Initiatives in the dairy industry to reduce energy and utilize byproducts creatively

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DISCLAIMER

The use of brands and images of branded products is intended only to provide examples of concepts being discussed, and does not imply endorsement of any brand or product.
Agenda

I. Who we are: Dairy Management Inc. (DMI) & National Dairy Council (NDC)

II. Dairy’s strong sustainability story

III. NDC-Product Research’s focus on sustainability
   I. Co-products utilization
   II. Smarter manufacturing technologies

IV. Takeaways
Dairy Management Inc.™ is the management organization that builds trust and demand for dairy products funded by America’s nearly 41,000 dairy farmers, as well as dairy importers.
NDC Product Research program objectives

Goal:
Catalyze dairy industry innovation through research to fuel new opportunities for product and ingredient usages which build demand and trust.

- Exports
- Dairy Foods for Health
- Consumer-Focused Benefits
- Sustainability
- Food Safety
- Applications, Education and Training
Dairy’s Strong Sustainability Story
Key Figures
Dairy community- Good stewards of the environment!

• Dairy in the U.S. contributes **only 2% of GHG**
  • Total agriculture – 9%

• Dairy farmers today use **90% less land, 63% less carbon/GHG and 65% less water** to make a gallon of milk than in 1944

• U.S. dairy community has **committed towards 25% reduction** in GHG for fluid milk by 2020 from 2007

https://www.usdairy.com/sustainability/commitment
Opportunities for innovation
Lets look at the dairy value chain……

Agricultural Production
- Feed Production
- Milk Production
- Feed production
- Manure
- Enteric Methane

Processing, Transport, Packaging and Distribution
- Milk transportation
- Fluid milk and dairy products
- Ingredients
- Finished product transportation
- Co-products
- Packaging
- Fuel
- Energy
- Further processing of co-products

Retail and Consumption
- Retailers
- Food Service
- Consumers
- Fuel
- Food Loss/Shrinkage
- Food Waste
Advance **sustainability through product and process research**

- To ensure **every drop of dairy is utilized**
  - Co-Product Utilization

- To deliver **smarter manufacturing technologies**
  - Increased energy efficiency

**Processing, Transport, Packaging and Distribution**

- Milk transportation
- Fluid milk and dairy products
- Ingredients
- Finished product transportation

**Co-products**

- Packaging
- Fuel
- Energy
- Further processing of co-products
Focus 1
Co-product utilization
Using every drop of milk: Co-Products Utilization

In the past: Whey was an environmental burden and a lost opportunity

- Lost calories
- Lost nutrients
  - 20% of the milk protein
  - 95% of carbohydrate in milk
- ~50% of carbon footprint of making cheese
Today: whey protein is a core product

Whey protein (MT)

High quality protein back in diet


Landfill

Improved Separation Technology

Improved Flavor

Improved Performance for Applications

Improved Processing

Education and Technical Support
Major milk and whey co-products affecting the dairy industry today

- Milk
  - Cheese
  - Whey
  - Whey Proteins
    - Whey Permeate
    - Whey Protein phospholipid concentrate
  - Lactose
  - Delactosed permeate
Major milk and whey co-products affecting the dairy industry today

- Milk Proteins
  - Milk permeate
    - Lactose
    - Delactosed Permeate
Major milk and whey co-products affecting the dairy industry today

Typical Composition (% on dry basis)

Whey Permeate | Milk Permeate | Whey Protein Phospholipid Concentrate
--- | --- | ---
Lactose | Lactose | Lactose
Ash | Ash | Ash
Fat | Fat | Fat
Protein | Protein | Protein

Center for Dairy Research, WI
Co-products Research - Why?

2017 Milk Solids Utilization Map (Est.)
(Thousand Pounds of Milk Solids)

- Raw Milk: 27,033,000
- Cheese/Whey: 12,815,000
  - Cheese: 7,113,000
  - Whey Prod.: 3,888,000
  - Other (b): 1,814,000
- Frozen: 1,333,000
- Cultured: 1,166,000
- Fluid: 5,395,000
- Other (a): 1,350,000
- Powder/Butter: 4,964,000
- Butter: 1,518,000
- Dry Milk: 2,625,000
- Cond. Milk: 677,000
- Buttermilk: 144,000

- Dry Whey: 996,000
- Lactose: 1,079,000
- Whey Perm.: 1,056,000
- Whey Prot.: 589,000
- Mod. Whey: 58,000
- Cond. Whey: 110,000

- WPC 35: 173,000
- WPC 80: 292,000
- WPI: 112,000
- Other: 12,000

- NFDM: 1,788,000
- SMP: 513,000
- WMP: 121,000
- MPC/MPI: 135,000
- Milk Perm.: 68,000
- Sweetened: 70,000
- Unsweetened: 490,000
- Canned: 117,000
- Cond. BM: 34,000
- BM Powder: 110,000

(a) Includes milk used on the farm, plant and shipping losses, anhydrous milkfat, butter oil, acid whey and other miscellaneous products
(b) Includes delactosed permeate (DLP), unprocessed whey and permeate

ADPI, 2017 Dairy Products Utilization and Production Trends
Co-products Research - Why?

2017 Milk Solids Utilization Map (Est.)
(Thousand Pounds of Milk Solids)

Whey Permeate
1.06 Billion lbs

(a) Includes milk used on the farm, plant and shipping losses, anhydrous milkfat, butter oil, acid whey and other miscellaneous products
(b) Includes delactosed permeate (DLP), unprocessed whey and permeate
Co-products Research - Why?

2017 Milk Solids Utilization Map (Est.)
(Thousand Pounds of Milk Solids)

Other 1.8 Billion lbs
- Lost during production (drain)
- Not collected??

ADPI, 2017 Dairy Products Utilization and Production Trends
Co-products Research - Why?

<table>
<thead>
<tr>
<th>Total Yogurt</th>
<th>Greek</th>
<th>Non-Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,838,825,893</td>
<td>1,194,420,441 (42.1% vol. share)</td>
<td>1,622,722,124 (57.2% vol. share)</td>
</tr>
</tbody>
</table>

Source: IRI DMI Custom Milk Database, 2017, All Volumes Listed in Pints

Liquid Greek Yogurt Whey ~ 3.7 Billion lbs*

- ~ 222 MM lbs Total Solids
- ~ 148 MM lbs of Lactose
- ~ 26 MM lbs of Dairy Minerals

*Assuming 90% strained yogurt.
2.7 lbs of acid whey produced for every lb of Greek yogurt.
6% TS.
4% Lactose.
0.7% Minerals

Current NDC Focus: Co-products

**Goal:**
Improve quality and performance, and increase utilization of co-products

**STRATEGIES**
- Create New Opportunities
- Enhance capability

**TACTICS**
- Create and expand applications for co-products
- Manufacture co-products on a competitive cost
- Improve consistency and quality through process improvements
- Develop cost effective technologies (physical, chemical, enzymatic, microbial etc.) to mine value-added ingredients
- Explore new ways to extract dairy ingredients / fractions such as phospholipids and minerals.
The Co-products Opportunity – Permeate Case Study

For illustrative purposes only
The Co-products Opportunity – Permeate Case Study

Value Added Product / Derivatives

Animal feed

Bakery

Current

New

For illustrative purposes only
The Co-products Opportunity –Permeate Case Study

Value Added Product / Derivatives

Current

New

Nutrition and Health

Hydration solution

Enhanced Na reduction

Na reduction

Sweetener solutions

Animal feed

Bakery

For illustrative purposes only
The Co-products Opportunity – Permeate Case Study

- Nutrition and Health
  - Hydration solution
  - Enhanced Na reduction
- Sweetener solutions
- Na reduction
- Animal feed
- Bakery
- GOS
- Biodegradable polymers
- Dairy Minerals

For illustrative purposes only
Current NDC funded projects

1. Permeates: Enhanced Sodium Reduction – NCSU and SDSU
2. New Applications for Permeates, WPPC, DLP – WI CDR
3. Permeate for low sodium mozz – Minnesota
4. Permeate/Acid whey to sweeten milks and yogurts – NCSU, WI CDR
Current NDC funded projects

Value added products from co-products
5. Novel sweeteners – Cornell, SDSU
6. GOS – Wisconsin
7. Phospholipids – WI CDR, ISU
8. Minerals – WI CDR
“Converting waste streams to revenue streams!”

Enfamil® Enspire™
Milk-based powder with iron with two new ingredients: MFGM to foster cognitive development and lactoferrin to support immune health.

Last Updated: Friday, October 27, 2017

Composition

Ingredients: Nonfat milk, lactose, vegetable oil (palm olein, coconut, soy and high oleic sunflower oils), whey protein-lipid concentrate® (milk), whey protein concentrate and less than 2% lactoferrin, galactooligosaccharides#, polydextrose®, Mortierella alpina oil®, Cryptocodinium cohnii oil†, potassium citrate, calcium carbonate, calcium phosphate, sodium chloride, potassium chloride, ferrous sulfate, magnesium oxide, zinc sulfate, cupric sulfate, manganese sulfate, potassium iodide, sodium selenite, soy lecithin, choline chloride, ascorbic acid, niacinamide, calcium pantothenate, riboflavin, thiamin hydrochloride, vitamin D₃, vitamin B₁₂, hydrochloric acid, vitamin K₃, biotin, vitamin B₁₃, inositol, vitamin E acetate, vitamin A palmitate, nucleotides (cytidine 5'-monophosphate, disodium uridine 5'-monophosphate, adenosine 5'-monophosphate, disodium guanosine 5'-monophosphate), taurine, L-carnitine.

# A type of prebiotic.


Whey Permeate May Substitute for Salty Flavor

May 12, 2011

Dairy specialist Proliant Dairy Inc. (Ankeny, IA) is promoting its VersiLac whey permeate as a solution for reducing sodium levels in finished products. The company says research has shown that VersiLac enhances salty perception and may allow for reduction of added salt between 25 to 100%. The company says the ingredient so far has been used to reduce salt in products such as Alfredo sauce, caramel, cookies, dips, soups, pie crust, pizza crust, and potato chips.

http://www.nutritionaloutlook.com/article/whey-permeate-may-substitute-salty-flavor

https://www.blackcow.co.uk/

https://www.newyorkupstate.com/breweries/2018/04/beer_made_from_milk_cornell_researcher_finds_a_whey_to_brew_it.html

http://www.nutritionaloutlook.com/article/whey-permeate-may-substitute-salty-flavor
Focus 2
Smarter manufacturing technologies
Driving sustainability through investing in smarter manufacturing technologies

- Next gen filtration – charged membranes, Wisconsin
- Next gen concentration – forward osmosis, Cornell
- High solids drying, SDSU
- Concentrates vs dried ingredients, SDSU

Kulozik, U.,
Summary

- The U.S. dairy community has always been good stewards of the environment and continue to show a strong commitment towards environmental sustainability.

- With an increase in the demand for higher-protein dairy ingredients as well as popularization of dairy products such as Greek yogurt, there is a significant amount of co-products produced that are underutilized:
  - Lost nutrients
  - Economic and environmental impact
  - Reduced competitiveness of the U.S. dairy industry

- The US dairy industry is committed in it’s continued focus on improving the post farm-gate sustainability by investing in co-products utilization and smarter manufacturing technologies.
Thank you!
Balance between dimensions of sustainability critical to benefit people, animals and the planet

Dairy’s daily contribution to the average American diet:

- 56% Vitamin D
- 54% Calcium
- 29% Vitamin A
- 28% Phosphorus
- 27% Vitamin B12
- 24% Riboflavin
- 18% Protein
- 17% Zinc
- 14% Potassium


National Dairy Council. NHANES 2011-2014 - Table 1, Americans 2+ Years of Age (https://www.usdairy.com/science-and-research/dairys-role-in-the-diet)