Food Science Graduate Seminar Series Spring 2022

Tuesdays from 3:45– 4:35 PM
7-*week course, session 2*
Stocking Hall
Cornell University

Seminar Chair: Dr. Julie Goddard

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Respect Statement

Diversity in the field of food science – in race, gender, sex, religion, language, ability, veteran status, place of origin, academic specialization, etc. – is an asset to our learning experience. As a result, we hope to provide an inclusive and welcoming space for our speakers to share their expertise. We want to reaffirm our commitment to speaking respectfully and mindfully to members of our Cornell community as well as our guests and note that individuals identifying with historically minoritized groups should not be expected to describe or provide perspective on these groups unless they themselves volunteer to relate their experiences. We value the scholarship of each of our speakers, and we invite our speakers in order to hear their unique contributions to the field.

Date	Speaker	Seminar Title
Mar 22	**Nicole Martin**, PhD Associate Director, Milk Quality Improvement Program Cornell University	"Cow to Carton – The (R)evolution of Dairy Foods Quality"
Mar 29	**Joseph Dumpler**, PhD Postdoctoral Researcher, Cornell University	"Microwave Vacuum Drying – Opportunities and challenges with a special reference to dairy products"
Apr 5	**Spring Break**	**Spring Break**
Apr 12	**Viviane Romani**, PhD Professor State University of Midwest, UNICENTRO, Brazil	"Food packaging technologies: an exploration of raw materials, development and application"
Apr 19	**Paola Appendini**, PhD Principal Packaging Engineer Mars Inc.	"Sustainable Packaging and the Food Industry"
Apr 26	**Apratim Jash** PhD Candidate, Cornell University	"Heat-stable liposomes made by using venturi-based rapid expansion of a supercritical solution (Vent-RESS) for simultaneous target-specific delivery of hydrophilic and lipophilic bioactives: Synthesis and characterization"
	Zhixin Wang PhD Candidate, Cornell University	"Biocatalytic Approaches to Valorization of Food and Agriculture Waste Streams"
May 3	**Martin Liu** PhD Candidate, Cornell University	"Improving Hemp Seed Protein Isolate by Germination and Ultrafiltration"
	Samantha Lau PhD Candidate, Cornell University	"Reducing Milk Waste Through Modelling and Interventions"
May 10	**Maria Gallo**, PhD Chancellor University of Wisconsin-River Falls	"The Stress Test: The Story of Food During COVID-19 and Beyond"

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Nicole Martin

Dr. Nicole Martin is the Associate Director of the Milk Quality Improvement Program (MQIP) in the Department of Food Science at Cornell University. Nicole grew up in the beautiful Southern Tier of New York State where she began a life-long love of dairy by working on a local dairy farm. She received her BS ('06), MS ('11) and PhD ('18) degrees in Food Science from Cornell University with minors in microbiology and animal science.
In her role, Nicole oversees the farm to consumer dairy microbiology research conducted in the MQIP and works closely with dairy industry stakeholders including producers and processors. Nicole's research interests take a holistic approach to dairy product quality and safety, with the mindset that providing consumers with high quality dairy products must start at the farm and be a priority throughout processing, distribution and retail. In particular, Nicole is interested in the transmission of dairy associated spoilage organisms from environmental niches into raw and processed dairy products, strategies to reduce or eliminate this transmission, the implications of spoilage organisms on finished product and methods of detection.
Nicole is a member of the American Dairy Science Association (ADSA) and was awarded the ADSA Foundation Scholar Award in Dairy Foods in 2019. Nicole currently serves as the vice-chair of the ADSA Dairy Foods Division and is a section editor for the Journal of Dairy Science. She is also a member of the International Association of Food Protection (IAFP) and the New York State Association of Food Protection (NYSAFP). Nicole is a regular contributor to the Cornell Dairy Foods Extension programs, teaching at courses such as Fluid Milk Processing for Quality and Safety, The Science of Yogurt and Fermented Dairy Products and Membrane and Evaporation and Drying Technology.

"Cow to Carton – The (R)evolution of Dairy Foods Quality"

Research on dairy product quality dates back over a century. In the years since the foundational work of early dairy microbiologists, whose ranks included W.A. Stocking, the namesake of our own Stocking Hall, our understanding of dairy product quality has evolved dramatically. Over the last twenty years, research in the Milk Quality Improvement Program has been instrumental in advancing the understanding of i) the impact of microbial populations in raw milk on pasteurized dairy product quality and, ii) the role of indicator organisms for detecting post-pasteurization contamination of dairy foods. To achieve these advances, our research has focused on i) sources of microbial contaminants at the farm and processing levels, ii) implications of microbial contaminants on processed dairy product quality, and iii) method development for detection, enumeration and tracking of microbial contaminants in contemporary dairy products. Now, more than ever, our research indicates that a comprehensive approach to dairy product quality is needed throughout the dairy supply chain to ensure the manufacture of high-quality dairy products.

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Joseph Dumpler

Joseph Dumpler studied Food and Bioprocess Engineering at the Technical University of Munich (TUM), Weihenstephan, in Germany. He received his PhD in Dairy Science and Technology with special focus on UHT treatment of concentrated skim milk. For his work on reaction kinetics of heat-induced aggregation of proteins in concentrated skim milk he was awarded the J.T.M. Wouters Young Scientist Award, the Julius Maggi Research Award (2018), and the award for the best PhD thesis granted by the Association of Dairy, Food and Biotechnologists at TUM.
Currently, he is a postdoctoral associate in the Department of Food Science at Cornell University, working on vacuum microwave drying of dairy products such as milk, cheese, and cream.

Microwave Vacuum Drying – Opportunities and challenges with a special reference to dairy products

Microwave Vacuum Drying (MVD) has evolved as an alternative to traditional drying methods. MVD is a relatively gentle drying process that leads to low Maillard browning, heat damage, or off-flavors in the dried product. However, the interaction of multiple processing parameters (microwave power, vacuum level, dielectric properties, shape, size, product structure, and texture) have contributed to the limited application of this promising and versatile drying technology in the food and dairy industry to date. To explore its potential for dairy applications, the use of VMD (nutraREVTM, Enwave, BC, Canada) for drying concentrated skim milk, cheese, and heavy cream was investigated.

Concentrated skim milk was obtained by reconstituting non-fat dried milk to 37.5% total solids. A custom factorial design was used to optimize drying parameters with respect to product properties and drying efficiency. Drying conditions that maximized yield and minimized drying time while maintaining a good product quality were identified as 2 mm layer thickness, 60 mbar, and specific microwave power input of 1.29 W g-1. Regression analysis indicated that layer thickness was the most important parameter ($P < 0.01$) to limit the product temperature to below 55 °C in the final drying stage. This allowed good solubility indices of the powder (< 0.3 mL) to be achieved. Specific energy input and vacuum level did not affect solubility ($P > 0.1$), but significantly affected foaming, as did layer thickness ($P \ll 0.01$).

Samples of part-skim Mozzarella cheese with an initial moisture content of ~50% w.b. were cut into 3/8” cubes and microwave vacuum dried. In each trial, the cheese was dried for 20 min at 1.5 W g-1

and 30 min at 1 W g-1 to reduce temperature gain. After MVD, all cheese samples puffed into porous spheres, with a final moisture content ranging from 5 - 9% w.b.. The pressure in the microwave vacuum chamber had a significant effect ($p < 0.05$) on volumetric expansion, which varied from 75 - 300%, with maximum expansion occurring at 8 kPa. Pressure also had a significant effect ($p < 0.05$) on the texture of the final product and showed an inverse relationship to that of the volumetric expansion because expansion defines the internal structure.

Heavy cream was adjusted to 30% fat, left unhomogenized and homogenized at 65 °C at 1000 psi and in two passes at 1000 psi and 500 psi. The cream was microwave vacuum dried at 2 and 3 mm layer thickness, 1.5 W g-1, and 27 – 37 mbar or 60 – 67 mbar. A lower pressure and thicker layer resulted in faster drying while overall the drying conditions had a small effect on reconstitution as compared to the pretreatment and the reconstitution conditions. Moisture content, color, solvent extraction, and SEM were used to characterize dehydrated heavy cream. Particle size, color, whipping properties, microscopy, and confocal microscopy were used to characterize the reconstituted dehydrated heavy cream. Homogenization conditions significantly affected dehydrated cream structure, free fat content ($P < 0.05$), fat globule size and cream microstructure after reconstitution as well as whipped cream properties.

These findings can be useful for dairy processors interested in adopting MVD as a versatile drying process for long life dairy product innovations with novel functionalities and structures.

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Viviane Romani

Dr. Viviane Romani is a Professor of Food Engineering at the State University of Midwest, UNICENTRO, Brazil. She obtained her undergraduate degree in Food Engineering (2012) from the State University of Santa Catarina (2012), Brazil. She received her master's (2015) and Ph.D. (2019) degrees in Food Science and Engineering from the Federal University of Rio Grande, Brazil. During her Ph.D. program, she was visiting student in the US where she developed projects at Massachusetts Institute of Technology (2015-2016) and Cornell University (2018-2019). At Cornell University she was a Fulbright Scholar under the supervision of Prof. Julie Goddard.
Since her master's she is dedicated to improving food packaging sustainability and reducing food waste and environmental burden through the development of biodegradable and active materials.

Food packaging technologies: an exploration of raw materials, development and application

Packaging has a crucial role in preserving quality and safety of food products. However, the growing utilization of synthetic materials, especially plastics, has resulted in a significant environmental pollution. Biodegradable resources, such as polysaccharides, proteins and lipids, are being explored to produce alternatives to synthetic plastics. They can be obtained by polymerization in chemical processes, from microbial fermentation processes or from agriculture and food industries. Since most of these biodegradable materials generally lack the barrier and mechanical properties required for food packaging, the application of strategies (e.g. cold plasma and UV radiation, incorporation of additives, and blending) to improve their performance is under study. Besides biodegradable materials, packaging technologies to prevent food degradation reactions (active packaging) and/or to inform consumers about products freshness (intelligent packaging) have been explored too. These new materials have, in addition to the traditional packaging functions, the capacity to prolong the shelf life of products and ensure the safety of consumers. Various molecules, production processes and applications were already explored while developing new technologies for food packaging. This seminar will present some raw materials from agriculture, functional substances and technologies used in the production of biodegradable and active packaging for food.

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Paola Appendini

Paola has worked with Mars as a Global Packaging Principal Engineer since April 2018. Mars is a global, family-owned business that produces a diverse portfolio of confectionery, food, and pet care products. Her areas of focus include research on Reuse Models for packaging elimination, developing Packaging "fit" for digital demand and new technologies exploration. She is also responsible for strategy development and building capabilities for the Mars Wrigley Global Packaging organization.

Immediately prior to joining Mars, Paola worked as a Global Nutrition Packaging Innovation Manager with PepsiCo for two and a half years and she spent an additional fourteen years as an Associate Principal Engineer with The Kraft Company. In these roles, Paola launched to market new product packages for several food categories and lead sustainable packaging platforms. She holds 6 design and utility patents.

Paola earned both a Master of Science and a Ph.D. in Food Science from Cornell University. She has published several papers on antimicrobial & active food packaging. Paola has also been active in the past with organizations like Keep Chicago Beautiful, which promote recycling, composting, and reuse.

Sustainable Packaging and the Food Industry

This talk will cover what are the typical materials used in the Food Industry, the challenges these materials represent for the environment, and what companies are doing to remediate problems related to single-use plastics.

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Apratim Jash

Apratim Jash is a PhD candidate in the Department of Food Science & Technology at Cornell University, with major in Food Engineering and minor in Chemical Engineering and Food Processing Waste Technology. He is pursuing his research under the supervision of Dr. Syed S.H. Rizvi to investigate the feasibility of using green processing for site-specific oral delivery of bioactives. He received his master's degree from University of Guelph, Canada. His research interests include liposomal microencapsulation and controlled delivery applications, supercritical fluid engineering, polymer processing and engineering.

Heat-stable liposomes made by using venturi-based rapid expansion of a supercritical solution (Vent-RESS) for simultaneous target-specific delivery of hydrophilic and lipophilic bioactives: Synthesis and characterization.

Liposomes have been extensively used in the pharmaceutical and cosmetic industries as an effective way of delivering bioactive compounds and more recently in the food industry to explore their ability to deliver flavors, nutrients, and antimicrobial compounds. The major drawbacks for the conventional liposome production methods include the use of toxic organic solvents and the instability of synthesized liposomes at elevated temperatures (> 60 °C) which limits their use in food systems. Inspiried by the heat stability of milk fat globules, heat stable multi-vitamin loaded liposomes were successfully fabricated from a cocktail of supercritically extracted milk fat globule membrane phospholipids. Liposomes were synthesized using a venturi-based system which involves rapid expansion of a supercritical solution (Vent-RESS), a green, novel, and environmentally benign technology developed in our lab. Synthesized liposomes were surface modified with a pH-responsive polymeric coating for simultaneous site-specific delivery of both the hydrophilic and lipophilic bioactives. The polymer coating enabled the protection of the encapsulated payload against the deleterious gastric pH and subsequent delivery in the in-vitro simulated intestinal environment. This method offers an attractive approach to fabricating heat-stable liposomal vehicles for site-specific delivery of bioactive compounds with excellent potential for scale-up and use in the food industry.

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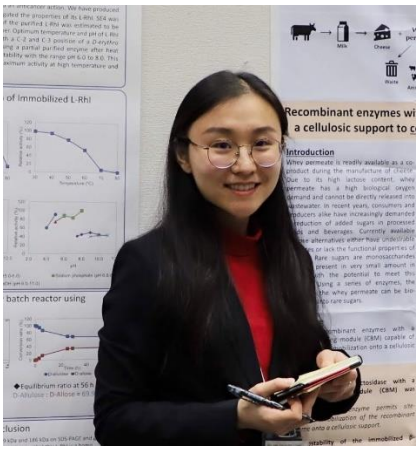
Zhixin Wang



Zhixin is a PhD candidate in Dr. Goddard's Lab studying biocatalytic approaches to valorize food and agricultural waste streams. She grew up in Montreal, Canada and received her bachelor's degree in Food Science and Technology from McGill University where she was introduced to research under Dr. Benjamin Simpson's lab and worked on developing a biodegradable plastic film from crustacean waste such as lobster shells. Prior to pursuing her PhD, she completed a Masters' degree and worked as a laboratory intern at the Kraft Heinz Company. Zhixin has a passion for food science and sustainability. She is excited to put her acquired knowledge from graduate school to use, whether it is in the industrial sector or in academia in the future.

Biocatalytic Approaches to Valorization of Food and Agriculture Waste Streams

The high lipid, protein and sugar content in agricultural waste streams are ideal for biochemical valorization into value added products. Innovative research on improving the stability and recovery of biocatalysts in extreme environments, typical of waste streams, is essential for their translation in bioprocessing. We explore biocatalytic valorization of lactose in whey permeate to rare sugars.

Rare sugars are monosaccharides with near-equivalent sweetness intensity as sucrose, but a fraction of the caloric density and minimal adverse health impacts. Present in very small amounts in nature, an opportunity remains to produce these natural sweeteners from agricultural 'waste' sugars such as lactose. Tagatose and allulose, are of particular interest as they have been granted GRAS status by the USDA.

We successfully have bioengineered a recombinant fusion protein, lactase, that can effectively self-immobilize onto cellulose in less than 2 hours and confirmed that the addition of a carbohydrate binding module (CBM) does not alter the optimum reaction conditions of the native enzyme. The protecting effect of sugars on enzymes to improve their catalytic activity was studied.

At 50 ˚C, lactase was inactivated within 2 hours, whereas lactase in the same buffer supplemented with 40% (% w/w) trehalose, glucose and sucrose enabled retention of 91 %, 37 % and 79 % of the original enzyme activity, respectively, after 25 hours exposure, an important consideration for higher temperature bioprocessing. To optimize the recombinant enzyme's performance, both rigid

and flexible linkers between the enzyme and the CBM will be studied. Improving the stability of enzymes for the valorization of whey permeate waste streams into rare sugars will promote economic and environmental sustainability of global dairy processing.

Innovative research to improve or supplement synthetic biology and biocatalyst is crucial in valorizing waste streams into value added products and in reducing the environmental burden of food manufacturing.

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Martin Liu

Martin Liu is a 4th year PhD candidate in the Abbaspourrad Lab. After completing an internship at Eat Just and receiving his Bachelor's degree in Chemistry from UC Berkeley, he joined the Department of Food Science in 2018. The research he is presenting today is funded in part by the Good Food Institute, and in the future, he hopes to work at the intersection of the food system, sustainable business, and public policy. In his spare time, Martin interns at the Cornell Center for Technology Licensing, stays active in the food science community, and looks for pockets of sunshine to bathe in.

Improving Hemp Seed Protein Isolate by Germination and Ultrafiltration

Plant protein-based foods are gaining popularity, so producing high quality plant protein ingredients is necessary to meet consumer demand. By leveraging the millennia-old process of seed germination with modern filtration techniques, plant proteins can be modified for improved functional properties. In this case study, hemp seeds are taken through this novel processing method to result in protein isolates with improved solubility, increased colloidal properties, and more suitable functionalities for utilization in plant-based foods.

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Samantha Lau

Samantha Lau was born and raised in New York City. She started at Wesleyan University in Chemistry and transferred to Cornell University to finish her undergraduate degree in Food Science.

She stayed at Cornell to pursue her PhD under the direction of Dr. Martin Wiedmann. Following graduation, Sam will work in industry.

Reducing Milk Waste Through Modelling and Interventions

In the US, dairy products are among the top three food groups representing the largest share of the total volume of food lost or wasted, with fluid milk responsible for approximately 65% of food wasted in volume attributed to dairy products. The value of fluid milk loss in the US is estimated to be $6.4 billion per year. Globally, fluid milk production, processing, and transport is estimated to be responsible for 2.4 kg CO2e per kg of milk. Thus, reducing the volume of fluid milk wasted represents an opportunity with potential for economic and environmental impact.

One solution to reducing the volume of fluid milk is through the use of modelling and implementing interventions. A Monte Carlo simulation model was developed to predict spoilage due to post-pasteurization contamination and to predict the impact of different intervention strategies. The potential economic and environmental implications of the intervention strategies were evaluated to determine the most cost-effective strategy for processing plants to achieve shelf-life improvements.

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Maria Gallo

Dr. Maria Gallo was named the 20th chancellor of the University of Wisconsin-River Falls (UWRF) in May 2021 and began as chancellor on July 15, 2021. Gallo is a Fulbright Scholar and a fellow of the American Society of Agronomy and the Crop Science Society of America. Before joining UWRF, she served as president of Delaware Valley University for five years.

Earlier, Gallo was dean of the College of Tropical Agriculture and Human Resources at the University of Hawaii (UH) at Mānoa as well as director of research and director of cooperative extension. Prior to UH, Dr. Gallo was professor and chair of the Agronomy Department at the University of Florida.

Dr. Gallo is a plant molecular biologist and an author on 82 research articles and nine book chapters. She was recently featured in the book, “Rethink: Smashing the Myths of Women in Business” by Dr. Andi Simon.

A native New Yorker, Dr. Gallo earned her B.S. in agronomy from Cornell University, and both her M.S. in crop science and Ph.D. in genetics from North Carolina State University. She currently serves as the vice chair of the Women's Network Executive Council of the American Council on Education.

The Stress Test: The Story of Food During COVID-19 and Beyond

Our food system has been under enormous pressure during the pandemic. Challenges faced are numerous and include keeping essential workers safe, maintaining supply and distribution chains open, and battling an almost constant barrage of misinformation. Lessons from the pandemic will be highlighted, as well as the tools and techniques that can be used to help make the “new normal” a safer and healthier one

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