Northeast Dairy Center

What do we do?

- Conduct fluid milk and dairy ingredient research
- Provide applications and technical support for the improvements in milk powder quality
- Help establish the next generation of dairy ingredients

https://blogs.cornell.edu/nedfrc/
Northeast Dairy Center Projects

Impact and success stories

**Cottage cheese**: Use of CO\(_2\) improved taste and extended shelf life from 21 days to 50 - 90 days → increased sales and consumption in NY State & US

**Ultrafiltered milk & the “milk refinery”**
Impact and success stories

Extended shelf life milk Use of microfiltration and bactofugation as nonthermal alternatives for bacterial removal (Barbano and Moraru projects)

The Cornell-Tetra Pak webinar on ESL in September 2018 had over 500 participants, mostly from industry
Northeast Dairy Center Projects

Technology transfer success stories (Dave Barbano)

Oatka

Cayuga Milk Ingredients
Northeast Dairy Center Projects

Continuing Projects

Project 1: Alireza Abbaspourrad - Conversion of lactose to GOS
Project 2: Syed Rizvi – Functionalization of Whey protein
Project 3: Samuel Alcaine – Elasto-sense measurement of texture
Project 4: Samuel Alcaine – Upcycling of acid whey
Project 5: Dave Barbano/ Maryanne Drake (NC State)/ Grant – Sources of autoxidized off flavor in milk
Project 6: Dave Barbano - Center technology transfer (ongoing)
New Projects (2019)

Project 7: Alireza Abbaspourrad - Nutritious Spreads and Fillings using Milk Ingredients

Project 8: Carmen Moraru - Vacuum Microwave drying of milk and milk proteins

Project 9: Samuel Alcaine - Improving UHT milk shelf-life

Project 10: Dave Barbano - Rapid method to determine raw milk protein and fat quality
Update on research projects: Moraru group
Use of novel technologies to improve dairy foods quality & shelf life

- Focus area: milk powder
- Strategy:
  - *Past work*: Microbial removal to improve quality and shelf life of milk and dairy products
    - Microfiltration, bactofugation
  - *Current work*: Nonthermal concentration of milk (DMI funding)
    - Forward osmosis or reverse osmosis + forward osmosis
  - *Future work (new project)*: Vacuum microwave drying of nonthermally concentrated milk
**Past work:** Effectiveness of different processing methods for bacterial reduction

<table>
<thead>
<tr>
<th>Process</th>
<th>Vegetative bacteria reduction (Log CFU)</th>
<th>Spore reduction (Log CFU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microfiltration 1.2 µm, 4°C*</td>
<td>~5.4</td>
<td>4.5 – 6.5 (depending on spore size)</td>
</tr>
<tr>
<td>Microfiltration 1.4 µm, 4°C*</td>
<td>~3.4</td>
<td>2 – 6.5 (depending on spore size)</td>
</tr>
<tr>
<td>Bactofugation, 60°C **</td>
<td>~1.8</td>
<td>~ 0.8</td>
</tr>
<tr>
<td>“Regular” centrifugal separation, 60°C**</td>
<td>~1</td>
<td>~ 0.4</td>
</tr>
<tr>
<td>HTST Pasteurization*</td>
<td>~ 2.5</td>
<td>-</td>
</tr>
</tbody>
</table>

* Inoculated study, high initial bacterial/spore count
** Very low initial spore counts, removal may be higher if initial concentration higher
Ongoing work: FO concentration of milk (DMI project)

- Can reach very high concentration factors
- Product concentration comparable to thermal concentration, but at low temperatures (4-15C tested)
  - Product quality maintained
  - No microbiological issues
Next step:
Microwave Vacuum Drying (MVD)

Why MVD?

- MVD uses microwave energy under vacuum to efficiently remove moisture from foods, at low temperatures.
  - Microwaves $\rightarrow$ internal heat generation $\rightarrow$ water vapors, which are then removed using vacuum

- Advantages of MVD:
  - Product quality comparable to freeze drying, but in much shorter time
  - Less heat damage compared to air drying
  - Oxidation is prevented (it operates under vacuum)
  - Potential for microbial reduction in the dried samples
  - Potential for improved powder storage and reconstitution
Research Objectives

- **Objective 1 (year 1):** Identify the optimal parameters and processing conditions for the Vacuum Microwave Drying of nonthermally concentrated skim milk.

- **Objective 2 (year 1):** Evaluate the quality, functionality and storage behavior of the powders.

- **Progress to date:**
  - Equipment in place
  - Preliminary tests performed
  - Hired postdoc with prior experience
Anticipated benefits for the Dairy Industry

- Powders of superior quality compared to powders obtained using traditional thermal concentration and spray drying.
- Overall process less energy intensive than traditional thermal concentration + drying

➔ Competitive advantage for the NY & US Dairy Industry
THANK YOU!

Questions?
Publications

Refereed papers


- Griep, Emily and Moraru, C.I. Removal of bacterial spores from milk by centrifugation: impact of temperature and centrifugal force. Manuscript ready for submission

- Griep, Emily and Moraru, C.I. Short communication: Effectiveness of bactofugation for the removal of bacterial spores and vegetative cells from milk. Manuscript ready for submission

- Griep, Emily and Moraru, C.I. Extending the microbial shelf-life of skim milk using 1.2 µm pore size cold microfiltration. Manuscript ready for submission
Symposia, Webinars

- Co-developer and speaker at the TetraPak – Cornell Webinar: Extended Shelf Life: Adding Value to Pasteurized Milk. September 18, 2018. 60 minutes, over 500 registered participants. Link: https://www.tetrapak.com/about/events/webinar-esl-milk-2018

Conference Presentations

- Shaun Sim, Linran Wang, Lee Cadesky, Mukund V. Karwe and Carmen I. Moraru. 2018. High Pressure Structure Engineering of High Concentration Food Protein Systems. IUFoST Congress, Mumbai, India, October 2018 (poster presentation)


- Shaun Sim, Linran Wang, Lee Cadesky, Mukund V. Karwe, and Carmen I. Moraru. 2018. High pressure structure engineering of high concentration food protein systems. IUFoST Congress, Mumbai, India, October 2018 (poster presentation)


Invited Presentations


- Carmen I. Moraru. 2018. Membrane Separation Research at Cornell University. Department of Food and Biomaterials Processing, TU München, Weihenstephan, Freising, Germany, October 30, 2018

- Carmen I. Moraru. 2018. Food Safety Engineering: How we use engineering approaches to improve food safety. Department of Process Systems Engineering, TU München, Weihenstephan, Freising, Germany, November 5, 2018

- Carmen I. Moraru. 2018. Forward Osmosis Research at Cornell University. Nestle Product Technology Center - Coffee Department, Orbe, Switzerland, November 8, 2018


- Moraru C.I. 2018. Use of forward osmosis as a non-thermal method of concentration for the manufacture of high quality milk concentrates and powders. Annual Meeting of ADSA. Nashville, TN. June 2018
