

DAIRY RESEARCH INSTITUTE®
NATIONAL DAIRY FOODS RESEARCH CENTERS



RESEARCH AND APPLICATIONS RESOURCES

- Dairy Research Centers
- Applications Labs
- Facilities and Equipment
- Technical Training and Short Courses
- Technical Assistance



DAIRY RESEARCH AND APPLICATION CENTERS SUPPORT INNOVATION

National Dairy Foods Research Centers, supported by the Dairy Research Institute®, provide industry with dairy product and ingredient research and technical resources to help industry innovate to address unmet consumer demand for dairy and dairy-based products. The Dairy Research Institute leverages the expertise of the six dairy research centers and works in partnership with major universities and government agencies.

All dairy research centers have a dairy pilot plant and other facilities for research on dairy products, ingredients, processing and packaging. Research centers also offer technical assistance, technical training and short courses. The dairy applications and technology development labs assist in prototype and concept development, product and process troubleshooting, scale-up and sensory evaluation.

For the most up-to-date information, visit www.USDairy.com/DairyResearchInstitute

For questions, contact the Dairy Technical Support Line at 800-248-8829 or DairyResearchInstitute@USDairy.com.

ABOUT THE DAIRY RESEARCH INSTITUTE

Dairy Research Institute® was established under the leadership of America's dairy farmers with a commitment to nutrition, product and sustainability research. The Dairy Research Institute is a 501(c)(3) non-profit organization created to strengthen the dairy industry's access to and investment in the technical research required to drive innovation and demand for dairy products and ingredients globally. The Institute works with and through industry, academic, government and commercial partners to drive pre-competitive research in nutrition, products and sustainability on behalf of the Innovation Center for U.S. Dairy®, the National Dairy Council® and other partners. The Dairy Research Institute is primarily funded by the national dairy checkoff program managed by Dairy Management Inc.™



CALIFORNIA DAIRY FOODS RESEARCH CENTER

- Dairy Products Technology Center (DPTC)
California Polytechnic State University-
San Luis Obispo, CA
www.dptc.calpoly.edu
- University of California, Davis
- California Dairy Research Foundation
www.cdrf.org



CENTER DIRECTORS

Phillip S. Tong, Ph.D.
Director, Dairy Products Technology Center
San Luis Obispo
805-756-6101/6102
ptong@calpoly.edu

Gonca Pasin, Ph.D.
Interim Executive Director,
California Dairy Research Foundation
530-753-0681
gspasin@ucdavis.edu

OVERVIEW

The California Dairy Foods Research Center is a comprehensive effort to bring the full capabilities of the Dairy Products Technology Center (DPTC) at California Polytechnic State University at San Luis Obispo and programs at the University of California, Davis, to support the dairy industry from farm to table. Working with the California Dairy Research Foundation (CDRF), whose purpose is to promote research and development activities that benefit dairy producers and processors in the consumer marketplace, the scientists, technologists and other experts at the two universities continue to work with industry to provide innovative solutions that support the nation's dairy industry and the global marketplace. The California Dairy Foods Research Center 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. Its applications and outreach programs facilitate innovative uses of dairy foods and ingredients by the food industry. Facilities at DPTC are state of the art, equipped with advanced and routine analytical equipment, dairy foods pilot plants and a commercially licensed dairy processing facility. The DPTC 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 DPTC is the university dairy farm where fresh milk is available for research and development activities. CDRF supports the Foods for Health Institute (FFHI) at the University of California, Davis, which explores the concept that the components of milk represent the product of evolutionary pressure to deliver complete nutrition and health in the most efficient and effective way possible to growing mammals. Research from many campus laboratories across the College of Agriculture and Environmental Sciences, School of Medicine, School of Veterinary Medicine, College of Liberal Arts and Sciences and many institutes focuses on describing the health benefits of specific high-value milk components for commercial application. Commercial application will be facilitated by the Milk Processing Laboratory, which is part of the Robert Mondavi Institute of Wine and Food Sciences.

RESEARCH FOCUS

The California Dairy Foods Research Center 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. Current research includes:

- Cheese technology (e.g., 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 (e.g., membrane and other concentration/fractionation processes, UHT and other heat treatments, and nonthermal process evaluation)
- Product development, dairy ingredients applications (prototypes, nutritional labels) and flavor lexicons
- Dairy nutrition and health (e.g., probiotics, bioactives, milk genomics)
- Dairy quality assurance (e.g., food safety, environmental stewardship, testing methods development)

DAIRY INGREDIENTS APPLICATION PROGRAM

(Cal Poly State University, San Luis Obispo, CA)



This program provides technical support to manufacturers, users and marketers of dairy protein, dairy carbohydrate, and dairy fat-based powders and concentrates [nonfat dry milk (NFD), skim milk powder (SMP), milk protein concentrate (MPC), whey protein concentrate (WPC), lactose, delactosed permeate (DLP), butter and milkfat]. It involves transfer of existing research information, technical training, preparation of information bulletins, providing solutions/information on technical product applications issues and conducting targeted short-term projects to address specific applications needs including new food and product development. Approximately 8,000 square feet of processing area is available in the pilot plant facilities. Applications support and specialized analytical capabilities are also available. Sensory expertise is available for food and beverages by QDA style descriptive testing and affective/consumer testing with the use of Compusense® Five or Compusense at-hand software. 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 of dairy foods. Additionally, space is available to accommodate specialized equipment for research and development projects on a short-term basis. Four analytical labs support work in the areas of microbial, physical and chemical analyses of dairy foods and ingredients.

For additional information, visit
www.dptc.calpoly.edu/facilities.html

FACILITIES AND EQUIPMENT

DAIRY PRODUCTS TECHNOLOGY CENTER

California Polytechnic State University, San Luis Obispo

CONTACT: PHILLIP S. TONG, PH.D.

Director

805-756-6101/6102

ptong@calpoly.edu

- EQUIPMENT:**
- HTST — 270 to 600 gph for ice cream mix, milk, etc., and associated cold milk separator, batch tanks, pasteurized surge tanks, CIP systems, etc. (HTST is a legally sealed unit by the state of California)
 - ½ gallon to 1 gal. plastic federal rotary filler
 - 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 (Hoyer Frigus SF 600) (50 to 150 gal./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)
 - Emery Thompson batch ice cream freezer (40 qt.)
 - Egli continuous pilot-scale butter churn (1 to 2 lbs./min.)
 - PMS 30-gal./hr. HTST with two-stage homogenizer
 - Technogel 100 L/hr. continuous ice cream freezer
 - Marriott Walker rising film evaporator (100 lbs./hr. evaporative capacity)
 - Open-water jacketed cheese vats (Stoelting 500 gal., Stoelting 3 to 50 gal., Kusel 2 to 100 gal. with drain table)
 - 2 Universal 50-gal. specialty cheese vats
 - 150-gal. Damrow Double-O enclosed cheese vat
 - Blentech process cheese cooker (50 to 100 lbs.)
 - Stefan process cheese cooker (5 lbs.)
 - Suprema pasta filata system (mixer/molder and cooker/stretcher)
 - Koch vacuum packaging system (1- to 40-lb. block)
 - Miscellaneous tanks and pumps
 - High-shear Silverson mixer
 - 4 Groen process steam kettles (40 to 60 gal.)
 - 2 APV conical bottom swept-surface processors (100 gal.)
 - Legal batch pasteurizer system (200 gal.)
 - 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)
 - Small pilot-scale supercritical carbon dioxide fluid extraction system

SUPPORTING ANALYTICAL EQUIPMENT

Fast-performance liquid chromatograph	Separation analysis and isolation of proteins from milk, whey and dairy products
Capillary electrophoresis	Analysis of proteins, DNA and RNA
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
PCR 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

SUPPORTING ANALYTICAL EQUIPMENT

GC/MS	Flavor and other compound characterization and identification
High-pressure liquid chromatograph (HPLC)	Protein and peptide analysis of dairy foods
Laser diffraction particle size analyzer	Particle size and particle size distribution of dry dairy powders, emulsions and colloidal dispersions
TX.T2 analyzer	Texture profile analysis, firmness, etc.
Formagraph	Coagulation studies
Hunter colorimeter	Whiteness, color intensity and hue, appearance of dairy foods and ingredients
Differential scanning calorimeter (DSC)	Thermal properties of milk components
Dynamic stress rheometer	Flow properties, gel strength, viscosity
Block digestion and distillation system	Nitrogen/protein analysis
Autotitration system	Determination of buffering capacity
High-throughput nitrogen analyzer	Quantification of total milk protein, casein and whey protein content of foods
Fourier transform infrared analysis	Milk component analysis

NOTE 1:

In addition to the specialized equipment available, DPTC routinely conducts chemical (fat, protein, ash, total solids, pH, etc.), physical (viscosity, color, etc.) and microbiological (APC, yeasts, molds, coliform, lactobacilli, etc.) analyses and related research, plus the development of dairy foods and ingredients.

NOTE 2:

In addition, Cal Poly works with several entities on campus (Materials Engineering, Biological Science and Food Science & Nutrition) for more specialized expertise, instrumentation, process equipment, etc.

Ongoing collaboration with the Cal Poly Environmental Biotechnology Institute (Dr. Raul Cano, director) provides access to the following capabilities:

- High-throughput DNA sequencing (gene or chromosome sequencing and species identification)
- Fatty acid methyl ester (FAME) analysis (used to determine strain relatedness of microorganisms of significance to dairy/food industry)
- Terminal restriction fragment polymorphism (TRFP) (characterization of changes in microbial communities)

UNIVERSITY OF CALIFORNIA, DAVIS

CONTACT: MICHAEL MCCARTHY, PH.D.
Chairman, Department of Food Science and
Technology, University of California, Davis
530-752-2490
mjmccarthy@ucdavis.edu

The new dairy-grade UC Davis Milk Processing Laboratory will become fully operational in 2012. This small, flexible facility is intended to advance new UC Davis concepts from lab bench-scale by providing opportunity to produce larger samples and explore basic processing issues. It is intended to integrate with the larger Cal Poly DPTC pilot plant.

A major focus of the dairy research at UC Davis is the Milk Bioactives Program within the Foods for Health Institute. The Milk Bioactives Program aims at increasing understanding of the chemical and biological properties of milk components. Specifically, this involves characterization, separation and then incorporation of bioactive milk compounds into foods. An example of this research is using the dairy-grade equipment in the UC Davis Milk Processing Lab to generate new milk carbohydrate fractions for functional studies to support the utilization of these molecules as selective prebiotics in foods.

MILK PROCESSING LAB FACILITIES AND EQUIPMENT

- EQUIPMENT:**
- 100-gal. Sprinkman raw milk receiving/cooling tank
 - GEA Westfalia MTC 3 separator
 - 100-gal. Sprinkman skim receiving/cooling tank
 - 25-gal. cream receiving/cooling tank
 - MicroThermics Electric Development HSTS/UHT lab processor (2 L/min.)
 - MicroThermics/Niro Soavi NS-2006 homogenizer
 - MicroThermics Clean-fill Hood with Sterile Product Outlet
 - GEA Model L membrane filtration system
 - Hoyer KF80 ice cream maker
 - Delta LactoScope FTIR Advanced

COURSES, SYMPOSIA AND EVENTS

- Annual International Symposium on Milk Genomics & Human Health: www.cdrf.org
- Annual Symposium on Advances in Dairy Product Technology — Dairy Ingredients Symposium: www.dptc.calpoly.edu
- Annual Cheese Short Course: www.dptc.calpoly.edu
- Annual Dairy Processing 101 Short Course: www.dptc.calpoly.edu
- Annual Dairy Science and Technology Basics for the Farmstead/Artisan Cheese Maker: www.dptc.calpoly.edu
- Annual Frozen Dairy Desserts Manufacturing Short Course: www.dptc.calpoly.edu
- Global Cheese Technology Forum
- The International Milk Genomics Consortium (IMGC) provides a collaborative and interactive pre-competitive resource platform for researchers and research end users to accelerate the understanding of the biological process underlying the mammalian milk genome: www.cdrf.org
- Dairy 101: www.dptc.calpoly.edu

RESEARCHERS AND STAFF

MATT ARNOLD**Research Associate**

Dairy Products Technology Center
California Polytechnic State University
marnold@calpoly.edu

Gas chromatography/mass spectrometry of cheese, cheese technology.

DANIELA BARILE, PH.D.**Assistant Professor**

Department of Food Science & Technology
University of California, Davis
dbarile@ucdavis.edu

<http://foodscience.ucdavis.edu/people>
<http://ffhi.ucdavis.edu/people/directory/leadership>

Bovine milk functional glycomics and bioactive components in industrial by-products.

JIM CULLOR, PH.D., DVM**Professor and Associate Dean**

Vet. Medicine Teaching and Research Center
University of California, Davis
jscullor@ucdavis.edu

Director, Dairy Food Safety Laboratory
www.vmtc.ucdavis.edu/laboratories/DFSL/dfs.html

Advanced processing technologies for milk and dairy products; basic and applied research regarding animal health, public health and food safety concerns.

ED DEPETERS, PH.D.**Professor**

Department of Animal Science
University of California, Davis
ejdepeters@ucdavis.edu

NANA Y. FARKYE, PH.D.**Professor of Dairy Science**

California Polytechnic State University
nfarkye@calpoly.edu

Dairy chemistry and biochemistry, cheese technology, food enzymology, heat-induced changes in milk and milk protein structure-function relationships.

BRUCE GERMAN, PH.D.**Professor of Food Science & Technology**

Director of the Foods for Health Institute
University of California, Davis
jbgerman@ucdavis.edu

<http://ffhi.ucdavis.edu>

Functional deconstruction of milk oligosaccharides; functional chemistry of complex lipids and fats in milk and their effects on metabolism; functional properties of structures in milk including the milkfat globule.

ERIC GERSHWIN, PH.D.**Professor**

Internal Medicine
University of California, Davis
megershwin@ucdavis.edu

KRISTEN HERBAUGH**Administrative Program Assistant**

Dairy Products Technology Center
California Polytechnic State University
kherbaug@calpoly.edu

Center and programs administration.

LAURIE JACOBSON**Outreach Specialist**

Dairy Products Technology Center
California Polytechnic State University
ljacobso@calpoly.edu

Communications and outreach programming.

RAFAEL JIMENEZ-FLORES, PH.D.**Professor of Dairy Science**

Dairy Products Technology Center
California Polytechnic State University
rjimenez@calpoly.edu

Milk protein, function and quality of dairy products; application of biotechnology to dairy; identification of dairy products' point of origin; characterization of milkfat globular membrane function in binding mechanism of probiotic bacteria.

JOHN KROCHTA, PH.D.**Professor Emeritus**

Department of Food Science and Technology
Department of Biological and Agricultural Engineering
University of California, Davis
jmkrochta@ucdavis.edu

Edible whey films and coatings.

AMY LAMMERT, PH.D.**Assistant Professor of Dairy Science**

Dairy Products Technology Center
California Polytechnic State University
alammert@calpoly.edu

Sensory evaluation of dairy foods and ingredients.

RESEARCHERS AND STAFF

ANDREA LAUBSCHER**Research Associate**

Dairy Products Technology Center
California Polytechnic State University
alaubsch@calpoly.edu

Microbial and biochemical analysis of dairy foods.

CARLITO LEBRILLA, PH.D.**Distinguished Professor**

Department of Chemistry
Department of Biochemistry (School of Medicine)
University of California, Davis
cblebrilla@ucdavis.edu

KATY LEES**Research Assistant**

Dairy Products Technology Center
California Polytechnic State University
klees@calpoly.edu

Dairy ingredients applications support.

MARIA MARCO, PH.D.**Assistant Professor of Food Science & Technology**

University of California, Davis
mmarco@ucdavis.edu

Interactions between probiotics, dairy, gut microbiota and health. Molecular microbial ecology of dairy.

JUAN MEDRANO, PH.D.**Professor of Animal Science**

University of California, Davis
jfmedrano@ucdavis.edu

Improving the fatty acid composition of milkfat; identification of the high-growth gene in mice.

DAVID MILLS, PH.D.**Associate Professor of Viticulture & Enology**

University of California, Davis
damills@ucdavis.edu

Genomics of lactic acid bacteria; wine microbial ecology.

DENISE MULLINAX**Assistant Director**

California Dairy Quality Assurance Program
California Dairy Research Foundation
mullinax@cdrf.org

GONCA PASIN, PH.D.**Interim Executive Director**

California Dairy Research Foundation
gspasin@ucdavis.edu

MICHAEL PAYNE, PH.D., DVM**Director**

California Dairy Quality Assurance Program
University of California, Davis
mpayne@ucdavis.edu

www.cdqa.org

HELEN RAYBOULD, PH.D.**Professor**

Department of Veterinary Medicine, Anatomy, Physiology
and Cell Biology
School of Veterinary Medicine
University of California, Davis
heraybould@ucdavis.edu

Gut physiology, including luminal chemosensing in gut endocrine cells and the gut-brain axis in GI physiology; obesity and metabolic disease.

MOSHE ROSENBERG, D.SC.**Professor and Dairy Technology and Engineering Specialist**

Department of Food Science and Technology
University of California, Davis
mrosenberg@ucdavis.edu

PAUL ROSSITTO**Dairy Food Safety Lab**

University of California, Davis
prossitt@vmtrc.ucdavis.edu

MARY ELLEN SANDERS, PH.D.**Research Professor**

Dairy Products Technology Center
California Polytechnic State University
mes@mesanders.com

Probiotic microbiology; strain development of lactic acid bacteria; genetic improvement of starter cultures; in vitro characterization and identification of probiotic lactobacilli and bifidobacteria for commercial applications; speciation of lactobacilli and bifidobacteria; evaluation of probiotics on fecal microecology.

RESEARCHERS AND STAFF

VANDNA SIKAND, PH.D

Research Scientist
 Dairy Products Technology Center
 vsikand@calpoly.edu

Functional properties of dairy ingredients.

JENNIFER T. SMILOWITZ, PH.D.

Associate Director, Human Health Assessment
 Foods for Health Institute
 University of California, Davis
 jensm@ucdavis.edu

<http://ffhi.ucdavis.edu/>

Discovery of metabolic phenotypes in response to diet; influence of maternal phenotypes on the complex structures in milk across lactation and their functions in the neonate.

PHILLIP S. TONG, PH.D.

Professor of Dairy Science
 Director, Dairy Products Technology Center
 California Polytechnic State University
 ptong@calpoly.edu

Bioseparation of dairy food systems and processes; structure and stability of frozen desserts; physicochemical properties of dairy ingredients and food systems.

SEAN VINK

Research Associate
 Dairy Products Technology Center
 California Polytechnic State University
 svink@calpoly.edu

Pilot plant operations.

ANGELA ZIVKOVIC, PH.D.

Associate Director of Scientific Development & Translation
 Foods for Health Institute
 University of California, Davis
 amzivkovic@ucdavis.edu

<http://ffhi.ucdavis.edu>

Effects of dairy fat on postprandial inflammation.



MIDWEST DAIRY FOODS RESEARCH CENTER

www.midwestdairy.umn.edu



- University of Minnesota (St. Paul)
- South Dakota State University (Brookings)
- Iowa State University (Ames)

CENTER DIRECTOR

Lloyd Metzger, Ph.D.

Center Director

605-688-5477

lloyd.metzger@sdsstate.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). 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 products used as an ingredient.

RESEARCH FOCUS

- Improving and controlling flavor development and functionality in cheese
- Improving the performance of cheese starter cultures through genetics
- Adding value to milk-based products with probiotics and nutraceuticals
- Improving shelf life of flavored milks
- Reducing undesirable taste attributes of milk
- Improving functionality and controlling flavor attributes of milk fractionation components
- Developing methods for effective and profitable uses of whey

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.
- Flavor Research and Education Center — *Devin Peterson, Director*
The flavor center is a member-based facility that offers innovative flavor research solutions to the food, flavor and fragrance industries. Research solutions include: isolation and analysis for aroma (volatiles) and taste compounds; taste-aroma interactions and flavor modulation; flavor synthesis, flavor processing and flavor release.
- Joseph J. Warthesen Food Processing Center — *Tonya Schoenfuss, Director*
 - Dairy Processing Equipment
 - Cheese Curing Rooms (includes brining and sporulation rooms)
 - Cereal milling, mixing, extrusion and baking equipment

FACILITIES AND EQUIPMENT

EQUIPMENT:

- Agglomerator: Glatt, 3-lb. cap.
- Blue cheese needler
- Buhler twin-screw extruder with loss-in weight powder feed and flow metered liquid injection
- 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.
- Cheese vats: Kusel, 2,000 lbs.
- Cheese vats: Nu-Vat, 800 lbs. (2)
- Coating drum: Spray Dynamics
- Colloid Mill
- Curdmill: Damrow
- Decanter: Sharples, 1 gal./min.
- Desludging centrifuge: Westfalia, 3 to 5 L/min.
- Dewheying and salting belt
- Drum dryer: Buffalovac 6-in. drums
- Dryer: Coulter, 90 lbs./hr.
- Dryer: Niro, 20 lbs./hr.
- Evaporator: CE Rogers, 200 lbs./min.
- Fluidized bed dryer
- Freeze dryer
- Fruit/nut feeder
- Hammermill: Fitzpatrick, 5-lb. hopper
- Homogenizers: Gaulin 30 and 125 gal./hr.
- HTST and homogenizer: APV 30 gal./hr.
- HTST pasteurizer: Cherry-burrell, 4,000 lbs./hr.
- Microfluidizer

FACILITIES AND EQUIPMENT

**EQUIPMENT
(cont.):**

- Microthermics UHT System: includes homogenizer and HEPA filtered filling hood, 1 to 3 L/min.
- Mix process unit (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 lbs.
- PTI RO/UF system multitube
- Ribbon blender
- Separator: Westfalia, 2,000 lbs./hr.
- Storage tank: Cherry-Burrell, 200 gal.
- Temperature- and humidity-controlled environmental chamber
- Tetra-Hoyer Frigus SF600 continuous ice cream freezer: 120 gal./hr.
- Tray dryer
- UF system: DDS-20, Plate and Frame, 10-L
- UF system: Osmonics 5 m², spiral-wound
- Univats: Cherry-Burrell, 50 gal.
- Vacuum pan evaporator: Rogers, 100 lbs.
- Variegator
- Water activity testing

FACILITIES AND EQUIPMENT

SOUTH DAKOTA STATE UNIVERSITY DAIRY PLANT

CONTACT: HOWARD BONNEMAN
Dairy Plant Research Manager
605-688-5478
Howard.Bonnemann@sdstate.edu

SOUTH DAKOTA STATE UNIVERSITY INSTITUTE FOR DAIRY INGREDIENT PROCESSING

CONTACT: CHENCHIAH MARELLA
Manager
605-688-6301
DairyIngredientProcessing.com

FACILITIES AND EQUIPMENT

- 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-O on load cells with pre-draw and final drain
 - Cold bowl cream separator: DeLaval, 5,000 lbs./hr. and 7,500 lbs./hr. cold bowl
 - Crystallization tank: 3,000 lbs.
 - Drain table for HCV and 100 lbs. Double-O
 - 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
 - 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.

FACILITIES AND EQUIPMENT

IOWA STATE UNIVERSITY

CONTACT: HUI WANG
 Pilot Plant Manager
 515-294-3572
 huiwang@mail.adp.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 unit
- Process development lab
- Product development capabilities
- Technology transfer pilot plant and theater
- Test kitchen and sensory lab
- Wet processing pilot plant

FACILITIES AND EQUIPMENT

A fee for use may be associated with some of the listed equipment. Please contact Stephanie Clark or Hui Wang if you are interested in more information about equipment or services provided at Iowa State University.

- EQUIPMENT:**
- Acid digester: Labconco
 - Aroma scan
 - Autoclave
 - Brookfields HBYR1
 - CEM Microwave Ashing System 300
 - Centrifuge: Autocrit Ultra 3
 - Centrifuge: Beckman J2-21
 - Centrifuge: Beckman J2-2M/E, refrigerated
 - Centrifuge: Beckman J2-HC, high-speed
 - Centrifuge: Cepa Z41, continuous
 - Centrifuge: Clinical
 - Centrifuge: Damon/IEC, tabletop
 - Centrifuge: IEC, explosion-proof, low-speed
 - Centrifuge: International Model HN
 - Centrifuge: Sorvall RC3B Plus
 - Centrifuge: Swing Bucket, 4-L
 - Centrivap concentrator: Labconco
 - Cheese press
 - Cheese vats: jacketed stainless steel w/agitation
 - Cold and dry storage lockers
 - Compression and injection molding machines
 - Consistometer: Adams
 - Consistometer: Bostwick
 - Extrusion systems for grain processing
 - Fermentors: Benchtop, 1-, 2-, 5-, 10-L
 - Fermentors: sterilizable-in-place, 15-, 50-, 100-L
 - Filters
 - Filtration unit: Amicaon hollow-fiber
 - Flow cytometer: Accuri C6
 - Food extrusion
 - Freeze drying
 - Freezer: ultralow (-70 C)
 - Refrigerator/Freezer: explosion-proof, isotherm

FACILITIES AND EQUIPMENT

EQUIPMENT (cont.):

- Gamma counter
- Gas chromatography: Varian
- Gas chromatography-mass spectrometry: Agilent
- Gel imaging cabinet
- Glue depositing
- High-performance liquid chromatograph
- High-temperature short-time pasteurizer (Microthermics)
- Homogenizer: Brinkman
- Hunter Labscan XE
- Incubator shaker: New Brunswick Sci
- Instron 1122
- Kettle: 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
- Milestone M/S Meba Micro Digest Units
- Oven: Fisher Isotemp
- Oven: Lindberg Blue M
- PCR Cycler: Applied Biosystems, Biorad, Finnzymes
- Penetrometers
- Photochem (oxidation potential system)
- Plastic film and sheet extruder
- Rapid Visco Analyzer
- Refractometer
- Retorts
- Rotary evaporator and vacuum pump
- Screens and mixing tanks
- SLM French Pressure Cell Press
- Spectronics XL-1500 UV Crosslinker
- Spectrophotometer: Beckman DU 640
- Spectrophotometer: Genesys 20
- Spectrophotometer: HP PDA 8452
- Spectrophotometer: Spectronic 21D
- Spinning disc colorimeters
- Spiral filter/pump
- Stomachers
- Texture analyzer (TAXT2)
- Toxic diet prep room and pelletor and mixer
- Ultracentrifuge: Beckman L8M
- UV illuminator: Fisher Biotech
- Vacuum oven: food-grade
- Viscometers: Digital Brookfield (YR-1; HDB, RV)
- Rotary evaporator: food-grade
- Water activity meter: AquaLab
- Wet grinders
- Wire cheese block cutter

COURSES, SYMPOSIA AND EVENTS

University of Minnesota

- Artisan Cheese Making Workshop
- Extrusion Workshop
- Food Chemistry Workshops
- Flavor Chemistry Workshops
- Serv Safe
- Microbiology and Engineering of Sterilization Process
- Milk Pasteurization and Dairy Plant Sanitation Workshops

South Dakota State University

- Cheese Judging Workshops
- Micro and Ultra Filtration Workshops

RESEARCHERS AND STAFF

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 Science Department and the Iowa State University Food Science and Human Nutrition Department, addressing new product development and processes for dairy products and ingredients.

SANJEEV ANAND, PH.D.

Associate Professor of Dairy Microbiology,
Food Safety

South Dakota State University

sanjeev.anand@sdsstate.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.

ROBERT BAER, PH.D.

Professor Emeritus of Dairy Science

South Dakota State University

robert.baer@sdsstate.edu

Dairy products with beneficial fatty acids, emulsifiers in low-fat and fat-free ice cream, analysis of dairy products.

LANCE BAUMGARD, PH.D.

Associate 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.

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.

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.

STEPHANIE CLARK, PH.D.

Associate 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.

SAARI CSALLANY, PH.D.

Professor of Food Science

University of Minnesota

ascsalla@umn.edu

Lipids, vitamin E, oxidative enzyme systems, edible fats and oil nutritional biochemistry, free radicals.

FRANCISCO DIEZ-GONZALEZ, PH.D.

Professor of Food Science

University of Minnesota

fdiez@umn.edu

Food safety microbiology, foodborne pathogens, preharvest control of pathogenic *E. coli*, bioterrorism.

CARRIE EARTHMAN, PH.D.

Associate Professor of Nutrition

University of Minnesota

cearthma@umn.edu

Clinical nutrition, medical nutrition therapy, body cell mass, nutrition support and assessment for patients at risk for wasting and gastric bypass surgery.

RESEARCHERS AND STAFF

ASHRAF HASSAN, PH.D.

Associate Professor of Dairy Science
South Dakota State University
ashraf.hassan@sdstate.edu

Lactic acid bacteria, fermented milks, low-fat cheeses and exopolysaccharides.

BARAEM ISMAIL, PH.D.

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

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

STEPHANIE JUNG, PH.D.

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

High-pressure treatment of foods; effects of processing on food components (proteins and enzymes); use of enzymes to modify protein characteristics (extractability and functional properties).

THEODORE LABUZA, PH.D.

Morse Alumni Distinguished Teaching Professor of Food Science
University of Minnesota
tplabuza@umn.edu

Water activity, food stability and safety, food law, shelf-life testing, glass transition phenomena, bioterrorism, contaminants in food, time-temperature integrator tags.

BUDDHI LAMSAL, PH.D.

Assistant 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.

RUTH MACDONALD, PH.D.

Professor and Food Science and Human Nutrition Department Head
Iowa State University
ruthmacd@iastate.edu

Identifying factors in foods that reduce the incidence of progression of cancer.

LARRY MCKAY, PH.D.

Professor Emeritus of Food Science
University of Minnesota
lmckay@umn.edu

Microbiology, gene transfer systems, plasmids, bacteriophages of cheese starter cultures, microbiology of food fermentations.

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.

LLOYD METZGER, PH.D.

Associate Professor and Alfred Chair in Dairy Education, Director of Dairy Center
South Dakota State University
lloyd.metzger@sdstate.edu

Structure and functional roles of cheese components and modification of manufacturing parameters; cheese technology; dairy products processing.

RESEARCHERS AND STAFF

VIKRAM MISTRY, PH.D.

Professor and Department Head of Dairy 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.

DEVIN PETERSON, PH.D.

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

Flavor generation, characterization of flavor compounds and flavor delivery in foodstuff.

GARY REINECCIUS, PH.D.

Professor and Department Head 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.

DAVID SCHINGOETHE, PH.D.

Distinguished Professor Emeritus of Dairy Science
South Dakota State University
david.schingoethe@iastate.edu

Distillers grains, fiber-digesting enzymes in dairy rations, bovine somatotropin (bST), rumen bypass proteins and dietary fat in lactating cows.

TONYA SCHOENFUSS, PH.D.

Assistant 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.

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.

RESEARCHERS AND STAFF

TONG WANG, PH.D.

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

Lipid chemistry and analysis; value-added processing and utilization of soybeans and other oilseeds; vegetable oil refining.

LESTER A. WILSON, PH.D.

University Professor
Iowa State University
lawilson@iastate.edu

Food quality determination (instrumental and sensory methods: color, flavor, aroma, taste, texture, viscosity and pungency); influence of radiation on rennet activity (NASA); food safety and quality training; influence of processing and storage on food acceptance.



NORTHEAST DAIRY FOODS RESEARCH CENTER



- **Cornell University**

<http://foodscience.cornell.edu/cals/foodsci/research/dairy-center/overview.cfm>

CENTER DIRECTORS

David M. Barbano, Ph.D.
Center Director
607-255-4122
barbano@aol.com

Martin Wiedmann, Ph.D., Dr. Med. Vet.
Center Associate Director
607-254-2838
mw16@cornell.edu

OVERVIEW

The Northeast Dairy Foods Research Center located at Cornell University, Ithaca, N.Y., was formed to conduct fluid milk and dairy ingredient research, provide applications and technical support for the improvements in milk powder quality and help establish the next generation of dairy ingredients.

The Northeast Dairy Foods Research Center also provides new learning opportunities for the industry with short-course training in dairy food safety and Hazard Analysis and Critical Control Points (HACCP) and dairy processing with a particular focus on fluid milk processing, cheese making and artisan dairy production.

RESEARCH FOCUS

Value Added Dairy

- Physical and engineering properties of dairy ingredients
- Supercritical Fluid Extrusion processing of dairy foods
- Functionalization of whey protein
- Technological approaches to produce longer shelf-life-concentrated micellar casein from skim milk for ingredient use in dairy and nondairy food products

Dairy Microbiology and Safety/Fluid Milk Quality

- Investigate farm management practices associated with high sporeformers levels in raw milk
- Influence of processing parameters on bacterial outgrowth in pasteurized fluid milk
- Develop molecular-based raw milk testing methods
- Dairy foods safety: intervention strategies for microbial inactivation
- Tracking and characterization of sporeformers in dairy processing systems
- Evaluation of raw milk tests for predicting pasteurized milk quality
- 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

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
[http://www.cals.cornell.edu/cals/
foodsci/research/FPDL/index.cfm](http://www.cals.cornell.edu/cals/foodsci/research/FPDL/index.cfm)

The goal of the Cornell University Food Processing and Development Laboratory (FPDL) is to create a professional environment in which teaching, research and extension activities can be conducted in support of the mission of the Institute of Food Science and College of Agriculture and Life Sciences program at Cornell. As such, FPDL priorities are as follows:

- Teaching: Provide hands-on learning experiences for students enrolled in Food Science and related curricula.
- Research: Provide a state-of-the-art facility and technical assistance for conducting food-related research at the testing/research/pilot plant level of production.
 - 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 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 with personnel, 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 ingredients and raw materials.

The 10,000-square-foot main processing area is adjacent to our fully licensed operating dairy plant (currently under construction and slated to open in the summer of 2013). It has a temporary HTST system installed for larger production runs that will remain in the FPDL after the new dairy plant is completed. This combination allows for scaling up of production in order to provide a variety of products for customer demonstrations, food shows and exhibitions. Cornell University's research and extension staff provides our clients a resource to find answers to tough research development problems.

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
- Model GA 31 Yamato Pulvis Mini Spray Dryer — 1600-mL/hr. evaporative capacity
- Buflovak Laboratory Atmospheric Double Drum Dryer — 8-in. drying width

EVAPORATOR

- Model Type E — Anhydro Laboratory Vacuum Evaporator (rising film)

ICE CREAM FREEZERS

- Emory Thompson — 20-qt. batch freezer
- Technogel 80 — continuous freezer
- Armfield 25 BA Scraped Surface Processing system — continuous freezer, 20 L/hr.
- Plate Heat Exchangers — 1 pt./min. to 15 gal./min.

HTST/UHT PASTEURIZING EQUIPMENT

- PMS Universal Pilot Plant — 3 L/min. (HTST)
- 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
- PMS Universal Pilot Plant — 1-gal. vats (2)
Additional Jacketed Vats — 400-gal. vats (2)

EXTRUSION TECHNOLOGY

- Wenger TX 52

MIXING EQUIPMENT

- Various high- and low-shear mixers

RETORT

- Static or rotating retort

CHEESE MAKING EQUIPMENT

- Kusel A-Frame cheese press
- Kusel L/I Laboratory cottage cheese vat
- Damrow S4-2M starter tank
- Supreme Mini Mixer Mozzarella cheese stretcher
- 2,250-gal. cheese vats
- 300-gal. Cheddar cheese vat
- 4 Damrow 5-can open vats
- 2 Kusel "Double-O" 5-can automatic vats

GAULIN TWO STAGE HOMOGENIZERS

- 42 to 1,000 gal./hr.

BUTTER CHURN

- Model A 50SS Vane Churn

CANNING EQUIPMENT

- Model 23 Dixie Canner

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

- Equipment Engineering Model 590
- DeLaval Model 340
- DeLaval Model 366
- CO₂ incorporation system
- Various Membrane Systems

EQUIPMENT**(cont.):****PACKAGING SYSTEMS**

- Koch Multivac vacuum sealer
- Filler Specialties ½-gallon and gallon plastic jug 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 105 F

DAIRY PROCESSING PLANT**CONTACT: JASON HUCK**

General Manager, Cornell University

Phone: 607-254-4882

jason.huck@cornell.edu

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, yogurt and ice cream products to be sold on the Cornell University, Ithaca campus, to offset the total costs incurred in the equipping and operations of the dairy plant.

DAIRY PROCESSING LABORATORY

The Dairy Processing Laboratory research focus areas include Food Safety Engineering and Food Quality. Research in the area of 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

MILK QUALITY IMPROVEMENT PROGRAM

The laboratories and staff of the MQIP are involved in a variety of applied research projects related to the quality and safety of milk and dairy products. A number of research projects are conducted in collaboration with the Cornell Food Science Department Food Safety Laboratory. Results from these research projects are rapidly communicated to the dairy industry, resulting in immediate improvements for the industry.

EQUIPMENT: – Autoplate 4000 – Q-Count

FOOD SAFETY LABORATORY AND LABORATORY FOR MOLECULAR TYPING

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 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 disease. Both basic and applied research in the laboratory is targeted toward developing the scientific knowledge necessary to improve our ability to prevent foodborne diseases.

Most of the current research in the Food Safety laboratory focuses on studying *Listeria monocytogenes* as a model system for bacterial pathogens that can cause disease in both human and animals.

EQUIPMENT:

- RiboPrinter — Microbial Characterization System
- Pulsed Field Gel Electrophoresis (PFGE) — Genetic Fingerprinting
- PCR and Sequence Based Characterization (16S, *rpoB*, etc.)
- Agilent 2100 Bioanalyzer, REP-PCR Based Microbial Characterization
- Illumina — Full Genome Sequencing (Life Sciences Core Laboratory)
- ABI Prism — Real Time PCR Detection System

DAIRY FOODS ENGINEERING LABORATORY

The Dairy Foods Engineering Laboratory is engaged in research on experimental and theoretical aspects of bioseparation processes, high pressure extrusion with supercritical fluids, 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 sterilization systems for liquid and solid foods – Dynamic Mechanical Analyzer and Brookfield viscometers

COURSES, SYMPOSIA AND EVENTS

- HTST Pasteurizer Workshop (2 times per year)
- Vat Pasteurizer/Cheese Grading Workshop
- Cultured Dairy Products Workshop
- Certified Milk Inspectors School
- Dairy Laboratory Workshop
- 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)

<http://foodscience.cornell.edu/cals/foodsci/extension/extension-calendar.cfm>

RESEARCHERS AND STAFF

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.

KATHRYN J. BOOR, PH.D.

Dean/Professor*Cornell University**kjb4@cornell.edu*

Bacterial response and adaptation to environmental stresses; bacterial virulence; physiology and genetic characteristics of pathogenic bacteria; and dairy microbiology. Dr. Boor 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.

NANCY CAREY

Research Support Specialist I*Cornell University**nrs13@cornell.edu*

Data management and sensory analysis.

KATHY CHAPMAN, M.S.

Research Support Specialist II*Cornell University**kwc3@cornell.edu*

Sensory panel training.

JASON R. HUCK, M.S.

General Manager, Dairy Operations*Cornell University**jason.huck@cornell.edu*

Dairy processing plant operations.

JANENE LUCIA

Extension Support Specialist*Cornell University**jgg3@cornell.edu*

Dairy Extension program training/workshop coordination and management.

NICOLE HELEN MARTIN, M.S.

Research Support Specialist I*Cornell University**nhw6@cornell.edu*

Dairy microbiology and chemistry.

CARMEN I. MORARU, PH.D.

Associate Professor*Cornell University**cim24@cornell.edu*

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.

RESEARCHERS AND STAFF

STEVEN C. MURPHY, M.P.S.

Senior Extension Associate
Cornell University
scm4@cornell.edu

Dairy Foods Extension — dairy product quality and safety; milk shelf life; dairy laboratory programs; HACCP training and implementation.

ROBERT D. RALYEA, M.S.

Senior Extension Associate
Cornell University
rdr10@cornell.edu

Milk Quality Improvement Program
Food science, dairy microbiology, improved and sustainable dairy agriculture, agroterrorism prevention.

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.

SEAN SCHELL

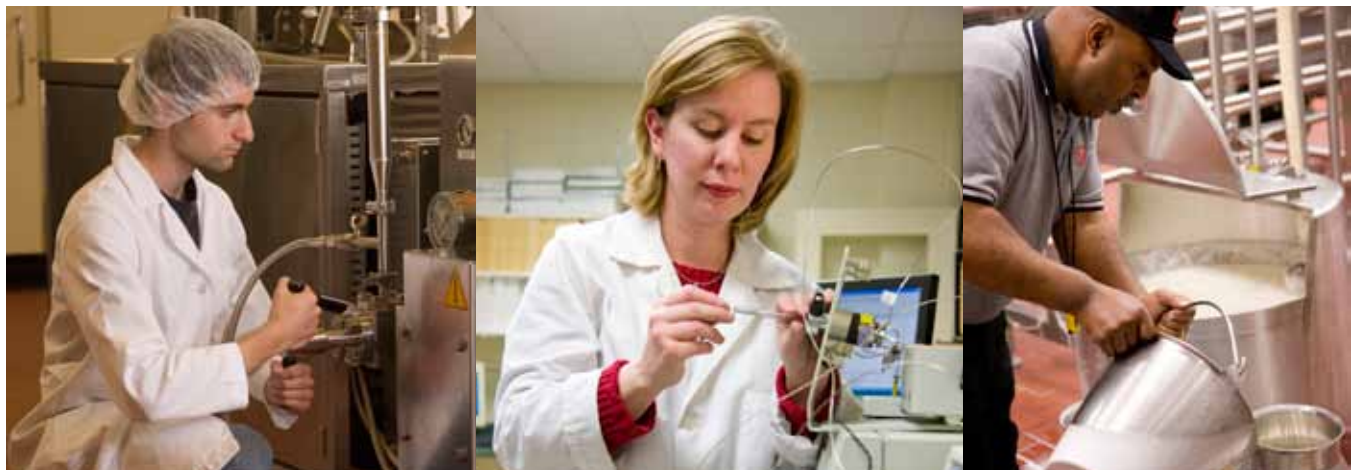
Equipment Tech V
Cornell University
sss38@cornell.edu

Food Processing Development Lab

**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 of psychrotolerant sporeformers; 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

www.cals.ncsu.edu/food_science/sdfrc/sdfrc.html



- North Carolina State University (Raleigh)
- Mississippi State University (Starkville)
- Sensory Applications Laboratory
(North Carolina State University)
www.ncsu.edu/sensory

CENTER DIRECTOR

Todd Klaenhammer, Ph.D.
Center Director
919-515-4197
klaenhammer@ncsu.edu

OVERVIEW

The Southeast Dairy Foods Research Center, with facilities and support at North Carolina State University (Raleigh) and Mississippi State University (Starkville), has been operating since 1988 and actively participates in national research planning and execution on behalf of the dairy industry and other entities. The center's researchers work nationally on cutting-edge information and technologies, educate future professionals for the dairy industries, and help food processors address applications challenges and develop new products and processes using dairy products and 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 high-precision 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: TODD KLAENHAMMER, PH.D.
 Director, Southeast Dairy Foods
 Research Center
 919-515-4197
sdfrc@ncsu.edu

FACILITIES AND EQUIPMENT

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

FACILITIES AND EQUIPMENT

- 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

FACILITIES AND EQUIPMENT

MISSISSIPPI STATE UNIVERSITY

CONTACT: JUAN L. SILVA, PH.D.
 Professor and Interim Head, Food Science,
 Nutrition and Health Promotion
 662-325-3200, 662-325-8728
jls46@msstate.edu

EQUIPMENT

- EQUIPMENT:**
- Double-O cheese vat — 65 gal. with stirrers
 - Square cheese vat — 100 gal., hand-stirred
 - Cheese vats — 750 gal. with stirrers (2)
 - Vats — 2- to 3-gal. capacity, hand-stirred (4)
 - Cultured products vat — 50 gal., heated and stirred
 - Continuous ice cream freezer — 150 gal./hr.
 - Emery Thompson batch ice cream freezer — 5 liters
 - Anderson HTST unit
 - Anderson, 2-stage homogenizer (30 gal./hr.)
 - Walts UHT unit-indirect steam-heated (40 gal./hr.)
 - Romicon ultrafiltration unit (1,700 lbs./hr.)
 - CO₂ freezing tunnel — 24 ft. long
 - APV spray dryer — 7 kg./hr., 1-m diameter
 - Dayton Electric steam-closing canning machine
 - Rooneys semiautomatic canning machine

FACILITIES AND EQUIPMENT

- EQUIPMENT**
- (cont.):**
- Retort — approx. 120 1-lb. cans
 - Ultracentrifuge
 - Kemotech smoking room —
4- by 5-ft. firebox
 - Oven
 - CEM microwave moisture analyzer
 - Walk-in freezer
 - APV homogenizer — 2 stages
 - Cooler
 - Gas chromatographs (GC), GC-MS, GC-O
 - Grape crusher
 - HPLC, LC-MS
 - Juice processing
 - Mass spectrometers (MS)
 - Freeze dryers
 - Spectrophotometers
 - Deep-fat fryers

COURSES, SYMPOSIA AND EVENTS

- 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
- FNH 4143 Dairy Foods Processing
- FNH 4990 Dairy Products Judging
- Cheese Making Short Course
- Annual Farmstead Cheese Manufacture Short Course

RESEARCHERS AND STAFF

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.

GARY CARTWRIGHT

Dairy Enterprise System Director

North Carolina State University

gary_cartwright@ncsu.edu

Dairy processing, aseptic processing and packaging, continuous-flow microwave processing.

CHRISTOPHER R. DAUBERT, PH.D.

**Professor of Food, Bioprocessing and
Nutrition Sciences**

Director of Food Rheology Laboratory

North Carolina State University

chris_daubert@ncsu.edu

Process cheese structure and texture; functionality of dairy ingredients; protein interactions in gel formation; fracture and texture design of dairy products.

MARYANNE DRAKE, PH.D.

**Professor, Food, Bioprocessing and Nutrition Sciences,
and Director of DMI Sensory**

Applications Laboratory and NCSU Sensory

Services Center

North Carolina State University

mdrake@unity.ncsu.edu

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

RESEARCHERS AND STAFF

E. ALLEN FOEGEDING, PH.D.

William Neal Reynolds Distinguished Professor
 Department of Food, Bioprocessing and
 Nutrition Sciences
 North Carolina State University
allen_foegeding@ncsu.edu

Whey and milk protein ingredient functionality; using dairy proteins to design food structures with desirable properties regarding texture and health; controlling astringent flavor and stability in high-protein/high-acid drinks.

TAEJO KIM, PH.D.

Research Assistant Professor
 Department of Food Science, Nutrition and
 Health Promotion
 Mississippi State University
tkim@foodscience.msstate.edu

Food safety and molecular microbiology, rapid detection methods, analysis and synthesis of bioactive components.

TODD KLAENHAMMER, PH.D.

**Dairy Center Director,
 Distinguished University Professor and
 William Neal Reynolds Distinguished Professor**
 Department of Food, Bioprocessing and
 Nutrition Sciences
 North Carolina State University
klaenhammer@ncsu.edu

Microbiology of starter cultures and probiotics; controlling fermentations and understanding probiotic bacteria through genomics.

RAMA NANNAPANENI, PH.D.

Assistant Research Professor
 Department of Food Science, Nutrition and
 Health Promotion
 Mississippi State University
nannapaneni@fsnhp.msstate.edu

Food safety and molecular food microbiology with focus on microbial stress adaptation and antimicrobial resistance; and microbiological safety of soft process cheeses.

CAROL REILLY

Program Coordinator
 Southeast Dairy Foods Research Center
 Department of Food, Bioprocessing and
 Nutrition Sciences
 North Carolina State University
carol_reilly@ncsu.edu
SDFRC@ncsu.edu

WES SCHILLING, PH.D.

**Associate Professor, Food Chemistry and Sensory
 Analysis**
 Department of Food Science, Nutrition and
 Health Promotion
 Mississippi State University
schilling@foodscience.msstate.edu

Sensory and flavor analysis of foods; consumer testing, descriptive analysis, gas chromatography, flavor and preference mapping.

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.

KAMLESH SONI, PH.D.

Research Associate
 Department of Food Science, Nutrition and
 Health Promotion
 Mississippi State University
ksoni@fsnhp.msstate.edu

Food safety and molecular food microbiology, Quorum sensing molecules, microbial stress and microbiology of fresh soft cheeses.



WESTERN DAIRY CENTER



- **Utah State University (Logan)**
www.usu.edu/westcent

CENTER DIRECTOR

Donald J. McMahon, Ph.D.
Center Director
435-797-3644
donald.mcmahon@usu.edu

OVERVIEW

The Western Dairy Center's primary location is Utah State University in Logan, with additional resources available at other universities in the Intermountain West. The faculty has extensive expertise in dairy processing/production, microbiology, chemistry and sensory analysis. An integral part of the center is a newly established Dairy Technology Innovation Laboratory group of researchers dedicated to providing innovative solutions to challenges and opportunities facing today's dairy processing industry.

RESEARCH FOCUS

- Cheese flavor and functionality
- Cheese technology
- Fermented products, including cheese and yogurt
- Ultra-high-temperature and extended-shelf-life fluid milk beverages
- Milk protein chemistry, including coagulation, denaturation and separation
- Milk fractionation and use of membrane separation in dairy foods
- Anaerobic digestion of dairy processing waste
- Whey protein extrusion
- Application of genetics, genomics and metabolomics to lactic acid bacteria
- Whey and milk utilization
- Microstructure of dairy products
- Sensory analysis

FACILITIES AND EQUIPMENT

The Gary Haight Richardson Dairy Products Laboratory at Utah State University is a complete dairy processing facility. It operates daily to produce the dairy products used on campus. It also is used extensively by the researchers at the Western Dairy Center, as well as by researchers from industry for research and product development. Facilities are available on a daily basis for research, product development, formulation, manufacture and scale-up of dairy products. The efficient operation and flexible scheduling ensure a short turnaround time for the customers' products.

TO ARRANGE USE OF THE PILOT PLANT FACILITY, CONTACT:

CONTACT: RANDALL BAGLEY
 Manager, Gary Haight Richardson
 Dairy Products Laboratory
 435-797-2108
randall.bagley@usu.edu

TO ARRANGE RESEARCH TRIALS, CONTACT:

CONTACT: CARL BROTHERSEN, M.S.
 Associate Director, Dairy
 Technology Innovation Laboratory
 435-797-3466
carl.brothersen@usu.edu

- EQUIPMENT:**
- Scherping horizontal cheese vats (1,500 lbs.) (2)
 - Bench scale cheese vats (30 lbs., 10 lbs.)
 - Open cheese vats (500 lbs.) (3)
 - Homogenizer and pasteurizer
 - Tetra Pak Sterilab ultra-high-temperature processor (steam injection and indirect heating)
 - High-pressure, high-temperature extruder
 - Process cheese cooker
 - Ice cream freezer, continuous and batch
 - Ultrafiltration, microfiltration, nanofiltration and reverse osmosis separation
 - Mozzarella cooker/stretcher
 - Grinder
 - Vacuum packager
- SUPPORTING ANALYTICAL EQUIPMENT:**
- Rheometer
 - Texture profile analyzer
 - High-performance chromatograph
 - High-performance chromatograph/mass spectrometer
 - Gas chromatograph
 - Gas chromatograph/mass spectrometer
 - Capillary electrophoresis
 - Babcock apparatus
 - Microtome
 - Water activity meter
 - Fermenters
 - BSL2+ laboratory with necessary equipment
 - Twin-screw extruder
 - Titrater
 - Freeze dryer
 - Particle analyzer
 - Light microscope
 - Polarized light microscope
 - Turbidity meter
 - Low-intensity ultrasound

**SUPPORTING
ANALYTICAL
EQUIPMENT
(cont):**

- High-intensity ultrasound
- Thermo analyzer
- Moisture analyzer
- Spectrophotometer UV/Vis
- Centrifuges
- Sample homogenizers
- Freezer (-80 C)

COURSES, SYMPOSIA AND EVENTS

- Basic Cheese Making Short Course for Industrial Cheese Makers (Utah State University)
- Advanced Cheese Making Short Course for Artisan Cheese Makers (Utah State University)
- Industrial Cheese Making Short Course (with University of Idaho Extension)
- Artisan Cheese Symposium (Utah State University)
- GMP Workshop (Utah State University)
- HACCP Workshop (Utah State University)
- Advanced Sanitation Workshop (Utah State University)
- Behavior-Based Food Safety (Utah State University)
- Statistical Process Control Workshop (Utah State University)
- Safe Quality Foods Workshop (Utah State University)

RESEARCHERS AND STAFF

DAVID BRITT, PH.D.

Assistant Professor, Biological Engineering
Utah State University
dbritt@cc.usu.edu

Surface chemistry, interfacial water structure (hydration layers) and associated surface potential of membranes and biomaterials as related to protein absorption and biofilm formation; lactose-hydrogels for enhanced water retention in soil and crop yield.

JEFF BROADBENT, PH.D.

Professor, Dairy Microbiology
Utah State University
jeff.broadbent@usu.edu

Genomics of lactic acid bacteria, nonstarter lactic acid bacteria in cheese; improvements in low-fat cheeses; functionality in high-moisture cheeses; effect of oxidation reduction potential on growth of lactic acid bacteria; use of adjunct cultures.

CARL BROTHERSEN, M.S.

Associate Director, Western Dairy Center
Associate Director, Dairy Technology Innovation Laboratory
Utah State University
carl.brothersen@usu.edu

Chemical diffusion of molecules in cheese matrix; oxidation-reduction potential in Cheddar cheese; value-added cheese.

DAREN CORNFORTH, PH.D.

Winder Professor, Meat Technology
Utah State University
daren.cornforth@usu.edu

Dried milk mineral as an antioxidant in processed meats; lipid oxidation in precooked meats by dairy calcium and phosphoproteins; dried whey mineral as an antioxidant.

BALASUBRAMANIAN GANESAN, PH.D.

Research Scientist
Dairy Technology Innovation Laboratory
Utah State University
g.basu@usu.edu

Genomics, metabolomics and informatics of lactic acid bacteria.

CONLY HANSEN, PH.D.

Professor, Food Engineering
Utah State University
conly.hansen@usu.edu

Anaerobic digestion as a waste management tool for decreasing effluent load from farms and food processing facilities and generation of energy.

DAVID IRISH, B.S.

Dairy Processing Specialist
Dairy Technology Innovation Laboratory
Utah State University
david.irish@usu.edu

Cheese making, UHT processing, filtration and membrane processing.

SILVANA MARTINI, PH.D.

Assistant Professor, Lipids, Sensory Evaluation
Utah State University
silvana.martini@usu.edu

Technologies for designing healthy, high-quality, fat-containing foods for today's consumer; fat crystallization and phase transition theory; encapsulation; relationships between physicochemical properties of fats and emulsions and sensory characteristics.

DONALD J. MCMAHON, PH.D.

Director, Western Dairy Center
Director, Dairy Technology Innovation Laboratory
Professor, Dairy Food Processing
Utah State University
donald.mcmahon@usu.edu

Structure and function of casein proteins, milk coagulation, cheese manufacture, low-fat cheese texture and flavor, mozzarella cheese functional properties; membrane fractionation and processing of milk and whey; ultra-high-temperature processing of milk.

WILLIAM R. MCMANUS, M.S.

Research Technician
Utah State University
bill.mcmanus@usu.edu

Microstructure of foods, electron microscopy, confocal laser microscopy, low-fat cheese.

RESEARCHERS AND STAFF

BRIAN NUMMER, PH.D.

Assistant Professor, Extension Food Safety Specialist
Utah State University
briann@usu.edu

Food safety manager education, retail-foodservice food safety, small food entrepreneur food safety, home food storage, HACCP short course.

CRAIG J. OBERG, PH.D.

Regents Professor, Microbiology
Weber State University
coberg@weber.edu

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

MICHAEL QIAN, PH.D.

Associate Professor, Food Science
Oregon State University
michael.qian@oregonstate.edu

Flavor chemistry, food analysis and dairy chemistry. Characterization of aroma compounds, and chemical and biological generation in dairy, small fruits and wines. Instrumental analysis of food components.

KIMBERLY RASMUSSEN

Dairy Technology Innovation Laboratory Staff Assistant
Utah State University
kimberly.rasmussen@usu.edu

J. ANTONIO TORRES, PH.D.

Associate Professor, Food Process Engineering
Oregon State University
j_antonio.torres@oregonstate.edu

Novel and conventional applications of high-pressure processing with emphasis on bacterial spore inactivation mechanisms, in-line/real-time optical polarization measurements in food systems.

MARIE WALSH, PH.D.

Associate Professor, Dairy Chemistry
Utah State University
marie.walsh@usu.edu

Whey proteins (formulation, extrusion and production) in snack foods and meat extenders; immobilized enzyme reactors.

ROBERT WARD, PH.D.

Assistant Professor, Bioactive Food Components
Utah State University
robert.ward@usu.edu

Lipid analysis and metabolism, plus novel bioactivities associated with the milkfat globular membrane.

WISCONSIN CENTER FOR DAIRY RESEARCH



- **University of Wisconsin-Madison**
www.cdr.wisc.edu

CENTER DIRECTOR

John Lucey, Ph.D.
Director
608-262-1195
jalucey@cdr.wisc.edu

OVERVIEW

The Wisconsin Center for Dairy Research (CDR) is located within a licensed, operating dairy plant 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 250 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 a pilot plant) 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

- Explore and understand the functional properties of cheese, cheese products and cultured dairy products
- Functional dairy proteins (casein alternatives, milk protein concentrate (MPC), modified whey protein concentrate (WPC), etc.) and ingredients
- Dairy food safety and quality systems
- Dairy processing (membrane filtration, drying, separation, etc.)

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.

The CDR cheese making pilot plant is located within the University of Wisconsin-Madison Dairy Plant, an operational dairy. This setting allows for flexibility in all aspects of the cheese making process. The facility 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.

CDR cheese applications staff, through consultation, pilot plant trials, applications 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

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 information, training, seminars, process development, process troubleshooting, ingredient functionality testing and prototype development. Application areas of expertise are beverages, baked products, confections, dairy products, energy bars and prepared foods.

ANALYTICAL SERVICES

Analytical services are offered to support projects carried out at the Wisconsin Center for Dairy Research. CDR provides comprehensive chemical and microbiological testing services and follows *EURACHEM-CITAC Guide CG-2* as quality assurance guideline of nonroutine and R&D analysis of samples. Tests performed include crude protein, casein, true protein, milkfat, total solids, mineral content by reference methods, enzymatic determination of lactose and galactose, protein profiles of milk and milk products by capillary 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 works with facility personnel to improve their GMP program and establish or modify an 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.

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

SENSORY ANALYSIS

This area designs, conducts and summarizes sensory analysis of cheese and dairy ingredients, using modern sensory testing approaches including the use of FIZZ Networks software with trained panelists performing a wide range of consumer and quantitative tests to meet the customers' needs. Evaluations include flavor, body/texture and appearance profiles, as well as cheese functionality for shredding/slicing and cooking applications. Panels conducted range from trained to focus group, from descriptive to consumer.

FACILITIES AND EQUIPMENT

The CDR pilot plant facilities meet the needs of the dairy and food processing industry by offering access to smaller-scale equipment. The small-vat new 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.

FACILITIES AND EQUIPMENT

WISCONSIN CENTER FOR DAIRY RESEARCH/UW-MADISON PILOT PLANT EQUIPMENT

CONTACT: THOMAS SZALKUCKI
Wisconsin Center for Dairy Research
608-262-9020
tszal@cdr.wisc.edu

EQUIPMENT: Full cheese making manufacturing line located in a state-licensed, state-inspected, operating dairy manufacturing facility. Natural cheese manufacturing line includes multiple raw storage tanks, separator, homogenizer, HTST and various membranes (RO, UF, MF) for full milk standardization based on any desired ratios or incorporation of any ingredient before pasteurization of cheese milk. Capabilities to manufacture any style and variety of cheeses.

- 30-gal. bulk starter preparation tank
- pH meters with computer hookup to continuously monitor pH reading in 4 vats or redox potential in 2 vats over the course of manufacture
- 4 Stoelting 600-lb. vats with variable speed agitators and ¼-in., ⅜-in. and ½-in. knives
- Kusel 5,400-lb. cheese vat
- Kusel 600-lb. Double-O cheese vats (2)
- Small 5-gal. capacity mini-cheese vats with automatic agitation with continuous pH monitoring (4)
- 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)
- EBR curd mill for Cheddared slabs
- Miller horizontal cheese press with 2 air rams
- Kusel A-frame vertical cheese press
- DR Tech Carousel Cheese Vacuum Press for blocks and horns
- Stainless steel cheese forms (Wilson 10-, 20- and 40-lb. block, perforated brick/Muenster hoops, 5-lb. round Muenster hoops)
- Plastic cheese forms of various sizes and shapes, including 10-lb. wheels (both Crellin and Fromagex), 5-lb. loaves, smaller sizes for 1-lb. Edam balls, Camembert, ricotta and panela baskets, etc.
- Stacked fiberglass circulating brine system
- Hot Pack Environmental Chamber Model 317532 for ripening mold and surface-ripened cheeses; off-site ripening also available upon request
- Warm room capabilities for eyed cheese storage
- Various cold storage capabilities with variety of temperature ranges for cheese ripening

EQUIPMENT: Full cream cheese manufacturing line. Cream cheese manufacturing line includes items listed below, as well as equipment listed under other categories. Processing lines include cheese vats, pumping line to collect whey and cream cheese, holding vessel, through packaging.

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

Cold pack and process cheese manufacturing line. Cold pack and process cheese manufacturing line includes items listed below, as well as 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 cold pack cheese blender, 10-lb. capacity
- Stephan high-speed cutter, Model UMC 5, 5-lb. capacity, direct and indirect steam with vacuum
- Pick Heater for jet cooking sauces
- Blendtech twin-screw process cheese cooker, Model CC 0025, 20-lb. capacity, direct and indirect steam with vacuum
- Gerstenberg Schröder scraped surface heat exchanger (SSHE), Model VP 90/50
- Stephan vertical cutter/mixer, Model 17 91, 50-lb. capacity, indirect steam only
- Gerstenberg Schröder emulsifying machine for water/oil emulsions
- Gerstenberg Schröder mixing and holding tanks

Other various equipment used in the processing, converting and packaging of cheese:

- Winning Designs stainless steel butter churn, 1-gal. capacity
- Lincoln Impinger oven, Model 1130, for baking of Juustoleipä
- Urschel cheese shredder, Model CC-D
- Multivac vacuum sealer with gas flush capabilities, Model C400
- Vemag V 500 robot cheese grinder and vacuum machine with guillotine cutoff
- Variety of portable holding tanks

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

**DAIRY
INGREDIENT
PROCESSING
EQUIPMENT**

- Three spiral-wound UF- or MF-compatible systems that contain multiple vessels
- One system using up to six 3.8-in.-dia. vessels holding two elements each
- One system using up to two 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 3.8-in.-dia. vessel, one or two elements long
- Ceramic microfiltration system (not UF)
- One single-stage spiral-wound membrane filter system (UF/MF)
- Ceramic membrane system (UF/MF)
- Pilot-scale plate evaporator capable of 200 to 400 lbs. of water evaporation/hr.
- Pilot-scale spray dryer capable of 40 to 60 lbs. of water evaporation/hr.
- Stephan mixer with 40-L capability
- Homogenizer (two-stage)
- Two pilot-scale milkfat separators
- Small HTST/UHT pasteurizer
- Ion exchange chromatography system – 10 L
- Tanks ranging from 5 to 100 gal.
- Gerstenberg Schröder scraped surface heat exchanger (SSHE)
- Gerstenberg Schröder emulsifying machine
- Swept-surface jacketed tank with heating and cooling (100 gal.)
- APV Gaulin homogenizer Model M3, 2-stage minimum, 2 gal. of product

**ADDITIONAL
PROCESSING
EQUIPMENT**

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

SUPPORTING ANALYTICAL EQUIPMENT

Moisture analyzers	Total solids, moisture
Forced-air ovens	Total solids, moisture, total solids (nonfat)
pH/mV meters	pH
Balances (capable of reading to 1 mg)	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
Immersion sonicators	Solutions, suspensions, degasification
Centrifuges (various sizes to 25,000 rpm)	Soluble nitrogen, milkfat separation
Paar Physica and Malvern Rheometers	Gelation, small deformation technology
Zeiss Epi-Fluorescence Microscope	Light and fluorescent microscopy

SUPPORTING ANALYTICAL EQUIPMENT

Centrifuge rotors (fixed-angle and swing bucket)	Soluble nitrogen, milkfat separation
Microcentrifuges	Protein composition
Microwave mineralization oven	Mineral analysis
Viscometer	Viscosity
Electrophoresis tanks	Protein composition (10 to 250 kD), protein composition (casein variants)
Electrophoresis power supplies	Protein composition (10 to 250 kD)
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
Melt meter	Melt test
-80 C freezers	Sample preservation, starter culture storage
Low-temperature incubators	Various microbiological tests
Refrigerated circulating water baths	Sample preparation
Rotary evaporators (1 L)	Solvent evaporation
Soxhlet extractors (100 mL)	Fat extractions
Sample homogenizers	Sample preparation
Particle size analyzer (20 to 2,000 μm) with autosampler	Particle size determination
Microfluidizer	Preparation of liposomes
Multi-angle laser light scattering detector (MALLS)	Determination of molecular weight of polymers

SUPPORTING ANALYTICAL EQUIPMENT

Inductively coupled plasma-axial optical emission spectroscopy with autosampler	Mineral analysis
Gas chromatograph-flame ionization detectors with autosampler	Fatty acid composition, triglycerides, fatty acid sn- triglyceride positional analysis
High-performance liquid chromatograph with autosampler	Phospholipids, carbohydrates
Evaporative light-scattering detector	Phospholipids, carbohydrates, triglycerides
Drop point analyzer	Melt point
Walk-in coolers (4 C)	Sample preservation
Commercial deli-style slicers	Melt test
Vacuum sealers	Sample preservation
Oxidative stability instrument	Accelerated oxidative stability
Chloride analyzers	Salt determination
Shaker water bath	Lactose

COURSES, SYMPOSIA AND EVENTS

- Applied Dairy Chemistry Short Course
- Cleaning and Sanitation Workshop
- Cheese Grading and Evaluation Short Course (two times per year)
- Cheese Technology Short Course (two times per year)
- Cultured Dairy Products Short Course (odd-numbered years)
- Dairy and Food Plant Wastewater Short Course
- Dairy HACCP Workshop
- Dairy Ingredients Utilization Short Course (odd-numbered years)
- Ice Cream Makers Short Course
- Dairy Ingredient Manufacturing Short Course (even-numbered years)
- Master Cheese Maker Short Course (Focus on specific trends and technologies in the manufacture of various cheeses)
- Milk Pasteurization and Process Control School (two times per year)
- Process Cheese Short Course
- World of Cheese — Pasture to Plate Short Course
- Buttermakers Short Course

COURSES, SYMPOSIA AND EVENTS

- Various courses related to sustainability
- Custom company training programs for industry
- CDR Industry Team Research Forum
- International Cheese Technology Exposition
- Wisconsin Cheese Industry Conference

COMMUNICATIONS AND OTHER RESOURCES

- *The Dairy Pipeline* technical newsletter (published quarterly)
- Technical reviews
 - Dried Dairy Ingredients
 - Dairy Proteins
 - Whey Processing — Bleaching
 - Fact sheets
 - 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



RESEARCHERS AND STAFF

ROBERT BRADLEY, JR., PH.D.**Professor Emeritus of Food Science***UW-Madison**rbradley@wisc.edu*

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.

KIMBERLEE (K.J.) BURREINGTON**Coordinator, Dairy Ingredients Applications Program***Wisconsin CDR**burrington@cdr.wisc.edu*

Coordinates dairy ingredients program targeting industry needs in the areas of whey processing/component separation and utilization of these components in a variety of food and beverage products.

CAROL CHEN**Researcher, Sensory Analysis***Wisconsin CDR**cchen@cdr.wisc.edu*

Designs, conducts and summarizes sensory analysis of cheese; evaluations include flavor, body/texture and appearance profiles, as well as cheese functionality for shredding/slicing and cooking applications; types of panels conducted range from focus group to descriptive to consumer.

BÉNÉDICTE COUDÉ**Assistant Coordinator, Cheese Industry & Applications***Wisconsin CDR*

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.

SRINIVASAN DAMODARAN, PH.D.**Winters-Bascom Professor, Food Chemistry***UW-Madison**sdamodar@wisc.edu*

Enzyme chemistry and technology; food chemistry; protein chemistry and technology.

MARK ETZEL, PH.D.**Professor, Food Science (joint with Chemical Engineering)***Food Research Institute**UW-Madison**etzel@che.wisc.edu*

Food and bioprocess engineering; mass transfer and bioseparation processes; membrane bioseparations; protein purification; drying of foods and microorganisms.

KATHY GLASS, PH.D.**Assistant Scientist, Microbial Sciences***Food Research Institute**UW-Madison**kglass@facstaff.wisc.edu*

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

RANI GOVINDASAMY-LUCEY, PH.D.**Senior Scientist***Wisconsin CDR**rani@cdr.wisc.edu*

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.

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.

RESEARCHERS AND STAFF

KRISTEN HOUCK

Research Specialist
 Wisconsin CDR
houck@cdr.wisc.edu

Coordinator of microbiological services.

BARBARA INGHAM, PH.D.

Associate Professor, Food Science
 UW-Madison
bingham@wisc.edu

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

JOHN JAEGGI

Cheese Industry and Applications Coordinator
 Wisconsin CDR
jaeggi@cdr.wisc.edu

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

LUIS JIMENEZ MAROTO

Sensory Coordinator
 Food Science/Wisconsin CDR

Designs, conducts and summarizes sensory analysis of cheese; evaluations include flavor, body/texture and appearance profiles, as well as cheese functionality for shredding/slicing and cooking applications; types of panels conducted range from focus group to descriptive to consumer.

MARK JOHNSON, PH.D.

**Assistant Director
 Senior Scientist**
 Wisconsin CDR
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.

SUSAN LARSON, PH.D.

Research Specialist
 Wisconsin CDR
slarson@cdr.wisc.edu

Dairy ingredient applications and responsible for the InnovateWithDairy.com website and dairy technical-support line.

YANJIE LU, PH.D.

Associate Researcher, Lab Manager
 Wisconsin CDR
yanjielu@cdr.wisc.edu

Supports research projects on cheese and dairy ingredients. Lab manager for Dr. Lucey lab.

JOHN LUCEY, PH.D.

**Director, Wisconsin CDR
 Professor, Food Science**
 UW-Madison
jalucey@cdr.wisc.edu

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

FRANCO MILANI, PH.D.

**Assistant Professor and Extension Specialist,
 Food Science**
 UW-Madison
milani@wisc.edu

Application of sustainable practices in food process, product and marketing designs; support for short courses in dairy/food industry; food analytical and application testing method development, process development and optimization.

SARAH MINASIAN

Applications Lab Coordinator
 Wisconsin CDR
sminasian@cdr.wisc.edu

With a culinary background, supports research and development application projects for the CDR.

GINA MODE

Assistant Coordinator, Cheese Industry & Applications Program
 Wisconsin CDR
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

Pilot Plant Technical Support
 Wisconsin CDR
molitor@cdr.wisc.edu

Coordinates the center's pilot plant use for filtration, evaporation and spray-drying projects; serves as department resource for equipment design and maintenance; supports processing of dairy products, including yield and mass balance.

RESEARCHERS AND STAFF

KIRK PARKIN, PH.D.

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

Food chemistry and biochemistry, particularly enzymology and bioactive phytochemicals and nutraceuticals; identification, characterization and enrichment of health promoting, bioactive compounds in foods; characterization of enzymes in foods and as processing aides.

SCOTT RANKIN, PH.D.

Associate 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

Researcher
Wisconsin CDR
romero@cdr.wisc.edu

Supports analytical activities for the CDR, including comprehensive chemical, microbiological, sensory and rheological testing services.

**PAMELA L. RUEGG,
DVM, MPVM, DABVP (Dairy Practice)**

Professor, Dairy Science
UW-Madison
plruegg@wisc.edu

Milk quality specialist; on-farm implementation of best management practices to improve milk quality and safety; research interests focused on the application of epidemiologic techniques to critical issues related to milk quality and safety; influence of cow and farm hygiene on milk safety and quality.

KAREN SMITH, PH.D.

Dairy Processing Technologist
Wisconsin CDR
smith@cdr.wisc.edu

Specializes in process development, scale-up and troubleshooting; conducts research in milk/whey separation, concentration and drying; develops materials for industry education.

MARIANNE SMUKOWSKI

Safety and Quality Coordinator
Wisconsin CDR
msmuk@cdr.wisc.edu

Serves as technical adviser to the dairy industry for safety/quality programs, HACCP implementation and dairy facility audits; facilitates industry/regulatory interactions; and is technical coordinator for the Wisconsin Master Cheesemaker® Program.

DEAN SOMMER

Cheese and Food Technologist
Wisconsin CDR
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.

JAMES STEELE, PH.D.

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

Dairy microbiology; genetics and physiology of lactic acid bacteria; cheese flavor; probiotics.

TOM SZALKUCKI

Wisconsin CDR
tszal@cdr.wisc.edu

Serves as assistant to the director with specific additional duties related to projects, contracts, reports, technical information and CDR physical facilities.

DEBRA WENDORF BOYKE

Communications Coordinator
Wisconsin CDR
dwboyke@cdr.wisc.edu

Manages all internal and external communication and short course/training activities of the center.

RESEARCHERS AND STAFF

WILLIAM WENDORFF, PH.D.

Emeritus Professor, Food Science
UW-Madison
wlwendor@wisc.edu

Quality and environmental concerns of the dairy industry; sheep milk processing.

DANA WOLLE, PH.D.

Research Specialist
Wisconsin CDR
dwolle@cdr.wisc.edu

Supports applied and basic research and development projects in both the dairy ingredients and cheese utilization group.

