DAIRY MANAGEMENT INC.™

NATIONAL DAIRY FOODS RESEARCH CENTERS

RESEARCH AND INNOVATION RESOURCES

DAIRY INNOVATION LABS

FACILITIES AND EQUIPMENT

TECHNICAL TRAINING AND SHORT COURSES

TECHNICAL ASSISTANCE

FUTURE PROOFING

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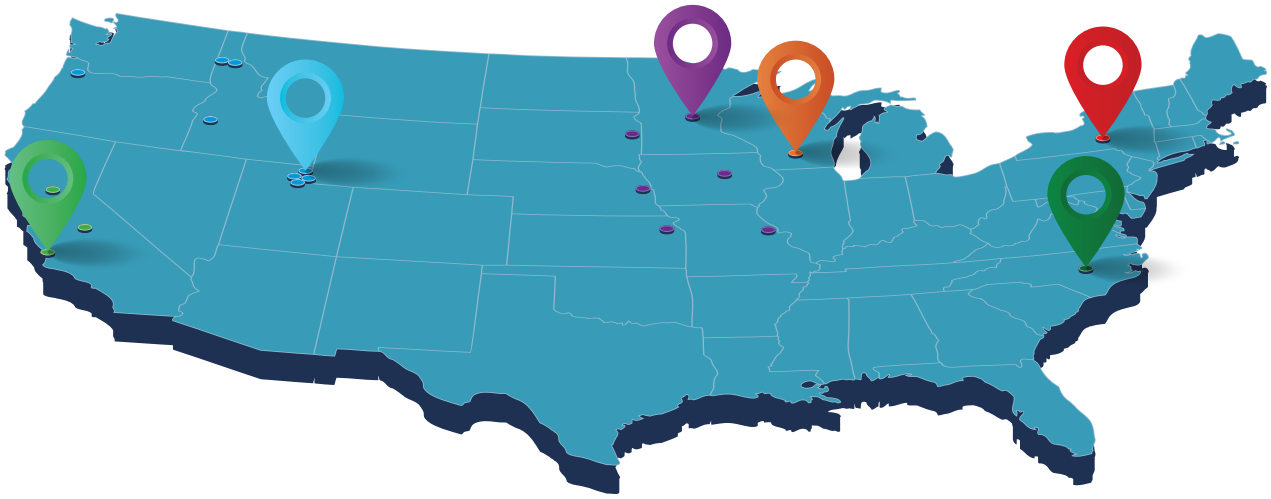
NATIONAL DAIRY FOODS RESEARCH CENTERS

National Dairy Foods Research Centers, supported by Dairy Management Inc. (DMI), ensures the U.S. dairy industry stays relevant to consumer needs and preferences, drives innovation, contributes to a healthier planet, and creates a profitable and agile U.S. dairy value chain.

Established in 1987, the network is made up of six dairy centers encompassing over 20 universities across the United States. The Center's mission is to ensure that the U.S. dairy industry continues to nourish the world by offering safe, quality, and innovative dairy products. The mission is enabled by providing the dairy industry access to research leaders who provide innovative solutions through their world-renowned research programs. The centers are also instrumental in developing talent who are the industry's future. The dairy innovation labs at the centers assist the industry in concept creation, prototype development, troubleshooting, scale-up, and sensory services. The centers also offer technical training and short courses that ensure that the industry talent is continuously updated on technological advancements in product innovation, quality, and safety.

For over 30 years, the centers have contributed to building a vibrant U.S. dairy industry that continues to innovate and nourish the world.



CALIFORNIA DAIRY INNOVATION CENTER

WESTERN DAIRY CENTER

MIDWEST DAIRY CENTER

CENTER FOR DAIRY RESEARCH

NORTHEAST DAIRY FOODS RESEARCH CENTER

SOUTHEAST DAIRY FOODS RESEARCH CENTER

DMI DAIRY MANAGEMENT INC.™

Dairy Management Inc.™ (DMI) is funded by America's nearly 32,000 dairy farm families, 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 AND DEVELOPMENT

DAIRY MANAGEMENT INC.

Rosemont, IL

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OVERVIEW

Among the priorities of DMI is to deliver breakthrough science and innovations to redefine U.S. dairy wellness and product leadership. It also aims to renew U.S. dairy's image and relevance to build trust and grow incremental and sustainable sales. The Dairy Products Research team strives to advance these priorities through targeted research and development activities that address consumer needs and expand dairy choices in domestic and international markets. The group develops and executes a strategic plan for the product research program. This includes funding research projects at various dairy research centers and universities in the U.S. These programs lead to cutting-edge research findings, platform technologies, and quality and food safety solutions that enable the U.S. dairy industry to generate high-quality, innovative products and ingredients.

Furthermore, the group directs strategic resources to offer expert product/process development, technical support, and food safety and quality resources to the U.S. dairy industry. Developing current and future workforce through education and development through the National Dairy Foods Research Centers is also one of our primary goals. The team also ensures that the industry adopts platform technologies from our research partners to ensure a sustainable and innovative U.S. dairy value chain. We strive to future-proof the U.S. dairy industry by sponsoring and supporting transformative technologies and tapping the collective expertise of our 138+ experts across our dairy centers to drive innovation and address current and future challenges.

CALIFORNIA DAIRY INNOVATION CENTER

DAIRY INNOVATION INSTITUTE (DII)

California Polytechnic State University
San Luis Obispo, CA

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY MILK PROCESSING LAB

University of California – Davis, CA

DAIRY SCIENCE ACADEMICS & RESEARCH

Jordan College of Agricultural Sciences and Technology (JCAST)
California State University – Fresno, CA

CENTER DIRECTOR

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OVERVIEW

The CDIC is a collaboration of California dairy producers, processors and universities focused on one primary objective: driving dairy innovation. The CDIC operates across major universities in California, in collaboration with the California Dairy Research Foundation (CDRF), as well as the other dairy research centers funded by Dairy Management Inc. across the country and industry representatives. The CDIC also partners, as needed, with leading international research organizations, experts and key solution providers throughout the supply chain. The major academic collaborators of the CDIC are California Polytechnic State University, San Luis Obispo, the University of California, Davis, and Fresno State University, Fresno.

The CDIC's program of work is guided by a Steering Committee which helps develop the Center's Strategic Plan and provides guidance for the execution of research programs as well as educational activities. The focus of the Center is on product, packaging innovation as well as training and education of the current and future California dairy's workforce. CDIC also support the CMAB's product innovation competitions, brand managers and entrepreneurs, and California dairy processors of all sizes through services ranging from technical support to training programs. In addition to the major academic institutions listed in this brochure, the CDIC works with other research institutions, private labs, consultants and experts in their field, domestically and internationally, to deliver best-of-class expertise to the industry throughout the supply chain.

FACILITIES AND EQUIPMENT

DAIRY INNOVATION INSTITUTE (DII)

California Polytechnic State University
San Luis Obispo, CA

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OVERVIEW

The Dairy Innovation Institute conducts applied and strategic dairy research and development in the areas of product technology and utilization, ingredient technology and utilization, products for health enhancement, food quality, and food safety. The applications and outreach programs facilitate innovative uses of dairy foods and ingredients by the food industry. A diverse, highly experienced staff offers a broad set of expertise, and is called upon by dairy foods processors of all sizes for a range of services, as well as extensive research projects.

Facilities at the Dairy Innovation Institute are state-of-the-art, equipped with advanced and routine analytical equipment, dairy foods pilot plant, and a commercially licensed dairy processing facility. The DII serves as the focal point to draw upon expertise and resources from throughout Cal Poly and other collaborating institutions in the packaging, engineering, business, chemistry, microbiology and other disciplines.

Adjacent to the Dairy Innovation Institute is the Cal Poly dairy farm, where fresh milk is available for research and development activities, as well as raw material for the creamery's operations. Faculty from both the Animal Science and Food Science & Nutrition Departments of the College of Agriculture, Food & Environmental Sciences provide expertise and support programs.

RESEARCH FOCUS

The Dairy Innovation Institute offers significant expertise in, and resources for, research and development involving dairy products and ingredients. Research is industry-driven and can address the specific needs of companies in research or applications. Areas of research and expertise include:

- Cheese technology (flavor, texture, yield, starter culture performance functional properties)
- Milk, dairy ingredients and dairy products quality (sensory, functionality, composition, physical properties manufacturing efficiency) and shelf-life
- Process development (membrane and other concentration/fractionation processes, UHT and other heat treatments, and non-thermal processes)
- Product development, dairy ingredients applications (prototypes, nutritional labels)
- Dairy nutrition and health (probiotics, bioactive ingredients and components)
- Dairy quality assurance (food safety, environmental stewardship, testing methods development)

APPLICATION PROGRAM AND PROTOTYPING

This program provides technical support to innovators, start-ups, manufacturers, users and marketers of milk and dairy ingredients. It involves transfer of existing research information, technical training, providing solutions/information on technical product applications issues, and carrying out targeted short-term projects to address specific applications needs, including new food and product development.

Approximately 8,270 square feet of processing area is available in the pilot plant facilities. Services are available on a fee-for-service basis. The pilot plant is widely used by industry for the development of prototypes, testing of processes, and to support entrepreneurs as well as large-scale processors. The plant is fully equipped for all traditional unit operations for the manufacture of dairy foods and ingredients and is licensed by the state of California for commercial manufacture.

Applications support and specialized analytical capabilities are also available on campus in the extensive Boswell Ag Tech Center opened in 2022. Functions include an experience innovation lab, teaching and research instrumentation laboratory, a nutrition and food and beverage laboratory. The new Center features a culinary teaching lab, sensory analysis teaching and research lab, and food safety laboratories.

Additionally, space is available to accommodate specialized equipment for research and development projects on a short-term basis. Four chemistry labs support work in the areas of microbial, physical and chemical analyses of dairy foods and ingredients.

EQUIPMENT

- HTST – 270 to 600 gallons per hour for ice cream mix, milk, etc., and associated cold milk separator, batch tanks (1×80 gallons, 2×100 gallons, 1×200& 1×300 gallons with heating and cooling, 1×400 gallons with heating, 2×500 gallons), pasteurized surge tanks, CIP systems, etc. (HTST is a legally sealed unit by the state of California)
- Scholle filler for 3- to 6-gallon bags
- Microthermics UHT (direct and indirect heating) with clean-fill hood and aseptic homo (25 L/hr)
- Continuous ice cream freezer (HoyerFrigus SF 600) (50 to 150 gallons/hr)
- Ingredient feeder (Hoyer Addus FF 2000 C2) (10 to 200 L/hr)
- Sawvel cup filler–pint to 3.5 oz.;35 cups/minute (pint)
- Egli continuous pilot-scale butter churn (1 to 2 lbs/min)
- PMS 30-gallons/hr HTST
- Technogel 100 L/hr continuous ice cream freezer
- Marriott Walker rising film evaporator (100 lbs/hr evaporative capacity)
- Open, water-jacketed cheese vats (5 vats: 3 vats hold up to 50 gallons each, 1 vat holds up to 175 gallons and 1 vat holds up to 500 gallons)
- Blentech process cheese cooker (50 to 100 lbs.)
- Stephan process cheese cooker (5 lbs.)
- Vacuum packaging system (1- to 40-lb. block)
- High-shear Silverson mixer
- 4 Groen process steam kettles (40 & 60 gallon capacity)
- 2 APV conical bottom swept-surface processors (100 gallons)
- Legal batch pasteurizer system (200 gallons)
- 4-booth sensory evaluation area with test/ preparation kitchen and Compusense software system
- Controlled atmosphere cold storage (approx. 3,000 sq. ft.)
- Cold storage (-15 to -40 F) (approx. 200 sq. ft.)
- Spiral-wound DDS UF and RO system (50 to 100 L/hr)
- Niro Pilot R-12 MF/UF/RO system (60 to 90 gal. feed/min)
- Niro Filterlab spray dryer FLG-60 (60 lb,/hr. water evaporation rate, capable of drying milk, whey and agglomeration)
- Modified atmosphere packaging

SUPPORTING ANALYTICAL EQUIPMENT

In addition to the specialized equipment listed below, the Dairy Innovation Institute routinely carries out chemical (fat, protein, ash, total solids, pH), physical (viscosity, color) and microbiological (APC, yeasts, molds, coliform, lactobacilli) analyses and related research, plus the development of dairy foods and ingredients.

Furthermore, the Dairy Innovation Institute works with several departments on campus (Materials Engineering, Biological Science, and Food Science & Nutrition) for more specialized expertise, instrumentation, and processing equipment.

Pulsed field gel electrophoresis
» DNA-based differentiation of probiotic lactic acid bacteria

Gel electrophoresis acrylamide
» Analysis of proteins and peptides: native, denaturing, urea, gradient and two-dimensional

Preparative isoelectric focusing
» Isolation and characterization of proteins

Gel densitometer
» Individual protein concentration determination

Polymerase chain reaction thermal cycler
» DNA characterization, bacteria identification and determination, gene manipulation, etc.

ELISA plate reader
» Multiple antibody and enzymatic assays for milk product component analysis or microbiological safety

Membrane transfer platform
» Northern, southern and western blots of RNA, DNA, and protein analysis and identification

Dot blot instrument
» Antibody and enzyme quantification and titration

Ultracentrifuge
» Sedimentation of milk and cellular components

Phase contrast microscope
» Microbiological analysis of spores

Digital imager
» Quantification and record-keeping of dairy product sample structure and composition

Pilot plant scale affinity chromatography column
» Large scale-up of laboratory affinity chromatography procedures

Gas pycnometer, tap density, powder flowability
» Characterization of bulk density, particle density and angle of repose

Texture analyzer
» Texture profile analysis, firmness, etc.

Hunter colorimeter
» Whiteness, color intensity and hue, appearance of dairy foods and ingredients

Block digestion and distillation system
» Nitrogen/protein analysis

Autotitration system
» Determination of buffering capacity

Water activity meter
» Water activity measurement

Countertop food dehydrator
» Food dehydration

EDUCATION AND TRAINING

In addition to the dairy processing and product development classes offered as part of the University's curriculum, the Dairy Innovation Institute offers focused short courses throughout the year which are designed to meet the needs of the current workforce, as well as other educational events, lectures, conferences and symposia.

STAFF AND RESEARCHERS

MATT ARNOLD

Research Associate
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Cheese technology research focusing on texture and functional properties, laboratory analysis of industry products.

YIMING FENG, Ph.D.

Assistant Professor
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Food structure characterization, hydrocolloids & emulsions, food waste valorization. Food material sciences, food processing engineering.

AMY LAMMERT, Ph.D.

Associate Professor
Department of Food Science and Nutrition
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Sensory evaluation of dairy foods and ingredients, product development.

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Center and programs administration.

KATY PANKEY

Creamery Production Manager & Industry Short Course Support
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Organization of short courses, training. Specialty cheese production expert, food safety.

JENNIFER PELAYO

Dairy Processing Operations Manager
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Manager of the Cal Poly Creamery.

SEAN VINK

Research Associate
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Pilot plant operations and trials; industry projects and dairy foods research.

C. K. VINCENT YEUNG, Ph.D.

Professor in Dairy Science
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Dairy foods and health: prebiotics, probiotics, and bioavailability of minerals; clean-label ice-cream processing; MPC functionalities.

ADDITIONAL EXPERTISE:

Product Packaging Research and Testing is also available at Cal Poly through the Cal Pack Lab. Contact staff for more information.

FACILITIES AND EQUIPMENT

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY MILK PROCESSING LAB

University of California
Davis, CA

CONTACT:

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Milk Processing Lab Manager
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OVERVIEW

Department of Food Science and Technology features the Milk Processing Lab, which offers services to the industry, as well as numerous specialized laboratories focused on specific areas of milk processing and nutritional attributes, staffed by experts in their respective fields.

UC-Davis features extensive research capacity in state-of the art laboratories and faculty engages in collaborative research with dairy industry processors domestically and internationally.

MILK PROCESSING LAB

The state-of-the-art 800 square foot Milk Processing Laboratory was designed and built to enable collaborative and multi-disciplinary food science research to bring exciting innovations to the food industry, particularly in the realm of novel methods for the fractionation and recovery of bioactive milk components. The Milk Processing Lab provides an excellent resource for scholarly research as well as collaborations with dairy industry partners.

The facility features 110/208/480 V (single & three-phase) power supplied by eight utility stations, steam, chilled and RD water, an isolated drainage system, and HEPA filtration to ensure air quality. Additionally, the Milk Processing Lab complies with all specifications required to produce materials for animal trials with an approved Institutional Review Board protocol. Outside the Milk Processing Lab, is a facility of 300 square feet featuring ambient equipment storage to pretreat larger volumes of raw materials as well as a walk-in fridge and walk-in freezer to store processing samples.

RESEARCH FOCUS

The state-of-the-art Milk Processing Laboratory enables the scale-up of bench-top research to the transitional pilot plant stage before it can be implemented commercially. The Milk Processing Lab boasts a highly flexible design with all equipment mounted on wheels. This flexibility and the variety of equipment enables the exploration of a wide range of research concepts. Research in the milk lab aims at increasing our understanding of the chemical and biological properties of milk components; specifically, this involves separation, characterization and then incorporation into foods.

The Milk Processing Lab frequently is used to isolate and characterize bioactive milk components, develop and prepare samples for studying packaging, stability testing, and formulating novel ingredients. Thus far the Milk Processing Lab has been crucial in research efforts including isolating and testing bioactive milk compounds via safe and environmentally friendly methods before implementing them as functional food ingredients, studying dairy fluid processing, investigating the fermentation of lactose and monosaccharides, performing stability testing, preparing samples for clinical studies, and formulating novel dairy ingredients and products.

Partners span companies of all sizes, from start-ups to multinational corporations and cover nearly every facet of the food and beverage industry including all types of dairy products, infant formula, breast milk, water treatment and processing co-products or by-products. Simultaneously, the facility enables the training of students on the latest separation and analytical technologies.

EQUIPMENT

The Milk Processing Lab is designed to be highly flexible by having all of the equipment on wheels and the Microthermics equipment at the MPL is certified by Nationally Recognized Testing Laboratory (NRTL).

PROCESSING SYSTEMS

- Pasteurizer/UHT Unit (Microthermics)
  - Can perform HTST and UHT pasteurization on milk, skim, or cream
  - Pilot plant scale, typically operated at 2 L per min, CIP cleanable
- Homogenizer (GEA)
  - 2 stages to maximize homogenization
  - In-line with Microthermics HTST/UHT unit
  - Pilot plant scale and CIP cleanable
- Filler with automatic fill control
  - Capable of aseptic filling in a ultra-clean filling environment
  - In-line with Microthermics HTST/UHT unit
  - Pilot plant scale and CIP cleanable
- Membrane filtration (GEA)
  - Capable of micro, ultra and nano-filtration and reverse osmosis to isolate milk bioactive components
  - Operates with flat sheet or spiral (up to 3 membranes in series)
- Cream Separator (GEA)
  - Separates raw milk into skim and cream fractions
  - Typically operated at 3.3 L/min
  - Connects to heat exchanger and milk receiving tanks
- Fermenters
  - Custom-designed stainless-steel fermenters
  - Frequently used for lactose and monosaccharide fermentation

OTHER EQUIPMENT

- Receiving tanks (up to 100 gallons capacity, Sprinkman Corp)
- Water Circulating Temperature Heat Transfer System
- Heat Exchanger
- High-Performance Desalination unit

SUPPORTING ANALYTICAL EQUIPMENT

With extensive research over many years, we have developed specialized protocols to isolate and analyze glycans, peptide, proteins and MFG from dairy samples. The Barile lab maintains an array of advanced analytical equipment that is used to guide the separation of bioactive milk components in near real-time.

Triple Quad LC-MS (Agilent Technologies)

- 6470 Triple Quadrupole Liquid Chromatography Mass Spectrometer

Dionex HPAE-PAD (2 units - Thermo Scientific)

- High Performance Anion-Exchange Chromatography with Pulsed Amperometric Detection

Nano LC Chip QToF (Agilent Technologies)

- Nano Liquid Chromatography chip Quadrupole Time-of Flight mass spectrometer

MALDI ToF (Bulker Daltonics)

- Microflex LRF Matrix-Assisted Laser Desorption/ Ionization Time-of-Flight mass spectrometer

EDUCATION AND TRAINING

Contact Dr. Moshe Rosenberg, Professor and Specialist, Dairy Engineering and Technology, for more information on UC Davis Extension Services mrosenberg@ucdavis.edu

STAFF AND RESEARCHERS

DANIELA BARILE, Ph.D.

Professor
Department of Food Science & Technology
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Discovery of novel milk bioactive components and their functions. Characterization and quantification of compounds such as glycoproteins, peptides, glycans, and glycolipids in milk and dairy streams. With Dr. Juliana De Moura Bell and Dr. David Mills, Dr. Barile manages the Milk Processing Lab.

JULIANA DE MOURA BELL, Ph.D.

Associate Professor
Departments of Food Science & Technology and Biological & Agricultural Engineering
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Development of sustainable processing techniques (i.e., membrane fractionation, enzymatic reactions, fermentation, enzyme-and microwave-assisted extractions) to extract, modify, and isolate food compounds (using bovine colostrum as a model system) with desired functional and biological properties. Processing scale-up and conversation of food processing byproducts into added value compounds.

GAIL BORNHORST, Ph.D.

Associate Professor and Engineer
Departments of Food Science and Technology and Biological and Agricultural Engineering
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The Bornhorst lab specializes in food processing and food digestion, with a focus on food structural breakdown during digestion and relationship with physical property changes and macronutrient release and hydrolysis; food processing and structuring techniques to modulate food gastric behavior; development of physiologically-relevant in vitro digestion models.

J. BRUCE GERMAN, Ph.D.

Professor
Department of Food Science & Technology
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Research in the German lab is designed to understand how the components of foods in the diet can affect the various biological processes in humans that we consider health.

DANIELLE LEMAY, Ph.D.

Research Molecular Biologist, USDA ARS
Adjunct Professor, Department of Nutrition
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Studies on dietary components, including milk compounds, and fermentable carbohydrates, and how they affect host response and whether that response is modulated by the functional capabilities of resident microbiota. Approaches employ big data techniques, such as sequencing technologies and machine learning, to understand the effects of diet on human health.

MARIA MARCO, Ph.D.

Professor
Department of Food Science & Technology
mmarco@ucdavis.edu

The Marco lab specializes in food microbiology with an emphasis on dairy food microbiomes, fermented dairy foods, probiotics, and spoilage and product defects.

DAVID A. MILLS, Ph.D.

Professor
Peter J. Shields Chair in Dairy Food Science
Departments of Food Science & Technology and Viticulture & Enology
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Research on the influence of milk components on gut health. Exploration on interactions among milk-borne prebiotics, probiotics, antimicrobials and other bioactive molecules on the host gut microbiota with links to overall host health.

NITIN NITIN, Ph.D.

Professor
Departments of Food Science & Technology and Biological & Agricultural Engineering
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Research on development and evaluation of bio-based materials including dairy-derived components for the delivery of micronutrients and probiotics; design of novel materials and processes, including synergistic and non-thermal processes and biosensors to improve safety of food products; development and deployment of mechanistic and machine learning models to predict and optimize process efficiencies, product design and sustainability.

MOSHE ROSENBERG, D.SC.

Professor and Specialist
Department of Food Science & Technology
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Dairy chemistry and microbiology; milk processing technology and engineering. Cheese making science and technology. Milk processibility. Evolution of cheese quality attributes during aging; Technological and quality aspects of ESL and UHT milk products. Structural properties of dairy products. Quality attributes of milk and dairy products. Authentication of milk and dairy products; Regional origin of milk and dairy products; Milk proteins and lipids as microencapsulating agents in food and pharma applications; Advanced milk processing technologies.

CAROLYN SLUPSKY, Ph.D.

Professor
Department of Nutrition and Food Science & Technology
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Impact of food (including dairy) and nutrition on health; using small molecular chemical profiling to support integration of diet and nutrition in a complex biosystems approach; relationship between diet and gut microbiota; impact of microbial derived metabolites on host health.

AMEER TAHA, Ph.D.

Associate Professor
Department of Food Science & Technology
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Focus on characterizing lipid bioactives in milk and understanding their role in brain development. The lab uses quantitative mass-spectrometry methods to quantify lipid bioactives in various milk lipid fractions (e.g. cream, procream), and to probe their bioavailability and brain uptake.

FACILITIES AND EQUIPMENT

DAIRY SCIENCE ACADEMICS & RESEARCH

Jordan College of Agricultural Sciences and Technology (JCAST)

California State University
Fresno, CA

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OVERVIEW

Two of the six departments within JCAST are specifically devoted to dairy science academics and research. Faculty from the other four departments (Agribusiness, Plant Science, Industrial Technology, and Viticulture) regularly collaborate on dairy related research and outreach endeavors. The Institute for Food and Agriculture is one of the three centers within JCAST that supports faculty-led research and outreach in partnership with students, community, and/or industry members.

Food Science and Nutrition Department inspires students with the academic rigor and experiential learning to pursue two bachelor of science majors: Food and Nutritional Sciences including Culinology® and Food Technology options and Human Nutritional Sciences. The Department also offers a Master's in Food and Nutritional Sciences for students who want to gain further experience in the Food and Dairy Industries.

Animal Science and Agriculture Education Department creates a multi-faceted approach for students to pursue BS and Masters degrees in Animal Science, some featuring a Dairy Science emphasis.

Institute for Food and Agriculture (IFA) emerged from recommendations by the President's Commission on Agriculture which was charged to link Fresno State's agricultural programs with science, mathematics, engineering, business, and other disciplines to best serve the dynamic food and agriculture industry. IFA facilitates applied research and outreach opportunities through disciplinary and interdisciplinary research and innovation in food science, dairy science, food safety, nutrition, agribusiness, animal science, agriculture education, industrial technology, plant science, and entomology. IFA works hand-in-hand with faculty and industry leaders to disseminate research findings via workshops, trainings, conferences, publications, and receiving visiting food and agriculture scholars (community, industry, academic).

RESEARCH FOCUS

Fresno State enthusiastically provides direct technical assistance to dairy businesses through hands-on value-added product development consultancies, workshops, and workforce training. Specific areas of expertise include milk production, milk processing, development of new and current dairy products, and sensory evaluation. Current research emphasizes

- New product development (specialty and ethnically rich cheeses)
- Quality attributes of dairy products (yield, composition, sensory evaluation, consumer perceptions)
- Dairy food safety and quality assurance

FACILITIES

DAIRY PROCESSING PLANT

The Dairy Processing Plant facility (The Creamery) provides students from multiple disciplines across campus with hands-on experiential learning in managing a facility and operating equipment to produce a multitude of dairy products including thirty-five ice cream flavors, butter, spreadable butter, cheese, and fluid milk (including chocolate milk). Under the supervision of a general manager, a staff of about 10 students runs the facility and operates equipment such as the pasteurizer, homogenizer, cheese vat, ice cream maker, and filling machine along with other minor specialty equipment. The students also engage in multiple faculty-supervised research projects related to dairy products. The facility is commercially certified and products are sold on campus via Fresno State's Rue and Gwen Gibson Farm Market as well as at select local and regional markets.

DAIRY DIAGNOSTICS LABORATORY

Created to simultaneously enhance student laboratory practice skills and real time data upon which to base nutrition, cow health, and cow productivity decisions, the Dairy Diagnostic Lab is the location for compositional and microbiological diagnostic analyses of animal feeds, blood, and milk. It is specifically designed to give students new opportunities to work with the latest technology to ensure herd health, nutrition and milk standards as well as encourage higher milk production. The lab can easily be utilized by undergraduate and graduate students, students in dairy classes, as well as students working at the dairy unit to conduct milk quality analysis and also assessment of blood samples from cows with mastitis to determine the most effective antibiotic treatments.

MANUAL MANCEBO, JR. AND KATYE MANCEBO DAIRY UNIT

The Fresno State Dairy is one of the few collegiate dairies run entirely by students. A staff of approximately 20 students maintains two different breeds of dairy cattle (the Holstein and the Jersey) 24 hours per day, 7 days per week, and 52 weeks per year. There are 275-300 cows within the dairy herd. Fresno State uses about 1/7th of the milk for production activities at its Dairy Processing Plant and the remainder is sold to a local dairy processing company for commercial usage.

FOOD SAFETY & MICROBIOLOGY LABORATORY

Specific to this laboratory, student and industry research projects are able to test microorganisms and chemicals used by the food industry, including pathogenic microorganisms such as *Salmonella spp.* or *Staphylococcus aureus.*

JORDAN AGRICULTURAL RESEARCH CENTER (JARC)

This 30,000 square foot world-class research center focuses on investigating advanced concepts and practices of agriculture, food, and the natural resources. It was specifically designed to foster multidisciplinary and interdisciplinary collaborations between bright minds within the three colleges addressing food and agricultural sciences, engineering, and science and mathematics.

- **Olam Sensory Laboratory** is a dedicated space in which researchers investigate how agricultural practices and post-harvest processing affect consumers' perception of agricultural products such as wine, cheese, and desserts. It features seven sensory cubicle stations. Food and beverage products tested to date include wine (including smoke-tainted), fresh fruit grown on the campus farm, dessert products in development by students for commercial purposes, and targeted consumer products developed by faculty. The sensory lab aids researchers in gathering data for their trials and provides students with the hands-on experience they need in preparation to work in the industry.
  (note: video available at https://fresnostate.edu/jcast/jarc/jarc-consumer-sensory-research.html) (fresnostate.edu))
- **Wonderful Training Room** adjoins the Olam Sensory Laboratory. This space is a multipurpose room in which panelists can receive training prior to engaging in sensory evaluation activities. It also serves as a great space to host small-group workshops, short-courses, conferences, and symposia.
- **Food Preparation Area** is also located next to the Olam Sensory Laboratory and is equipped with an industrial kitchen. This space is useful for preparation purposes for sensory evaluation experiments.

RUE AND GWEN GIBSON FARM MARKET

In many aspects, the Gibson Farm Market represents the culminating student supply chain experience as every product offered for sale therein has been grown, harvested, processed, packaged, and/or marketed by students. Dairy products include Fresno State's famous ice cream, milkshakes created on demand, milk (including chocolate), and cheese. While an on-campus location, the market is open to both the campus community and the general public. Key celebration events include Opening Corn Weekend and the Fall Festival and Plant Sale - both which feature student-led activities for youth/families along with the sale of food and agricultural products.

EQUIPMENT

- Refrigerated delivery van
- Tanker (600 gallon)
- HTST System (pasteurizer and homogenizer) for Milk and Ice Cream Mix (300 gallon/hour; HTST is a legally sealed unit by the state of California)
- Rotary Filler (½ - 1 gallon)
- Cold Milk Separator - DeLaval (250 gallon/hour)
- Holding Tank (600 gallon)
- Round Open Cheese Vat (32 gallon)
- Rectangular Open Cheese Vat (215 gallon)
- Cheese Press (vertical)
- Ice Cream Batch Freezer (1 quart)
- Ice Cream Batch Freezer (40 quart)
- Ice Cream Batch Freezer (44 quart)
- Ice Cream Piston Depositor (8-32 oz)
- Ice Cream Piston Depositor (20-80 oz)
- Butter Churn (25 gallon)
- Processing Vat (150 gallon)
- High Shear Mixer
- Powder Induction Mixer

SUPPORTING ANALYTICAL EQUIPMENT

- MilkoScan FT1 - Foss
- BacSomatic - Foss
- VetScan VS2-1200 Abaxis
- Near Infrared Spectrometer DS2500FSR - Foss
- Fiber Analyzer A200 Ankom Technologies
- RT-PCR Detection System Acumen
- Laminar Flow Hood
- Elemental Analysis for CHNS Elementar
- Thermo Scientific Gallery for food and beverage automatic photometric analyzer
- Texture Analyzer
- Water Activity Meter
- Halogen-Moisture Analyzer

SENSORY EVALUATION

- 7-Booth Sensory Evaluation Area with food preparation industrial kitchen equipped with portable devices and Compusense software and adjoining training room as well as indoor open space
- BIOPAC MP160 system equipped with bionomadix wireless system to measure skin conductance, heart rate, respiration and facial electromyography

COURSES, SYMPOSIA AND EVENTS

- Cows to Neurons: Dairy Economic Development and Innovation
- USDA Cochran International Study Tours focused on Dairy
- Agriculture Kids' Camp for 7-11 year old youth
- Dairy Lab Skills Enrichment Workshop
- Cheesemaking 101 Workshop in collaboration with the California Artisan Cheese Guild
- International Restaurateurs Study Tour
- Livestock Artificial Insemination
- Dairy Calf Health

STAFF AND RESEARCHERS

DANIEL AVILA

Manager
Creamery and Dairy Processing Plant
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Mr. Avila draws upon over 30 years of experience in dairy products manufacturing to guide the student employee team operating the dairy processing center. He is the certified person to pick up and receive milk, to assess quality of the received milk and to pasteurize milk. Mr. Avila is a proud Fresno State bulldog alum.

ERIN DORMEDY, Ph.D.

Professor
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Dr. Dormedy is a Full Professor with extensive research experience on food safety and microbial food analysis. Her students benefit greatly as she shares with them more than 20 years of research experience addressing food microbiology, food protection and farm hygiene.

CARMEN LICON, Ph.D.

Assistant Professor
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Innovation in dairy product development and education in culturally specific as well as artisan dairy products (e.g., cheeses, yogurts, etc.). Dairy products development, with particular emphasis on cheese and sensory evaluation. Dr. Licon is bilingual, biliterate, and bicultural Spanish and English as well as being fluent in French. She is an active member of Institute of Food Technologists (IFT), American Dairy Science Association (ADSA) and American Cheese Society (ACS). She has extensive international experience in Spain, France and Mexico involving internships, professional training, and research activities. She holds a patent for the production of saffron cheese. Dr. Licon's appointment is a liaison between Food Science and Food Engineering.

STEVEN PAO, Ph.D.

Professor
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Dr. Pao is a Full Professor with far-reaching research in the areas of food protection and farm hygiene. He has consulted in numerous countries to address food safety and quality management, including dairy products, and regularly draws upon those experiences to enrich his academic teaching with students.

SUSAN PHEASANT, Ph.D.

Director
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Dr. Pheasant has a passion for organizing people and projects as well as conducting utilization-focused evaluations. She embraces fully her role to support faculty, students, and the food and ag sector through applied research, grant development and management, and educational outreach. Her most recent degree integrates agricultural economics, marketing, education, and rural sociology in addressing how producers adopt new ideas and technologies. Dr. Pheasant also serves as the JCAST representative to Fresno State's United Nations Global Compact steering committee; Fresno State is the first (and only) CSU/UC institution to become a member of the United Nations Global Compact.

KYLE THOMPSON, Ph.D.

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Dr. Thompson oversees the student-run 300+ dairy cow enterprise on campus, advises numerous dairy related student clubs and judging teams, teaches both undergraduate and graduate dairy science courses, and conducts research addressing dairy nutrition and lactating cow probiotics. He is a proud Fresno State bulldog alum.

CENTER FOR DAIRY RESEARCH

www.cdr.wisc.edu

UNIVERSITY OF WISCONSIN-MADISON

www.cdr.wisc.edu

CENTER DIRECTOR

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OVERVIEW

The Center for Dairy Research (CDR) is a state-of-the-art research center with a licensed, operating dairy plant located on the University of Wisconsin-Madison campus and is one of the premier dairy research centers in the world. Building on Wisconsin's tradition as the "Dairy State," the Center explores functional, flavor and physical properties of cheese/cheese products and other milk components used as ingredients and as finished products. CDR researches cheese making and dairy protein processing/separation procedures, use of dairy ingredients in foods, and technologies for product safety and quality. More than 30 researchers and scientists are involved in conducting basic and applied dairy research. Collectively, the CDR staff has over 280 years of food industry experience, which creates a unique mix of academic and industry perspectives to help address any challenges facing the dairy industry. The facilities (including two pilot plants) and equipment are extensive, allowing the Center to not only create new products, uses and processes, but also to meet the unique needs of the food industry. Annually, the CDR provides specialized training and short courses to over 1,400 industry personnel.

RESEARCH FOCUS

- Functional properties of cheese, cheese products and cultured dairy products
- Functional dairy proteins (casein, milk protein concentrate (MPC), modified whey protein concentrate (WPC), etc.) and ingredients
- Dairy-based beverages
- Dairy food safety and quality systems
- Dairy processing
  - » Membrane filtration, drying, separation, etc.
- Cheese technology
  - » Coagulation, yield, performance, ripening
- Specialty cheese

CHEESE

The University of Wisconsin-Madison has a long and proud history of cheese research and outreach. The CDR extends the art and science of cheese making into the realm of specialty cheese innovation, as well as cheese as an ingredient. Its licensed cheese makers/scientists provide industry with training programs, research facilities, cheese making protocols for specific end use, and leading-edge technologies for adjusting the texture, taste and/or functionality of cheese in food applications.

CDR's cheese making pilot plant is a licensed dairy plant located at the University of Wisconsin-Madison. This setting allows for flexibility in all aspects of the cheese making process. The pilot plant is designed for manufacture of any retail cheese variety (fresh, cream, cottage, hard, soft, semisoft, surface-ripened, molded, and eyed), process cheese and cheese food, plus cold pack. Its new facilities include 9 unique cheese ripening caves that are individually temperature and humidity controlled.

CDR cheese applications staff, through consultation, pilot plant trials, applications, sensory and analytical laboratory evaluation, and on-site trials and visits, works in a confidential manner with all entities of the dairy industry. From dairy producers and manufacturers to ingredients suppliers and equipment manufacturers, applications staff works with the entire cheese distribution system, including foodservice, retail, wholesale, brokers, converters, warehouses, executive chefs, and quick-service restaurants – wherever cheese is used in food application systems. Staff members also provide direct technical support for the end use of natural, process and cold pack cheeses, as well as cheese in food applications.

DAIRY PROTEIN/INGREDIENTS AND PROCESSING

CDR has an extensive program focusing on dairy ingredients. Working on a confidential basis, the program strives to meet the needs of regional and national dairy ingredient processors and food manufacturers. These needs include process, product, and applications support. The dairy ingredient program and applications lab offer technical support for whey, buttermilk, nonfat dry milk, permeate, whey protein concentrate (WPC), whey protein isolate (WPI), individual whey proteins, milk protein concentrates and isolates, milk protein fractions and native whey protein. Services include training and seminars, process development, process troubleshooting, ingredient functionality testing and prototype development. Application areas of expertise are beverages, baked products, confections, dairy products, energy bars, cultured products, and prepared foods. CDR's new facility now offers a Siccadania 3-stage pilot dryer capable of 120 lbs. of water evaporation/hour in addition to its APV single stagespray dryer and fermentation equipment.

ASEPTIC/UHT BEVERAGE INNOVATION FACILITY

CDR's beverage innovation center offers a flexible, modular system for processing and aseptic packaging of beverages including aseptic homogenizer, indirect and direct heating unit, bag in a box packaging and other small-scale processing equipment for dairy beverage innovation.

ANALYTICAL SERVICES

Analytical services are offered to support projects carried out at the Center for Dairy Research. CDR provides comprehensive chemical and microbiological testing services. Tests performed include crude protein, casein, true protein, milkfat, total solids, mineral content by reference methods, enzymatic and HPIC determination of lactose and galactose, protein profiles of milk and milk products by electrophoresis, cheese proteolysis and determination of particle size analysis. Rheological tests performed include texture profiles, cheese meltability and functional properties of milk products.

Microbiological dairy food safety and quality tests are routinely determined, including tests for coliforms, standard plate count, plus yeast and mold. Shelf life and microbial challenge studies also are performed.

SAFETY/QUALITY APPLICATIONS

Providing an active approach to safety and quality, the CDR staff performs audits of dairy facilities, solves problems for dairy plants and reviews dairy facilities' good manufacturing practice (GMP) programs. CDR staff work with facility personnel to improve their GMP program and establish or modify a HACCP program. Staff members also interpret government regulations related to specific dairy products and dairy facilities and provide technical expertise in HACCP implementation and compliance with the Committee for the Assurance of Wisconsin Dairy Product Safety requirements, as well as training on implementation of the Food Safety Modernization Act (FSMA).

In addition, cheese and dairy ingredients produced at CDR are monitored for microbial safety.

TURBO

The TURBO program, or Tech Transfer of University Research for Business Opportunity, is an economic development initiative that supports the commercialization of novel dairy technologies and products. Whether your company is interested in licensing a CDR technology or working with CDR to develop a novel technology or product, the TURBO program can help bring your idea to the market. This assistance may include technical support, reimbursable grants, market research or another form of business assistance. TURBO also supports entrepreneurs and small companies in developing new, innovative dairy products and beverages by working with them to develop their product ideas, assisting them with scale up and then helping them find co-packers or licensed space to produce their products on a commercial basis. Services include business development assistance from business plans to regulatory information, legal expertise to financing guidance.

SENSORY ANALYSIS

The CDR is a trusted sensory partner from start to finish. CDR staff begin by pinpointing the exact purpose and end goal for a requested sensory analysis, and then proceed to design sensory tests and ballots with the right questions to optimize value and insight for the client. CDR utilizes industry best practices and modern Compusense cloud software to reach panelists wherever and whenever they may be needed. CDR employs a standing trained descriptive panel to analyze flavor, texture, and appearance profiles, as well as functionality such as shredding, slicing, or cooking applications. CDR also has sensory experts with collective decades of industry experience to screen products and offer technical advice and troubleshooting. CDR also has an extensive database of diverse consumer panelists from the Madison area, that can evaluate products in brand new sensory booths or be interviewed in focus groups on site. Our trained panel can also be utilized for discrimination testing such as triangle or tetrad methodologies. After the data is collected, the CDR can provide exceptional analysis and insights, including data visualizations, statistical analysis, and interactive business intelligence style interactive reports.

Sensory testing capabilities:

- Descriptive Analysis Flavor
- Descriptive Analysis Texture
- Descriptive Analysis Functionality
- Expert Screening
- Consumer Liking / Hedonics
- Consumer Preference / Ranking
- Consumer Focus Group
- Difference/Similarity Testing (Triangle, Tetrad, etc.)
- Shelf-Life Evaluation

FACILITIES AND EQUIPMENT

THE CENTER FOR DAIRY RESEARCH

UW-Madison
Pilot Plant Equipment

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OVERVIEW

The CDR's new state-of-the-art pilot plant facilities meet the needs of the dairy and food processing industry by offering access to smaller-scale equipment. The small-vat product development capability in the cheese pilot plant helps evaluate new cheese making processes. The dairy ingredient pilot plant has the capability to perform milk and whey processing of all types to produce beverages, yogurt, ice cream, sauces, spreads, dips and salad dressings. In addition, the applications lab at CDR has equipment to test the functionality of cheese as an ingredient, including a full line of foodservice pizza ovens. CDR also can evaluate the functionality of dairy ingredients and formulate dairy ingredients into baked products and confections. The chemical and microbiological laboratories extend more than 5,000 square feet and offer some unique testing capabilities.

EQUIPMENT

CHEESE MANUFACTURING

CDR offers a state of the art, full line of cheese making manufacturing and processing equipment located in a state-licensed, state-inspected, operating dairy manufacturing facility. The natural cheese manufacturing area includes a 1400 square foot raw milk processing area including tanks of various sizes for cooling and heating, all set up to incorporate various membranes such as ultrafiltration, microfiltration, diafiltration, nanofiltration and reverse osmosis to standardize milk based on any desired ratios or incorporation of any ingredient before pasteurization of cheese milk. The new raw milk processing area includes a GEA Westfalia ecocream separator and a MP&C HTST system with a 6000 lb. per hour capacity and the only HTST in Wisconsin time/sealed in Celsius. CDR has the capabilities to manufacture any style and variety of cheeses and offers nine unique temperature/humidity controlled aging caves.

- 4 Relco 1000-lb vats with networked control panel, CIP, individual drain/finishing tables and Optiset coagulation sensors
- 6 Stoelting 600-lb. vats with variable speed agitators and 1/4-in., 318-in. and 1/2-in. knives
- Kusel 5,400-lb. scale up cheese vat
- Kusel 600-lb. Double-0 cheese vats (2)
- Small 5-gal. capacity mini-cheese vats with automatic agitation (4)
- 9 independent ripening and drying rooms, each with its own hygienic air conditioner (USDA approved), temperature, humidity and air flow controls; includes Swiss cheese warm room
- 4 Kusel finishing tables with independent controls, automated agitation, networked control panel; milled or stirred curd
- 2 APT 2500-lb horizontal cheese vats with Kusel drain/finishing table (700 lb) with agitators, CIT system, PLC controls
- Kalt Copper cheese vat, hot water heated; for Alpine-styles as well as hard Italian types
- Kalt cheese press with various sizes of molds; variable pressure with each air ram independently controlled
- Alpma KBA tipping vat, chute and drain table with two 450 lb holding tanks, and cutting knives for high solids milks
- Tetra Pak Johnson waterless mixer molder, multiple stage unit; ability to heat pasta filata cheese up to 190°F
- GEA Niro Soavi 2-stage homogenizer

- Supreme steel fabricating cooker/ stretcher (mixer/ molder) Model 640 mixing machine; includes ends for string cheese, 5-lb. loaves with capability for 20-lb. block
- Stoelting prepress with 4 separate pressing chambers (for pressing of eyed cheeses)
- Damrow horizontal cheese press with 2 air rams
- Kusel 450 lb. portable cheese vat
- Kusel A-frame vertical cheese press
- 30-gal. bulk starter preparation tank
- Stainless steel cheese forms (Wilson 10-, 20- and 40-lb. block, perforated brick/Muenster hoops, 5-1b. round Muenster hoops)
- Plastic cheese forms of various sizes and shapes, including 10-lb. wheels (both Crellin and Fromagex), 5-1b. loaves, smaller sizes for 1-1b. Edam balls, Camembert, ricotta and panela baskets, etc.
- Stacked fiberglass circulating brine system
- Two Norlake Scientific NSR1331WSW/8H 33 cubic foot incubators for ripening mold and surface-ripened cheeses; off-site ripening also available upon request

FULL CREAM CHEESE MANUFACTURING LINE:

Also includes equipment listed under other categories. Processing lines include cheese vats, pumping line to collect whey and cream cheese, holding vessel, as well as packaging equipment.

- Sharpies Penwalt Model DS2 cream cheese separator
- APV Gaulin homogenizer Model M3, 2-stage
- Scherping Systems PT 30G 30-gal. capacity swept-minimum, 2 gal. of product surface tank with heating/cooling capability

COLD PACK AND PROCESS CHEESE MANUFACTURING LINE:

Also includes equipment listed under other categories. Processing lines include mixing/cooking vessels, homogenization and blending. All direct steam comes from culinary steam source.

- Biro cheese grinder, Model 922, includes various plate sizes
- Stephan UM/SK5 high shear (bowl-chopper style) Processed Cheese cooker
- Blentech twin-screw process cheese cooker, Model CC 0025, 20-lb. capacity, direct and indirect steam with vacuum
- Stephan cold pack cheese blender, 10-lb. capacity Pick Heater for jet cooking sauces
- Loos 10 lb. Low shear, twin screw process cheese cooker
- Koss ST Low shear, twin screw process cheese cooker (25 – 45 lbs finished batch size)
- Stephan vertical cutter/mixer, Model 17 91, 50-lb. capacity, indirect steam only

OTHER VARIOUS EQUIPMENT USED IN THE PROCESSING, CONVERTING AND PACKAGING OF CHEESE:

- Urschel cheese shredder, Model CC-D
- Vemag V 500 robot cheese grinder and vacuum machine with guillotine cutoff
- Dairy product aerator, 10 lb minimum batch size
- Lincoln Impinger oven, Model 1130, for baking of Juustoleipä
- Multivac vacuum sealer with gas flush capabilities, Model C400
- Variety of portable holding tanks
- Large and small volume scales from 600 lb scales in 0.2 lb increments down to analytical balances with 0.0001 gram accuracy
- Sprinkman batch butter churn
- Cultured/Fermented Products:
  - Four 40-gallon fermenters
  - Four 150-gallon fermenters
  - Cream cheese separator for high fat products
  - Quark separator for nonfat products

***PLEASE NOTE:** Additional equipment may be obtained by the CDR on a project-specific basis

ASEPTIC BEVERAGE LINE:

- Continuous flow UHT pilot line
- System capacity: 200 L/hr (53 gal/h)
  - Formulation tank
  - Direct and Indirect Heating
  - Various Holding Times
  - Cooling (tubular heat exchangers) Homogenizer
  - Aseptic Tank
  - Filling station 1: Pre-sterilized PET screw cap bottles (Gosselin/Nalgene)
  - Filling station 2: Bag-in-Box (pre-sterilized Scholler bags – 3 L)

DAIRY INGREDIENT PROCESSING EQUIPMENT:

- Four spiral-wound UF- or MF-compatible systems that contain multiple vessels
- One system using one or two 3.8 in. elements
- One system using up to six 3.8-in.-dia. vessels holding two elements each
- One system using up to three 4.3-in.-dia. vessels holding two elements each
- One system using one or two 8.0-in.-dia. vessels holding one element each
- NF or RO operated with one or two 3.8-in.-dia. vessel, one or two elements each
- Membrane filter system (UF/MF)
- Pilot-scale plate evaporator capable of 200 to 400 lbs. of water evaporation/hr.
- Pilot-scale spray dryer capable of 40 lbs. of water evaporation/hr. utilizing a pressure nozzle
- Stephan mixer with 40-L capability
- Homogenizer (two-stage)
- Two pilot-scale milkfat separators
- Small HTST research pasteurizer
- Tanks ranging from 5 to 500 gal.
- Swept-surface jacketed tank with heating and cooling (100 gal.)
- APV Gaulin homogenizer Model M3, 2-stage, minimum,2 gal. of product
- Spray Dryer:
  - Siccadania 3-stage pilot dryer capable of 120 lbs. of water evaporation/hr.

ICE CREAM EQUIPMENT:

- Emery Thompson, Taylor and Coldelite batch
- Taylor soft serve
- Tetra Pak continuous

SUPPORTING ANALYTICAL EQUIPMENT

General Analysis
Fat, nitrogen, lactose, galactose, lactates, protein composition, acid degree value, titratable acidity, whey (undenatured) protein number, coliforms, yeast and mold, starter organisms, Lactococcus starter, nonstarter lactic acid bacteria, Lactobacillus (hetero), standard plate count, ash, mineral analysis, triglycerides

Moisture analyzers
Total solids, moisture

Water Activity Meter
Water activity

Forced-air ovens
Total solids, moisture, total solids (nonfat)

pH/mV meters
pH

High Performance Ion Chromatography
Sugar profile (glucose, galactose, lactose); D/L lactic acid

Spectrophotometer
Lactose, galactose, D/L lactic acid

Acid Degree Value Testing equipment

Fourier Transform Infrared Spectrometer (FTIR)
Fat, total solids, total protein, nonprotein nitrogen, casein lactose

Free Fatty Acid testing equipment

Near Infrared Analyzer
Fat, moisture, total protein, salt

Immersion sonicators
Solutions, suspensions, degasification

Centrifuges (various sizes to 25,000 rpm)
Soluble nitrogen, milkfat separation, fat

Paar Physica and Malvern Rheometers
Gelation, small deformation technology

Zeiss Epi-Fluorescence Microscope
Light and fluorescent microscopy

Centrifuge rotors (fixed-angle and swing bucket)
Soluble nitrogen, milkfat separation

Microcentrifuges
Protein composition

Microwave mineralization oven
Mineral analysis

Viscometer
Viscosity

Electrophoresis
Protein composition (10 to 250 kD), protein composition (casein variants)

Capillary electrophoresis
Protein composition (10 to 250 kD)

Block digesters (6 and 20 Place)
Nitrogen content

Automated nitrogen analyzer with autosampler
Nitrogen content

Furnaces
Ashing

Cryoscope
Freezing point depression

ALP analyzer
Alkaline phosphatase

-80 C freezers
Sample preservation, starter culture storage

Low-temperature incubators
Various microbiological tests

Rotary evaporators (1 L)
Solvent evaporation

Soxhlet extractors (100 mL)
Fat extractions

Sample homogenizers
Sample preparation

Particle size analyzer (0.01 to 1,000 um) with autosampler
Particle size determination for liquids and solids

Multi-angle laser light scattering detector (MALLS)
Determination of molecular weight of polymers

Inductively coupled plasma-axial optical emission spectroscope with autosampler
Mineral analysis

Gas chromatography-flame ionization detectors with autosampler
Fatty acid composition, triglycerides, fatty acid sn-triglyceride positional analysis

High-performance liquid chromatography with autosampler
Phospholipids, carbohydrates, protein, composition (casein variants)

Evaporative light-scattering detector
Phospholipids, carbohydrates, triglycerides

Walk-in coolers (4 C)
Sample preservation

Commercial deli-style slicers
Melt test

Vacuum sealers
Sample preservation

Chloride analyzers
Salt determination

COURSES, SYMPOSIA AND EVENTS

- Applied Dairy Chemistry Short Course
- Cleaning and Sanitation Workshop
- Cheese Grading and Evaluation Short Course (2 times per year)
- Advanced Cheese Technology Short Course (2 times per year)
- Cultured Dairy Products Short Course (odd-numbered years)
- Batch Freezer Workshop
- HACCP Certification
- Dairy Ingredients Utilization Short Course (odd numbered years)
- Ice Cream Makers Short Course
- Dairy Ingredient Manufacturing Short Course (even-numbered years)
- Cheesemaking Fundamentals Short Course
- Dairy Ingredients Short Couse
- Food Fraud Short Course
- Dairy Plant Quality Assurance
- Master Cheese Maker Short Course (Focus on specific trends and technologies in the manufacture of various cheeses)
- Milk Pasteurization and Process Control School (2 times per year)
- Process Cheese Short Course
- World of Cheese - Pasture to Plate Short Course
- Buttermakering Fundamentals Short Course
- Advanced Buttermaking Short Course
- Buttermakers License Apprenticeship
- Cheesemaking Fundamentals
- Various courses related to sustainability
- Custom company training programs for industry
- CDR Industry Team Research Forum
- Cheese Technology Expo
- Certificate in Dairy Processing (3 times per year)
- Dairy Protein Beverages Short Course

COMMUNICATIONS AND OTHER RESOURCES

- *The Dairy Pipeline* quarterly technical newsletter
- Technical reviews
  - » Dried Dairy Ingredients
  - » Dairy Proteins
  - » Whey Processing – Bleaching
  - » Fact sheets
  - » Whey Processing - Annatto and Color Removal
  - » Cracker and Cheese Pairing Guide
  - » Distribution of Milk Components Between Cheese & Whey
  - » Membranes 101
  - » Membrane Configurations
  - » Quick Guide to Choosing the Best Type of Whey
  - » Relative Milk Component Sizes in Comparison with Membrane Pore Size Ranges
  - » Use of Membranes for Standardizing Milk for Cheese Production
  - » Guide to Smoked Cheeses
  - » Brining Cheese, A Comprehensive Guide
  - » Dust Fires and Explosions Associated with Dairy Powders
  - » Better Butter Book

STAFF AND RESEARCHERS

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Food chemistry and analysis, dietary phytochemicals, functional foods and prevention of chronic disease.

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Processing and utilization of dairy foods, analytical methods of analysis; food product development; ultrafiltration and reverse osmosis, frozen dessert technology, analytical methods of food analysis and dairy foods technology; stabilization and emulsification of food systems, environmental toxicants in food products; independent third-party, 3A-mandated equipment cleanliness evaluations.

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Provides technical assistance to clients as they develop their concepts/products in the CDR facility as well as on-site support with troubleshooting and scale-up assistance.

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Protein chemistry to improve food quality, sustainability and nutrition; protein-polyphenol interactions.

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Process cheese safety; shelf-life studies with foodborne pathogens; evaluation of product safety for new formulations.

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The Center for Dairy Research
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Coordinates research projects within CDR. Areas of expertise include evaluation of texture and rheological properties of cheese; standardization approaches for cheese making, including cheese yield determination; design of cheese projects/trials; determination of the coagulation properties of cheese milk; membrane processing for cheese making; cream cheese properties; buttermilk as an ingredient; low-fat cheese.

VIC GRASSMAN, CECD

Technology Commercialization Manager
The Center for Dairy Research
vgrassman@cdr.wisc.edu

TURBO program manager, lead coordinator and partner contact for all commercialization and economic development initiatives. Brings research and technology to the private sector.

GARY GROSSEN

Research Cheesemaker
ggrossen@cdr.wisc.edu

An award-winning Wisconsin Master Cheesemaker with over 50 years of experience in the dairy industry.

TOM GUERIN, Ph.D.

Research Program Manager
The Center for Dairy Research
tguerin@cdr.wisc.edu

More than 20 years of experience in research and product development in dairy and food ingredients. Responsible for client interaction, project management and ensuring alignment with changing demands and trends of the food industry.

SUNDARAM GUNASEKARAN, Ph.D.

Professor, Biological Systems Engineering (joint with Food Science)
UW-Madison
guna@wisc.edu

Determining physical properties and quality factors of food materials and design of sensors and instrumentation for quality evaluation of food materials nondestructively; rheological and transport properties, structure-function relationships; value-added food and nonfood processes of biomaterials.

RICHARD HARTEL, Ph.D.

Professor, Food Science (joint with Biological Systems Engineering)
UW-Madison
rwhartel@wisc.edu

Food engineering/processing, separations, crystallization/ particulate processes, structure-function relations.

REBECCA HOHLSTEIN, M.S.

Assistant Coordinator, Cheese Industry & Applications
The Center for Dairy Research
rhohlstein@cdr.wisc.edu

Expertise in technical support, training, product development and troubleshooting. Specialization in starter culture performance, enzyme functionality and industry problem solving.

KRISTEN HOUCK

Research Specialist
The Center for Dairy Research
houck@cdr.wisc.edu

Coordinator of microbiological services at CDR, responsible for microbial testing, analysis and safety of dairy products. Brings 20+ years of lab experience to the position.

MELLISA HOUFE

Researcher
mhoufe@cdr.wisc.edu

A licensed buttermaker, cheesemaker, butter grader. Assists with the operations of the pilot plant, guiding research and helping with special projects.

TU ANH HUYNH, Ph.D.

Assistant Professor, Food Science
UW-Madison
Thuynh6@wisc.edu

Molecular mechanisms of bacterial pathogenesis and stress response, bacterial signaling, bacterial pathogen – host interactions, small molecule-protein interactions, food safety.

RODRIGO IBÁÑEZ, Ph.D.

Associate Scientist
The Center for Dairy Research
Ribanez@cdr.wisc.edu

Knowledge and expertise conducting research in cheese science and technology with a focus on microbiological topics related to cheese and dairy products.

BARBARA INGHAM, Ph.D.

Professor, Food Science
UW-Madison
bhingham@wisc.edu

Analytical methods for food analysis; microbial quality and safety of foods; HACCP, food quality and food safety.

JOEY JAEGGI

Research Cheesemaker
jjaeggi@cdr.wisc.edu

A third-generation licensed cheesemaker with more than 30 years of experience having been a plant manager as well as owner of his own plant for 14 years. Expert in soft cheeses, such as Muenster and Brick but also has experience making Swiss, Monterrey Jack, Cheddar and many others.

JOHN JAEGGI

Coordinator, Cheese Industry and Applications Program
The Center for Dairy Research
jaeggi@cdr.wisc.edu

Third generation cheesemaker. Coordinates cheese making trials; serves as an industry information resource, provides technical support for specialty cheese makers.

HONG JIANG

Research Specialist
The Center for Dairy Research
hfiang@cdr.wisc.edu

Assists the Dairy Ingredient and Beverage group as well as the Cultured Products group with basic research to product formulation, with particular interest in protein.

LUIS JIMÉNEZ-MAROTO, Ph.D.

Assistant Coordinator, Cheese Industry & Applications
The Center for Dairy Research
ljimenez@cdr.wisc.edu

Expertise in research, data analysis, sensory, judging and training. Research on the effects of high-pressure processing and low temperature storage on the long-term performance and shelf life of various cheeses.

ANDY JOHNSON

Assistant Coordinator, Cheese Industry a Applications
The Center for Dairy Research
ajohnson@cdr.wisc.edu

Coordinates cheese making trials involving a wide variety of natural and specialty cheeses; provides information and technical support for brokers, end users, ingredients suppliers, manufacturers and others in the industry. Manages Wisconsin Master Cheesemaker® program.

MARK JOHNSON, Ph.D.

Assistant Director, Distinguished Scientist
The Center for Dairy Research
jumbo@cdr.wisc.edu

Coordinates CDR's strategic and applied cheese research program; cheese technology; manufacturing procedures and effects on quality; technology and microbiology of reduced-fat cheeses; enhanced ripening of cheese using lactobacilli; and cheese defects.

JEREMY JOHNSON

Research Cheesemaker
jjohnson@cdr.wisc.edu

Licensed cheese, butter and butter grader. Experience in cheese and ice cream making.

SUSAN LARSON, Ph.D.

Research Specialist
The Center for Dairy Research
slarson@cdr.wisc.edu

Dairy ingredient applications, formulation development and functionality work. Website and dairy technical-support line.

YANJIE LU, Ph.D.

Researcher, Lab Manager
The Center for Dairy Research
yanfielu@cdr.wisc.edu

Provides technical support and conducts analysis for research and industry projects. Develops and adapts methods involved in dairy products and dairy processing. Serves as lab manager for Dr. Lucey lab.

JOHN LUCEY, Ph.D.

Director, CDR; Professor, Food Science
UW-Madison
jlucey@cdr.wisc.edu

Dairy chemistry/technology; physicochemical properties of dairy products; cheese technology; rheological properties of dairy products; milk proteins; yogurt science and technology.

ANDREA MILLER, RD

Communications and Training Manager
amiller@cdr.wisc.edu

Manages internal and external communications, stakeholder relations and short course/training program for the Center.

GINA MODE, MBA

Assistant Coordinator, Cheese Industry Applications Program
The Center for Dairy Research
gmode@cdr.wisc.edu

Coordinates cheese making trials involving a wide variety of natural and process cheeses; provides information and technical support for brokers, end users, ingredients suppliers, manufacturers and others in the industry.

MIKE MOLITOR

Process Pilot Plant Manager
The Center for Dairy Research
molitor@cdr.wisc.edu

Manages CDR process laboratory activities, especially projects utilizing pasteurization, MF, UF, NF, RO filtration, evaporation and/or spray drying equipment. Expertise in process engineering with over 18 years of experience. Serves as technical resource for domestic dairy manufacturers.

ALEX O'BRIEN

Coordinator, Dairy Food Safety/Quality
Assists dairy plants with food safety plans, quality issues, and performs third party audits.

BEN OLDENBURG

Research Cheesemaker
boldenburg@cdr.wis.edu

More than 25 years of experience in dairy plants as a cheesemaker, supervisor and safety and loss control manager. Pasteurizer operator and assistant with industry trials and research cheesemaking.

NATHAN PRICE, Ph.D.

Coordinator, Dairy Ingredients
nprice@cdr.wisc.edu

Research in concentration and isolation of phospholipids from various dairy by-products. Experience in research and development, working with many types of milk powders, specialty whey powders, and butter production.

BRANDON PROCHASKA, M.S.

Coordinator, Sensory
bprochaska@cdr.wisc.edu

Experience in sensory science including different sensory techniques such as consumer testing, triangle testing, shelf life testing, trained and maintained panelists as well as dairy technical services, and data visualization/process improvement.

SCOTT RANKIN, Ph.D.

Professor, Food Science
UW-Madison
sarankin@wisc.edu

Characterization primarily of dairy food flavor with sensory and instrumental techniques; programs and short courses in support of the dairy foods processing industry.

JUAN ROMERO, M.S.

Assistant Coordinator, Cheese & Industry Applications
The Center for Dairy Research
romero@cdr.wisc.edu

Develops and adapts methods involved in dairy product processing. Advises on dairy related research projects. Provides client support.

EMILY SLATTER

DBIA Coordinator
eslatter@cdr.wisc.edu

Experience in grant management. Provides business development training and support for dairy entrepreneurs in the Midwest.

DEAN SOMMER, M.S.

Cheese and Food Technologist
The Center for Dairy Research
dsommer@cdr.wisc.edu

Serves as a resource for cheese manufacturers and end users interested in expanding the use of cheese, particularly as an ingredient.

VICTOR UJOR, Ph.D.

Assistant Professor, Food Science
UW-Madison
ujor@wisc.edu

Fermentation, renewable fuels and biochemicals, metabolic engineering/synthetic biology, bioprocess design, bioconversion of food wastes and agricultural residues to value-added products.

BEN ULLERUP MATHERS

Research Cheesemaker
bmathers@cdr.wisc.edu

A licensed cheesemaker, with experience in all parts of the cheesemaking process, from vat to packaging.

ANALYTICAL STAFF

Expertise in chemical and microbiological testing techniques of various dairy products.

MIDWEST DAIRY FOODS RESEARCH CENTER

UNIVERSITY OF MINNESOTA

St. Paul, MN
www.midwestdairy.umn.edu

SOUTH DAKOTA STATE UNIVERSITY

Brookings, SD

IOWA STATE UNIVERSITY

Ames, IA

AFFILIATE UNIVERSITIES:

University of Nebraska
Kansas State University
University of Missouri

CENTER DIRECTOR

JAYENDRA AMAMCHARLA, Ph.D.
Center Director (Interim)
785-532-1221
jayendra@ksu.edu

OVERVIEW

The Midwest Dairy Foods Research Center has resources within the University of Minnesota (St. Paul), South Dakota State University (Brookings), and Iowa State University (Ames) as core universities and University of Nebraska (Lincoln), Kansas State University (Manhattan), and University of Missouri (Columbus) as affiliate universities. The dairy center was formed to conduct research and provide support needed to increase the viability of the United States dairy industry and ensure its future competitiveness. The center offers expertise in dairy foods research for both traditional dairy products and dairy derived ingredients.

RESEARCH FOCUS

- **Exports:** Increase the demand for the US Dairy worldwide through research efforts to improve shelf-life, quality, and functionality of cheese and dairy derived ingredients.
- **Consumer Solutions:** Expand dairy products and ingredients consumption through technologies to measure and improve flavor, functionality, quality, perception, education to meet current consumer needs.
- **Sustainability:** Improve economic, social, and environmental impact of dairy through value addition to dairy co-products, lean manufacturing, and water usage and wastewater management.
- **Food Safety:** Ensure the safety of dairy products and ingredients.

FACILITIES AND EQUIPMENT

UNIVERSITY OF MINNESOTA

CONTACT:

RAY MILLER
Plant Manager
612-624-7776
rmiller@umn.edu

FACILITIES

SENSORY CENTER

Zata Vickers, Director

The sensory center has two tasting suites, and each suite contains eight booths and a food preparation area. Both suites have computerized data collection systems. Sensory center staff routinely train and administer descriptive analysis panels, and recruit and administer consumer taste panels.

JOSEPH J. WARTHESEN FOOD PROCESSING CENTER

Dr. David Smith, Director

The food processing center has a large variety of dairy and food processing equipment. We are state certified as a Grade B dairy and have a certified HTST milk pasteurizer and vat pasteurizer. We welcome industry clients to conduct R&D trials in our facility, and cheese and ice cream start-ups to manufacture in our facility as they develop their own plants.

EQUIPMENT

PASTEURIZERS/PROCESSORS

- Microthermics UHT System: includes homogenizer and HEPA filtered filling hood, 1 to 3 L/min.
- Vat pasteurizer, homogenizer and plate cooler: 50 to 100 gal.
- Pasteurizer: Cherry-Burrell, 4,000 lbs./hr.
- Process cheese cooker: Blentech, 10 lbs.
- Process cheese cooker: Damrow, 40 lb
- Tetra All-mix vacuum blender

DRYERS/AGGLOMERATORS

- Fluid bed: Glatt GPCG-1, Wurster spray process, 3-lb. cap.
- Drum dryer: Buffalovac 6-in. drums
- Spray dryer: Coulter, 90 lbs./hr.
- Spray dryer: APV, 20 lbs./hr.
- Freeze dryer

CHEESE PROCESSING

- Blue cheese Punch
- Cheddaring belt: Tetra-Scherping, 200 to 300 lbs./hr.
- Cheese presses: vertical and horizontal with various hoop styles
- Cheese vat: Damrow, 5,000 lbs.
- Cheese vat: Tetra-Scherping, automated, 2,500-lb. cap.
- Dewheying and salting belt
- Cheese vats: Kusel, 2,000 lbs.
- Cheese vats: Nu-Vat, 800 lbs. (2)
- Curdmill: Damrow

FROZEN DAIRY PROCESSING

- Tetra-Hoyer Frigus SF600 continuous ice cream freezer: 120 gal./hr.
- Fruit/nut feeder

HOMOGENIZATION AND BLENDING

» Colloid Mills

» Homogenizers: Gaulin 30 and 125 gal./hr.

» Microfluidizer

FILTRATION/SEPARATION/ CONCENTRATION

» Decanter centrifuge: Westphalia, 1-2 gal./min.

» Desludging centrifuge: Westfalia, 2-3 L/min.

» PTI RO/UF system Spiral wound

» UF system: DDS-20, Plate and Frame, 10-L

» Evaporator: Forced Circulation, 75-100 lbs./hr.

MIXERS/CHOPPERS

» Hammermill: Fitzpatrick, 5-lb. hopper

» Ribbon blenders

» Colloid Mill Fryma Toothed

OTHER

» Twin-screw extruder: Buhler 44 mm twin-screw with loss-in weight powder feed and flow metered liquid injection

» Coating drum: Spray Dynamics

» Temperature- and humidity-controlled environmental chamber

» Rack oven & proofer

» Horiba L-960A Laser Diffraction Particle Size Analyzer

» Malvern ZetaSizer Nano ZS

FACILITIES AND EQUIPMENT

SOUTH DAKOTA STATE UNIVERSITY

DAVIS Dairy Plant

SOUTH DAKOTA STATE UNIVERSITY

Institute for Dairy Ingredient Processing (IDIP)

CONTACT:

STEVE BECKMAN
Dairy Plant Research Manager
605-688-5480
steven.beckman@sdstate.edu

https://www.sdstate.edu/dairy-and-food-science

EQUIPMENT

» Batch freezer: 40-qt. Emery Thompson

» Butter churns: 15 to 450 lbs.

» Centrifugal pumps

» Cheddar mill

» Cheese block cutter (pneumatic)

» Cheese press (pneumatic)

» Cheese sealer: Sipromac

» Cheese shredder: Hobart

» Cheese vat: 2,500 lb. HCV

» Cheese vat: 2x Kusel Double-O, 500 lbs.

» Cheese vat: 1,000 lbs. fully enclosed, double-0 on load cells with pre-draw and final drain

» Cold bowl cream separator: DeLaval, 5,000 lbs./hr. and GEA 7,500 lbs./hr. cold bowl

» Crystallization tank: 3,000 lbs.

» Drain table for HCV and 100 lbs. Double-0

» Evaporator: multi-pass, falling film with high concentration finisher and single-stage flesh cooler, 1,500 lbs./hr., custom built, Dahmes Equipment

» Filler: Bag-n-Box, Scholle

» Filtration systems: multi-stage, low, and high pressure

» Fruit feeder

» Benchtop Crystallization equipment

- Benchtop filter (flat sheet) tester
- Homogenizer: Gaulin, 5,000 lbs./hr., 4,000 psi
- Homogenizer: 7,500 lbs./hr., 3,500 psi
- HTST systems: 5,000 lbs./hr. and 7,500 lbs./hr.
- Ice cream freezer: APV K110, 150 gal./hr.
- Likwifier: 100 gal.
- Microfiltration system: 1.7 m2, ceramic membranes
- Nano/reverse osmosis filtration, pilot lab, spiral wound with 3.8-in. elements
- Niro spray dryer: rotary atomizer
- Platform scales: 75 lbs. and 400 lbs.
- Positive pump for revel in ice cream
- Process cheese cooker: single-screw, 30-lb. culinary steam generator
- Process vats: 20, 50, 200, 300, 500 and 600 gal.; steam and cool
- Raw milk storage: 2 x 8,500 gal. silos
- Refrigerated and frozen storage facilities, includes -40 F blast freezer
- Spray dryer: two-stage with vibrating fluid bed and agglomeration capacity, custom built, Dahmes Equipment, 300 lbs./hr.
- Steam culture chest
- Ultrafiltration pilot lab, spiral-wound with 3.8-in. elements
- Ultra/microfiltration system, 4-stage w/mag flow meters and pressure transducers, process 1,000 to 1,500 lbs./hr

ANALYTICAL CAPABILITIES

HPLC, Capillary Electrophoresis, ashing oven, vacuum oven	Wet chemistry analyses
Microbiological analyses	Rapid protein (CEM Sprint, FTIR), rapid TS (CEM Smart 5)
Water analyses (BOD, COD, TSS, TOC)	Rapid gross composition (Bentley DairySpec)
Turbidity, colorimetric	

FACILITIES AND EQUIPMENT

IOWA STATE UNIVERSITY

CONTACT:

JORDAN FUNKHOUSER
Pilot Plant Manager
phone: 515-294-3572
jfunk@iastate.edu

FACILITIES

- Dry processing pilot plant
- Fermentation facility
- Food microbiology lab
- High hydrostatic pressure processing facility
- Nutrition and Wellness Research Center
- Fitness and metabolism unit
- Meeting rooms
- Sensory evaluation units

PROCESS DEVELOPMENT LAB

- Product development capabilities
- Technology transfer pilot plant and theater
- Test kitchen and sensory lab
- Wet processing pilot plant

A fee for use may be associated with some of the listed equipment. Please contact Sarah Canova (scanova@iastate.edu), or Stephanie Clark (milkmade@iastate.edu), if you are interested in more information about equipment or services provided at Iowa State University.

EQUIPMENT

» Acid digester: Labconco
» Autoclave
» Brookfield viscometers
» CEM Microwave Ashing System 300
» Centrifuges: call for options
» Centrivap concentrator: Labconco
» Cheese press (approximately 100-lb capacity Longhorn hoop press)
» Cheese vats: 2 400-lb capacity jacketed stainless steel
» Compression and injection molding machines
» Consistometers: Bostwick, Adams
» Extrusion systems for grain processing
» Fermentors: Benchtop, 1-, 2-, 5-, 10-L
» Fermentors: sterilizable-in-place, 15-, 50-, 100-L
» Filtration unit: hollow-fiber
» Food extrusion
» Freeze drying
» Freezer: ultralow (-70C)
» Fryers
» Gas chromatography: Varian
» Gas chromatography-mass spectrometry: Agilent
» High shear blender (Admix Rotosolver)
» High-temperature short-time pasteurizer (Microthermics)
» Homogenizer: Avestin
» Hunter Labscan XE
» Ice cream freezer: Taylor
» Incubator shaker: New Brunswick Sci
» Instron Universal Testing Unit 1122
» Pasteurizer-Cheese Vat: C. vant' riet
» Pumps: call for options

- » Refrigerator/Freezer: explosion-proof, isotemp
- » Kettles: electric-heated with agitation, 10 gal.
- » Kjeldahl: Labconco
- » Membrane filter system
- » Microbiological incubators: regular, refrigerated
- » Microplate reader
- » Microscopes, light and fluorescence with digital- imaging capability
- » Oven: Fisher Isotemp
- » Penetrometers
- » Photochem (oxidation potential system)
- » Plastic film and sheet extruder
- » Rapid Visco Analyzer
- » Refractometers
- » Retort
- » Rotary evaporator and vacuum pump
- » Screens and mixing tanks
- » Spectronics XL-1500 UV Crosslinker
- » Spectrophotometers: call for options
- » Stomachers
- » Texture analyzer (TA.XT Plus)
- » Ultracentrifuge: Beckman L8M
- » UV illuminator: Fisher Biotech
- » Vacuum oven: food-grade
- » Viscometers: Digital Brookfield (YR-1; HDB, RV)
- » Water activity meter: AquaLab
- » Wet grinders

COURSES, SYMPOSIA AND EVENTS

UNIVERSITY OF MINNESOTA

- Artisan Cheese Making Workshop
- Extrusion Workshop
- Food Chemistry Workshops
- ServSafe
- Milk Pasteurization and Dairy Plant Sanitation Workshops
- Identifying, controlling and labeling food allergens for the food industry
- Food Establishment Sanitation Workshop
- Microbrewery Food Safety and HACCP
- Listeria Monitoring and Validation of Food Safety Plans for Retail Establishments
- Dry Sanitation for Food Plants
- Food Allergen Training
- Hazard Analysis Critical Control Points (HACCP): Intro and advanced training
- Food Plant Environmental Monitoring
- Food Plant Sanitation
- Acidified Foods Training for Entrepreneurs and Food Processors
- Juice HACCP Workshop
- Food Safety Roundtable Meetings

SOUTH DAKOTA STATE UNIVERSITY

- Cheese Judging Workshops
- Micro and Ultra Filtration Workshops
- Cheese Manufacture Workshops

IOWA STATE UNIVERSITY

- Hazard Analysis Critical Control Points (HACCP) 101
- ServSafe

STAFF AND RESEARCHERS

Researchers and nutritionists work within the dairy research program and are closely aligned with the University of Minnesota Food Science Department, the South Dakota State University Dairy and Food Science Department, the Iowa State University Food Science and Human Nutrition Department, the Kansas State University Animal Sciences and Industry Department, the University of Nebraska-Lincoln Food Science and Technology Department, and the University of Missouri Food Science Department addressing new product development and processes for dairy products and ingredients.

JAYENDRA AMAMCHARLA, Ph.D.

Professor of Food Science
Kansas State University
jayendra@ksu.edu

Advanced sensing technologies for dairy and food process monitoring; rapid and alternative methods for dairy and food analysis (functional, chemical, and microbial); Protein functionality.

SANJEEV ANAND, Ph.D.

Professor of Dairy Microbiology, Food Safety
South Dakota State University
sanjeev.anand@sdstate.edu

Public health microbiology of milk and food products, predictive microbiology, quality systems implementation, biofilms, nutraceuticals and molecular methods in microbiology. Bioluminescent markers and signal molecules.

LANCE BAUMGARD, Ph.D.

Professor; Norman Jacobson
Endowed Professor, Animal Science
Iowa State University
baumgard@iastate.edu

Environmental and nutritional physiology; post-absorptive carbohydrate and lipid metabolism; bioenergetics; dairy science and nutrition.

DONALD BEITZ, Ph.D.

Distinguished Professor in Agriculture and
Professor of Animal Science and Biochemistry
Iowa State University
debeitz@iastate.edu

Lipid metabolism; cholesterol; nutritional and genetic control of animal food.

ANDREIA BIANCHINI, Ph.D.

Associate Professor of Food Science
University of Nebraska-Lincoln
abianchini2@unl.edu

Evaluate ingredients, assess processes, and develop strategies to reduce/prevent contamination of final products with mycotoxins and bacterial pathogens; develop quality control mechanisms; and HACCP assistance focusing on food, dairy and feed products.

TERRY BOYLSTON, Ph.D.

Associate Professor of Food Science
and Human Nutrition
Iowa State University
tboylsto@iastate.edu

Lipid and flavor composition of foods; conjugated linoleic acid formation in dairy products.

MARIN BOZIC, Ph.D.

Assistant Professor of Dairy Foods Marketing Economics
University of Minnesota
mbozic@umn.edu

U.S. dairy policy analysis; dairy risk analysis; demand analysis and elicitation of consumers' willingness to pay for new dairy foods products; and feasibility assessments of new dairy technologies, processing investments and new products.

BYRON BREHM-STECHER, Ph.D

Associate Professor of Food Science
and Human Nutrition
Iowa State University
byron@iastate.edu

Food safety and biosecurity; rapid molecular detection of foodborne pathogens and spoilage organisms; flow cytometry; biomimetics; multicomponent antimicrobial systems.

REBECCA CADEMARTIRI, Ph.D.

Adjunct Assistant Professor
of Materials Science and Engineering
Iowa State University
rcademar@iastate.edu

Interactions of biological entities, especially bacteriophages, with materials for detecting bacteria, protecting plants, animals and humans from bacterial infections; and treating bacterial infections in animals and humans.

LAKSHMIKANTHA H. CHANNAIAH, Ph.D.

Assistant Professor of Food Science
University of Missouri
lchannaiah@missouri.edu

Extension programming in food processing and food safety.

STEPHANIE CLARK, Ph.D.

Professor of Food Science and Human Nutrition;
Associate Director of the Midwest Dairy Foods Research Center
Iowa State University
milkmade@iastate.edu

Applies food microbiology and chemistry approaches to bridge the gap between dairy product sensory quality and human health.

BARAEM ISMAIL, Ph.D.

Professor of Food Science
University of Minnesota
bismailm@umn.edu

Phytochemica ls, protein and enzyme chemistry; improving the functionality and bioactivity of food constituents; soy isoflavones (chemical structure, protein association, extractability, stability and bioavailability).

BUDDHI LAMSAL, Ph.D.

Professor of Food Science and Human Nutrition
Iowa State University
lamsal@iastate.edu

Food processing and engineering; crops utilization and industrial value-addition through enzyme application, fermentations and bio-based products; engineering properties of food; structure-functional properties of proteins, polysaccharides and food rheology.

PEGGY LEHTOLA

Assistant Director of Midwest Dairy Foods Research Center
University of Minnesota
plehtola@umn.edu

Assistant to the Director, MDFRC.

AUBREY MENDONCA, Ph.D.

Associate Professor of Food Science and Human Nutrition
Iowa State University
amendon@iastate.edu

Rapid detection of human pathogens in dairy foods; development and application of natural antimicrobials to enhance the safety and quality of dairy foods.

VIKRAM MISTRY, Ph.D.

Interim Assoc. Dean of CAFES Academic Programs
Professor, Dairy and Food Science
South Dakota State University
vikram.mistry@sdstate.edu

Reduced-fat dairy products; membrane processing; process cheese manufacture; salt whey in cheese making; cheese making characteristics of milks from Holstein and Brown Swiss cows.

KASIVISWANATH MUTHUKUMARAPPAN, Ph.D.

Professor of Agricultural and Biosystems Engineering
South Dakota State University
muthukum@sdstate.edu

Dairy rheology and microstructure; physical and functional properties of dairy products.

DANIEL O'SULLIVAN, Ph.D.

Professor of Food Science
University of Minnesota
dosulliv@umn.edu

Bacteriophage resistance and bacteriocin production in lactococci, genetic regulatory circuits, genetic fingerprinting, probiotic cultures.

SONIA PATEL

Dairy Application Scientist
University of Minnesota
shpatel@umn.edu
605-690-6747

GARY REINECCIUS, Ph.D.

Professor of Food Science
University of Minnesota
greinecc@umn.edu

Flavor chemistry, off-flavors and flavor processing.

R. ROGER RUAN, Ph.D.

Professor of Biosystems and Agricultural Engineering
University of Minnesota
ruanx001@umn.edu

Imaging and spectroscopy technology, shelf-life testing, structure-function relationships of biological materials.

PRAFULLA SALUNKE, Ph.D.

Assistant Professor, Dairy and Food Science
South Dakota State University
prafulla.salunke@sdstate.edu

Processing and product manufacturing impacts on dairy product quality and functionality attributes. Focus on cheese, dairy ingredients, and enzymes used in dairy processing.

TONYA SCHOENFUSS, Ph.D.

Associate Professor of Food Science
University of Minnesota
tschoenf@umn.edu

How formula and manufacturing processes affect natural and process cheeses, fermented milks and other dairy ingredients.

KAREN SCHMIDT, Ph.D.

Professor of Food Science
Kansas State University
kschmidt@ksu.edu

Dairy foods chemistry; dairy foods quality; dairy foods technology, and dairy protein chemistry.

BONGKOSH VARDHANABHUTI, Ph.D.

Associate Professor of Food Science
University of Missouri
vardhanabhutib@missouri.edu

Improve functional properties of dairy proteins; understand relationships between structure, physical properties, stability, and functionality of proteins and mixed protein-polysaccharide systems; develop protein and polysaccharide complexes having enhanced functional properties.

ZATA VICKERS, Ph.D.

Professor of Food Science
University of Minnesota
zvickers@umn.edu

Food aromas and acceptability; sensory evaluation of food; improved sensory and flavor techniques for fermented dairy products.

NORTHEAST DAIRY FOODS RESEARCH CENTER

CORNELL UNIVERSITY

https://blogs.cornell.edu/nedfrc

CENTER DIRECTORS

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MARTIN WIEDMANN, Ph.D., DR. MED. VET.
Center Associate Director
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OVERVIEW

The Northeast Dairy Foods Research Center located at Cornell University, Ithaca, NY, pursues a wide spectrum of dairy foods research with a specific focus on fluid milk, dairy ingredients, yoghurt, cheese, dairy powders, food safety, sustainability, and novel dairy processing technologies. The program also works on the impact of primary dairy production and animal health on milk quality.

The Northeast Dairy Foods Research Center also provides learning opportunities for the industry with short-course training in dairy food safety and dairy processing with seperate certificate programs in fluid milk processing, cheese, yoghurt, and dairy powders (see https://cals.cornell.edu/dairy-extension/what-we do/training-programs/certificate-program).

RESEARCH FOCUS

Value Added Dairy

- Physical and engineering properties of dairy ingredients
- Functionalization and value added utilization of milk proteins
- Novel processing (High Pressure Processing, High Pressure Homogenization, Supercritical Fluid Extrusion) of dairy products and ingredients
- Technological approaches to increase the shelf-life of fluid milk and other dairy foods.
- Upcycling of dairy byproducts by fermentation and processing
- Technological approaches to produce new dairy beverages and ingredients from milk that have sensory and nutritional attributes that consumers desire
- Development of analytical tools for management of milk quality, composition, and sustainability of milk produced for dairy product manufacture

Dairy Microbiology and Safety/Fluid Milk Quality

- Dairy foods safety: intervention strategies for microbial inactivation
- Source tracking of microbial contaminants from farm through finished product
- Predictive modeling of dairy product spoilage and assessment of intervention strategies
- Environmental monitoring for pathogens in dairy processing environments
- Impact of raw milk quality on processed product quality
- Molecular and microbiological method development for detection, identification and subtyping dairy associated microbial contaminants
- Extension of chocolate milk shelf life
- Extension of dairy foods' shelf life by supercritical carbon dioxide treatments
- Determine the impact of annatto and bleaching on flavor and functionality of WPC 80 and SPC 80
- Mechanisms for control of spoilage organisms
- Applications of bacteriophage to improve health
- Novel applications for co-products of dairy fermentations
- Investigate farm management practices associated with high sporeformers levels in raw milk
- Development of modeling and digital tools for the dairy industry
- Develop molecular-based raw milk testing methods

Dairy Processing

- Milk protein rheology and functional properties
- Novel processing methods for the dairy industry

FACILITIES AND EQUIPMENT

FOOD PROCESSING AND DEVELOPMENT LABORATORY (FPDL)

CONTACT:

ROBERT RALYEA
General Manager, Cornell University
Phone: 607-255-7643
rdr10@cornell.edu

https://cals.cornell.edu/food-science/outreach-extension/services/food-processing-and-development-laboratory

OVERVIEW

The Cornell University Food Processing and Development Laboratory (FPDL) is a highly flexible pilot plant that allow industry access to equipment and expertise to facilitate the development of new dairy products and/or to produce new dairy products on a small scale. Our 'plug and play' design means we can emulate your plant processing parameters for accurate product development projects while the company can get product trials completed without stopping actual production. Since the facility is a licensed dairy plant permitted by NY State, our products can be used for sensory or consumer acceptance studies.

- **Research:** Provide a state-of-the-art facility and technical assistance for conducting food and dairy-related research and development using Cornell's pilot plant facilities.
  - » Assist in the transfer of new technology from the research program to the industry.
  - » Provide facilities and staff support on a fee-for-use basis to assist companies and individuals with production and testing of product formulations provided by the client.
- **Extension:** Provide facilities for use in applied extension research and continuing education programs.

The 6,000-square-foot main processing area is directly adjacent to our fully licensed operating dairy plant. The pilot plant houses a small scale HTST system capable of continuous pasteurization of batches as small as 100 gallons with up to a 12-minute extended hold. The facility has multiple cheese vats from 50-500 gallon capacities (with associated equipment such as cheddar milling equipment, cheese presses, a variety of moulds, etc.) For yoghurt and cultured products production, the facility has a Greek yoghurt separator, fermentation vats from 50-500 gallons,

several filling capabilities as well as fermentation rooms to 110°F. We have continuous and batch ice cream freezing capability as well as a walk-in hardening freezer (-40°F). We also have access to very high-quality milk from our Vet School farm located less than a mile away. This combination allows for scaling up of production to provide a variety of products for consumer demonstrations, food shows and exhibitions.

The facility has experienced full-time staff professionals who are able to assist in all aspects of food product development and processing. Companies/individuals can visit our facilities and work collaboratively or the staff of the FPDL can process products to your specifications and ship it to you overnight. Customized small product development runs can be conducted with our established access to suppliers of ingredients, cultures and raw materials or if a company prefers, they can ship their preferred ingredients to us.

EQUIPMENT

DRYING CAPABILITIES
» Model 1 Niro Atomizer Versatile Utility Spray Dryer – 22-kg/hr. evaporative capacity

» 100SRC Virtis Freeze Dryer – 45.5 kg condenser ice capacity

» Buflovak Laboratory Atmospheric Double Drum Dryer – 8-in. drying width

EVAPORATOR
» Model Type E – Anhydro Laboratory Vacuum Evaporator (rising film)

ICE CREAM FREEZERS
» Emery Thompson – 20-qt. batch freezer

» Emery Thompson - 6-qt. batch freezer

» Technogel 80 – continuous freezer

» Plate Heat Exchangers – 1 pt./min. to 15 gal./min.

HTST/UHT PASTEURIZING EQUIPMENT
» APV HTST Pasteurizer (400 gal/hr) Homogenization optional

» Extended hold tube (up to 12 min hold time)

» Microthermics 25DH – 1 to 2 L/min. (HTST/UHT indirect steam application)

VAT PASTEURIZING EQUIPMENT
» Walker Cone Bottom Processor – 40 min./100 gal. max capacity

» 5 can vat pasteurizer (15 min/50 gal max capacity)

» Additional Jacketed Vats – 400-gal. vats (2)

EXTRUSION TECHNOLOGY
» Wenger TX 52

CHEESE MAKING EQUIPMENT
» Kusel A-Frame cheese press

» Supreme Mini Mixer Mozzarella cheese stretcher

» 300-gal. Cheddar cheese vat - 4 Damrow 5-can open vats

» 2 Kusel "Double-O" 5-can automatic vats

» 50 can Qualtech automatic cheese vat

» Qualtech 8 foot, 4 tiered horizontal cheese press, 2 shelves per tier (8 shelves total)

GAULIN TWO STAGE HOMOGENIZERS
42 to 1,000 gal./hr.

SEPARATORS/CLARIFIERS
(1,750 lbs./hr. to 13,000 lbs./hr.)

» Equipment Engineering Model 590

» DeLaval Model 340

» DeLaval Model 366

» GEA KNA-3 Greek Yogurt Separator

» CO2 incorporation system

» Various Membrane Systems

PACKAGING SYSTEMS
» Koch Multivac vacuum sealer

» ILPRA glass jar rotary filler

» Modern 4/6 oz cup filler

UTILITIES
» Electrical, chilled water, steam (culinary and regular), reverse osmosis water and pressurized air

COOLERS
» Various walk-in coolers and wind tunnels, temp range from -35 F to 110 F

FACILITIES AND EQUIPMENT

DAIRY PROCESSING PLANT

CONTACT:

TIMOTHY BARNARD
Dairy Plant Manager
Cornell University
607-254-6512
Tjb233@cornell.edu

OVERVIEW

The Cornell Dairy Processing Plant (permitted by New York State Agriculture & Markets) supports the primary teaching, research, and outreach missions of the Department of Food Science, the Cornell Institute of Food Science and the College of Agriculture and Life Sciences. Specifically, the Dairy contributes to undergraduate and graduate instruction in food science; to basic and applied dairy foods research; to public service through extension programs; and as a designated training facility for New York State Certified Milk Inspectors and New York State Department of Agriculture and Market Inspectors. As a by-product of its mission-based functions, the Cornell Dairy also produces fluid milk, juices, yogurt, butter and ice cream products to be sold on the Cornell University, Ithaca campus, as well as Ithaca College, SUNY Cortland, and Tompkins Cortland Community College, to offset the total costs incurred in the equipping and operations of the dairy plant. This facility is available for hands-on workshops as well as demonstrations and test runs of new technologies.

DAIRY PROCESSING LABORATORY

The Dairy Processing Laboratory research focus areas include Food Safety Engineering and Food Quality. Research in Food Safety Engineering focuses on the development of new and improved processing methods able to reduce the microbial load in food systems, of current interest being membrane separation and Pulsed Light treatment. The Food Quality component of research aims at elucidating the intermolecular interactions and structural transformations that occur during processing of dairy and complex foods and using this understanding to improve their quality and functionality.

EQUIPMENT

- Strain-controlled Advanced Rheometric Expansion System (ARES) (TA Instruments)
- Zeta potential and particle size analysis instrumentation (Brookhaven Inc.)
- Thermal analysis system (DSC and TGA, Seiko Instruments)
- Pulsed Light treatment unit (Xenon Corp.)
- Incubators
- Colorimeter
- Basic equipment for physical, chemical and microbiological analyses
- Pilot scale, automated microfiltration unit equipped with ceramic membranes

FOOD SAFETY LABORATORY, LABORATORY FOR MOLECULAR TYPING, AND MILK QUALITY IMPROVEMENT PROGRAM

Research in Food Safety Laboratory focuses on the pathogenesis of foodborne diseases, pre- and postharvest food safety and on improving our understanding of the transmission of foodborne bacterial pathogens and spoilage organisms from farm animals and from foods to humans. A better understanding of the transmission pathways of foodborne pathogens is necessary to design better strategies to prevent and control human foodborne disease outbreaks and food contamination events. Both basic and applied research in the laboratory is targeted toward developing the scientific knowledge necessary to improve our ability to prevent foodborne diseases and food spoilage. Our group also has considerable expertise in developing mathematical modeling and decision support tools that can help industry identify the most effective strategies for reducing foodborne pathogens and spoilage organism contamination risks.

Current research in the Food Safety laboratory focuses on a number of dairy relevant pathogens including *Listeria monocyogenes*, Salmonella, and Bacillus cereus as well as detection identification, and tracking of different spoilage organisms (e.g., sporeformers, Gram-negative spoilage organisms [Pseudomonas, coliforms], as well as yeast and molds).

The laboratories and staff of the Milk Quality Improvement Program are involved in a variety of applied research projects related to the quality and safety of milk and dairy products and are available to conduct and support dairy industry projects. For details on services of the Laboratory of Molecular typing, which offers fully confidential subtyping, including whole genome sequencing and PFGE, please refer to our www page at: https://foodsafety.foodscience.cornell.edu/laboratory-molecular-typing-lmt/

EQUIPMENT

- Pulsed Field Gel Electrophoresis (PFGE) –Genetic Fingerprinting
- PCR and Sequence Based Characterization (16S, rpoB, etc.)
- Agilent 2100 Bioanalyzer
- Illumina – Full Genome Sequencing (Life Sciences Core Laboratory)
- ABI Prism – Real Time PCR Detection System
- Applied Biosystems Quant Studio 6Flex system for quantitative PCR
- Autoplate 4000- Q-count

FOOD SAFETY ENGINEERING AND FOOD QUALITY LAB

Moraru's group research program is dedicated to developing technical solutions for improving food safety and quality and to advancing the knowledge in the area of microbial, physical and engineering properties of foods, particularly dairy foods. Our efforts are channeled in two distinct research areas: Food Safety Engineering and Food Quality.

EQUIPMENT

- Strain-controlled Advanced Rheometric Expansion System (ARES) (TA Instruments)
- Zeta potential and particle size analysis instrumentation (Brookhaven Inc.)
- Thermal analysis system (DSC and TGA, Seiko Instruments)
- Pulsed Light treatment unit (Xenon Corp.)
- Colorimeter (Konica Minolta CR-400)

DAIRY FOODS ENGINEERING LABORATORY

Rizvi's research group is engaged in research on experimental and theoretical aspects of bioseparation processes, highpressure extrusion with supercritical fluids, cryogenic freezing, physical and engineering properties of biomaterials and novel food processing technologies. A major long¬term goal is to develop new and improved unit operations for value-added processing of food and biomaterials. Derivative goals include new techniques for measurement and control of processes and properties for industrial applications.

EQUIPMENT

- Supercritical fluid extraction, drying, sterilization and nanoencapsulation systems for liquid and solid foods
- Supercritical fluid extrusion system
- Texture Analyzer
- Dynamic Mechanical Analyzer and Brookfield viscometers
- Differential scanning colorimeter
- Dense gas freezing system

FACILITIES AND EQUIPMENT

HIGH PRESSURE PROCESSING

Located within the Food Research Lab at Cornell AgriTech, Geneva, NY

CONTACT:

ANN VEGDAHL
Lab Manager, Cornell University
Phone: 315-787-2258
acv45@cornell.edu

https://cals.cornell.edu/cornell-agritech/partners-institutes/hpp-validation-center

EQUIPMENT

HIPERBARIC 55

- 55 L volume vessel, 200 mm diameter
- 22 m^2 surface requirement
- Automatic loading/unloading system
- Ergonomics and speed

COURSES, SYMPOSIA AND EVENTS

- HTST Pasteurizer Workshop (3 times per year)
- Vat Pasteurizer
- Yogurt and Fermented Dairy Products Workshop
- Certified Milk Inspectors School
- Dairy Laboratory Seminar
- New York State Cheese Manufacturers Annual Conference
- New York State Association for Food Protection Annual Conference
- Processing Plant Superintendent Schools (in cooperation with New York State Department of Agriculture and Markets Department of Dairy Services)
- Introduction to Ice Cream and Frozen Desserts
- The Science of Cheese (Cheese making) Workshop
- Fluid Milk Quality and Safety Workshop
- FSMA Preventative Controls Qualified Individual Training
- Membrane Filtration and Separation Workshop
- Pathogen Environmental Monitoring Workshop
- Food Safety Plan (HACCP) Training
- Dairy Science and Sanitation

https://cals.cornell.edu/dairy-extension/course-calendar

FACILITIES AND EQUIPMENT

CORNELL SENSORY EVALUATION CENTER

CONTACT:

ALINA STELICK
Manager, Cornell University
607-255-3463
ap262@cornell.edu

OVERVIEW

The mission of the center is three-fold: to provide training and hands-on learning opportunities to students that are interested in the fields of sensory and consumer research, to further research in the areas of sensory science and consumer product testing, and to help businesses develop and improve their product offering through consumer and sensory testing.

We conduct Sensory Evaluation and Consumer Product Research. Among the standard services that are offered to commercial clients are Consumer Acceptability, Preference and Discrimination Testing, Product Sensory Profiling, and custom Employee Sensory and Consumer Research Training Programs. In addition, we provide consultations in all matters related to sensory product testing: appropriateness of particular test method, study sample size, questionnaire design, statistical analyses, sample blinding and serving sizes, to name a few.

The fees collected from our commercial clients go directly back to the Department of Food Science to support student programs and research (such as student product development teams, travel to conferences and competitions, scholarships, etc.)

FACILITIES AND EQUIPMENT

CORNELL INSTITUTE FOR FOOD SYSTEMS INDUSTRY PARTNERSHIP PROGRAM

CONTACT:

RAJNI ANEJA
Industry Liaison Officer
Cornell University
607-255-0860
ra283@cornell.edu

OVERVIEW

The Cornell Institute for Food Systems Industry Partnership Program (CIFS-IPP) is an exciting public-private partnership that expands and enhances engagement of Cornell University faculty and staff with industry scientists, engineers, and business leaders throughout the food system. With expertise in business and industry, CIFS-IPP finds solutions to today's food system challenges while shaping tomorrow's discoveries. Together, we inform and advance industry practice with cutting-edge science that pushes our food industry partners to the forefront of research, development, and technology.

STAFF AND RESEARCHERS

ALIREZA ABBASPOURRAD, Ph.D.

Assistant Professor
Cornell University
alireza@cornell.edu

Food chemistry and ingredient technology. Our overarching goal is to stimulate a circular economy through conversion of waste to value and the development of clean label formulation. We developed a comprehensive platform to screen a broad range of dairy byproducts, characterize their physicochemical properties, and sequester high-value compounds. In this vein, we have been working with the dairy industry to identify their waste stream and convert them to milk oligosaccharides, galacto-oligosaccharides, and clean label emulsifiers as well as isolation of lactoferrin from whey. Another active research area in our lab is fortifying and adding healthpromoting functionalities to dairy products through encapsulation platform; examples include encapsulation of amino acids, vitamins, and probiotics.

SAM ALCAINE, Ph.D.

Assistant Professor
Cornell University
Sda23@cornell.edu

Dairy cultures and fermentation; Dairy microbiology; food fermentations, spoilage organisms, bacteriophage; molecular biology. Dr. Alcaine's research focuses on developing technologies that improve the quality, safety, and potential applications of fermented dairy products and co-products. Current research program includes: mechanisms for control of spoilage organisms, applications of bacteriophage to improve health, dairy safety, and fermentation performance, as well as novel applications for co-products of dairy fermentations.

DAVID M. BARBANO, Ph.D.

Professor
Cornell University
barbano1@aol.com

Membrane filtration of milk, improvement of chemical analysis methods for milk and dairy products, Fourier transform mid-infrared milk analysis – development of models to measure the fatty acid composition of milk, impact of milk somatic cell count on dairy product quality and yield. Methods for production of robust calibration samples for milk analysis. Microfiltration for bacteria and spore removal. Strategies to improve the safety of farmstead raw milk cheese.

TIMOTHY BARNARD

Dairy Plant Manager
tjb233@cornell.edu

KATHRYN J. BOOR, Ph.D.

Dean/Professor
Cornell University
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Bacterial response and adaptation to environmental stresses; bacterial virulence; physiology and genetic characteristics of pathogenic bacteria; and dairy microbiology.

MACKENZIE BROWN

FPDL Technician
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KIMBERLY BUKOWSKI

Extension Support Specialist
Cornell University
krb14@cornell.edu

Dairy plant auditing, food safety systems; GFSISafe Quality Foods; good manufacturing practices; dairy manufacturing; ice cream; FSMA Preventive Controls.

LOUISE FELKER

Extension Support Specialist
Cornell University
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Workshop/short course organization and planning; food safety systems; good manufacturing practices; social media/web development; FSMA Preventive Controls.

NICOLE HELEN MARTIN, Ph.D.

Research Associate
Cornell University
nicole.martin@cornell.edu

Dairy Microbiology, Dairy Quality and Safety, Dairy Farm Practices, Dairy Farm and Processing Extension, Microbiological Methods. Dr. Martin collaborates with the department's Food Safety Laboratory (FSL) and the Milk Quality Improvement Program (MQIP). Scientists in the FSL conduct basic and applied research in microbial food safety using the tools of molecular biology and microbiology. Scientists in the MQIP focus on identification and elimination of spoilage microbes in dairy food systems. Work in progress focuses on the genetics and physiology of foodborne bacterial pathogens and spoilage organisms, including Listeria monocytogenes and Bacillus spp. and related spore-forming bacteria.

CARMEN I. MORARU, Ph.D.

Professor
Cornell University
cim24@cornell.edu

Expertise: Dairy Foods Engineering, Food Safety Engineering. Specific research projects include: functionality and processing behavior of milk protein preparations obtained by membrane filtration, microfiltration processing for the physical removal of microorganisms from milk, pulsed light treatment for inactivation of microorganisms on food (including dairy) and food contact surfaces, and nanotechnology-based approaches for controlling microbial attachment to food contact surfaces. The broader objective of Carmen Moraru's research is to develop processes capable of delivering safe dairy foods of high quality and nutritional value.

ROBERT D. RALYEA, M.S.

Senior Extension Associate
Cornell University
rdr10@cornell.edu

Dairy systems environmental microbiology, product processing and regulations; small-scale dairy production; general food security and risk assessment.

SYED S.H. RIZVI, Ph.D.

Professor
Cornell University
srizvi@cornell.edu

Physical and engineering properties of foods; bioseparation and extrusion processes; supercritical fluid-based extraction, sterilization, functionalization and texturization processes.

DEANNA SIMONS

Quality Manager and Academic Programs Coordinator
Cornell University
dds85@cornell.edu

ALINA STELICK

Cornell Sensory Evaluation Center Manager/MQIP Sensory Program Manager
Cornell University
ap262@cornell.edu

Sensory Evaluation and Consumer Research, Product Sensory Quality over its shelf-life, Sensory Evaluation training and education, consultation in all matters, Sensory including test method, design, and statistical analyses.

MARTIN WIEDMANN, Ph.D., DR. MED. VET.

Professor
Cornell University
mw16@cornell.edu

Food Microbiology. Research focus includes: tracking and characterization of sporeforming bacterial contaminants through farm environments and dairy processing systems; development of molecular-based raw milk tests for the detection of psychrotolerant sporeforming bacteria; full genome sequencing and molecular characterization of bacterial pathogens and spoilage organisms; influence of processing parameters on bacterial outgrowth in milk; evaluation of pasteurized milk quality using microbiological, sensory and chemical parameters; chocolate milk shelf-life extension and other areas concerning improvement of dairy product quality.

SOUTHEAST DAIRY FOODS RESEARCH CENTER

NORTH CAROLINA STATE UNIVERSITY

Raleigh, NC
www.sdfrc.ncsu.edu

SENSORY APPLICATIONS LABORATORY

North Carolina State University
www.ncsu.edu/sensory

CENTER DIRECTOR

MARYANNE DRAKE, Ph.D.
Center Director
919-513-4598
mdrake@ncsu.edu

OVERVIEW

The Southeast Dairy Foods Research Center, with facilities and support at North Carolina State University (Raleigh) has been operating since 1988 and actively participates in national research planning and execution on behalf of the dairy industry and other entities. The Southeast Dairy Foods Research Center will conduct research, educate scientists, and develop and apply new technologies for processing of milk and its components into dairy products and ingredients with improved health, safety, quality, and expanded functionalities. Areas of research emphasized in this center are notably in whey protein functionality, extended shelf-life processing, probiotics, dairy starter cultures, and the rheology, flavor, chemistry, and sensory quality of cheese and dairy ingredients. The center also hosts a Food Rheology Laboratory, Nutrition Technical Services Laboratory and a Sensory Applications Laboratory, conducting analytical, qualitative and affective sensory tests and flavor chemistry analyses tailored to meet specific needs of the food industry.

RESEARCH FOCUS

- Milk protein and whey ingredient functionality
- Thermal and biological processing
- Extended shelf-life processing
- Sensory properties and flavor chemistry of cheese and dairy ingredients
- Dairy food safety
- Dairy starter cultures and probiotics

SENSORY APPLICATIONS LABORATORY

The Sensory Applications Laboratory at North Carolina State University specializes in dairy sensory and flavor chemistry analysis, including consumer testing (qualitative and quantitative), preference mapping, instrument flavor analysis techniques (gas chromatography mass spectrometry, gas chromatography olfactometry and HPLC) and descriptive analysis. The center maintains three trained descriptive panels. Ongoing flavor research is primarily focused on dairy products (including milk, cheese, milk powders, whey proteins and butter), dairy ingredients applications, and how flavor varies with processing and storage. A specific focus is development of defined sensory languages and the application of these languages to enhanced product understanding, links to volatile compounds (flavor chemistry) and enhanced consumer understanding.

FOOD RHEOLOGY LABORATORY

The research objective of the Food Rheology Laboratory at North Carolina State University is the explanation of the physical chemistry, molecular-level interactions and effect of processing conditions within a food system, through an understanding of rheological behavior, while solving processing and product development problems facing the food industry. Particular emphasis is placed on evaluating rheological contributions to sensory properties of materials during oral processing. The laboratory maintains a full complement of highprecision rheometric, viscometric and compression/extension equipment for complete characterization of food material properties as they relate to material structure and texture. Complementary techniques including tribology and acoustic emission are being developed in the laboratory to expand the scope of research capabilities with respect to food material characterization functionality.

FACILITIES AND EQUIPMENT

NORTH CAROLINA STATE UNIVERSITY

CONTACT:

MARYANNE DRAKE , Ph.D.
Director, Southeast Dairy Foods Research Center
919-513-4598
sdfrc@ncsu.edu

EQUIPMENT

- Cherry-Burrell EQ-3 ESL Gable-top filler
- LiquiBox Semi-automatic Bag-n-box filler
- HTST system (700/350 gal./hr.)
- Feldmeier tubular ultrapasteurization booster
- DeLaval 590 cold milk separator
- Multiple batch tanks
- Admix Rotosolver submersible mixer
- Tri-clover blender
- CEM SMART Trac fat/solids analysis system
- APV Gaulin 2-stage homogenizer
- Ice cream processing
- Tetra Hoyer Frigus 600 and S1200 freezers
- Tetra Hoyer FF 2000 ingredient feeder
- Tetra Hoyer variegation system
- Sweetheart rotary 4-oz. cup filler
- Sawvel rotary pint cup filler
- Shrink-wrap oven
- Cheese vat – 300 gal. (automatic stir, jacketed)
- Kusel 4MX cheese vat – 65 gal.
- Manual cheese vat – 50 gal. (jacketed)
- Cheddar mill
- Cheese hoops and presses
- Koch vacuum sealer
- VRC multicoil processor XXI
- Feldmeier tubular heat exchanger
- 75-kw continuous microwave processor
- Marlen piston pump Model 629
- ASTEPO low-acid aseptic Bag-n-box filler

- Radio Frequency Co. Macrowave processor
- Superspeed and ultracentrifuges
- Gas chromatography/mass spectrometry (GC/MS)
- Gas chromatography olfactometry (GCO)
- Benchtop micro- and ultrafiltration
- Pilot scale ultrafiltration
- High-pressure liquid chromatography (HPLC)
- Microscopy: light, phase and fluorescent
- Microbiological support laboratory
- Autoclaves
- Rheometers
- Electrophoretic analyses: DNA and protein
- DNA fingerprinting
- Kitchen preparation room
- Consumer testing booths with Compusense
- Descriptive panel room
- Sensory panel room
- Atomic absorption spectrophotometry
- Visible, UV and fluorescent plate readers
- Mammalian cell culture
- Stock retort and can sealer
- Anhydro pilot scale spray dryer
- Buchi benchtop spray dryer
- Retort – approx. 120 1-lb. cans
- Kemotech smoking room – 4- by 5-ft. firebox
- CEM microwave moisture analyzer
- APV homogenizer – 2 stages
- Gas chromatographs (GC), GC-MS, GC-O
- HPLC, LC-MS
- Mass spectrometers (MS)
- Spectrophotometers

SENSORY SERVICE CENTER

ANALYTICAL TECHNOLOGY & EQUIPMENT

Perkin Elmer Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES)

- Mineral and element analysis
- Can be used with liquid, semi-solid, and solid samples

HunterLab Colorimeter

- Can measure samples in both reflection and transmission of colors, spectral reflectance and transmission of samples
- Ability to analyze opaque solids, clear liquids, transparent films, powders, and opaque liquids
- Allows for analysis of color change of samples over time in support of data from other analytical analysis techniques

Agilent Technologies GC/MS/MS

- Agilent tandem GC/MS System
- Analysis of volatile compounds in very low concentrations
- Analysis of degradation products that play a role in flavor
- Equipped with Gerstel sniffer port

Agilent Technologies GC/MS

- Three (3) - Agilent GC/MS systems
- Equipped for Solid Phase MicroExtraction (SPME)
- Volatile analysis of a variety of sample types

Agilent Technologies GC/MS with Thermal Desorption Unit (TDU)

» Able to analyze lower volatility compounds by heating the sorption onto a substrate for introduction into the GCMS

» Suited for liquid, gaseous, and solid samples

» Equipped with Gerstel Twister technology that allows Stir Bar Sorptive Extraction (SBSE)

» Equipped with Gerstel sniffer port

Agilent Technologies GC/O

» Two (2) - Agilent GC Olfactometry Systems

» Human Nose as the detector for compounds

» Used in conjunction with GC/MS to determine flavor compound quantification

Waters HPLC

» Separation of nonvolatile compounds in liquids for qualification with various detectors

» Equipped with Photo Diode Array (PDA), Refrac- tive Index (RI) detectors

» Previous work analyzing sugar alcohols, furosine, phospholipids

Waters Aquity UPLC/MS

» Separation of nonvolatile compounds in liquids for qualification with various detectors

» Higher pressure allows for shorter run times, and better resolution of compounds over traditional HPLC

» Equipped with Photo Diode Array (PDA), Evaporative Light Scattering (ELS), Fluorescence, and mass spectrometry detectors

» Previous work analyzing carotenoids, norbixin, organic acids, lysoalanine

Delta Instruments Lactoscope

» Ability to measure many different basic components found in the milk (fat, protein, lactose, solids)

» Able to determine other important components of milk: Casein, Density, True Protein, NPN/Calculated Urea, and pH

Malvern Particle Size Analyzer

» Rapid and effective wet dispersion for particle analysis in liquids

» Fast particle size measurement of fragile and cohesive dry powders

Formulation Turbiscan

» Analysis of particles in liquid suspensions in very complex mixtures with multiple dispersed components

» Used to measure the mean particle size on concentrated media, as no dilution nor sample stress are required

» Analysis of agglomerates or flocs without altering the particle size of the liquid sample

COURSES, SYMPOSIA AND EVENTS

- HTST Pasteurizer Operator shortcourse (2 times per year)
- Dairy Supplier Sensory on/offsite (4 times per year)
- Antibiotic residuals course (dairy farm)
- FDA Training Dairy and Food Processing
- Sensory and Instrumental Analysis of Dairy Flavors Short Course
- FS 324 Milk and Dairy Products (Internet-based distance education course)
- FS 554 Lactation, Milk and Nutrition
- Cheese Making Short Course

STAFF AND RESEARCHERS

JON ALLEN, Ph.D.

Professor of Food, Bioprocessing and Nutrition Sciences
North Carolina State University
jon_allen@ncsu.edu

Mammary gland biology and lactation; milk composition, chemistry and functional properties; mineral and vitamin nutrition and metabolism; food allergy; epithelial transport; regulatory biology; nutrition education; diabetes and obesity; glycemic index.

RODOLPHE BARRANGOU, Ph.D., MBA

Associate Professor, Department of Food, Bioprocessing and Nutrition Sciences
North Carolina State University
rodolphe_barrangou@ncsu.edu

Laboratory focuses on the biology and genetics of CRISPR-Cas immune systems in bacteria, using microbiology, molecular biology and genomics approaches investigate the use of CRISPR-Cas systems.

MARYANNE DRAKE, Ph.D.

Director SDFRC, William Neal Reynolds Distinguished Professor, Food, Bioprocessing and Nutrition Sciences, and Director of DMI Sensory Applications Laboratory and NCSU Sensory Services Center
North Carolina State University
mdrake@ncsu.edu

Sensory perception and chemistry of dairy flavors; understanding consumer needs, including market drivers and segmentation.

CARL HOLLIFIELD

Associate Director – Administration Department of Food, Bioprocessing and Nutrition Sciences
North Carolina State University
919-513-2388
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Directs business operations of the Southeast Dairy Foods Research Center and the farm to processing Dairy Enterprise System.

JOSIP SIMUNOVIC, Ph.D.

Research Associate Professor, Department of Food, Bioprocessing and Nutrition Sciences
North Carolina State University
josip_simunovic@ncsu.edu

Conventional and advanced aseptic processing, continuous-flow microwave thermal processing, monitoring and validation of thermal processes for high-acid and low-acid dairy, particulate/multiphase foods and biomaterials.

CLINT STEVENSON, Ph.D.

Assistant Professor and Distance Education Coordinator Department of Food, Bioprocessing and Nutrition Sciences
North Carolina State University
cdsteve@ncsu.edu

Assessing the effectiveness of various teaching methods and instructional design, determining the education, training and workforce needs in dairy food safety and quality assurance, and applied quality control research projects.

HAOTIAN ZHENG, Ph.D.

Assistant Professor, Department of Food Bioprocessing and Nutrition Sciences
North Carolina State University
haotian.zheng@ncsu.edu

Dairy NTD & NPD, Dairy Ingredients/powder manufacturing & application; Stabilizer and texturizer application in dairy products, Characterization of Physicochemical Properties of dairy products (liquid, semi-solid, & solid), Dairy Rheology/Tribology, Dairy Protein & Lipid (phospholipid) Chemistry, Scale-up (Engineering)

WESTERN DAIRY CENTER

UTAH STATE UNIVERSITY

Logan, UT
www.builddairy.com,
www.caas.usu.edu/westerndairycenter

CENTER DIRECTOR

ERIC BASTIAN, Ph.D.
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OVERVIEW

The Western Dairy Center, based at Utah State University is a virtual dairy research center with foci on dairy research, driven by the western region dairy industry, and a technically trained, workforce-development pipeline. The center links strongly to the BUILD Dairy program, that was initiated in 2014, with a mission of fostering participation and success of students in dairy research activities that can lead to employment in the dairy industry as well as academia. This is achieved through the BUILD Dairy program designed to BUILD University-Industry Linkages through Learning and Discovery. BUILD Dairy students are supervised by professors from Brigham Young University, University of Utah, Weber State University, Utah State University, University of Idaho, Boise State University, Washington State University, and Oregon State University. Included in the BUILD Dairy program are opportunities for undergraduate research as well as Masters and PhD research involving a range of dairy food topics. The BUILD Dairy students participate in leadership and other activities that increase their understanding of dairy food technology and its importance in innovation, quality, and manufacturing.

RESEARCH FOCUS

- Cheese flavor and functionality
- Cheese technology
- Dairy processing
- Physiological & nutritional impacts of dairy proteins
- Sports nutrition
- Environmental sustainability
- Milk protein chemistry
- Dairy microbiology and safety
- Concentrated dairy products
- Lactic acid bacterial genetics, genomics and metabolomics
- Dairy powders – whey protein, milk protein concentrate, and non-fat dried milk
- Lactose bioconversion
- Dairy sensory (collaboration with SDFRC)

FACILITIES AND EQUIPMENT

UTAH STATE UNIVERSITY

OREGON STATE UNIVERSITY

BRIGHAM YOUNG UNIVERSITY

CONTACT:

KIM RASMUSSEN
BUILD Dairy Program Coordinator
435-797-3466

LISBETH GODDIK
Department Head
541-737-8322

MIKE DUNN
Professor
801-422-6670

COURSES AND EVENTS

- Basic Cheese Making Short Course
- Advanced Cheese Short Course
- GMP Workshop
- Advanced Sanitation Workshop
- Safe Quality Foods Workshop
- FSMA Workshop

STAFF AND RESEARCHERS

GENE AHLBORN, Ph.D.

Dairy Technology
Brigham Young University
gene_ahlborn@byu.edu

Process cheese functionality, enzymes and flavor development in cheese.

MICHELE CULUMBER, Ph.D.

Microbiology
Weber State University
mculumer@weber.edu

Immunology, molecular biology, microbiology, biotechnology.

CHRIS CURTIN, Ph.D.

Food and Dairy Fermentations
Oregon State University
cristopher.curtin@oregonstate.edu

Role of microbes in alcoholic beverage fermentation, with emphasis on brewing microbiology, identification of natural mold inhibitors to control mold growth on cheese.

DAVID DALLAS, Ph.D.

Dairy Nutrition
Oregon State University
dave.dallas@oregonstate.edu

Bioactive milk proteins and fragments of proteins–peptides–released within the mammary gland and during digestion.

MICAH DRUMMOND, Ph.D.

Muscle Cell Metabolism
University of Utah
micah.drummond@hsc.utah.edu

Mechanisms of muscle growth and metabolic function in healthy and mobility impaired older adults, Novel exercise and nutritional strategies to improve muscle, metabolic and physical function deficits in older adult's recovery during rehabilitation.

MICHAEL DUNN, Ph.D.

Food & Dairy Technology
Brigham Young University
michael_dunn@byu.edu

Food technology, ice cream stabilization and formulation, micronutrient fortification and stability, long-term food storage.

LISBETH GODDIK, Ph.D.

Dairy Processing
Oregon State University
lisbeth.goddik@oregonstate.edu

Impact of milk hauling on raw milk quality, evidence of *Terroir* in Oregon milk sources and impact on cheese characteristics, start-up and operating costs associated with artisan cheese production.

TANYA HALLIDAY, Ph.D.

Sports Nutrition
University of Utah
tanya.halliday@utah.edu

How type of exercise (e.g. aerobic vs resistance) influences hormonal and behavior indices of appetite regulation and weight regulation.

LAURA JEFFRIES, Ph.D.

Sensory & Consumer Acceptance
Brigham Young University
Laura_jeffries@byu.edu

Sensory perception, labeling, dairy technology, meat technology.

JASON KENEALEY, Ph.D.

Chemotherapeutics
Brigham Young University
jason_kenealey@byu.edu

Identification of natural compounds with therapeutic activity, enzyme technology, immobilized enzymes.

JUYUN LIM, Ph.D.

Consumer & Sensory Evaluation
Oregon State University
juyun.lim@oregonstate.edu

Taste and smell perception, consumer acceptance and development of friendly labels for food and dairy products. Sensory evaluation of foods.

SILVANA MARTINI, Ph.D.

Lipids and Sensory
Utah State University
silvana.martini@usu.edu

Lipid chemistry, butter functionality, sensory evaluation.

OWEN MCDOUGAL, Ph.D.

Dairy Protein Chemistry
Boise State University
owenmcdougal@boisestate.edu

Dairy protein chemistry, structure and analysis using spectroscopic and IR instrumentation, exploring the interface between chemistry and biology to understand the mechanism of action for bioactive components isolated from natural products.

DONALD MCMAHON, Ph.D.

Dairy Food Processing
Utah State University
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Structure and function of casein proteins, milk coagulation, cheese manufacture, cheese texture and functionality.

MINTO MICHAEL, Ph.D.

Dairy Biotechnology and Microbiology
Washington State University
minto.michael@wsu.edu

Dairy probiotics, pathogens, rapid detection of pathogens, and biofilm control.

CRAIG OBERG, Ph.D.

Dairy Microbiology
Weber State University
coberg@weber.edu

Cheese starter cultures, microbiology of lactic acid bacteria, probiotic cultures.

TAYLOR OBERG, Ph.D.

Dairy Microbiology
Utah State University
taylor.oberg@usu.edu

Genomics of lactic acid bacteria, nonstarter lactic acid bacteria in cheese, use of adjunct starter cultures in cheese.

SIHONG PARK, Ph.D.

Food and Dairy Microbiome
Oregon State University
Sihong.park@oregonstate.edu

Microbiome sequencing in gastrointestinal tracts of humans, food animals (poultry and cattle), catfish and experimental animals to evaluate the microbial diversity in the presence of food.

KIM RASMUSSEN

BUILD Dairy Program Coordinator
Utah State University
kimberly.rasmussen@usu.edu

CAROLYN ROSS, Ph.D.

Sensory & Consumer Science
Washington State University
cfross@wsu.edu

The influence of agronomic and environmental conditions on the chemical and sensory profiles of foods and the enhancement of food quality through studies of consumer perception.

PRATEEK SHARMA, Ph.D.

Processing & Rheology
Utah State University
prateek.sharma@usu.edu

Cheese structure-function relationships, Food structure design and its impact on functionality of dairy ingredients and products, Rheology of dairy products.

BRAD TAYLOR, Ph.D.

Dairy Microbiology
Brigham Young University
b_taylor@byu.edu

Dairy microbiology, milk spores, infant formula, lactose bioconversion, pathogen control in dairy products.

GULHAN UNLU, Ph.D.

Dairy Microbiology
University of Idaho
gulhan@uidaho.edu

Fermented dairy products incl. cheese, yogurt and kefir.

ALMUT VOLLMER, Ph.D.

Microscopy
Utah State University
Almut.vollmer@usu.edu

Biostructure of dairy foods incl. milk, cheese, emulsions, and powders using scanning and transmission electron microscopy.

JOY WAITE-CUSIC, Ph.D.

Dairy Microbiology
Oregon State University
joy.waite-cusic@oregonstate.edu

Pre-harvest food & dairy safety, process validation, prevalence of pathogens in food & dairy systems, and microbiological quality indicators and spoilage.

MEIJUN ZHU, Ph.D.

Food Microbiology
Washington State University
meijunzhu@wsu.edu

Microbiological food safety and effects of dietary bioactive compounds on gut microbiota and chronic diseases, cheese microbiome.

NOTES

NOTES

California Dairy Innovation Center | BUILD DAIRY | WDC Western Dairy Center | Midwest Dairy Foods Research Center | Center for Dairy Research CDR UW | Northeast Dairy Foods Research Center | SDFRC Southeast Dairy Foods Research Center

DAIRY CENTER NETWORK:

CALIFORNIA DAIRY INNOVATION CENTER
- CALIFORNIA POLYTECHNIC STATE UNIVERSITY
- UNIVERSITY OF CALIFORNIA, DAVIS
- CALIFORNIA STATE UNIVERSITY, FRESNO

WESTERN DAIRY CENTER
- UTAH STATE UNIVERSITY
- BRIGHAM YOUNG UNIVERSITY
- OREGON STATE UNIVERSITY
- WEBER STATE UNIVERSITY
- UNIVERSITY OF IDAHO
- WASHINGTON STATE UNIVERSITY
- UNIVERSITY OF UTAH
- BOISE STATE UNIVERSITY

MIDWEST DAIRY CENTER
- UNIVERSITY OF MINNESOTA
- SOUTH DAKOTA STATE UNIVERSITY
- IOWA STATE UNIVERSITY
- KANSAS STATE UNIVERSITY
- UNIVERSITY OF MISSOURI
- UNIVERSITY OF NEBRASKA

CENTER FOR DAIRY RESEARCH
- UNIVERSITY OF WISCONSIN, MADISON

NORTHEAST DAIRY FOODS RESEARCH CENTER
- CORNELL UNIVERSITY

SOUTHEAST DAIRY FOODS RESEARCH CENTER
- NORTH CAROLINA STATE UNIVERSITY

138+ EXPERTS

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20 UNIVERSITIES

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