Storage Temperatures Necessary to Maintain Cheese Safety

• Manufacture of cheeses must be done under the proper conditions GHP, GMP, HACCP principles and according to CFR requirements. The cheese must have active cultures, and storage and display temperatures do not exceed 30°C (86°F)
Safety Factors Inherent in Cheese

- Reduced moisture
- Lower water activity
- Low pH (lactic acid)
- Salt
- Competing flora
- Biochemical metabolites
- Bacteriocins (antibacterial substance)
Safety Factors in Cheese Manufacture

- Highly regulated - farm to plant
- Good manufacturing practices
- HACCP
- Heat treatments
- Hurdle technology
Cheese Related Foodborne Outbreaks

- Variety/volume cheese consumed
- Foodborne outbreaks/diseases incidence very low
Temperature Issues

• Date marking mandate
• Storage temperature

http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/FoodCode/FoodCode2009/
FDA/USDA Evaluation of Foods

Date marking exemptions:

- Asiago
- Blue
- Brick
- Cheddar
- Colby
- Edam
- Feta
- Gorgonzola
- Gouda
- Gruyere
- Limburger
- Monterey Jack
- Muenster
- Parmesan
- Pasteurized Process
- Provolone
- Reggiano
- Romano
- Sapsago
- Swiss/Emmentaler
FDA/USDA Risk Categories

High  →  soft unripened cheeses
Moderate  →  fresh soft cheeses
             soft ripened cheeses
             semi-soft cheeses
Very low  →  hard cheeses
             pasteurized process cheeses
Literature Research

• Approx. 20 cheese varieties
• Various pathogens: L. monocytogenes
  S. aureus
  E. coli
  Salmonella
  Y. enterocolitica
  C. botulinum
  A. hydrophils
  C. jejuni
  P. aeruginosa
CDR Conclusions from Research

- Less than 50% moisture
- Active lactic acid cultures
- Traditional levels salt, pH, fat

- Do not allow pathogens growth in cheeses
- Higher storage temperatures lead to significant bactericidal activity
Recommendations for Cheeses

- Pasteurized or heat-treated (> 63°C / > 16 sec) milk
- Good hygienic practices
- Good manufacturing practices
- Operating HACCP systems
- Active lactic acid cultures
- FDA CFR specifications
Following Cheeses

- Should be considered exempt from refrigeration requirements
- During aging, storing, shipping and display
- Maximum temperature of 30°C (86°F)
- *For Safety Purposes Only*
Cheeses

- Asiago (medium and old)
- Aged Cheddar
- Colby
- Feta
- Monterey Jack
- Muenster
- Parmesan
- Pasteurized Process Cheese
- Provolone
- Romano
- Swiss/Emmentaler
Scientific information indicates some cheeses may be safe when displayed at room temperature.

FDA Memo ⇒ “storage and display of wheels, rolls, or wedges of hard or semi-soft cheese which still retain the original, undisturbed wax or cloth packaging has been accepted practice in retail food establishments to date, provided no breaks, cracks, punctures, etc. of the protective covering have occurred.”

Conference recommended that FDA work with stakeholders on scientific issues and product assessments related to food safety to determine that certain cheeses do not need temperature control for safety.

We didn’t break down a door, but we opened a window.
Request FDA to consult with National Advisory Committee on Microbiological Criteria for Foods on the science ... (to allow) ..., as a minimum, the Tier 1 cheeses (Asiago (med/old), Cheddar, Colby, Provolone, Romano, and Swiss/Emmentaler) be classified as non-Potentially Hazardous Food / Time/Temperature Control for Food Safety food at storage temperatures not to exceed 30°C (86°F).
### Table A. Interaction of pH and a<sub>w</sub> for control of spores in food heat-treated to destroy vegetative cells and subsequently packaged.

<table>
<thead>
<tr>
<th>a&lt;sub&gt;w&lt;/sub&gt; Values</th>
<th>pH Values</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.6 or less</td>
<td>&gt; 4.6 - 5.6</td>
<td>&gt; 5.6</td>
</tr>
<tr>
<td>0.92 or less</td>
<td>Non-PHF*/non-TCS**</td>
<td>Non-PHF/non-TCS</td>
<td>Non-PHF/non-TCS</td>
</tr>
<tr>
<td>&gt; 0.92 - 0.95</td>
<td>Non-PHF/non-TCS</td>
<td>Non-PHF/non-TCS</td>
<td>PA***</td>
</tr>
<tr>
<td>&gt; 0.95</td>
<td>Non-PHF/non-TCS</td>
<td>PA</td>
<td>PA</td>
</tr>
</tbody>
</table>

* PHF means “Potentially Hazardous Food”
** TCS means “Time/Temperature Control for Safety Food”
*** PA means “Product Assessment Required”

Source: FDA
Application of Interaction Tables - Parmesan Cheese

- Parmesan Cheese:
  - $a_w = 0.68 - 0.76$
  - pH = 6.5
  - curd heated to ~ 130°F & cured 2-3 years, then packaged

- Ambient storage desired & no history of related illness
- The food is heat-treated/cured & packaged
- Locate the cheese’s $a_w (0.68 – 0.76)$ in the correct line and pH (6.5) in the correct column
- They intersect at “Non-PHF/Non-TCS”
  - No temperature control is required

- Source: FDA
Cheese Challenge Study

• **Purpose:** perform a product assessment on cheese to determine if it’s a potentially hazardous food using *Listeria monocytogenes* (LM) and *Staph aureus* (SA).

• **Scope:** Three vats of two cheese types were inoculated with LM and SA and stored under cycling temperatures (7°C/44°F and 22°C/72°F) at 12 hour intervals. Samples were analyzed at days 0, 1, 4, 7 and 14.

• **Conclusion:** Level of LM and SA in the cheese remained stable for 14 days under the cycling temperature conditions.
Table 3. Summary of data on cheeses reviewed, and compositional calculations (21, 68, 75)

<table>
<thead>
<tr>
<th>Cheese Type</th>
<th>Typical % H₂O</th>
<th>CFR Limit % H₂O</th>
<th>Aw</th>
<th>Typical pH</th>
<th>Typical % NaCl</th>
<th>Typical % Aqueous NaCl</th>
<th>% FDM **</th>
<th>Active Culture</th>
<th>Age at sale (days)</th>
<th>Other inherent characteristics</th>
<th>Pathogen Kill+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asiago</td>
<td>32-34</td>
<td>35</td>
<td>0.93</td>
<td>5.2-5.5</td>
<td>1.9-2.2</td>
<td>5.75</td>
<td>45</td>
<td>Thermophile</td>
<td>180-365</td>
<td>A/S Temp*</td>
<td>Ah, Cj, Ec, Lm, P, Sa, Sta, Ye</td>
</tr>
<tr>
<td>Cheddar</td>
<td>38</td>
<td>39</td>
<td>0.95</td>
<td>5.2</td>
<td>1.7</td>
<td>4.47</td>
<td>52</td>
<td>Mesophile</td>
<td>15-1,000</td>
<td>A/S Temp*</td>
<td>Lm, Sa, Sta, Ye</td>
</tr>
<tr>
<td>Colby</td>
<td>39</td>
<td>40</td>
<td>0.95</td>
<td>5.2</td>
<td>1.7</td>
<td>4.36</td>
<td>52</td>
<td>Mesophile</td>
<td>15-80</td>
<td>A/S Temp*</td>
<td>Ec, Lm, Sta, Ye</td>
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<tr>
<td>Feta</td>
<td>53</td>
<td>NA</td>
<td>0.95</td>
<td>4.5</td>
<td>3.0</td>
<td>5.66</td>
<td>29-52</td>
<td>Mesophile</td>
<td>7-90</td>
<td>A/S Temp*</td>
<td>Lm</td>
</tr>
<tr>
<td>Monterey Jack</td>
<td>38-42</td>
<td>44</td>
<td>5.25</td>
<td>1.7</td>
<td>4.05-4.47</td>
<td>52</td>
<td>Mesophile</td>
<td>15-150</td>
<td>A/S Temp*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mozzarella</td>
<td>45-52</td>
<td>45-52</td>
<td>4.9-5.4</td>
<td>1.6</td>
<td>3.07-3.56</td>
<td>52</td>
<td>Thermophile</td>
<td>5-150</td>
<td>Hot water/steam treatment</td>
<td>Lm kill cook/stretch Lm, Sa growth</td>
<td></td>
</tr>
<tr>
<td>Muenster</td>
<td>43</td>
<td>46</td>
<td>0.98</td>
<td>5.2</td>
<td>1.8</td>
<td>4.18</td>
<td>52</td>
<td>Thermophile</td>
<td>10-150</td>
<td>A/S Temp*</td>
<td>Lm</td>
</tr>
<tr>
<td>Parmesan</td>
<td>31</td>
<td>32</td>
<td>0.92</td>
<td>5.4</td>
<td>2.6</td>
<td>8.38</td>
<td>38</td>
<td>Thermophile</td>
<td>300-600</td>
<td>A/S Temp* Aged ≥300d High temp curd cook Lipase activity</td>
<td>Lm</td>
</tr>
<tr>
<td>Process (sliceable)</td>
<td>40</td>
<td></td>
<td>0.92</td>
<td>5.6</td>
<td>2.2</td>
<td>5.50</td>
<td>50</td>
<td>None</td>
<td>14-180</td>
<td>A/S Temp* Heated ≥150°F/≥30 sec</td>
<td>Clb, Ec, Lm, Sa, Sta</td>
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<tr>
<td>Provolone</td>
<td>42.5</td>
<td>45</td>
<td>0.91</td>
<td>5.2</td>
<td>1.8</td>
<td>4.24</td>
<td>45</td>
<td>Thermophile</td>
<td>15-150</td>
<td>A/S Temp*</td>
<td>Lm</td>
</tr>
<tr>
<td>Romano</td>
<td>33.5</td>
<td>34</td>
<td>0.92</td>
<td>5.3</td>
<td>2.2</td>
<td>6.57</td>
<td>40</td>
<td>Thermophile</td>
<td>150-180</td>
<td>A/S Temp*</td>
<td>Lm</td>
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<tr>
<td>Swiss/Emmentaler</td>
<td>38</td>
<td>41</td>
<td>0.97</td>
<td>5.6</td>
<td>1.2</td>
<td>3.16</td>
<td>43</td>
<td>Thermophile</td>
<td>61-300</td>
<td>A/S Temp*</td>
<td>Ah, Cj, Ec, Lm, Pa, Sa, Sta Ye</td>
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<td>Brick</td>
<td>43</td>
<td>44</td>
<td>5.3</td>
<td>1.6</td>
<td>3.72</td>
<td>52</td>
<td>Mesophile</td>
<td>7-50</td>
<td>A/S Temp*</td>
<td>Ec, Lm</td>
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<tr>
<td>Blue</td>
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<td>6.0</td>
<td>2.5</td>
<td>5.82</td>
<td>52</td>
<td>Mesophile</td>
<td>61-240</td>
<td></td>
<td>Lm</td>
</tr>
</tbody>
</table>

*A/S Temp => Increased pathogen kill at elevated aging/storage temperatures.
** %FDM => Percent fat in dry matter.
Summary

• Know your cheese manufacturers
• Know your local, state, and federal regulations
• Know the Food Code
Questions?