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Professor of Food Science

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Areas of Expertise

- Dairy Processing
- Food Rheology
- Food Engineering

Education

- B.S., University of Uruguay. Agricultural Engineering.
- Ph.D., Washington State University. Biological Systems Engineering.

Teaching

Dairy Foods processing

Food Rheology

Food Engineering

Current Key Members

Liz Astorga (MS student)

David Goulder (MS student)

Grace Voronin (PhD student)

Saurabh Lele (Postdoctoral Research Associate)

Stiphany Tieu (MS student)

Research Focus

Research focuses on processing interventions that strongly affect protein functionality and overall food physical properties. As we continue to seek for 'minimally processed' and 'clean' label foods, understanding the effect(s) of processing operations on the functionality of proteins, fats and carbohydrates becomes critical.

Recent projects have focused on

- Caseins as natural emulsifiers and foaming agents
- Functionality of lecithin phospholipid fractions beyond emulsification
- Cryo-electron microscopy to elucidate the structure of casein micelles
- Analytical methods to separate glycosylated casein proteins
- The emulsifier-free and stabilizer-free ice cream
- High pressure jet processing to dissociate protein quaternary structures
- Effect of ionic environment on protein integrity

Strong emphasis is given in the following areas: Dairy Processing and the structure-function properties of milk proteins

The casein proteins account for 80% of the total protein content in bovine milk and 40% of the total protein content in human milk. The casein proteins aggregate into so called "casein micelles" of spherical shape and ca. 150 nm diameter. Bovine milk is white because of the 10¹⁵ casein micelles dispersed in every mL of milk. The agreed biological function of the casein micelles is to transport amino acids and calcium from mother to young. This is widely accepted based on the fact that milk is supersaturated with calcium (bovine milk contains ca. 1.2 mg calcium per mL of milk whereas water can only dissolve up to 0.02 mg of calcium – as calcium phosphate – per mL) and because the phospho-serine amino acids responsible of holding calcium-rich clusters are conserved throughout virtually all mammal species. The casein micelles have also a tremendous technological relevance as they constitute the building blocks of traditional dairy foods, including cheese and yogurt. We are elucidating casein micelle structure-function relationships that are relevant to the fundamental understanding of the biological relevance of this nano-delivery system and the engineering of novel application within the food and health industries.

Nonthermal technologies for fluid foods: valve homogenization

Homogenization is a term used by food scientists and engineers to describe a wide variety of processes including ultrasonic, rotary, membrane, colloidal mill, and valve homogenization ... among others. The ambiguity in the use of the word "homogenization" rises from the fact that any process that reduces the relative heterogeneity of a system can be called homogenization. We focus on what is typically referred to as "high pressure valve homogenization" or "dynamic high pressure homogenization" where several physical phenomena (including hydrostatic pressure, cavitation, shear stress, temperature) promote changes ranging from microbial and virus inactivation to protein structural modification and atypical molecular interactions. This process is applied to liquid foods by devices consisting of a positive displacement pump (usually a plunger type pump) and one or more restrictions to flow (stages) created by valves or nozzles. We arbitrarily define "high pressure homogenization" as homogenization processes where pumps are able to deliver at least 100 MPa hydrostatic pressure to a liquid food. We are currently working at maximum pressures that are six times that at bottom of the Marianas trench. As homogenization technologies keep "evolving" and higher pressures are achieved, the agreement on how to define "high pressure" vs. "low pressure" will most certainly change too.

Publications

Tailoring the structure and mechanical properties of casein biodegradable films with decanoic acid

Food Hydrocolloids, Taha, Ahmed, Sharma, Deepika, Harte, Federico M., 2026

Instant and physicochemical properties of agglomerated high-pressure jet spray-dried skim milk powder

Journal of Dairy Science, Vyas, Megha, Harte, Federico, 2025

Similar size distributions of casein micelles determined by cryo-electron microscopy and nanoparticle tracking analysis

International Dairy Journal, Mohan, Maneesha S., Loughland, Isabella, Raynes, Jared K., Harte, Federico M., Holt, Carl, 2025

Fabrication and physicomechanical performance of casein-hydroxypropyl methylcellulose nanofibers

Journal of Colloid and Interface Science, Sharma, Deepika, Harte, Federico M., Ziegler, Gregory R., 2025



Formation of casein-based triglyceride amorphous solid dispersions

Food Hydrocolloids, Vyas, Megha U., Harte, Federico M., 2025

Fabrication and physicomechanical performance of κ -carrageenan/casein nanofibers

Food Hydrocolloids, Sharma, Deepika, Ziegler, Gregory Ray, Harte, Federico, 2025

Food Processing by High-Pressure Homogenization, Harte, Federico, Lewis, Grace, 2025

Ethanol-mediated electrospinning of casein-only bead-free nanofibers

Food Hydrocolloids, Deepika, Sharma, Sharma, Deepika, Ziegler, Gregory Ray, Harte, Federico, 2024

The MATH test. A three-phase assay?

FEMS Microbiology Letters, Salas-Tovar, Jesús A., Escobedo-García, Sarai, Olivas, Guadalupe I., Acosta-Muñiz, Carlos H., Harte, Federico, Sepulveda, David R., 2024



Effect of high-pressure jet processing on the structure and physicochemical properties of plant protein isolate aqueous dispersions

Food Hydrocolloids, Oquendo, Liz Astorga, Lewis, Grace, Mahdinia, Ehsan, Harte, Federico, 2023

Milk fatty acid profile from grass feeding strategies on 2 Holstein genotypes: Implications for health and technological properties

JDS Communications, Techeira, N., Keel, K., Garay, A., Harte, F., Mendoza, A., Cartaya, A., Fariña, S., López-Pedemonte, T., 2023



Functionality of glycomacropeptide glycated with lactose and maltodextrin

Journal of Dairy Science, Keel, Karen, Harte, Federico M., Berbejillo, Julio, López-Pedemonte, Tomás, 2022

Effect of mild thermal and pH changes on the sol-gel transition in skim milk

Journal of Dairy Science, Tieu, Stiphany, Harte, Federico, 2022

Ionic strength and buffering capacity of emulsifying salts determine denaturation and gelation temperatures of whey proteins

Journal of Dairy Science, Perez, D., Harte, F., Lopez-Pedemonte, T., 2022



Characterization of ethanol-induced casein micelle dissociation using a continuous protein monitoring unit

Journal of Dairy Science, Lewis, G., Bodinger, L. R., Harte, F. M., 2022

Characterization of high pressure jet-induced fat-protein complexation

Journal of Dairy Science, Lewis, G., Coupland, John, Harte, Federico, 2022

Prevention of low-temperature gelation in milk protein concentrates by calcium-binding salts

Journal of Dairy Science, Goulder, D. M., Harte, F. M., 2022

The effect of high-pressure jet processing on cocoa stability in chocolate milk

Journal of Dairy Science, Roberts, R, Tran, Michele, Coupland, J, Voronin, Grace, Lewis-Voronin, Grace, Roberts, R. F., Tran, Michelle, Lewis-Voronin, Grace, Coupland, J. N., Ziegler, G. R., Harte, F. M., 2021



Differential scanning calorimetry, Voronin, Grace, Harte, Federico, 2021

Tests done at the plant, López-Pedemonte, Tomás, Harte, Federico M., 2021

Microscopy (microstructure of milk constituents and products), Harte, Federico, 2021

Raw Milk: Nature's most perfect food?, Clark, Stephanie, Harte, Federico, 2021

Stability, temperature dependence, and microstructure of high pressure jet-treated dairy foams

Food Hydrocolloids, Voronin, Grace Lewis, Coupland, John, Harte, Federico, 2021



Method-induced variation in the bacterial cell surface hydrophobicity MATH test

Journal of Microbiological Methods, Salas-Tovar, Jesús A., Escobedo-García, Sarai, Olivas, Guadalupe I., Acosta-Muñiz, Carlos H., Harte, Federico, Sepulveda, David R., 2021

High pressure jet spray drying of condensed skim milk results in powders with enhanced interfacial properties

Journal of Food Engineering, Voronin, Grace Lewis, Hettiarachchi, Charith A., Harte, Federico M., 2021

Freezing kinetics and microstructure of ice cream from high-pressure-jet processing of ice cream mix

Journal of Dairy Science, Voronin, G.L., Ning, G, Coupland, John, Roberts, Robert, Harte, F.M., 2021

Differential Scanning Calorimetry, Voronin, Grace, Harte, Federico, 2021

Raw Milk: Nature's Most Perfect Food?, Clark, Stephany, Harte, Federico, 2021

Tests Done at the Plant, Tomas, López-Pedemonte, Harte, Federico, 2021

Assessing constituent volumes and morphology of bovine casein micelles using cryo-electron tomography
Journal of Dairy Science, Hettiarachchi, Charith A., Swulius, Matthew T., Harte, Federico, 2020

Effect of high-pressure-jet processing on the physiochemical properties of low-fat ice cream mix
Journal of Dairy Science, Voronin, G, Roberts, Robert, Felix, Tara L., Coupland, John N., Harte, Federico, 2020

Spray drying of high pressure jet-processed condensed skim milk
Journal of Food Engineering, Hettiarachchi, Charith A., Voronin, Grace L., Harte, Federico M., 2019



Critical phosphate salt concentrations leading to altered micellar casein structures and functional intermediates
Journal of Dairy Science, Saricay, Y., Hettiarachchi, C. A., Culler, M. D., Harte, F. M., 2019



Enhanced foaming and emulsifying properties of high-pressure-jet-processed skim milk
International Dairy Journal, Hettiarachchi, Charith A., Corzo-Martínez, Marta, Mohan, Maneesha S., Harte, Federico M., 2018

The association of lipophilic phospholipids with native bovine casein micelles in skim milk: Effect of lactation stage and casein micelle size
Journal of Dairy Science, Cheema, M, Smith, P. B., Patterson, Andrew, Hristov, A., Harte, F. M., 2018



Effect of high-pressure-jet processing on the viscosity and foaming properties of pasteurized whole milk
Journal of Dairy Science, Tran, M., Roberts, R., Felix, T. L., Harte, F. M., 2018



Effect of ethanol on the solubilization of hydrophobic molecules by sodium caseinate

Food Hydrocolloids, Qu, Yanqi, Harte, Federico M., Elias, Ryan J., Coupland, John N., 2018



Critical synergistic concentration of lecithin phospholipids improves the antimicrobial activity of eugenol against *Escherichia coli*

Applied and Environmental Microbiology, Zhang, Haoshu, Dudley, Edward G., Harte, Federico, 2017

The binding of orally dosed hydrophobic active pharmaceutical ingredients to casein micelles in milk

Journal of Dairy Science, Cheema, M, Hristov, Alexander, Harte, F. M., 2017



The effect of emulsifying salts on the turbidity of a diluted milk system with varying pH and protein concentration

Journal of Dairy Science, Culler, M. D., Saricay, Y., Harte, F. M., 2017



Critical concentration of lecithin enhances the antimicrobial activity of eugenol against *Escherichia coli*

Applied and Environmental Microbiology, Zhang, Haoshu, Dudley, Edward G., Davidson, P. Michael, Harte, Federico, 2017



Choline absorption and evaluation of bioavailability markers when supplementing choline to lactating dairy cows

Journal of Dairy Science, de Veth, M. J., Artegoitia, V. M., Campagna, S. R., Lapierre, H., Harte, F., Girard, C. L., 2016

Chromatographic fractionation and molecular mass characterization of *Cercidium praecox* (Brea) gum

Journal of the Science of Food and Agriculture, Castel, Virginia, Zivanovic, Svetlana, Jurat-Fuentes, Juan L., Santiago, Liliana G., Rubiolo, Amelia C., Carrara, Carlos R., Harte, Federico M., 2016



Solvent-free lipase-catalyzed synthesis of technical-grade sugar esters and evaluation of their physicochemical and bioactive properties

Catalysts, Ye, Ran, Hayes, Douglas G., Burton, Rachel, Liu, Anjun, Harte, Federico M., Wang, Yuemeng, 2016



Initial study on high pressure jet processing using a modified waterjet on physicochemical and rennet coagulation properties of pasteurized skim milk

International Dairy Journal, Mohan, M. S., Ye, R., Harte, F., 2016



Micro- and Nanoparticles for Controlling Microorganisms in Foods, Zhong, Q., Weiss, J., Harte, Federico, Davidson, P., 2016

Food processing by high-pressure homogenization

HIGH PRESSURE PROCESSING OF FOOD: PRINCIPLES, TECHNOLOGY AND APPLICATIONS, Harte, Federico, 2016
