Impact of Milk Sourcing on Cheddar Flavor: A Study in *Terroir*

Chris Baird, Gregg Turbes, Joy Waite Cusic, Elizabeth Tomasino, Juyun Lim, Robin Frojen, Lisbeth Goddik
Dept. Food Science & Technology

Photo by Lynn Ketchum
• **What is *terroir*?**
  - Literal – Land
  - Conceptually - the influence of land and climate on aromas and flavors of food

• **Impact of *terroir* on industry**
  - Potential marketing tool for highlighting regional uniqueness such as Oregon cheese
  - Lead to potential tools for mitigating *terroir*

Image Source: http://www.fws.gov/oregonfwo/ToolsForLandowners/Partners/Details.asp
Terroir | Does Milk Source Impact the Flavor of Cheddar Cheese?

1. Can consumers tell a difference in flavor between the cheeses?
2. What are the differences in flavor compounds?
3. What are the differences in microbial systems?
   - Milk was sourced from the Coastal Range, Columbia Basin, and Willamette Valley
   - Cheddar was made at Oregon State in the Arbuthnot Dairy Center
   - Cheddar was analyzed at 5 and 9 months

Image Source: http://www.fws.gov/oregonfwo/ToolsForLandowners/Partners/Details.asp
Results | 5 Months

1. **Sensory**
   - Cheeses separated based on respective geographic location; different farms produced different cheese
   - Cheddar made with commingled milk perceived as similar

2. **Chemistry**
   - Flavor compounds separated based on farm

3. **Microbiology**
   - Raw = *L. paracasei*
   - Pasteurized = *L. plantarum*
Results | 9 Months

1. **Sensory**
   - Cheese separated based on heat treatment of milk

2. **Chemistry**
   - Flavor compounds separated based on heat treatment of milk

3. **Microbiology**
   - Raw = *L. paracasei*

   Raw Coastal Plain Cheddar produced unique flavor chemistry
Microbiology | Starter vs. Non-starter Lactic Acid Bacteria

- **Cheddar Starter Culture**
  - *Lactococcus*
  - Used for acid production
  - Sensitive to acid

- **NSLAB**
  - *Lactobacillus*
  - Low levels found in fresh raw milk
  - Tolerant to acid
  - Potential source of *terroir*
Microbiology | Starter vs. Non-starter Lactic Acid Bacteria

Adapted from Rehman et al. (2000); Dansen et al. (2003)
Microbiology | Methodology

• Phenotypic Identification
  • **API 50**
    • Species identification through fermentation of 49 different carbohydrates
    • Limitations with genetically similar species
      • *L. casei, L. paracasei, L. rhamnoses*
  
• Genotypic Identification
  • **Pulsed Field Gel Electrophoresis (PFGE)**
    • Pulses of electricity separate DNA bands
    • Unique banding patterns reflect species/strains
  
• **Polymerase Chain Reaction (PCR)**
  • Still to come...
  • Amplifies DNA for identification
  • Sensitive to genetically similar species
Microbiology | Results

• API 50
  • Fermentation patterns were unique for farms for both 5 and 9 months
  • Less variation at 9 months

• PFGE
  • No strains were shared by Corvallis and the Coastal Plain
  • Corvallis: 3 strains
  • Coastal Plain: 4 strains
  • Supports API findings

NSLAB separated by location
Summary | Terroir and its Impact on Cheddar Flavor

1. Milk sourcing is a factor in cheddar flavor
2. NSLAB – A key factor in terroir
   • NSLAB were different for each milk source
   • Supported by API and PFGE

What is the next step?
Chris’ Work | Digging deeper into the *terroir* of cheese...

Raw Coastal Plain cheddar was very different...

Does coastal *terroir* exist?
Milk Collection and Production

Coast

North CA Coast
Oregon Coast
North Coast
South Coast

Inland
Willamette Valley
Farm A
Farm B

Raw Cheddar
Produced at the Arbuthnot Dairy Center
Analysis

Initial Analysis
• Microbial
• Milk
• Creamery

1 and 3 Month
• Microbial
• Chemical

5 Month
• Microbial
• Chemical
• Sensory

Image Sources:
2. http://www.murrayscheese.com/media/catalog/product/cache/1/image/9df78eab33525d08d6e5fb8d27136e95/c/h/cheddar_ms_quic kes.jpg