CO-EXTRUSION SYSTEMS USING ALGINATE

Jay B. Wenther, Ph.D.
Director of Meat Technology, Handtmann, Inc.

Gene Wachholtz
Sales Manager, North America, Ruitenberg Ingredients, Inc.
Ruitenberg Ingredients is a family company founded in 1938.

We serve the food industry with ingredients and specific applications.

In our state-of-the-art technology centre in Twello technologists and product developers work on optimising existing products and developing new concepts and tailor-made solutions for the bakery and the meat sector.
Ruitenberg Facilities

Ruitenberg Twello
Griftstraat

Ruitenberg Twello
Koppelstraat

Ruitenberg Ruinerwold

Ruitenberg Peize
Co-Extrusion. What is it?

Co-Extrusion definition:

“Simultaneous flow of multiple components”

Translated to sausage product:

“Simultaneous flow of one or two meat / sauce mixes and an encasing product”
An All Natural Vegetable Casing used in a continuous sausage production line with extremely low yield loss and give away creating a very cost effective product.
How do other casings compare to the RUDIN ALGINATE CASING.
## Preformed Casings in Sausage Manufacturing

### Continuous Production NOT Possible

<table>
<thead>
<tr>
<th>Edible</th>
<th>Non Edible</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product</strong></td>
<td><strong>Product</strong></td>
</tr>
<tr>
<td>Natural</td>
<td>Cellulose</td>
</tr>
<tr>
<td>Animal Gut</td>
<td>Plant (Tree)</td>
</tr>
<tr>
<td>Preformed Collagen</td>
<td>Plastic</td>
</tr>
<tr>
<td>Beef Hide</td>
<td>Synthetic</td>
</tr>
</tbody>
</table>
Co-Extrusion Casings in Sausage Manufacturing

Continuous Production

<table>
<thead>
<tr>
<th>Edible</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product</strong></td>
</tr>
<tr>
<td>Collagen Paste</td>
</tr>
<tr>
<td>Rudin® VegaCasing</td>
</tr>
</tbody>
</table>
Co-Extrusion Systems

Invented in the 1960’s
Introduced in the 1970’s

Extrusion of meat emulsions and collagen paste

- Complicated process
- Extensive equipment
- High investment
Collagen – Protein

Mainly from:
Bovine and porcine hides
Collagen – Protein

Building Blocks Collagen (~1000 units linked together)

Amino Acids (R = variable)
Crosslinking: Di-aldehydes

Collagen protein

\[
\begin{align*}
\text{NH}_2 \\
\text{NH}_2 \\
\text{NH}_2
\end{align*}
\]

\[+\]

Smoke (di-aldehydes)

\[
\text{H} - \text{O} - \text{C} - \text{H} - \text{C} - \text{H} - \text{C} - \text{H} - \text{C} - \text{O}
\]

Glutar-aldehyde

\[
\text{NH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{NH}
\]

Cross linking
Collagen Cross Linking

- No equilibrium
- Slow Reaction
- Dehydration and Heat Necessary
Collagen Co-Extrusion process:

Collagen Gel → Co-Extrusion nozzle (spinning) → Brine Application → Smoke Application → Air-Drying/partial cooking → Cooking → Packaging → Storage

Meat → De-hydration → Cross-Linking
Rudin® Vega Casing

Mixture of compounds to be extruded in thin film on meat matrix.

Composition:
- **Alginate** - film forming element
- **Biopolymers** - flowing properties
- **Insoluble elements** - appearance
- **Organic acids** - preservation/reactivity
- **Other elements** - texture of film
• Seaweed Extract
• Reactive Component = Sodium-Alginate
Alginate – Polysaccharide

Building Blocks Alginate (100-3000 units linked together)

(1, 4) β - D – Mannuronate

(1, 4) α - L – Guluronate

M-block

G-Block

Calcium Binding Site in G-blocks
Alginate Gel Formation

“Egg Box” Model
Alginate Reaction

- Equilibrium
- Very Fast Reaction

\[ \text{Na-Alginate} + \text{Ca}^{2+} \rightleftharpoons \text{Ca-Alginate} + \text{Na}^+ \]

\[ \text{Paste} \rightleftharpoons \text{Gel} = \text{Skin} \]
Alginate Co-Extrusion process:

- Algininate Gel
- Meat
- Co-Extrusion nozzle
- Ca Chloride Bath
- Cooking
- Packaging
- Storage
Rudin®VegaCasing VS Co-Ex Collagen Paste - Process

**Collagen**
- Extrusion
  - Dehydration
  - Drying
  - Cross-linking
  - Drying
  - Desired treatment

**Rudin®Vegacasing**
- Extrusion
  - Fixation with Ca$^{2+}$
  - Desired treatment
<table>
<thead>
<tr>
<th></th>
<th>Collagen</th>
<th>Vega Casing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complicated Process</td>
<td>Simple Process</td>
<td></td>
</tr>
<tr>
<td>Extensive Equipment</td>
<td>Compact Equipment</td>
<td></td>
</tr>
<tr>
<td>High Investment</td>
<td>Reasonable Investment</td>
<td></td>
</tr>
</tbody>
</table>
Rudin® VegaCasing VS Natural and Preformed Collagen

- Continuous production
- Vegetarian casing
- No Casing loss due to twisting and end-cuts
- No discussion about animal disease like BSE etc.
- USDA “All-Natural” approved
- Simple process
- Halal and Kosher
- Less Expensive by 25% to 75%

Actual casing costs East-European Market

<table>
<thead>
<tr>
<th>Casing type</th>
<th>Costs</th>
<th>Vegacasing / Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep casing caliber 22-24</td>
<td>0.118</td>
<td>0.050 (caliber 23, 4% skin)</td>
</tr>
<tr>
<td>Sheep casing caliber 20-22</td>
<td>0.202</td>
<td>0.042 (caliber 21, 4% skin)</td>
</tr>
<tr>
<td>Pork casing caliber 28-30</td>
<td>0.078</td>
<td>0.055 (caliber 28, 3% skin)</td>
</tr>
<tr>
<td>Collagen casing caliber 21</td>
<td>0.077</td>
<td>0.042 (caliber 21, 4% skin)</td>
</tr>
</tbody>
</table>
## Rudin® Vega Casing VS Co-Ex Collagen Paste

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Collagen Casing</th>
<th>Vegetable Casing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>Variable</td>
<td>Constant</td>
</tr>
<tr>
<td>Reaction speed</td>
<td>Slow</td>
<td>Very fast</td>
</tr>
<tr>
<td>Dehydration</td>
<td>Necessary</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Skin strength</td>
<td>At end of process</td>
<td>Immediately</td>
</tr>
<tr>
<td>Belt marks</td>
<td>Difficult to prevent</td>
<td>None</td>
</tr>
<tr>
<td>Adhesion to sausage dough</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Applicability</td>
<td>Limited</td>
<td>No limits</td>
</tr>
<tr>
<td>Appearance</td>
<td>Dull</td>
<td>Shiny, Dull, Color</td>
</tr>
<tr>
<td>Skin stability</td>
<td>Good</td>
<td>Needs attention</td>
</tr>
<tr>
<td>Heat resistance</td>
<td>Good</td>
<td>Excellent</td>
</tr>
<tr>
<td>Mouth feel</td>
<td>Tough</td>
<td>Pleasant</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>Substantial</td>
<td>Low</td>
</tr>
<tr>
<td>Waste flow</td>
<td>Substantial</td>
<td>Small</td>
</tr>
</tbody>
</table>
Alginate Reaction

- Equilibrium
- Very Fast Reaction

\[ \text{Na-Alginate} + \text{Ca}^{2+} \rightleftharpoons \text{Ca-Alginate} + \text{Na}^+ \]

\( \text{Paste} \rightleftharpoons \text{Gel} = \text{Skin} \)

- Attention give to Stability
- Ions in meat dough can attack the casing
  (mainly sodium/potassium ions, phosphates, citrates)
Introducing Ca\textsuperscript{2+} in meat system

Addition of Ca-lactate/Ca-acetate/CaCl\textsubscript{2} in meat

Introducing Ca\textsuperscript{2+} in production process

Addition of Ca Source (Ca-lactate/CaCl\textsubscript{2}) in bath/smoke/cooking water/chilling water

New VegaCasing Development

3 rd Generation of Casings (Internal Stabilization)
Rudin® Vega Casing Variety

- Film strength
- Film elasticity (texture)
- Color
- Flavor
- Appearance (shiny → dull)
# Available Casings Overview

<table>
<thead>
<tr>
<th>Article number</th>
<th>VC-Code</th>
<th>Hanging</th>
<th>Suitability</th>
<th>Properties</th>
<th>Opacity level</th>
</tr>
</thead>
<tbody>
<tr>
<td>XV1510</td>
<td>2001</td>
<td>No</td>
<td>Fresh and cooked sausages</td>
<td>Developed for Marel - QX system</td>
<td>0/5</td>
</tr>
<tr>
<td>XV1625</td>
<td>1501</td>
<td>Not tested</td>
<td>Fresh sausages</td>
<td>Improved extrusion</td>
<td>1/5</td>
</tr>
<tr>
<td>XV1670</td>
<td>3301</td>
<td>Yes, but VC7501 is prefered</td>
<td>Fresh, cooked, dried and semi-dried sausages</td>
<td>Opaque casing, natural look</td>
<td>2/5</td>
</tr>
<tr>
<td>XV1800</td>
<td>350164</td>
<td>No</td>
<td>Fresh and cooked sausages</td>
<td>Frozen applications</td>
<td>1/5</td>
</tr>
<tr>
<td>XV1850</td>
<td>350169</td>
<td>No</td>
<td>Fresh and cooked sausages</td>
<td>Frozen applications Semi-Skinless</td>
<td>1/5</td>
</tr>
<tr>
<td>XV2010</td>
<td>7501</td>
<td>Yes</td>
<td>Fresh, cooked, dried and semi-dried sausages</td>
<td>Very good in hanging applications</td>
<td>1/5</td>
</tr>
<tr>
<td>XV2090</td>
<td>81401</td>
<td>No</td>
<td>Fresh and cooked sausages</td>
<td>More opaque casing</td>
<td>3/5</td>
</tr>
<tr>
<td>XV2097</td>
<td>750161</td>
<td>No</td>
<td>Fresh sausages</td>
<td>Smoke flavor</td>
<td>1/5</td>
</tr>
<tr>
<td>XV5000</td>
<td>750170</td>
<td>Not tested</td>
<td>Fresh sausages</td>
<td>Maple flavor</td>
<td>1/5</td>
</tr>
<tr>
<td>XV7000</td>
<td>66001</td>
<td>No</td>
<td>Fresh and cooked sausages</td>
<td>Self - Stabilizing</td>
<td>1/5</td>
</tr>
</tbody>
</table>
Rudin® Vega Casing Application

- Meat products
- Fish products
- Cheese
- Pet Food Snacks
- Other “way of packaging”
Rudin® Vega Casing in Production

- Dry
- Semi dry-smoked
- Fresh
- Cooked

- Meatstick
- Cabanosz – Pleskoi
- Chipolata – Merguez
- Bratwurst
- Frankfurter
- German weisswurst
Benefits of Rudin Alginate Casing

- All Natural Vegetable Casing
- Approved for Kosher and Halal
- Lower cost casing than Natural and preformed
- Easier to produce than collagen paste
- Very versatile casing for multiple products
- Adaptable to your end users wants
- Extremely high yield of casing
- Very accurate weights reducing give away
- Labor efficient and very cost effective production
Thank You for Your Attention

• Questions on Casings

• Let’s look at added value of equipment