with cheese flavor and texture, such as blind cheese (lacking eye development) or splits. The objective of this research is to investigate specific cheese making conditions needed to achieve the targeted pH and mineral balance for proper eye development. This research will also explore the properties of the experimental cheese and the impact of culture selection and ripening conditions on Swiss cheese quality.

BENEFIT TO INDUSTRY/FARMER

This research will improve the quality of Swiss cheese to allow the variety to continue to be offered by the USDA for its school lunch program. This research will explore if these cheesemaking approaches could help eliminate current Swiss cheese issues, including splits and cracks. Improved quality Swiss cheese will help increase its sales and distribution in retail and food service.

INNOVATIVE APPROACHES TO INCREASE THE SHELF LIFE OF STRING CHEESE AND FRESH CHEESE CURDS

COMPLETED

INVESTIGATORS

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OBJECTIVE

Low-moisture part skim (LMPS) Mozzarella string cheese and cheese curds are perfect solutions for wholesome, protein-focused, on-the-go snacks, but their shelf life is short and limited by their loss of stringiness and squeak ability, respectively. Although freezing can be used to extend their shelf life, it is not ideal for snacks targeted for convenience or grocery stores. The objective of this project is to extend the shelf life of string cheese and cheese curds intended for domestic and export markets without the need to freeze the cheese, while still retaining the required texture, flavor, and performance of the cheese.

BENEFIT TO INDUSTRY/FARMER

This project aims to assist in the widespread sales and distribution of string cheese and cheese curds. The goal is to make “fresh” cheese curds a major product that is available throughout the U.S. and export markets, thus increasing sales of dairy.

INVESTIGATING THE CAUSES OF ASTRINGENCY AND CHALKINESS IN CONCENTRATED NONFAT YOGURTS

ANTICIPATED COMPLETION: *2025*

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OBJECTIVE

High protein, nonfat yogurt often has undesirable astringency and chalkiness, with no known mechanism. This study aims to investigate the cause of these defects by evaluating concentration methods, calcium content and post-fermentation mechanical force. The project will develop improved processing techniques to reduce the sensory defects, providing best practice and optimized processes for the dairy industry.

BENEFIT TO INDUSTRY/FARMER

The research will identify and mitigate major sensory defects in high protein, nonfat yogurt. It ensures a consistent product quality that improve consumer satisfaction and build trust in dairy brands. Additionally, the findings will help the dairy producers to optimize their processes, enhancing product competitiveness.

MANUFACTURE OF A MICROWAVEABLE NATURAL CHEESE EXPANDED SNACK

COMPLETED

INVESTIGATOR

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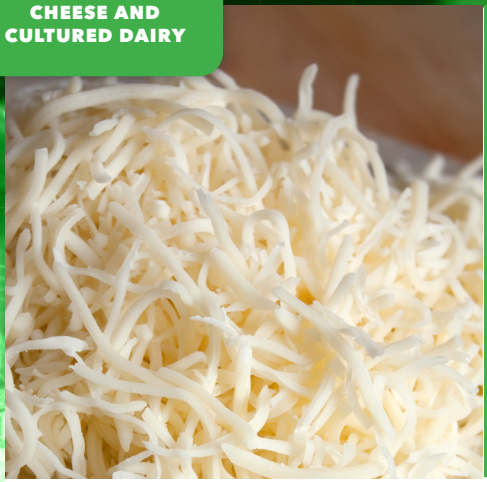
OBJECTIVE

Most cheese-flavored snacks available today are starch-based, with cheese added mainly for flavor. A starch-free, natural cheese expanded snacks are missing from the market. The project aims to develop a microwavable snack cheese that expands rather than melts during heating by modifying the composition and structure of natural cheddar cheese. Comprehensive evaluation of chemical, functional, and sensory properties will be performed to ensure product quality and extended shelf life.

BENEFIT TO INDUSTRY/FARMER

Successful development of a microwave-expandable natural cheese snack opens opportunities for value-added utilization of real cheese in a new snack format. The extended shelf life and consistent performance allows consumers to bake the snack at home when desired. It offers an innovative, high-quality snack cheese that meets consumer demand for convenient and novel food experiences, enhancing the market appeal of dairy products.



MANUFACTURE OF LOW MOISTURE PART-SKIM MOZZARELLA CHEESE USING MILKS HIGH IN CASEIN AND NOVEL CHEESEMAKING APPROACH

ANTICIPATED COMPLETION: *2025*

INVESTIGATORS

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OBJECTIVE

Modern cheese plants are becoming more focused on improving the consistency of their production processes and increasing cheese yields. Many large manufacturers have installed continuous coagulators to optimize plant efficiencies, and some are using concentrated milks to increase the throughput in their existing plants to avoid expanding their space. The objective of this study is to generate a novel cheesemaking approach using filtration operations and Alpma vats to produce low moisture part skim (LMPS) Mozzarella cheese from highly concentrated milk containing very high (5-10%) casein levels, reduced lactose, and desirable functionality.

BENEFIT TO INDUSTRY/FARMER

This research seeks to improve the efficiency of cheese production operations and to help US manufacturers be more competitive when exporting Mozzarella cheese. The results of this study will determine if continuous coagulators can handle highly concentrated milk to manufacture Mozzarella cheese. If successful, these operations will produce cheese with high yield efficiency, optimum functionality, and desirable bake performance.

REDUCING BUTTER HARDNESS THROUGH BUTTER MAKING PROCESS MODIFICATIONS

ANTICIPATED COMPLETION: *2026*

INVESTIGATORS

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OBJECTIVE

Increased butter hardness leads to consumer dissatisfaction due to the poor spreading of butter at room temperature. This research seeks to address the issue by identifying the optimal combination of milk fatty acid composition and butter making conditions, specifically temperature cycling. It provides a practical solution to improve texture and produce a softer, more spreadable butter.

BENEFIT TO INDUSTRY/FARMER

This study offers a valuable approach to produce more spreadable butter, improving product quality and consumer satisfaction. The optimized processing practice can help dairy industry enhance operational efficiency and product consistency, contributing to reliable butter products in a competitive market.

REDUCTION OF BROWNING IN DIRECT-SALTED PARMESAN CHEESE

ANTICIPATED COMPLETION: *2026*

INVESTIGATORS

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OBJECTIVE

Undesirable low temperature browning (LTB) defects via Maillard reactions can occur during ripening (often 4-6 months) of Parmesan. Methylglyoxal (MG), a metabolite of sugar metabolism, is a likely precursor of LTB in Parmesan and has been implicated in the formation of Maillard reaction products. MG is very reactive and can interact with amines and amino acids to form brown pigments. The possible role of MG as a contributor to LTB has only been studied in model systems and has not been verified in Parmesan cheese. Currently, no solutions to prevent LTB exist and are urgently needed by industry.

BENEFIT TO INDUSTRY/FARMER

Development of brown colors in direct salted block Parmesan is a significant issue causing economic concerns to the industry. It is a key defect limiting its usage in food service and retail channels. Use of cheesemaking approaches and selection of starter or adjunct strains capable of affecting MG metabolism to mitigate LTB would provide a very useful advancement for the dairy industry. Improved quality of Parmesan cheese will help increase its sales, distribution, and also increase export market opportunities in Asia-Pacific region.

SHELF-STABLE SNACKS MADE BY EXTRUSION OF NATURAL CHEESES

COMPLETED

INVESTIGATORS

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OBJECTIVE

Cheese is increasingly positioned as a healthy snack, but most of these products are refrigerated. There are some shelf-stable cheese snacks like crisps, but these tend to be hard and have high tooth-packing. The objective of this project is to manufacture various high protein, shelf-stable, extruded cheese snack concepts from natural cheese with a wide range of textural properties and desirable sensory attributes.

BENEFIT TO INDUSTRY/FARMER

This project aims to create a shelf-stable dairy product that would allow cheese to move out of the dairy (refrigerated) case and into a new snack platform that has significant opportunities. The results of this study will add to the fundamental knowledge base that manufacturers can use to produce snacks with various characteristics.

STRATEGIES TO CONTROL BROWNING/BLISTERING IN LOW-MOISTURE PART-SKIM MOZZARELLA CHEESE

ANTICIPATED COMPLETION: *2025*

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OBJECTIVE

Mozzarella cheese is the most popular cheese in the U.S. and is widely used for pizza applications around the world. The degree of blistering and browning are its key attributes for pizza baking. Common consumer complaints are excessive blistering or browning when baked on pizza. The objective of this study is to develop alternative approaches for cheesemakers to successfully manufacture low moisture, part skim (LMPS) Mozzarella cheese from concentrated milks with reduced blistering in both young and aged cheeses.

BENEFIT TO INDUSTRY/FARMER

This project will help improve the performance of LMPS mozzarella cheese on pizza. The strategies developed from this study will help eliminate the browning/blistering issues and improve cheesemaking efficiency by using highly concentrated cheese milks without negatively impacting quality parameters.

UNDERSTANDING IMPACT OF CONCENTRATED PLASMIN SYSTEM DUE TO ULTRAFILTRATION AND MICROFILTRATION PROCESS ON THE QUALITY OF CHEDDAR CHEESE PRODUCED FROM HIGH PROTEIN INGREDIENTS

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

The presence of excessive plasmin activity in cheese making can cause downgrades in the quality of cheese, causing extensive proteolysis and sometimes bitterness. With the increase in use of filtered milk in cheese making, understanding the concentration of the plasmin system becomes imperative so that strategies to mitigate defects may be devised. The objective of this project to understand the effect of filtration techniques on the concentration of the plasmin system in milk and its impact on the quality of cheddar cheese manufactured from this high-protein milk.

BENEFIT TO INDUSTRY/FARMER

This project will help the dairy industry understand the impact of the plasmin concentration in filtered milk used in cheese making. This includes a fundamental understanding of the impact of the concentrated plasmin system on milk proteins during ripening. Findings from the study will provide strategies to mitigate any quality concerns that may arise from using membrane-filtered milk in the cheese-making process.

UTILIZATION OF DAIRY PROTEIN-BASED PEPTIDES AND THEIR DERIVATIVES TO IMPROVE THE QUALITY OF HIGH MOISTURE CHEESES

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

The availability of U.S. manufactured soft cheese for export markets is limited by the short shelf-life of the product. Freezing is a convenient preservation method that extends the shelf-life of foods and retains their nutritional value, but it can also impair the functional and sensory quality of high moisture cheeses such as cream cheese. Dairy proteins have a great potential to be modified and used as anti-freezing agents. The purpose of this study is to create a dairy protein-based ingredient that will inhibit ice crystal growth and prevent or delay the structure and flavor degradation in cream cheese after frozen storage.

BENEFIT TO INDUSTRY/FARMER

This project will create a dairy-based ingredient that reduces the formation of large ice crystals during freezing of high moisture cheeses. This ingredient would have both antioxidant activity that prevent the oxidation of fats and off-flavor generation during refrigerated storage, and anti-freezing properties that preserve the structure of the product during and after frozen storage, consequently making the soft cheese dairy processors more competitive in export markets and more resilient through supply chain complications.

RELEVANT PUBLICATIONS

Wan Z, Fei T, & Wang T. 2022. Inhibition of ice crystal growth by protein hydrolysates from different plant-and animal-based proteins. Food Materials Research, 2(1), 1-9.

A MEMBRANE-BASED PURIFICATION METHOD FOR LACTIC ACID PRODUCED FROM THE FERMENTATION OF DAIRY COPRODUCTS

ANTICIPATED COMPLETION: *2025*

INVESTIGATORS

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OBJECTIVE

The objective of this research is to utilize acid whey as a model system to develop a membrane-based purification approach for lactic acid. Microfiltration or ultrafiltration will be used to separate the microorganisms, simulating continuous bioreactor conditions. Nanofiltration will be used to separate lactic acid, and some demineralization will be performed. The overarching goal is to make high purity lactic acid needed for polylactic acid (bioplastics) production. This process may further require electrodeionization.

BENEFIT TO INDUSTRY/FARMER

This research will focus on the development of novel filtration-based methods to purify lactic acid from real industrially produced dairy coproducts under various realistic conditions. The dairy industry already uses various filtration technologies to fractionate whey. The current world market for lactic acid is around $3 Billion and growing rapidly, and dairy companies could add the production of green chemicals as another profitable business to the cheesemaking activities.

BIOPLASTICS AND NATURAL CAROTENOID PRODUCTION FROM CHEESE BY-PRODUCTS

COMPLETED

INVESTIGATORS

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OBJECTIVE

Polyhydroxyalkanoates (PHA) are biodegradable bioplastics with similar properties as thermoplastics that can be used in a wide range of applications including packaging film, containers, and cutlery. The objective of this project is to use an organism called *Haloferax mediterranei* to convert two cheese waste streams, delactosed permeate (DLP) and whey permeate, into PHA and consequently formulate this PHA to produce single-use applications as a proof of concept. Additionally, *H. mediterranei* produces a natural pink pigment, a carotenoid, that could have value as a co-product. The pigment will be quantified to determine if an additional revenue stream can be obtained from this system.

BENEFIT TO INDUSTRY/FARMER

This research will deliver novel value-added uses for dairy co-products into biodegradable plastics for sustainable packaging solutions and further characterization of carotenoid pigments that are also co-produced during the process. This work will advance the value-added uses of dairy co-products into markets beyond human and animal food therefore adding to incremental sale of dairy-based ingredients while at the same time advancing the sustainability initiatives for the dairy industry.

This project is co-funded by the California Milk Advisory Board.

RELEVANT PUBLICATIONS

Wang, K., Hobby, A. M., Chen, Y., Chio, A., Jenkins, B. M., & Zhang, R. 2021. Techno-economic analysis on an industrial-scale production system of polyhydroxyalkanoates (PHA) from cheese by-products by halophiles. Processes, 10(1), 17.

Wang, K., Chen, C., & Zhang, R. 2022. Process Development of Polyhydroxyalkanoates Production by Halophiles Valorising Food Waste. Bioengineering, 9(11), 630.

Wang, K., & Zhang, R. 2021. Production of polyhydroxyalkanoates (PHA) by Haloferax mediterranei from food waste derived nutrients for biodegradable plastic applications. J Microbiol Biotechnol. 28;31(2):338-347.

BIOCONVERSION OF LOW-VALUE DAIRY SUGARS TO HIGH-VALUE PREBIOTICS

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

Human Milk Oligosaccharides (HMOs) promote the growth of beneficial gut bacteria and reduce incidences of other gut infections, which are in high demand for use in infant formula, probiotics, anti-adhesives, vaccine and tumor research. The project explores to establish a bench-scale proof of concept in using engineered enzymes to convert lactose and lactose-rich dairy co-products into prebiotic HMOs. The main objectives include validating enzyme capability and activity, enhancing its efficiency, scaling up the process and assessing in-vitro prebiotic potential.

BENEFIT TO INDUSTRY/FARMER

The project establishes a solid platform for the industry to produce high-value bioactive component through precision fermentation. This innovative ingredient solution promotes the upcycling of low-value lactose-rich dairy co-product. It also opens new opportunities in functional dairy ingredients, supporting the growing health and wellness market.

EXPLORING HEAT-INDUCED ALTERATIONS IN MILK PROTEINS: A CASE STUDY ON WHEY PROTEIN PHOSPHOLIPID CONCENTRATE

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

WPPC is a low value co-product from WPI manufacture. However, it is a rich source of various milk based bioactives such as phospholipids and glycoproteins that have substantiated health and wellness benefits. The objective of this project is to understand the various heat induced interactions among milk proteins (predominantly whey proteins) and milk fat globule membrane (MFGM) components that hinder effective partitioning, and consequently recovery of MFGM and whey proteins from whey protein phospholipid (WPPC) stream.

BENEFIT TO INDUSTRY/FARMER

This work will focus on the development of strategies to effectively concentrate and extract such bioactives from WPPC that will valorize a low value stream of dairy processing. This research will enable the delivery of unique high value bioactives to the dairy and food industry to enable innovation novel foods for health and wellness.

RELEVANT PUBLICATIONS

Rugji J., Ozturk, G. 2024. "Concentrated Forms of Nutrition for Next-Generation Dairy Foods," INFORM.

IMPROVED RECOVERY OF SUCCINIC ACID AND LACTIC ACID AS MICROBIALLY-PRODUCED VALUE-ADDED CHEMICALS FROM LACTOSE-RICH CO-PRODUCTS

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

The dairy industry produces large amounts of lactose-rich co-products such as ultrafiltered milk permeate and acid whey that have limited commercial value. Treating and disposing of these organic residues brings significant cost to industrial operations and reduces profitability of commercial products. The objective of this project is to evaluate the technical and economic feasibility of using fermentation bioreactors to convert these co-products into lactic acid or succinic acid for use in food ingredients, pharmaceuticals, cosmetics, and biodegradable polymer industries.

BENEFIT TO INDUSTRY/FARMER

This research will provide proof-of-concept work that dairy co-products can be valorized to lactic or succinic acid by microbial fermentation. This technoeconomic analysis will help the dairy industry assess how to best market these products as green or organic chemicals with a low-carbon footprint that supports a circular economy.

RELEVANT PUBLICATIONS

Walters, K. A., Mohan, G., Myers, K. S., Ingle, A. T., Donohue, T. J., & Noguera, D. R. 2023. A metagenome-level analysis of a microbial community fermenting ultra-filtered milk permeate. Frontiers in Bioengineering and Biotechnology, 11.

Walters, K.A., Myers, K.S., Donohue, T.J., Noguera, D.R. 2024. Metagenome-Assembled Genomes from Microbiomes Fermenting Dairy Coproducts. Microbiology Resource Announcements. 0:e00173-24.

DESIGN OF A SIMPLE PROCESS TO OBTAIN AN INGREDIENT RICH IN MILK FAT GLOBULE MEMBRANE AND MILK PHOSPHOLIPIDS

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

There is growing demand of milk fat globule membrane (MFGM) due to its health benefits and emulsifying properties. The underutilized buttermilk creates an opportunity for valorization as a source of MFGM. To address the challenge of increasing the value of buttermilk, this project explores the development of an efficient and simple procedure to isolate MFGM from buttermilk. The research focuses on optimizing pre-treatment conditions, refining centrifugal fractionation and improving processes to achieve the desired functionality and bioactivity.

BENEFIT TO INDUSTRY/FARMER

The project provides a simple and scalable technique to produce a functional ingredient rich in MFGM from buttermilk. This approach delivers MFGM at desired concentrations for nutritional dairy foods while maintaining the overall quality of buttermilk. This work will enable the dairy industry to develop innovative high-value dairy products through cost-effective production without requiring major equipment investments.

LEVERAGING THE US POTENTIAL TO DEVELOP AND MARKET PERMEATE POWDERS: PREDICTIVE APPROACHES BASED ON THE STATE DIAGRAM

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

The objective of this proposal is to utilize physical chemistry approaches to produce high quality whey and milk permeate powders that and make U.S. processors more competitive in local and global markets. This research will examine the variation in composition and physical properties of commercial permeates, and provide tailored drying standards for industrial permeate powders for optimized stability.

BENEFIT TO INDUSTRY/FARMER

Significant quantities of whey and milk permeate are produced as a co-product of whey and milk protein manufacture in the U.S. Due to its high lactose content, permeate faces various challenges such as browning and caking over its shelf life that limit its use in applications especially in export markets. The anticipated outcome of this project is to help solve this quality challenge, thereby helping increase the sale of U.S. permeates locally and in export markets such as China and southeast Asia.

PROCESS DEVELOPMENT FOR BIOPLASTICS PRODUCTION FROM LACTOSE PERMEATE

COMPLETED

INVESTIGATOR

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OBJECTIVE

The ever-growing global demand for petroleum-based plastics raises serious concerns over their low degradability and accumulation in the environment. Despite remarkable recycling efforts, most petroleum-based plastics are disposed of in landfills or incinerated for energy recovery. Biodegradable materials made with polyhydroxyalkanoates (PHAs) are valuable alternatives because they are synthesized by many microbes and their properties resemble or are superior to petroleum-based plastics. The objective of this study is to develop a cost-effective fermentation process for converting lactose permeate, a low-cost dairy processing waste/co-product, into PHAs.

BENEFIT TO INDUSTRY/FARMER

The anticipated outcome of this project is efficient conversion of low-value, lactose-containing dairy co-products into value-added PHAs for biodegradable materials. This would drastically decrease feedstock costs of PHA production and bypass treatment/disposal expenses of dairy processing waste. Moreover, PHA production would bring additional revenue to dairy farmers and industry and promote dairy sustainability and PHA biomanufacturing.

PRODUCTION OF SWEETENERS FROM GREEK YOGURT ACID WHEY

COMPLETED

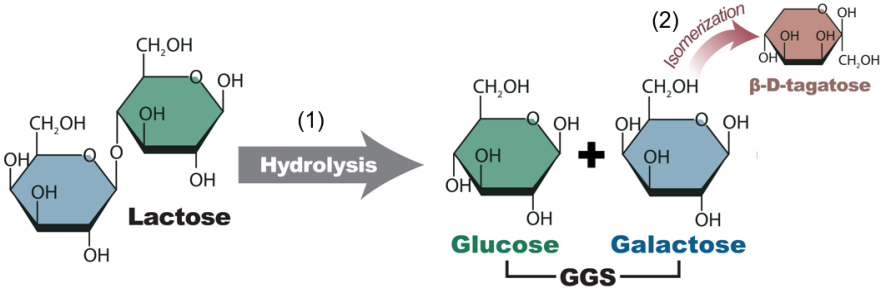

Fig. 1. Sugar conversions: (1) hydrolysis of lactose to glucose and galactose, and (2) isomerization of galactose to tagatose

INVESTIGATORS

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OBJECTIVE

Lactose present in Greek yogurt acid whey (GAW) has the potential to be transformed into value-added products such as sweeteners. The objectives of this project are to demonstrate a pilot-scale process to produce 200 liters of high-value glucose/galactose syrup (GGS) and milk minerals products from GAW and assess the process' economic potential. Further, this research will explore developing a process to convert the galactose component of GGS to tagatose, a high value, low calorie sweetener, at the lab scale.

BENEFIT TO INDUSTRY/FARMER

Increasing production of whey and milk protein powders as well as established market for Greek yogurt has concurrently led to increased production of co-product streams such as acid whey and milk permeates. It is imperative to find novel ways to utilize these "lactose rich" streams into value added products which will further lead to increasing the demand for dairy. The anticipated outcome of this project is to help realize the potential of GGS (made from dairy co-product streams such as acid whey and permeate) into various food applications thereby paving a path for the food industry to effectively utilize this derivative of dairy side streams. Additionally, such valorization will reduce the financial burden on local dairy businesses and address environmental stresses.

CONSUMER ACCEPTANCE OF LIQUID MF RETENTATES

ANTICIPATED COMPLETION: *2025*

INVESTIGATORS

MaryAnne Drake, Ph.D.[1] and Dave Barbano, Ph.D.[2]

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OBJECTIVE

Understanding consumer preference for protein beverages is essential for successful product development. This research focuses on evaluating flavored and unflavored protein beverages with minimal added sugar. These beverages will be made with liquid micellar casein concentrate (MCC) and milk protein concentrate (MPC) at varying protein concentrations. The insights from sensory profile and consumer acceptance evaluation will guide improvements in taste of protein beverages for expanded application.

BENEFIT TO INDUSTRY/FARMER

A key anticipated outcome of this project will be a digital dairy webpage that provides the industry with easy access to existing digital tools. Training will be provided for individuals affiliated with the dairy industry through office hours and workshops. This research will have a direct impact on dairy product quality and sustainability.

DEVELOPING TECHNICAL CAPABILITY FOR QUANTITATIVELY CHARACTERIZING MILK FOAMINESS, MILK FOAM STABILITY, AND MILK PROTEIN FRACTIONS

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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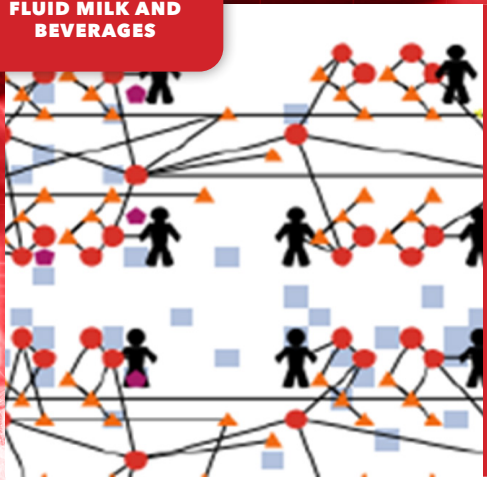
OBJECTIVE

Foam is an essential structure to diversified processed foods and beverages, in which milk components are used as foaming agents. Although milk foaminess and foam stability have been extensively studied, however, the mechanism and factors that govern milk foams are yet fully understood. The objective of this project is to study the effect of protein and fat content on dairy beverages' foaming and foam stability. This technical development will be a valuable addition to the dairy ingredient manufacturers in the US.

BENEFIT TO INDUSTRY/FARMER

Milk/dairy beverages as an ingredient, especially in beverages at food service and retail, is a growing category. The study aims to understand the influence of milk composition on foaming, a functionality that is desired in some beverage applications. The anticipated outcome of this project is to help aid the industry designing foaming dairy products with specific functionalities and applications, thereby driving sales in dairy.



DEVELOPMENT OF A DIGITAL DAIRY PLATFORM TO DRIVE DAIRY INNOVATION

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR
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OBJECTIVE

Digital tools are increasingly used in the food industry to drive innovation and to improve product development, process optimization, food safety, and sustainability. A digital twin is a virtual model (or twin) of an actual dairy system or processing line that can be used to understand a root cause of a problem or predict future changes in product quality before adjustments are implemented. The US dairy industry currently lacks a digital platform for developing and implementing digital twins as well as other digital tools. This objective of this project is to pilot digital tools that predict the impact of different changes and interventions on dairy product quality and to develop these tools so that they can be used as decision support tools by the industry.

BENEFIT TO INDUSTRY/FARMER

A key anticipated outcome of this project will be a digital dairy webpage that provides the industry with easy access to existing digital tools. Training will be provided for individuals affiliated with the dairy industry through office hours and workshops. This research will have a direct impact on dairy product quality and sustainability.

INVESTIGATION OF PLASMIN SYSTEM ACTIVITIES IN MILK PROTEIN FRACTIONS: TOWARDS APPLICATION OF HIGH PROTEIN BEVERAGES

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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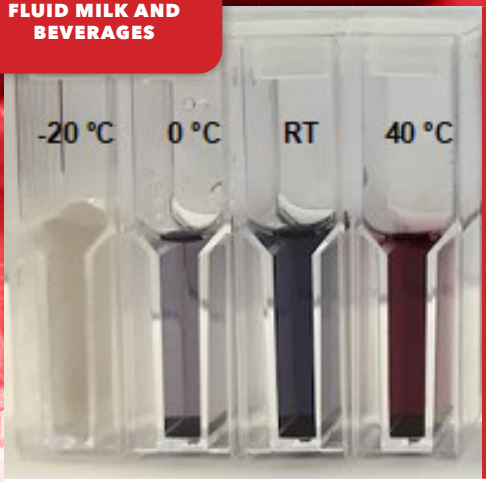
OBJECTIVE

A common industry problem with UHT milk and shelf-stable dairy protein beverages are undesirable quality defects such as sediments and gelation that develop during storage. Milk bovine enzymes (plasmin) are strongly associated with these defects. To ensure U.S. milk proteins are the preferred and reliable source of ingredients for use in ready-to-drink (RTD) protein beverages on a global scale, the knowledge about plasmin activity in MPC retentate and MPC powder is essential to MPC processors in the U.S. The objective of this project is to investigate the quality problems associated with (high-protein) shelf-stable dairy beverages with a focus on enzymatic activities.

BENEFIT TO INDUSTRY/FARMER

The anticipated outcome of this project is to provide baseline knowledge on behaviors of the plasmin system in MPC85 retentate and model high protein beverages. It will also provide data-based guidance to ingredient and food manufacturers regarding thermal inactivation of plasmin system in RTD protein beverages. This research will ensure U.S. milk proteins have a reputation of being high quality ingredients.



NANOMATERIALS-BASED TIME-TEMPERATURE INDICATORS FOR MONITORING THE QUALITY OF ASEPTIC MILK PRODUCTS

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

Consumers' decisions to consume or discard foods rely heavily on food-date labels such as "Best if used by". However, these conventional labels are not based on exact science and do not indicate if a product has been stored properly. Time-temperature indicators (TTIs), in contrast, can record the temperatures that the products have been exposed to, and for how long. So far, however, TTIs have been challenging for the food industry to adopt because they are costly and require extra work to tailor them to the complex differences among food products. Therefore, the goal of this project is to develop low-cost nanomaterials/biopolymer-based TTIs that provide consumers with non-reversible colorimetric information to help them monitor the quality of aseptic milk products.

BENEFIT TO INDUSTRY/FARMER

The main anticipated outcome of this project is a class of low-cost device suitable for monitoring the quality of aseptic milk products. Its success would give consumers a new way to assess the quality of their aseptic milk. Additionally, the project's results could potentially improve milk's long-term profitability by promoting consumers' trust in dairy products and the dairy industry.

PROCESSING AND INGREDIENT APPROACHES TO IMPROVE THE STABILITY OF HIGH PROTEIN UHT DAIRY BEVERAGES

ANTICIPATED COMPLETION: *2026*

INVESTIGATORS

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OBJECTIVE

High protein dairy beverages that are ultra-high-temperature (UHT) processed often experience instability issues, such as sedimentation during storage, raising consumer concerns. This project aims to identify effective processing and ingredient strategies to minimize sedimentation in high-protein UHT dairy beverages. The research investigates the effects of various preheat steps and explores using dairy calcium-binding ingredients as a natural solution to enhance product stability.

BENEFIT TO INDUSTRY/FARMER

The novel approaches improve the stability and shelf-life of high-protein UHT dairy beverages by addressing sedimentation using natural ingredients. The findings will enable dairy producers to offer products with consistent quality, fostering consumer trust to drive sales and strengthening international market position.

PROOF-OF-CONCEPT: A THERMOELECTRIC-BASED MULTI-PASS HEAT EXCHANGE TECHNOLOGY FOR DECARBONIZING AND ELECTRIFYING MILK PASTEURIZATION

ANTICIPATED COMPLETION: *2025*

INVESTIGATORS

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OBJECTIVE

The project aims to develop a ThermoElectric-based Multi-Pass (TEMP) heat exchange technology for decarbonizing and electrifying milk pasteurization. It will be achieved by creating a complete system that emulates commercial operation conditions and optimizes energy efficiency by incorporating power supplies, pumps, and system control. The TEMP technology actively transfers heat from pasteurized hot milk to raw cold milk, significantly minimizing the need for additional heating and cooling media, thereby reducing process complexity and cost.

BENEFIT TO INDUSTRY/FARMER

The project aims to deliver a fully operational TEMP heat exchange system evaluated against conventional High-Temperature-Short-Time (HTST) system in terms of processing efficacy, system reliability, and energy efficiency. This research will validate the proof of concept, demonstrating that the TEMP system is a more sustainable alternative method for dairy industry to save energy and water during operation with reduced complexity and costs. The technology is also suitable for on-farm milk pasteurization without using steam.

THE ROLE OF PH AND MINERAL SALTS ON HEAT STABILITY AND ACID GELATION OF COMMERCIAL LIQUID AND DRIED MPC

COMPLETED

INVESTIGATORS

MaryAnne Drake, Ph.D.,[1] and David Barbano, Ph.D.[2],

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OBJECTIVE

Protein beverages continue to increase in popularity and many of these ready-to-drink (RTD) beverages can be made from a variety of protein sources. Milk proteins are popular due to their high heat stability and functionality but there is little published work on using blended dairy proteins, or a specific unit operation, or additives to promote heat stability. This objective of this project is to investigate how pH adjustment and salts (native or supplementary) affect the heat stability and acid gelation of commercial liquid and dried MPC.

BENEFIT TO INDUSTRY/FARMER

The anticipated outcome of this project is to understand the differences in heat stability between liquid and spray dried powders, how those differences vary among manufacturers, and how mineral salts and the acidic environment impact the physical properties of these ingredients when used in heat stable beverages. This work will expand the application of dairy proteins in ready-to-drink beverages.

RELEVANT PUBLICATIONS

Hoyt HM, Pranata J, Barbano DM, and Drake MA. 2023. Effect of dipotassium phosphate and heat on milk protein beverage viscosity and color. J. Dairy Sci. 106.

Pranata, J., Hoyt, H., Drake, M.A. and Barbano, D.M. 2023. Effect of dipotassium phosphate addition and heat on proteins and minerals in milk protein beverages. J. Dairy Sci. 107:695-710.

THE ROLE OF SOLUBLE MILK COMPONENTS ON HEAT STABILITY OF MILK PROTEIN BEVERAGES

ANTICIPATED COMPLETION: *2026*

INVESTIGATORS

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OBJECTIVE

With the rising demand of high protein dairy beverages, its heat stability remains a challenge. The project aims to identify specific milk components that contribute to thermal stability and determine critical points during filtration where heat stability declines. A novel approach will be developed using these components to refine filtration process, improving shelf stability and quality of milk protein beverages without relying on additives.

BENEFIT TO INDUSTRY/FARMER

The research focuses on enhancing the heat stability of high-protein milk beverages. It enables innovation in dairy processing technology, ensuring consistent product quality and extended shelf life. The improved approach supports the development of additive-free options to enhance consumer trust in high-quality and safe dairy products.

UNDERSTANDING THE BASIC TASTES AND FLAVOR PROPERTIES OF LIQUID SKIM UF RETENTATES

ANTICIPATED COMPLETION: *2025*

INVESTIGATORS

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OBJECTIVE

The removal of lactose and soluble minerals during milk ultrafiltration (UF) causes a flavorless profile in the retentates, lacking characteristic milk flavor. The project aims to restore basic tastes and aromatic notes associated with skim milk by reintroducing permeates back to the retentates. To achieve this, liquid milk protein concentrate (MPC) at various concentrations will be formulated into milk beverages and assessed for sensory quality and consumer acceptance. The research will clarify the impact of lactose and minerals in flavor profile of UF retentates.

BENEFIT TO INDUSTRY/FARMER

Understanding the flavor contributions of lactose and minerals will improve the sensory quality of skim UF retentates. By enhancing the milk flavor in the retentates, the dairy industry can develop more flavorful and appealing protein beverages to build greater trust with consumers seeking both taste and nutrition.

ASSESSING AN ENVIRONMENTAL LISTERIA STRAIN FOR ITS ABILITY TO SURVIVE AND FORM BIOFILMS IN THE PRESENCE OF BACKGROUND MICROFLORA ISOLATED FROM DAIRY PROCESSING ENVIRONMENT

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

Listeria monocytogenes is a foodborne pathogen that can thrive and develop in a wide range of environments that provide adequate nutrients and water. They are also resilient to and protected from extreme environmental stresses such as sanitizers and disinfectants used in dairy processing plants because of their ability to form biofilms. The cross contamination of finished food products due to *L. mono* is a major concern. The objective of this study is to understand the persistent nature of *L. mono* and develop a biosurfactant of bacterial origin for preventing persistence of Listeria in dairy plants through limiting its biofilm forming ability.

BENEFIT TO INDUSTRY/FARMER

This project will aid in designing effective Listeria control strategies in the dairy industry, which would help to reduce the risk of environmental Listeria strains turning into persistent or resident strains and posing a risk of cross contaminating the processed products leading to potential outbreaks and expensive product recalls.

UNDERSTANDING CRONOBACTER DIVERSITY, DISTRIBUTION, AND ECOLOGY TO INFORM CRONOBACTER CONTROL STRATEGIES IN THE DAIRY INDUSTRY

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

This project is designed to help the dairy industry to more effectively control *Cronobacter*, by providing a better understanding of *Cronobacter* prevalence and diversity in natural, urban, and rural environments, which will provide improved information on sources and reservoirs of *Cronobacter*. This research will also provide a comprehensive WGS database for *Cronobacter* from non-food sources, which will be valuable for interpreting WGS findings and for defining *Cronobacter* species and subtypes that differ in their ability to cause infections in infants.

BENEFIT TO INDUSTRY/FARMER

While *Cronobacter* only causes a very small number of human infections, it represents a major concern for the dairy industry, including due to the severity of the disease it causes in infants. The key significance of this project is that it will provide the dairy industry with improved knowledge to facilitate risk-based approaches to control *Cronobacter*. This knowledge will not only be important to assure the public and regulators that the dairy industry is addressing *Cronobacter*, but also is essential to allow industry to effectively control *Cronobacter* in their facilities and products.

EFFECT OF BIOPROTECTIVE CULTURES ON LISTERIA MONOCYTOGENES IN MILK AND HIGH MOISTURE CHEESE

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

Listeria monocytogenes contamination continues to pose a threat to cheese safety, especially for high moisture cheeses. Due to restrictions on the use of most antimicrobial interventions imposed by the Standard of Identity for cheese, and the emerging consumer demand for safe, yet minimally processed cheese, the development and validation of more natural control measures are needed. The objective of this project is to determine the efficacy of commercially available protective bacterial cultures to control *Listeria monocytogenes* in milk and high moisture cheese. We hypothesize that this inhibitory effect will be greater than that of other protective cultures on the market.

BENEFIT TO INDUSTRY/FARMER

The US dairy industry has a long reputation of unsurpassed safety. However, occasional outbreaks still occur, particularly with high moisture cheese. Applications from this work can be utilized by high-risk cheese manufacturers to reduce risk in compliance with the Food Safety Modernization Act. The anticipated outcome of this research is to help ensure the safety of high moisture cheeses thereby upholding the reputation and consumer confidence in the dairy industry to provide safe, nutritional products resulting in sustained or increased consumption of dairy products.

IMPROVING OUTCOMES IN DOMESTIC AND EXPORT MARKETS BY PREPARING THE US DAIRY INDUSTRY TO ADDRESS MICROBACTERIUM, AN EMERGING BACTERIAL CONTAMINANT OF CONCERN

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

Microbacterium is a bacterial contaminant found throughout the dairy product continuum that represents an emerging concern for dairy product quality and conformance. *Microbacterium* exhibits characteristics that allow it to persist in milking and dairy processing equipment, survive extreme heat treatments, and impact dairy products. The objective of this research is to establish a single gene sequencing target for subtyping *Microbacterium*, evaluate the survival and spoilage potential of a standard set of *Microbacterium* that can be utilized for future research, and ultimately provide guidance for identifying, monitoring, and tracking *Microbacterium* to improve outcomes.

BENEFIT TO INDUSTRY/FARMER

Microbacterium represents an emerging microorganism that is a key risk to dairy product quality and conformance. In order to prepare the US dairy industry to combat this organism across the dairy continuum from the farm through processing, and in a variety of products including fluid milk, cheese, and powders, development of knowledge and tools is necessary. The anticipated outcome of this work is to provide the dairy industry with the tools needed to understand risks and outcomes associated with *Microbacterium*.

UTILIZATION OF THE NOVEL ATMOSPHERIC COLD PLASMA TECHNOLOGY FOR CONTROLLING LISTERIA MONOCYTOGENES IN BRINE SOLUTION AND PROCESSING EQUIPMENT

ANTICIPATED COMPLETION: *2025*

INVESTIGATORS

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[2] University of Wisconsin – Madison, Madison, WI

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OBJECTIVE

Listeria monocytogenes is one of the major foodborne pathogens in ready-to-eat foods, including dairy. Hence, it is important to control *L. monocytogenes* in the dairy industry. Currently, there is no effective method to eliminate post-pasteurization *L. monocytogenes* contamination during dairy processing. The objective of this research is to utilize novel nonthermal high voltage atmospheric cold plasma (HVACP) technology to eliminate *L. monocytogenes* contamination in brine solutions by producing high concentrations of reactive gas species (RGS) that are highly bactericidal. It is expected that HVACP-treated brine solution will inhibit the growth of L. monocytogenes and spoilage microorganisms in brined cheeses with minimal changes to the cheese quality.

BENEFIT TO INDUSTRY/FARMER

The completion of this project would allow the reduction of post-pasteurization *L. monocytogenes* contamination by cold plasma treatment, which can improve the safety and prolong the shelf-life of dairy products. It is expected that HVACP treatment will efficiently eliminate *Listeria* in brine solutions. Moreover, the HVACP-treated brine solutions could inhibit the growth of *Listeria* and spoilage microorganisms in brined cheese with minimal changes in cheese qualities. The successful delivery of a pathogen-free product with extended shelf-life would ensure the health of consumers, reduce the loss due to spoilage deterioration, and help build trust in dairy.

AN ALTERNATIVE APPROACH TO PRODUCE SUGAR-FREE HIGH PROTEIN INGREDIENTS: CONVERTING RESIDUAL LACTOSE INTO LACTOBIONIC ACID

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

The project aims to develop a method to produce sugar-free, high-protein dairy ingredients by converting residual lactose into lactobionic acid (LBA) using lactose oxidase (LOX). Unlike the traditional lactase hydrolysis, the novel approach eliminates the galactose production and minimizes water use. The research focuses on optimizing the enzymatic conversion in high-protein systems and enhancing the understanding of the chemical and functional properties of the resulting milk protein concentrate (MPC).

BENEFIT TO INDUSTRY/FARMER

The anticipated outcome of this study is to produce commercially viable, lactose-free, high-protein dairy ingredients that can be used in various food products, particularly in high-protein beverages and cheese. Developing a cost-effective and sustainable production method for sugar-free dairy ingredients with improved sensory and storage stability will support the dairy industry with innovative products that address the demands for health-conscious consumers.

APPLICATION OF COLD PLASMA TECHNOLOGY IN MANUFACTURING MILK PROTEIN CONCENTRATE: AN INVESTIGATION OF CRITICAL CONTROL PARAMETERS AND INGREDIENT FUNCTIONALITIES

ANTICIPATED COMPLETION: *2026*

INVESTIGATORS

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OBJECTIVE

Milk protein concentrates (MPC) are widely utilized for its functional benefits. Technological advancements are essential to further improve its functionality and stability for enhancing appeal across diverse food applications. The project explores to integrate atmospheric pressure cold plasma (ACP) and plasma-activated water (PAW) into MPC processing. The research focuses on establishing optimized protocol for using cold plasma technology in the production of MPC with improved functional properties.

BENEFIT TO INDUSTRY/FARMER

Advancing dairy processing with cold plasma technology enhances the quality and functionality of MPC, improving its solubility, stability, emulsifying/foaming properties and gelation performance. This innovation supports the development of scientifically enhanced dairy ingredients to boost consumer confidence and strengthen market competitiveness, meeting the growing demand for high quality and nutritious products with extended shelf life.

DETERMINATION OF MILK COAGULATION AND GELATION PROPERTIES BY HIGH FREQUENCY ULTRASOUND WAVE SPEED AND AMPLITUDE CHANGES

ANTICIPATED COMPLETION: *2026*

INVESTIGATORS

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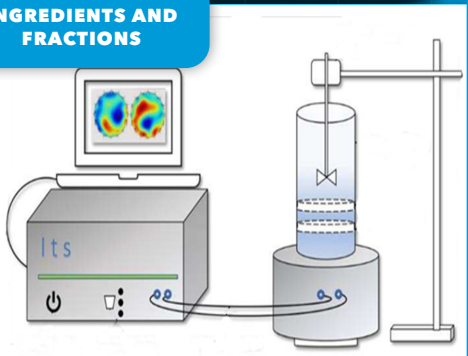
OBJECTIVE

Gelation is essential for traditional dairy products like yogurt and cheese. However, unintended coagulation creates challenges in high protein beverages, affecting their stability during processing and storage. The project aims to develop a non-destructive method for the early detection of milk coagulation and gelation in milk protein beverages using high-frequency ultrasound transducers. The method will be tested for its effectiveness across different processes, including gelation induced by acid and enzymes, and thermal coagulation.

BENEFIT TO INDUSTRY/FARMER

The early detection method will help dairy producers improve shelf-life stability and product quality. It will enhance consumer satisfaction and confidence in the product safety and consistency, leading to increased consumption and stronger market presence for dairy products.



WATER ADSORPTION METER, AMAMCHARLA

DEVELOPMENT AND VALIDATION OF A SIMPLE AND RAPID WATER ADSORPTION KINETICS-BASED APPROACH TO MEASURE SOLUBILITY OF DAIRY POWDERS

COMPLETED: *2024*

INVESTIGATOR

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OBJECTIVE

High protein milk ingredients such as MPC can not only play a major role in creation of "clean label" ingredients to enhance the consumer experience but also satisfy the high protein trend. Moreover, they are one of the major ingredients for export growth. The objective of this project is to use the concept of water activity to develop a rapid (in process) method to evaluate the final solubility of high protein dairy ingredients.

BENEFIT TO INDUSTRY/FARMER

This project will deliver a dual purpose for high-protein dairy powder manufacturers in the United States. They can use the system for both adjusting drying parameters during powder production as well as rapid hydration testing thereby not only enhancing final powder quality, but also capabilities of U.S. processors to deliver tailor made products for various applications for the global marketplace.

ENGINEERING HMO BIOSYNTHESIS IN L. ACIDOPHILUS FOR PEDIATRIC GASTROINTESTINAL HEALTH

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

The cost of purified or synthetic human milk oligosaccharides (HMOs) limits their use for food applications, despite their potential to support the development and intestinal microbiome of the infants. Microbial biosynthesis of HMOs via fermentation offers a cost-effective solution. The project aims to engineer Lactobacillus acidophilus for the biosynthesis of HMO 2′-fucosyllactose (2′-FL) through the addition of new metabolic genes that can carry out the necessary steps to build 2′FL from lactose. This work will establish a new platform to synthesize HMOs with increased efficiency and scalability for potential commercialization in the dairy industry.

BENEFIT TO INDUSTRY/FARMER

The engineered Lactobacillus acidophilus provides a scalable and sustainable platform for biosynthesis of HMOs. This innovation supports the dairy industry to access the nutritional benefits of human breast milk to improve pediatric health. The research outcome enables dairy product innovation with improved functionality and nutrition, positioning the dairy industry as a provider of advanced, health-promoting food products.

ENHANCING HEAT STABILITY OF WHEY PROTEINS VIA ENZYMATIC DEAMIDATION FOR BEVERAGE APPLICATION

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

Whey proteins in low acid protein beverage denature and aggregate during pasteurization. This leads to undesirable turbidity and sedimentation. The project explores enzymatic deamidation as a green, scalable method to increase the surface change and enhance thermal stability of whey proteins. It allows the development of clear, low-acid protein beverages. This approach will also be applied to develop whey protein powders with improved heat stability for potential commercialization.

BENEFIT TO INDUSTRY/FARMER

This innovation eliminates the restrictions on applying whey protein ingredients in low-acid protein beverages. It allows dairy producers to develop stable, clear protein beverages without the need for stabilizers. The research creates opportunities for new product segments, facilitating market growth and consumer trust in dairy protein-based products.

ENZYMATIC APPROACH TO TAILOR FUNCTIONAL PROPERTIES OF DAIRY INGREDIENTS

ANTICIPATED COMPLETION: *2025*

INVESTIGATORS

Prafulla Salunke, Ph.D.[1] and Jayendra Amamcharala, Ph.D.[2]
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[2] University of Minnesota, St. Paul, MN
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OBJECTIVE

Poor solubility of milk protein concentrate is a big challenge for dairy ingredient manufacturers, as high protein formulations are rising in popularity. This poses a challenge for high protein dairy product viscosity, drinkability, and shelf-life. Enzymes have potential to hydrolyze milk proteins and alter their functionality. The objective of this project is to optimize enzymes, specifically chymosin and other commercially available proteases to selectively hydrolyze caseins in milk protein concentrates, Isolates, and Micellar Casein ingredients and study the effects on the final functionality of these modified ingredients.

BENEFIT TO INDUSTRY/FARMER

Although, dairy protein ingredients are one of the most functional ingredients available in the marketplace for development of high-quality foods, one of the key challenges with current dairy protein ingredients is their limited functionality when used at higher levels in dairy and food products to venture beyond traditional high protein foods. This project attempts to resolve that challenge using enzymes to modify dairy protein functionality, thereby helping increase the utilization of dairy protein ingredients.

EVALUATING PULSED ELECTRIC FIELD TECHNOLOGY TO IMPROVE THE EFFICIENCY OF WHEY PROTEIN POWDER PRODUCTION

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

The primary method for processing liquid whey to powder is spray drying. However, this method energy intensive, and suffers from challenges with viscosity and solubility as the product is concentrated. This objective of this project is to reduce drying energy and improve the physical properties of whey protein powders. Pulsed electric field (PEF) technology will be utilized prior to spray drying whey protein concentrates (WPC) and isolates (WPI) with the intent of introducing higher solid content streams into spray dryers at reduced solution viscosity.

BENEFIT TO INDUSTRY/FARMER

WPC and WPI are important products for the U.S. dairy industry. Technologies to enhance the efficiency and quality of processing of WPC and WPI will amplify competitiveness for U.S. dairy products in the global marketplace, leading to expanded dairy market share. This research project will generate data required to calculate the return on investment for the adoption of PEF equipment to sustainably generate whey powder products.

This project is co-funded Dairy West through the BUILD program.

FUNCTIONAL ENHANCEMENT OF MILK PROTEIN CONCENTRATES WITH AGGREGATED WHEY PROTEINS FOR CONTROLLING VISCOSITY IN HIGH PROTEIN FERMENTED PRODUCTS

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

This project aims to solve textural issues associated with higher protein fermented dairy products by developing a novel milk protein concentrate. In the proposed project, whey protein-whey protein interactions are encouraged leading to microparticulated whey proteins (Micro-WP). Developed Micro-WP will be added back to microfiltration retentate to create a novel milk protein concentrate containing Micro-WP. This would help reducing the viscosity of high protein fermented beverages.

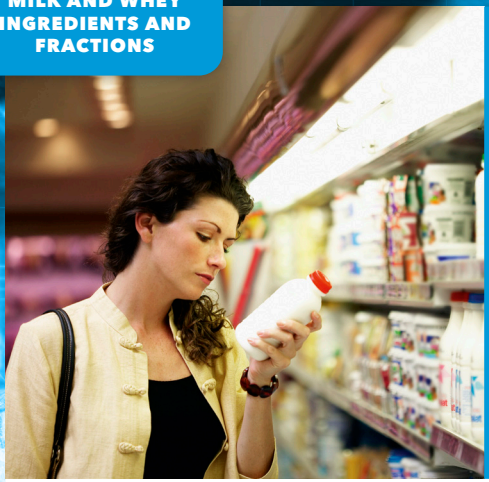
BENEFIT TO INDUSTRY/FARMER

High protein is a growing trend in the dairy and food industry. Additionally, the "clean label" and natural food movements are driving consumer trends. This project will deliver "clean label" dairy ingredient solutions to help deliver higher protein yogurt and yogurt based products to meet consumer demands.

RELEVANT PUBLICATIONS

Rathod, G., Amamcharla, J., 2024. Milk Whey Protein Fibrils–Effect of Stirring and Heating Time. Foods 13, 466.

Rathod, G., Kapoor, R., Meletharayil, G.H., Amamcharla, J.K., 2023. Development of spray dried functional milk protein concentrate containing whey proteins as fibrils. International Dairy Journal 145, 105719.



MAPPING AND IMPROVING FUNCTIONAL PROPERTIES OF PROCREAM FOR CLEAN-LABEL APPLICATIONS

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

The primary method for processing liquid whey to powder is spray drying. However, this method energy intensive, and suffers from challenges with viscosity and solubility as the product is concentrated. This objective of this project is to reduce drying energy and improve the physical properties of whey protein powders. Pulsed electric field (PEF) technology will be utilized prior to spray drying whey protein concentrates (WPC) and isolates (WPI) with the intent of introducing higher solid content streams into spray dryers at reduced solution viscosity.

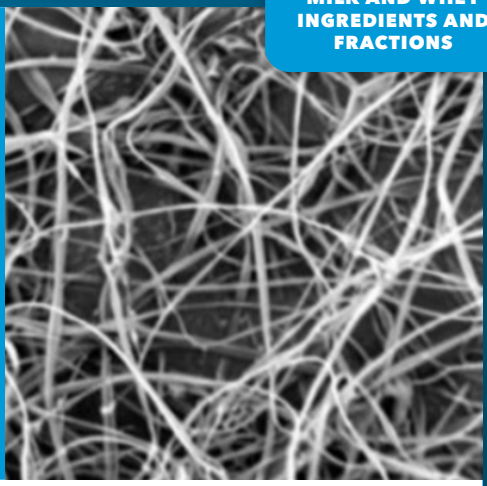
BENEFIT TO INDUSTRY/FARMER

WPC and WPI are important products for the U.S. dairy industry. Technologies to enhance the efficiency and quality of processing of WPC and WPI will amplify competitiveness for U.S. dairy products in the global marketplace, leading to expanded dairy market share. This research project will generate data required to calculate the return on investment for the adoption of PEF equipment to sustainably generate whey powder products.

This project is co-funded Dairy West through the BUILD program.

MILK TEXTILES: ELECTROSPINNING OF NEAT CASEIN NANOFIBERS

COMPLETED



INVESTIGATORS

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OBJECTIVE

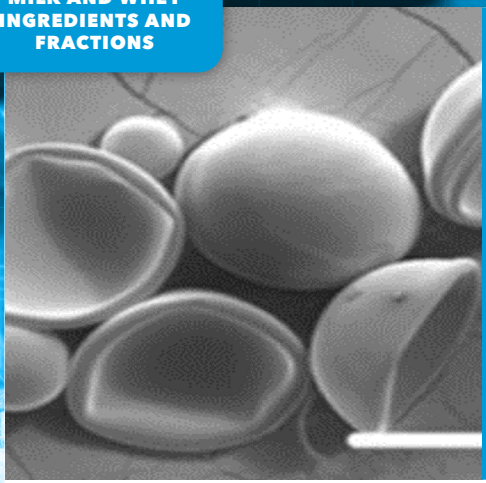
Electrospinning is a cost-effective, scalable technology that produces nanofibers with broad applications in the biomedical, cosmetic, food, and pharmaceutical industries. Electrospinning casein proteins into "clean label" fibers would allow product developers to use them directly in product formulations without adding other polymers or harsh solvents that render the product not "clean label." The objective of this project is to electrospin pure casein into dynamic, flexible fibrous mats that are biocompatible and biodegradable.

BENEFIT TO INDUSTRY/FARMER

The anticipated outcome of this research is to push forward cutting-edge research that leverages electrospinning as a new technology to keep the U.S. dairy industry at the forefront of innovation. This will greatly expand the scope of functional raw dairy materials into the biomedical and food packaging industries.

RELEVANT PUBLICATIONS

Sharma, D., Ziegler, G.R. and Harte, F.M.*, 2024. Ethanol-mediated electrospinning of casein-only bead-free nanofibers. Food Hydrocolloids, 148, p.109503.



MITIGATE THE ASTRINGENCY OF WHEY PROTEIN THROUGH COMPLEXATION AND ENCAPSULATION TECHNIQUES

COMPLETED

INVESTIGATOR

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OBJECTIVE

Astringency is an undesirable dryness or puckering sensation that is commonly associated with whey proteins and acidic beverages that negatively affects consumer acceptance. The goal of this project is to create microgel particles by encapsulating whey proteins in polysaccharides to help mask the undesirable bitterness or astringency when proteins interact with salivary proteins. These microgels will also allow a higher concentration of whey proteins to be formulated into acidic beverages for greater nutritional benefit.

BENEFIT TO INDUSTRY/FARMER

The anticipated outcome of this project is to make whey protein isolates (WPI) more accessible to be formulated in a broad range of beverages and food products. The increased consumer acceptance would increase the consumption of whey protein-based products, thus promoting its sales and market sizes.

MOLECULAR BASIS OF BITTERNESS OF WHEY PROTEIN HYDROLYSATES

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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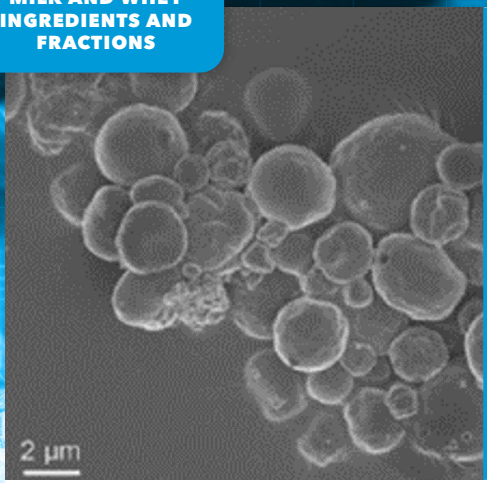
OBJECTIVE

Whey protein hydrolysate (WPH) is a key ingredient from the dairy industry that finds value added uses in foods, specifically foods and beverages developed for the sports nutrition market such as high protein bars and beverages. One of the key issues with using WPH is that it leads to a bitter taste in foods thereby limiting its use. The objective of this project is to identify TAS2R receptors on human tongue mediating the bitter taste of WPH and bitter-tasting peptides in WPH. This research aims to identify and develop blockers for WPH-activated bitter receptors to improve the taste and palatability of dairy and food products.

BENEFIT TO INDUSTRY/FARMER

The identification of bitter taste receptors and subsequent design of bitter blockers would help increase consumer acceptability of WPH, and promote the use of WPH in product formulations. This project can help overcome sensorial hurdles and help increase the sale and utilization of WPH and consequently the demand of high protein dairy ingredients.



PILOT SCALE PRODUCTION AND PRODUCT APPLICATION OF ENCAPSULATED TRYPTOPHAN NANOPARTICLES

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

Acidic whey protein (WP) beverages are an appealing protein delivery system because they require relatively mild heat treatment (compared to neutral beverages) to make them shelf stable. However, it is challenging to enrich acidic beverages with WP and essential amino acids because they are sensitive to heat and produce undesirable characteristics such as cloudy appearance and gritty mouthfeel. This project will explore the behavior of a newly created tryptophan (Trp)-rich dairy ingredient in acidic beverages and provide a technoeconomic feasibility study for manufacturing this ingredient in a commercial setting.

BENEFIT TO INDUSTRY/FARMER

This project will conduct pilot and techno-economic feasibility studies for the large-scale production of encapsulated Trp nanoparticles. The NP are expected to help the industry improve the stability and reduce bitterness of heat-treated protein beverages and at the same time provide a health benefit to consumers who wish to improve their sleep quality, and mental health.

RELEVANT PUBLICATIONS

Huang, Y., Mosleh, I., & Abbaspourrad, A. 2022. Impact of protein/peptide templates on metallic nanoparticle synthesis and applications. Nano-Structures & Nano-Objects, 30, 100864.

Dong, H., Yang, L., Dadmohammadi, Y., Li, P., Lin, T., He, Y., Zhou, Y., Li, J., Meletharayil, G., Kapoor, R., Abbaspourrad, A., 2024. Investigating the synergistic effects of high-pressure homogenization and pH shifting on the formation of tryptophan-rich nanoparticles. Food Chemistry 434, 137371.

PILOT SCALE PRODUCTION AND PRODUCT APPLICATION OF LACTOFERRIN COMPLEXES

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

Lactoferrin is an iron-binding multifunctional protein that occurs in many biological secretions, including bovine milk. Lactoferrin is commonly added into many commercial products such as nutritional supplements, infant formulas, cosmetics, and toothpaste because it possesses many beneficial properties for human health. One of the drawbacks of lactoferrin is that it is heat labile and loses its bioactive benefits after heat treatment. This limits its use in food products that undergo heat treatment such as pasteurization. Previously funded work showed successful development of novel lactoferrin complexes to overcome this challenge on bench top. The current study aims to scale up the novel process to industrial commercialization and examine its thermal and sensory properties in dairy-based beverages.

BENEFIT TO INDUSTRY/FARMER

The anticipated outcome of this study is to commercialize the novel technology that was successfully developed from previous work and create lactoferrin complexes, that are heat stable, and render it ready for industry adoption. This scalable technology will enable lactoferrin to be utilized in novel dairy applications and meet consumer needs.

RELEVANT PUBLICATIONS

Lin T, Dadmohammadi Y, Davachi SM, Torabi H, Li P, Meletharayil G. Kapoor R, and Abbaspourrad A. 2022. Improvement of lactoferrin thermal stability by complex coacervation using soy soluble polysaccharides. Food Hydrocolloids. 131:107736.

Lin, T., Zhou, Y., Dadmohammadi, Y., Yaghoobi, M., Meletharayil, G., Kapoor, R., Abbaspourrad, A., 2023. Encapsulation and stabilization of lactoferrin in polyelectrolyte ternary complexes. Food Hydrocolloids 145, 109064.

Lin, T., Dadmohammadi, Y., Abbaspourrad, A., Zhou, Y., Dong, H., Meletharayil, G.H., Nashed, E.S., Kapoor, R., 2023. Protein and Biopolymer Complexes and Methods of Making and Using the Same. WO 2023/225491 A1

Lin T., Dadmohammadi Y., Abbaspourrad A., Zhou Y., Meletharayil G.H., Nashed E.S., Kapoor R., 2024. Lactoferrin Complexes, Compositions Comprising the Same, and Methods of Making and Using the Same. WO 2024/086768 A1

RATIONAL DESIGN OF WHEY PROTEIN SELF-ASSEMBLIES FOR PICKERING STABILIZATION AT OIL-WATER INTERFACE

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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OBJECTIVE

Microparticulated whey protein has been available in the market; however, newly produced sub-micron whey protein particles display unique functionalities in gelation and interfacial stabilization. These recent discoveries shine a light on pathways to new application opportunities for whey protein. This project aims to build and elucidate functionalized whey protein particles using advanced techniques.

BENEFIT TO INDUSTRY/FARMER

The outcomes will provide dairy ingredient manufacturers with essential knowledge and technical capabilities for a rational design of functionalized whey protein ingredients for tailored Pickering stabilization. This work will help develop advanced capabilities for the U.S. dairy industry to deliver tailor made whey proteins to deliver innovative products for consumers in various growth spaces such as health and wellness, “clean label”, and high protein.

SCALABLE AND COST-EFFECTIVE LIQUID SHEAR-DRIVEN FABRICATION OF MESOSCOPIC WHEY PROTEIN ASSEMBLIES

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

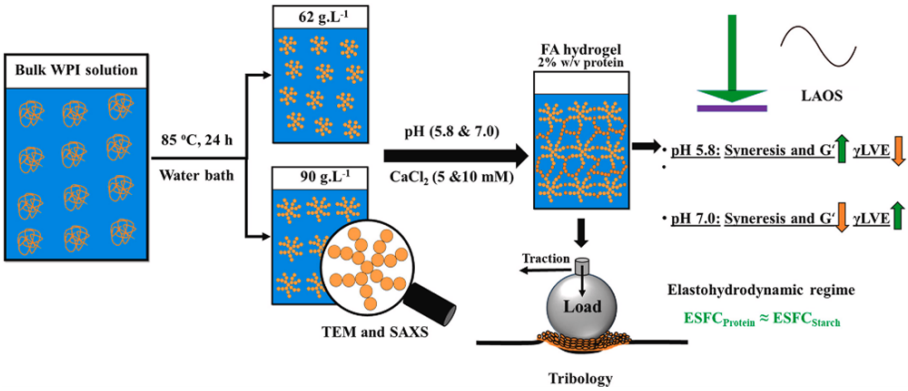
Whey protein particles with fractal dimensions may be used for multiple purposes in various food matrices such as interface stabilization and improving heat stability, and to reduce the viscosity of high protein food products. The goal of the project is to develop scalable manufacturing technology for mesoscopic-scale whey protein assemblies (MWPA) with unique heat stability and emulsion stabilizing functionality to be used as an ingredient by food manufacturers.

BENEFIT TO INDUSTRY/FARMER

The anticipated outcome of this study is to produce a feasible technology for MWPA fabrication that can be used by ingredient manufacturers in the U.S. without major modifications of their plants. The resultant MWPA ingredients will have unique and enhanced functionalities over whey protein isolates (WPI) in terms of heat treatment related physicochemical stability and emulsion/foam stabilization capacities.

SOFT MATTER STRATEGY FOR CREATING NOVEL FOOD TEXTURIZER: REPLACEMENT OF STARCH USING WHEY PROTEIN AGGREGATES AND AGGREGATES STABILIZEDOIL/WATER PICKERING EMULSION DROPLETS

ANTICIPATED COMPLETION: *2025*



INVESTIGATOR

Haotian Zheng, Ph.D. North Carolina State University, Raleigh, NC
Email: Haotian.zheng@ncsu.edu

OBJECTIVE

There is potential for whey protein to replace starch based thickeners in food applications, under the proper conditions. The objective of this project is to perform scalable interventions to whey proteins using pH, temperature, and salts to modify their structure and consequently functional properties so that whey proteins are effective in mimicking the functionality of food starches in various applications such as high protein yogurts.

BENEFIT TO INDUSTRY/ FARMER

High protein and clean label continue to remain strong consumer trends. Whey is uniquely positioned to support these growing consumer trends. This project will help deliver novel whey protein-based ingredients that can play a larger role in the clean label space, and at the same time, providing protein levels required in high protein foods. This will help increase the demand for dairy products and ingredients.

RELEVANT PUBLICATIONS

Amin, U., Lin, Y., Zuo, X., Zheng, H., 2024. Soft matter approach for creating novel protein hydrogels using fractal whey protein assemblies as building blocks. Food Hydrocolloids 151, 109828.

TAILORING STRATEGIES TO RETAIN THE INTRINSIC MILK FLAVOR IN HIGH PROTEIN SYSTEMS

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

The increasing consumer demand for nutritious and healthier products is driving the growth of high-protein dairy beverages (HPDB). Delivering high-quality beverages with enhanced milk flavor profile is essential for successful product development and consumer acceptability. The challenge with increasing protein content is that it tends to reduce sweetness and affects the flavor profile. This project aims to enhance the milk flavor in HPDB. The research focuses on understanding the influence of processing parameters on the flavor of milk protein concentrates (MPC) to guide ingredient development with improved flavor profile in high-protein applications.

BENEFIT TO INDUSTRY/FARMER

The research aims to enhance understanding of key factors influencing MPC flavor and provide guidance on ingredient development to improve taste and acceptance of high-protein products. It will benefit consumers with nutritious and tasty options, help the industry foster dairy product innovation and support the broader application of dairy ingredients.

THE ROLE OF MILK PROTEIN FRACTION, BEVERAGE HEAT TREATMENT AND ADDED INGREDIENTS ON FLAVOR BINDING IN READY-TO-DRINK PROTEIN BEVERAGES

ANTICIPATED COMPLETION: *2025*

INVESTIGATORS

MaryAnne Drake, Ph.D.[1], Dave Barbano, Ph.D.[2] and Haotian Zheng, Ph.D.1
[1] North Carolina State University, Raleigh, NC
[2] Cornell University, Ithaca, NY
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OBJECTIVE

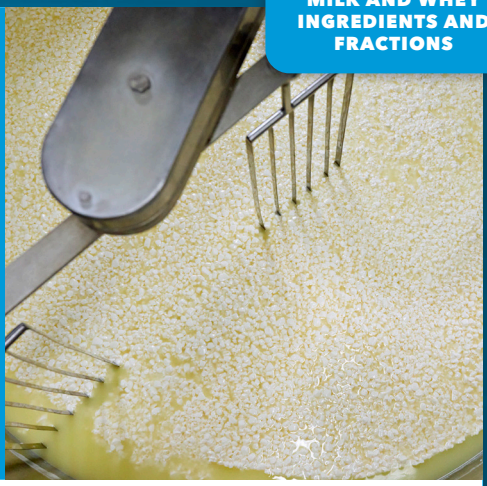
The aim of this project is to determine the critical factors that influence interactions between dairy proteins and added flavors, particularly in ready-to-drink (RTD) protein beverages. The research will investigate the effects of protein concentration, types of milk protein, heat treatment and chelating salt on protein-flavor binding in RTD protein beverage systems. Unique approaches combining instrumental and sensory methods will be applied to effectively optimize flavor of high protein foods.

BENEFIT TO INDUSTRY/FARMER

The actionable insights enable the dairy industry to improve the flavor profiles of high-protein drinks, enhancing consumer satisfaction and product appeal. The project delivers practical strategies to support the development of more flavorful and stable dairy beverages, strengthening brand trust and driving market growth.

TITANIUM DIOXIDE FOR RECOVERING PROTEINS AND PHOSPHOLIPIDS FROM CHEESE WHEY

ANTICIPATED COMPLETION: *2026*



INVESTIGATOR

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OBJECTIVE

Conventional purification technologies in the dairy industry are expensive and time-consuming in terms of sanitation and regeneration. The project aims to address these limitations using titanium dioxide (TiO2) for the efficient recovery of proteins and phospholipids from cheese whey. The research focuses on evaluating the adsorption/desorption capability of TiO2 and establishing novel purification processes to improve both product yield and purity.

BENEFIT TO INDUSTRY/FARMER

The novel approach offers a more efficient and cost-effective method for purifying whey proteins and phospholipids, leading to significant benefits for the dairy industry. By providing higher-purity, value-added dairy ingredients, the project enhances the utilization of whey and broadens its application in diverse sectors.

TRANSFORMING HIGH PRESSURE JET (HPJ) PROCESSING INTO A COMMERCIALLY VIABLE TECHNOLOGY FOR THE DAIRY INDUSTRY

ANTICIPATED COMPLETION: *2025*

INVESTIGATORS

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OBJECTIVE

High Pressure Jet (HPJ) processing is nonthermal technology that is used in non-food applications (i.e., waterjet cutting) but it is not currently used in the dairy industry. Research shows that HPJ is effective in creating unique functional properties (stabilization, foams, emulsification) in dairy products that are not possible using traditional processing operations or without using additives such as carrageenan or other stabilizing ingredients. This project will use HPJ to enhance or create unique physicochemical properties in milk beverages and powders for clean label dairy foods and ingredients and to help drive this processing technology into the dairy industry.

BENEFIT TO INDUSTRY/FARMER

The anticipated outcome of this project is to show the uniqueness of HPJ processing in creating clean label dairy products and help push this nonthermal technology into a high throughput processing option for the dairy industry. The chocolate milk from this research will be commercialized through the Berkey Creamery at Penn State University. Novel milk powder functionality will benefit the export dairy industry by creating dairy ingredients for high end applications and clean-label milk products that are commercialized in the US.

RELEVANT PUBLICATIONS

Voronin GL, Hettiarachchi CA, Harte FM. 2021. High pressure jet spray drying of condensed skim milk results in powders with enhanced interfacial properties. J Food Engineering. 292: 110249.

WHEY PROTEIN PHOSPHOLIPID CONCENTRATE AS AN EFFECTIVE DIETARY SOURCE OF CHOLINE IN POST-MENOPAUSAL WOMEN

ANTICIPATED COMPLETION: *2026*

INVESTIGATOR

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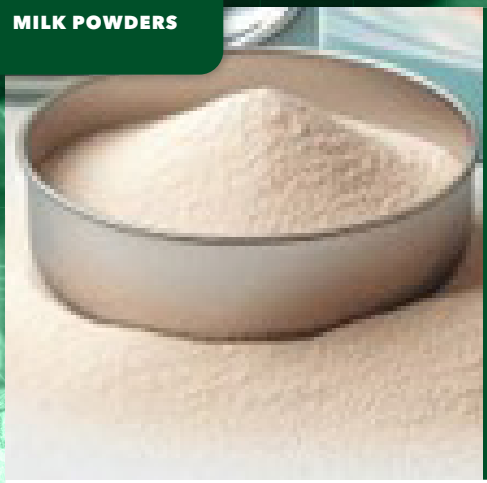
OBJECTIVE

Whey protein phospholipid concentrate (WPPC), an underutilized dairy stream, is a rich source of choline. Post-menopausal women are at increased risk of choline deficiency due to lower estrogen levels, linking to cognitive decline and organ dysfunction. The project aims to investigate the efficacy of WPPC as a dietary source of choline for post-menopausal women by evaluating its choline content, bioavailability and potential as a cost-effective and easily formulated option to enhance choline intake.

BENEFIT TO INDUSTRY/FARMER

This project highlights the potential of repositioning WPPC, a low-value dairy coproduct, as a nutritional supplement to improve human health, particularly for post-menopausal women. The findings will boost consumer trust in dairy products and their health benefits, support dairy product innovation for new markets with enhanced economic viability.



ESTABLISHING A DATABASE OF INTERFACIAL PROPERTIES FOR US MILK POWDERS: INTERFACIAL CHARACTERISTICS AS INDICATORS OF POWDER QUALITY AND FUNCTIONALITY

ANTICIPATED COMPLETION: *2025*

INVESTIGATOR

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OBJECTIVE

Dairy ingredients are used in various food applications for their superior functional properties. This project will provide an efficient analytical method for characterizing milk protein ingredient functionality (wettability, flowability, and emulsification properties). It will also include a database of interfacial properties for different dairy ingredients that may be used as a technical reference for quality control, ingredient innovation, and formulation development of new consumer foods.

BENEFIT TO INDUSTRY/FARMER

This project will deliver rapid interfacial characterization techniques for dairy protein powders which consequently will help processors to evaluate the quality and consistency of commercial powders in terms of application related functionalities.

PHYSICAL, CHEMICAL, AND FUNCTIONAL ASSESSMENT OF LOW-, MEDIUM-, AND HIGH-HEAT NONFAT DRY MILKS PRODUCED IN THE UNITED STATES

COMPLETED

INVESTIGATOR

Jayendra Amamcharla, Ph.D.
University of Minnesota, Minneapolis, MN
Kansas State University, Manhattan, KS
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OBJECTIVE

The overall objective of this project is to map the functional properties of Nonfat Dry Milk (NDM) and Skim Milk Powder (SMP) that have different heat classifications (low-heat, medium heat, and high heat). Low-, medium-, and high-heat nonfat dry milks produced in the United States will be assessed for their physical, chemical, and functional properties. Understanding the functional and physical properties using advanced techniques will help food formulators to select the appropriate NDM.

BENEFIT TO INDUSTRY/FARMER

U.S. Milk powders (NDM and SMP) have a significant local and global market and are used in various dairy and food applications across the globe. A major functional advantage in milk powders arises from the way they have been produced (specifically, the heat treatment they go through prior to concentration and drying). Research on specific functional differences and applications of these different milk powders is almost 25 years old. This research will provide the US milk powder processors concrete data on which powder will work best for their customers' end uses, thereby increasing the demand of U.S. produced milk powders.

PREDICTING HEAT STABILITY OF NONFAT DRY MILK IN THE APPLICATION OF RECONSTITUTED UHT MILK USING SPECTROSCOPIC TECHNIQUES AS A RAPID METHOD

COMPLETED

INVESTIGATOR

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OBJECTIVE

Milk and dairy-based beverages that are processed at ultra-high temperatures are stable at room temperature for several months. These products are used for both consumer foods and food service operations and have gained increased demand worldwide. UHT milk has issues with sedimentation and gelation during storage that are real life problems, and currently there is no robust method available for predicting these defects. This study will develop a rapid method to predict the long-term heat stability of UHT-treated reconstituted skim milk (RSM).

BENEFIT TO INDUSTRY/FARMER

The anticipated outcome of this work is to provide quantitative models that predict age gelation of UHT-treated RSM products made from either nonfat dry milk (NFDM) or skim milk powder (SMP). These timesaving tools will be essential for the industry when quick decisions are needed. They will help improve the functionality of NFDM/SMP, predict ingredient and product behavior in recombined applications, and promote sales for recombined UHT-related applications.

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