Gotcha Questions: A Look at Technical Inquiries from Consumers

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Metcalfe’s Market, Wisconsin Cheese Originals

Pat Polowsky
Wisconsin Center for Dairy Research
Interactive Session

Text ACScheese to 22333
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Overview

• Communicating cheese to consumers
• Why explanation is persuasion
• Cheese making
  • Milk type, culture, color, rennet
• Cheese after it’s made
  • Storage temp, lactose, crystals, freezing
• Cheese texture/flavor
  • Fat content
  • Burn
  • “Sharp” cheddar
Communication

Cheesemongers and consumers have different priorities

Consumers want to learn background information after getting their immediate question addressed

Figure adapted from American Association For The Advancement Of Science
Explaining cheese is an act of persuasion

“Why is this cheese orange?”

Annatto, the seeds from the achiote tree

“Some cheesemakers choose to add annatto during the process as a way of preserving a long-held tradition”

Tradition that dates back to the 16th century

Emotion

Credibility

At the cheesemaker’s discretion
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Cheese Making Steps
Common Questions

What’s the difference between Goat, Cow, and Sheep milk?

What does culture mean?

Why is cheese white/yellow/orange?

What’s rennet?
Cheese Making

How are consumers introduced to cheese making?

By reading the ingredient statement…

INGREDIENTS: Milk, Cultures, Salt, Enzymes (rennet), Annatto (color)
## Milk Type

### Differences in milk composition...

<table>
<thead>
<tr>
<th>Composition (%)</th>
<th>Cow*</th>
<th>Goat</th>
<th>Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>3.5</td>
<td>3.5</td>
<td>5.3</td>
</tr>
<tr>
<td>Protein</td>
<td>3.1</td>
<td>3.1</td>
<td>5.5</td>
</tr>
<tr>
<td>Lactose</td>
<td>4.9</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Solids</td>
<td>12.2</td>
<td>12.1</td>
<td>16.3</td>
</tr>
<tr>
<td>Yield</td>
<td>~10%</td>
<td>~10%</td>
<td>~20%</td>
</tr>
</tbody>
</table>

*Holstein

Data adapted from *Handbook of Milk of Non-Bovine Mammals*

...lead to differences in cheese making
Milk Type

• Differences in cheese flavor characteristics

Cow
• Lacks “animal” flavor

Sheep
• “Sheepy”
• “Caramel”
• Fatty acids and phenolics

Goat
• “Goaty”
• “Waxy”
• Fatty acids
Culture

• Starter cultures are bacteria
  • Lactic acid bacteria
  • Convert lactose to lactic acid (drop pH)
  • Flavor contributions
<table>
<thead>
<tr>
<th>Cheese</th>
<th>Microbe</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gouda</td>
<td><em>Leuconostoc\nL. diacetylactis</em></td>
<td>Eyes/Flavor</td>
</tr>
<tr>
<td>Swiss</td>
<td><em>Propionibacteria</em></td>
<td>Eyes/Flavor</td>
</tr>
<tr>
<td>Brie</td>
<td><em>Penicillium camemberti</em></td>
<td>Texture/Aroma</td>
</tr>
<tr>
<td>Blue</td>
<td><em>Penicillium glaucum Penicillium roqueforti</em></td>
<td>Bleu aroma Texture</td>
</tr>
<tr>
<td>Surface Ripened</td>
<td><em>Brevibacterium linens,</em> other bacteria and yeasts/molds</td>
<td>Color/Aroma Texture</td>
</tr>
</tbody>
</table>
Cheese Color

Goat
Cheddar
Cheese Color

• Orange
  • Annatto extract – achiote tree
  • No significant effect on flavor*

• Yellow
  • Beta-carotene – pasture
  • ↑ yellow color ≈ ↑ grassy flavor (usually)

• White
  • Goat and sheep*
  • Metabolize β-carotene to Vitamin A (colorless)
Rennet

• Enzyme(s) used to coagulate milk

• Added to the milk after culture/color
Rennet

- What’s going on?
### Rennet Types

<table>
<thead>
<tr>
<th>Rennet Type</th>
<th>Cost</th>
<th>Availability</th>
<th>Proteolytic Activity</th>
<th>Aged Flavor</th>
<th>Kosher/Halal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veal Rennet</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Very Good</td>
<td>No</td>
</tr>
<tr>
<td>Microbial Rennet (Vegetable)</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Okay</td>
<td>Yes</td>
</tr>
<tr>
<td>Fermentation Produced Chymosin (FPC)</td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
<td>Good</td>
<td>Yes</td>
</tr>
<tr>
<td>Thistle Seed, Others</td>
<td>Very High</td>
<td>Very Low</td>
<td>Very High</td>
<td>Very Poor</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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Vegetarian

@CHEESESOCIETY  #CHEESE2016
Cheese After It’s Made
Common Questions

Should I refrigerate this cheese?
Which cheese is best/worst* for lactose intolerance?
What does my cheese crunch?
Can I freeze cheese?
Cheese Storage

• Cheese has built-in safety factors

- Reduced moisture
- Lower water activity
- Low pH (acid development)
- Salt
- Competing flora
- Biochemical metabolites
- Bacteriocins (antibacterial substance)
FDA/USDA Risk Categories

High
- Soft unripened cheeses

Moderate
- Fresh soft cheeses
- Soft ripened cheeses
- Semi-soft

Very low
- Hard cheeses
- Pasteurized process cheeses
“…most cheeses containing < 50% moisture (or more, in the case of Feta) and active lactic acid starter cultures, along with traditional levels of salt, pH, fat, etc., do not allow the growth of pathogens at temperatures between 4°C and 30°C [39°F - 86°F]…”

- Storage Temperatures Necessary to Maintain Cheese Safety
JAY RUSSELL BISHOP and MARIANNE SMUKOWSKI. Food Protection Trends, Vol. 26, No.10
Recommendations For 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 (NOT FOR QUALITY)*

Asiago (medium and old)
Aged Cheddar
Colby
Feta (in brine)
Monterey Jack
Muenster
Parmesan
Pasteurized Process Cheese
Provolone
Romano
Swiss/Emmentaler
Quality

• What is safe for cheese isn’t necessarily the best thing to do to preserve cheese quality
• Elevated storage/display temperatures can have a **negative impact on quality**:
Lactose

- Lactose is fermented to lactic acid by culture

![Lactose molecule diagram]
Lactose

- cheeses to avoid:
  - uncultured, fresh/young, processed, brunost, etc.

  lactose isn’t broken down
  lactose not fully metabolized
  lactose may be added*

data adapted from fundamentals of cheese science
Spruce Bands

Mont d’Or

Agricultural and Food Institute of Lille - University of Lille

respectively (Table 8). Linalool, together with terpineol and isoborneol, was also identified as a major terpene present in Vacherin (Dumont, Roget, Cerf, & Adda, 1974). This cheese has a ring of spruce wood around it during its ripening. This ring is thought to be responsible for the high level of terpenes in this cheese type. In general, though, the importance of terpenes in the formation of cheese flavour remains controversial.

- Piney
- Herbaceous
- Minty
Cheese Freezing

• Usually has deleterious effects on cheese texture/body
  • Crumbly
  • Grainy

• If properly packaged, flavor is usually okay

Ice crystals → Texture breakdown → Protein dehydration
20-year cheddar is a 'cheese milestone'
Crystals

- Calcium Lactate
  - Aged cheddar-type cheeses

\[
\text{Calcium Lactate: } \text{Ca}^{2+} + 2\text{CH}_3\text{COO}^- + 2\text{H}_2\text{O} \rightarrow \text{Ca}^{2+} + 2\text{CH}_3\text{COOH}
\]
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Crystals

• Tyrosine
  • Aged Italian, Swiss, Dutch style cheeses
Cheese Texture and Flavor
Common Questions

Why is Brie so fatty?

How does cheese get its flavor?

What does “sharp” mean?

Why does my mouth tingle after eating some cheeses?
What's in Cheese/Milk?

Protein
- Casein
- Whey

Fat
- Triglycerides
- Fatty Acids

Carbohydrate
- Lactose
- Galactose

Water!
Understanding Cheese Composition

**Moisture** – measure of water

**Solids** – measure of things that aren’t water

**Fat in the Dry Matter (FDM/FDB)** – measure of fat in solids portion of cheese

**Fat (total %)** – measure of fat in cheese (overall)
FDM/FDB

- Fat in the dry matter/basis (FDM/FDB)

<table>
<thead>
<tr>
<th>Cheese</th>
<th>FDM (%)</th>
<th>Fat (%)</th>
<th>Water (%)</th>
<th>Solids (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brie (DC)</td>
<td>64</td>
<td>32</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Cheddar</td>
<td>55</td>
<td>35</td>
<td>36</td>
<td>64</td>
</tr>
<tr>
<td>Brie (TC)</td>
<td>76</td>
<td>38</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Mascar</td>
<td>79</td>
<td>41</td>
<td>48</td>
<td>52</td>
</tr>
<tr>
<td>Stilton</td>
<td>59</td>
<td>36</td>
<td>39</td>
<td>61</td>
</tr>
<tr>
<td>Butter</td>
<td>98</td>
<td>82</td>
<td>16</td>
<td>84</td>
</tr>
</tbody>
</table>

Data adapted from *Cheese: Chemistry, Physics, and Microbiology*
Cheese Flavor

**Proteolysis**
- Protein (casein/whey)
- Peptides/Amino acids/other flavor compounds

**Lipolysis**
- Triglycerides
- Free fatty acids and other compounds

**Fermentation**
- Lactose
- Lactic Acid
Cheese Flavor

Proteolytic Flavors

- Free fatty acids
- Protease
- Free amino acids & more flavor...

Aroma!

FFAs = volatile

http://bit.do/fattyacids
## Goat and Sheep Flavor

<table>
<thead>
<tr>
<th>Fatty Acid (g/100g fat)</th>
<th>Goat Milk</th>
<th>Sheep Milk</th>
<th>Cow Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caproic acid (C6:0)</td>
<td>2.78</td>
<td>1.87</td>
<td>2.01</td>
</tr>
<tr>
<td>Caprylic acid (C8:0)</td>
<td>2.92</td>
<td>1.87</td>
<td>1.39</td>
</tr>
<tr>
<td>Capric acid (C10:0)</td>
<td>9.59</td>
<td>6.63</td>
<td>3.03</td>
</tr>
<tr>
<td>Lauric acid (C12:0)</td>
<td>4.52</td>
<td>3.99</td>
<td>3.64</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19.8</strong></td>
<td><strong>14.4</strong></td>
<td><strong>10.1</strong></td>
</tr>
</tbody>
</table>

### “Animal” flavors

- Phenolic compounds important for sheep milk
  - Cresol
  - Dimethylphenols
  - Diethylphenols

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The Problem With “Sharp”

- Hundreds of possible flavors in cheese
- “Sharp” could mean:
  - Overall flavor
  - Acid/bitter
  - Sulfur
  - Brothy/umami
  - Texture
- Use as a measure of age

http://cheesescience.org/wheel/
Some feel a burning sensation after tasting raw milk cheese.
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