REVTECH PROCESS SYSTEMS

Heat treatment technology

IAOM

July 26th – Branson, MO
August 8th – Brainerd, MN

Celia Schlosser
<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Year</th>
<th>Number of cases</th>
<th>Isolated from product?</th>
<th>Outbreak location(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli O121, E. coli O26</td>
<td>2015–2016</td>
<td>63</td>
<td>yes</td>
<td>USA (24 states)</td>
</tr>
<tr>
<td>E. coli O121</td>
<td>2016–2017</td>
<td>30</td>
<td>yes</td>
<td>Canada (6 provinces)</td>
</tr>
<tr>
<td>E. coli O121</td>
<td>2017</td>
<td>6</td>
<td>yes</td>
<td>Canada (1 province: BC)</td>
</tr>
</tbody>
</table>

What is the common point?
<table>
<thead>
<tr>
<th>Product</th>
<th>Pathogen</th>
<th>Year</th>
<th>Number of cases</th>
<th>Isolated from product?</th>
<th>Outbreak location(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Mills, Kansas City, MO</td>
<td>E. coli O121, E. coli O26</td>
<td>2015–2016</td>
<td>63</td>
<td>yes</td>
<td>USA (24 states)</td>
</tr>
<tr>
<td>Ardent Mills, Saskatoon, SK</td>
<td>E. coli O121</td>
<td>2016–2017</td>
<td>30</td>
<td>yes</td>
<td>Canada (6 provinces)</td>
</tr>
<tr>
<td>Rogers Foods, BC</td>
<td>E. coli O121</td>
<td>2017</td>
<td>6</td>
<td>yes</td>
<td>Canada (1 province: BC)</td>
</tr>
</tbody>
</table>
RISK ASSESSMENT PROCESS

1. Identify hazards
2. Assess risk
3. Control risk
4. Review controls
WHY ? IDENTIFY HAZARDS

Is it ready to eat ?

Has it been processed in a manner to eliminate pathogens?

Instructions given to the consumer ?

Is there a chance he will not follow exactly the cooking process ?

Acceptable ? Validated ?

Safe | Risk

Yes | No

Risk | Risk

Yes | No

Safe | Risk

Yes | No

(baked, cooked, fried)
2009, 77 people reported as sick, 30 states
Toll House Cookie Dough, Nestle
Was written not to eat before warm up
FDA found E. Coli in chocolate chip cookie dough
> 3.6 million packages recalled

Survey: 1,032 individuals in the United States
⇒ 58% of consumers have tasted refrigerated rough before baking

2010: Nestle, USA decided using only heat-treated flours for refrigerated dough products
**IS IT GOING TO EXTEND?**

**Against**
- Majority still going through kill step
- Low moisture / water activity
- Low level of microorganisms
- Adverse effect on flour functionnality/quality
- Cost

**For**
- Product recalls
- Can be exposed to pathogens in soil/water or from birds/animals
- Can be impacted by wet harvest period / low harvest temperature
- Increase for wholegrain foods (might reduce obesity, cardio vascular disease, diabetes...)
- Can be eaten raw
- Can be added to foods that will not be cooked (milkshakes, ice cream...)

Pasteurization

Modification of flour properties

Stabilization

Roasting
HOW TO CONTROL THE RISK?


Heat treatment

Chlorinated water
Ozone
Acetic / Lactic acid

Antimicrobial agent

Wheat, 15% moisture
Heat treatment
1h, 60°C

Wheat
Cleaning
Tempering
Milling

Wheat, 15% moisture

APC: 2.43
APC: 4.69

Dhillon et al., 2010
Galeas, 2014

Pasteurization
Modification of flour properties
Stabilization
Roasting
HOW TO CONTROL THE RISK?

- Higher contamination on the outer layers
  
  *Miskelly & al., 2010*

- Higher risk for *whole* wheat flour

- Heat treat wheat kernels outer layers
  - Reduce microbiological load
  - Mill into flour

- Pasteurization
- Modification of flour properties
- Stabilization
- Roasting
THE REVTECH TECHNOLOGY

- Pasteurization
- Modification of flour properties
- Stabilization
- Roasting

- Stainless steel tube
- Support structure
- Product inlet
- Heat treated product outlet

- 25-35%
1. Transportation / mixing by vibrations
2. Heating by direct contact with a hot surface
3. Treatment in a confined atmosphere
THE REVTECH TECHNOLOGY

Pasteurization
Modification of flour properties
Stabilization
Roasting

Feeding system
Pasteurization tower
Steam boiler
Electrical cabinet
Cooling system
Air filtering unit
THE REVTECH TECHNOLOGY

- **Flowrate**
  - 200 lbs/h to -4,000 lbs/h (flour)
  - -11,000 lbs/h (grains)

- **Temperature**
  - 100 to 800°F

- **Residence time**
  - 1 to 40 mn

- **Atmosphere**
  - air, steam, nitrogen...

with 2 to 4 independent heating zones
## REVTECH RESULTS

### Pasteurization

Modification of flour properties

Stabilization

Roasting

### Average of 3 Samples

<table>
<thead>
<tr>
<th>Product</th>
<th>Conditions</th>
<th>Residence time</th>
<th>Steam</th>
<th>Tube temperature</th>
<th>TPC (cfu/g)</th>
<th>Enterobacteria (cfu/g)</th>
<th>Yeasts &amp; Molds (cfu/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat grains</td>
<td>Raw material</td>
<td></td>
<td></td>
<td></td>
<td>140,000</td>
<td>12,000</td>
<td>1,600</td>
</tr>
<tr>
<td></td>
<td>Revtech 1</td>
<td>5 min</td>
<td>10%</td>
<td>210°F</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>Revtech 2</td>
<td>5 min</td>
<td>10%</td>
<td>240°F</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>Revtech 3</td>
<td>5 min</td>
<td>10%</td>
<td>265°F</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
</tbody>
</table>

5 log TPC < 10 for Enterobacteria / Yeasts & Molds
Safer wheat flour!
**REVTECH RESULTS**

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<th>Residence time</th>
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<th>TPC (cfu/g)</th>
<th>Enterobacteria (cfu/g)</th>
<th>Yeasts &amp; molds (cfu/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat flour</td>
<td>Raw</td>
<td></td>
<td></td>
<td>2000</td>
<td>510</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Raw</td>
<td></td>
<td></td>
<td>5000</td>
<td>1500</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Raw</td>
<td></td>
<td></td>
<td>2300</td>
<td>120</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>Low temp</td>
<td>5 min</td>
<td>160°F</td>
<td>750</td>
<td>250</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 min</td>
<td></td>
<td>610</td>
<td>&lt; 40</td>
<td>&lt; 40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 min</td>
<td></td>
<td>720</td>
<td>~ 40</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>Medium temp</td>
<td>5 min</td>
<td>175°F</td>
<td>430</td>
<td>&lt; 40</td>
<td>~ 40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 min</td>
<td></td>
<td>170</td>
<td>~ 40</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 min</td>
<td></td>
<td>150</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>High temp</td>
<td>5 min</td>
<td>190°F</td>
<td>&lt; 400</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 min</td>
<td></td>
<td>&lt; 40</td>
<td>&lt; 10</td>
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**Pasturization works on wheat flour as well!**

- But higher surface/volume ratio
- Higher contact with heat
- Might change flour properties
IMPROVING FLOUR PROPERTIES

Chlorinated / Bleached flours

1200-2500 ppm
pH : 4.6-5.1 (≈ 6.0 for untreated flour)

Texture
- Stickiness, <- aeration

Color
- Crumb color, whiter flour

Starch
- Gelatinization T

Protein
- Gluten network strength

Carcinogenic effect
Must be labelled

High ratio cakes

Untreated
Chlorinated

in EU, Canada, UK, Japan and China
**REVTECH RESULTS**

- **Pasteurization**
- **Modification of flour properties**
- **Stabilization**
- **Roasting**

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**Russo et al., 1970**

1. Chlorinated flour
2. Untreated flour
3. Heat treated flour (Drum, 250°F)

**Keppler, 2017**

- Untreated flour
- Revtech 230°F, 10:45min
- Revtech 300°F, 9:50min
REVTECH RESULTS

Flour dissolved in water, RVA tests

- Temperature
- Processing time

Easier for granules to swell?

Instability of gluten network

Viscosity

Rheomixer tests

Pasteurization

Modification of flour properties

Stabilization

Roasting

Keppler, 2017
WHAT ABOUT BRANS / GERMS?

- Pasteurization
- Modification of flour properties
- Stabilization
- Roasting

Raw brans / germs
- Source of fibres
- High enzyme activity: Lipase + Lipoxygenase
- Short shelf life

About 250°F, 10 minutes
Enzyme inactivation
Shelf life
AND IF I WANT TO CHANGE COLOR/TASTE?

Temperature around 150 to 250°C / 300 to 480°F
Residence time around 10 to 20 mn

**Pasteurization**

**Modification of flour properties**

**Stabilization**

**Roasting**

*Wheat flour - 430°F, 0 – 3 – 6 – 9 – 15 – 30 mn*

*Wheat germs: 430°F, 0 – 3 – 6 – 12 – 18 – 24 mn*

*Wheat germs: 350°F, 0 – 6 – 9 – 12 – 21 mn*
More than 120 units installed around the world
More than **120 units** installed around the world
CONCLUSION

4 applications, 1 equipment

Great homogeneity

Only gentle vibrations (no auger, belt mixer)

Works for small pieces and powders

100 W/kg Pasteurization – 200 W/kg Roasting

Every machine can be validated to FDA standards
THANK YOU
Any question?

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References (ISO 690)

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