Application of Whey Protein for Meat and Poultry Industry

Mr. Jimmy Larsen

Arla Foods Ingredient, Denamrk
Business Unit Functional Milk Proteins

Generate know-how
- Functionality
  - whey protein concentrates
  - milk proteins in general
- Technology
  - specific application areas in the international dairy industry

Customer Service
- Technical solutions today
- Ideas for new product generations (the day after tomorrow)
- Establish close cooperation (confidential agreements possible)

Nutritional aspects
- Fat free
- Protein balanced
- Health
- Low carb (Atkins)
- Weight Management
- Pro & Prebiotic

Concept Development

Consumer Demands

Recipe
- Milk protein functionality

Production technology
- Process conditions

Marketing
- Consumer needs

Product
- Competitive advantage
Trouble Shooting
- Immediate technical advice (24/7 service)
- Technician available within 48h
- Experience exchange
- Culture
- Maturizers
- Process preparation
- Equipment

Pilot Plant
- Available for customer trials all year round

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Close Cooperation
- Individual developments
- Exclusivity
- Long-term relation
- Agreements
- Mutual benefits

Key application areas

Process Technology of Functional Milk Proteins

Milk Composition – Fractions in milk

B-Lactoglobulin

Protein gel: covalent cross-links

β-lactoglobulin is responsible for the gelation capacity of whey proteins. Whey proteins have a weight-holding capacity of 1:10.
Properties of Milk Proteins

<table>
<thead>
<tr>
<th></th>
<th>Whey Proteins</th>
<th>Caseinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gelation</td>
<td>high</td>
<td>none</td>
</tr>
<tr>
<td>Emulsification</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>Viscosity</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Solubility</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Wetability</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Taste</td>
<td>neutral</td>
<td>neutral</td>
</tr>
</tbody>
</table>

NB: The functionality of whey proteins differs significantly from the functionality of caseinates.

Concepts

- Restructured products
  - Phosphate free Chicken Burgers 20%

- Increased products
  - Chicken breast 10% 20%
  - Ham 40%
  - Ham 52%
  - Bacon 40%

Phosphate Free Chicken Burgers

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Dextrose</th>
<th>PO-7730</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken breast without skin</td>
<td>77.50</td>
<td>77.50</td>
</tr>
<tr>
<td>Water</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Nutriose PO-7730</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Dextrose</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Vacuum salt</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

- Chicken breast is minced on a kidney plate
- Chicken breast, PO-7730 and water are mixed on a Hobart mixer
- Salt and seasonings are added to the Hobart mixer
- Meat is formed to burgers (40gr.)
- Burgers are put into the freezer
- After 24 hours, the burgers are fired in the oven (180°C for 22 min.)

Phosphate Free Chicken Burgers

![Image of Chicken Burgers](image-url)

![Graph](image-url)

Dextrose PO-7730
Benefits of using Whey Protein in Burgers

- Improved yield
- Meat replacement & water binding
- Better form stability & texture improvement
- Good product appearance
- Easy to solubize
- No off taste
- No discoloration

Chicken Carbonate

Ingredients (25%)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken breast without skin</td>
<td>80.00</td>
</tr>
<tr>
<td>Water</td>
<td>15.65</td>
</tr>
<tr>
<td>PSMD 129</td>
<td>0.80</td>
</tr>
<tr>
<td>Vacuum salt</td>
<td>2.00</td>
</tr>
<tr>
<td>Sodium ascorbate</td>
<td>0.05</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>0.10</td>
</tr>
<tr>
<td>Sodium citrate</td>
<td>0.25</td>
</tr>
<tr>
<td>Spices</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Total 100.00

Brine (25%)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>80.00</td>
</tr>
<tr>
<td>PSMD 129</td>
<td>4.00</td>
</tr>
<tr>
<td>Vacuum salt</td>
<td>10.00</td>
</tr>
<tr>
<td>Sodium ascorbate</td>
<td>0.25</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>0.50</td>
</tr>
<tr>
<td>Potassium Citrate</td>
<td>1.25</td>
</tr>
<tr>
<td>Spices</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Total 100.00

Flow Diagram - Chicken Carbonate

Phosphate Free Chicken Carbonate

28% Increase
PSMD 129
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**Processing of Chicken Breast 25% Increase**

- Nuggets
- Braised chicken
- Braised chicken wings
- Thawing
- Cooking
- Stiring
- Seasoning

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**Result of using Nutrilac PO-7730 in Chicken Breast Filet**

![Graph showing the result of using Nutrilac PO-7730 in Chicken Breast Filet.]

**Business Unit Functional Milk Proteins**

**Benefits of using Whey Protein in Chicken products**

- Cost reduction at unchanged quality
- Improved yield
- Water binding
- Texture improvement
- Easy to solubilize
- No off taste
- No discoloration

**Business Unit Functional Milk Proteins**

**CHICKEN NUGGETS**

<table>
<thead>
<tr>
<th>Chicken breast</th>
<th>Nutrilac PO-7730</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken breast</td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Nutrilac PO-7730</td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Salt</td>
<td>1.5%</td>
<td>1.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2.1%</strong></td>
<td><strong>2.1%</strong></td>
</tr>
</tbody>
</table>

Conclusion

Using whey protein isolate resulted in a soft texture, had off taste and the final product had a dull appearance.

Using Nutrilac PO-7730 resulted in a product with a fresh taste and a white product appearance. Lower cooking loss was obtained when using Nutrilac PO-7730 compared to whey protein isolate.

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**Ham 52%**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% Hydroxyproline</td>
<td>6.4%</td>
<td>1% HAP</td>
</tr>
<tr>
<td>0.7% HAP</td>
<td>0.7%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Flavour</td>
<td>0.2%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Water</td>
<td>22.0%</td>
<td>22.0%</td>
</tr>
<tr>
<td>Phosphate</td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Sodium monoglutamate</td>
<td>0.7%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Sodium ascorbate</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Nutrilac PO-7730</td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Anhydrous milkfat</td>
<td>1.3%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Carageenan</td>
<td>0.3%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Phosphate (5%)</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Salt</td>
<td>1.25%</td>
<td>1.25%</td>
</tr>
<tr>
<td>Water</td>
<td>22.0%</td>
<td>22.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22.0%</strong></td>
<td><strong>22.0%</strong></td>
</tr>
</tbody>
</table>

Pilot plant procedure

- Prepare the brine & leave it at 3-5 °C
- Inject the meat - 35 strokes per min. at 2 bar
- Tenderize the meat using a roller tenderizer
- Put the meat into the tumbler and add the remaining brine until an increase of 52% is obtained
- Tumble the meat under vacuum for 5 hours at 12 p.m
- Take the meat out of the tumbler and let it rest for 19 hours
- Tumble the meat under vacuum for 30 min. at 12 p.m
- Stuff the meat into cook-in-casings
- Cook at a temperature of 80 °C until a core temperature of 72 °C is achieved
- The product is cooled and stored at 5 °C
Benefits of using Nutrilac

- Good alternative to soy protein
- Cost equal to soy
- No soy taste
- More enhanced meat texture and taste
- The functionality of Nutrilac is stable over 60 days
- GMO-free

**BETTER QUALITY  COST EQUAL**

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**Ham with 40% Increase**

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>End product (%)</th>
<th>Brine (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ham muscles</td>
<td>62.55</td>
<td></td>
</tr>
<tr>
<td>Sodium tripolyphosphate</td>
<td>0.40</td>
<td>1.07</td>
</tr>
<tr>
<td>Water</td>
<td>32.56</td>
<td>86.83</td>
</tr>
<tr>
<td>Nutrilac HA-7570</td>
<td>0.80</td>
<td>2.13</td>
</tr>
<tr>
<td>Venindic</td>
<td>1.70</td>
<td>4.53</td>
</tr>
<tr>
<td>Nitrite salt</td>
<td>2.00</td>
<td>5.33</td>
</tr>
<tr>
<td>So. ascorbate</td>
<td>0.04</td>
<td>0.11</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

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**Processing of Ham with 40% Increase**

- Process to inf. vacuum at 80°C for 60 min
- Use fresh water: 15°C for 1 min
- Minimum 98°C
- Temperature: 15°C
- Time: 3 hours
- Soft Rock and roll marinating
- Curing
- Smoke

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**Results of Ham with 40% increase**

**Benefits of using Whey Protein in Ham**

- Cost reduction at unchanged quality
- Improved yield
- Water binding
- Texture improvement & better sliceability
- Easy to solubilize
- No off taste
- No discoloration
Recipe – Loin Ham

- Piglet without fat and bone 62.50%
- Water 32.56%
- Curing salt 2.50%
- Variac 992 1.70%
- Nutraex 7870 0.80%
- Phosphate 0.40%
- Sodium Ascorbate 0.04%

Total 100.00% 100.00%

Recipe for bacon with a 40% increase

<table>
<thead>
<tr>
<th>Bacon</th>
<th>N</th>
<th>Final product</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>64.90</td>
<td>Water</td>
<td>24.90</td>
</tr>
<tr>
<td>Phosphate KTP</td>
<td>1.65</td>
<td>Phosphate KTP</td>
<td>0.50</td>
</tr>
<tr>
<td>Dehydrated</td>
<td>0.62</td>
<td>Dehydrated</td>
<td>1.72</td>
</tr>
<tr>
<td>Nutraex-3250</td>
<td>1.75</td>
<td>Nutraex-3250</td>
<td>2.94</td>
</tr>
<tr>
<td>Curing salt</td>
<td>7.00</td>
<td>Curing salt</td>
<td>2.00</td>
</tr>
<tr>
<td>Sodium ascorbate</td>
<td>0.18</td>
<td>Sodium ascorbate</td>
<td>0.08</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>Total</td>
<td>100.00</td>
</tr>
</tbody>
</table>

New Application
**Beef Quality**

Quality of beef refers to characteristics associated with the palatability of the meat:
- tenderness
- juiciness
- flavor
- appearance
  - color
  - amount of marbling
- fat cover

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**One new concept for fresh beef cuts**

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**Injection of meat**

Why inject?
- To add value to your product – in terms of juiciness
- customer satisfaction
- Cost saving

Challenge of injection
- What you inject must also stay inside the product and make the final product juicy
- Product appearance must be good

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**Cooking process of meat**

- When cooking meat – the meat fibres will undergo a contraction and cell membranes will be destroyed. When destroying the cell membranes the intracellular meat juice will be liberated.

  - The more you cook the meat the more meat juice will be set free and the drier the meat.

- 85 °C - Well done
- 68 °C - Medium
- 60 °C - Rare

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**Unique functionality of Nutrilac solution capable of gelification in a cold state**

Two step gelification process

1-Step
- Once injected into the meat the viscosity of the brine will increase due to the cold gelification properties – low dripping when stored fresh

2-Step
- When cooking the meat – the heat will provoke a contraction of the meat fibres and meat juice will be liberated. Gelifying capacity of whey proteins will help retain the free meat juice and assure a juicy and tender product.

- The firmness of the gel formed has a very meat like structure.
Recipe - Injected Beef 18%

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>End product (%)</th>
<th>Brine %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef meat</td>
<td>84.75</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>14.14</td>
<td>92.72</td>
</tr>
<tr>
<td>Nutrilac PO-7730</td>
<td>0.36</td>
<td>2.36</td>
</tr>
<tr>
<td>Phosphate</td>
<td>0.30</td>
<td>1.97</td>
</tr>
<tr>
<td>Salt</td>
<td>0.45</td>
<td>2.95</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Benefits

- Add value to beef product in terms of juiciness, taste and tenderness
- Good product appearance
- Cost saving
- No off - taste
- No discoloration

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Application Plant - Denmark

- 11 technicians
- Flexible setup of equipment
- 400 square meters x 300 square feet
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Meat & Fish Plant

- Beef chopper
- Vacuum tumbler
- Multi needle syringe
- Smoke oven
- Connection oven
- Sausage stuffer
- Roller tenderizer
- Capacity: Up to 10 t/h x day

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Application Plant, Evaluation Equipment - Denmark

- Flow vacuometer
- Brookfield
- Shape
- Texture analyzer
- Jet
- Oscillation measurement
- Microscope

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Equipment

- Multi needle injector
- Vacuum tumbler (3 compartments)
- Roller tenderizer
- Needle tenderizer
- Grinder (WAD)
- Bowl chopper
- Vacuum filling machine
- Smoke house
- TA-XT2 texture analyzer
- Closing
- Band saw

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Why chose Arla Foods Ingredients?

SIMPLY BECAUSE

- We develop products that fit your needs
- We help you optimize your recipe
- Price competitiveness
- Add value to your product
- We help you innovate

Arla Foods Ingredients

THANK YOU FOR YOUR ATTENTION!

Internet Homepages

- Arla Foods: http://www.arlafoods.com
- Arla Foods Ingredients: http://www.arlafoodsingredients.com
  - Welcome
  - Company presentation
  - Ingredients for industrial use
  - Consumer products
  - Contract manufacturing
  - News