

Reverse Engineering Cheese



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Analysis

Sensory Evaluation of Rind and Paste

- Size
- Shape
- Flavor
- Texture
- Body
- Rind



Size and shape determine aging potential



Texture and flavor indicate milk and culture selection and cheesemaking mechanics

- ❖ Open texture and eye development
 - Milk fat content and protein:fat ratio
 - Carbon dioxide production and less acid curds
 - Curd working and whey drainage
 - Salt level and aging temperature
- ❖ Supple texture and elasticity
 - Thermophilic cultures or curd washing to lower acidity
- ❖ Flaky and crumbly texture
 - Mesophilic cultures or mixed meso/thermo cultures
 - Higher acidity
- ❖ Runny and pudding texture
 - Can be either thermo, meso or mixed cultures
 - Culture choice determines the flavor: starter and ripening microbes



Texture and Flavor

- ❖ Granular and crystalline texture
 - Milk fat content and protein:fat ratio
 - Aging time and proteolysis
- ❖ Fungal and mushroom flavors
 - *Geotrichum* and *Penicillium candidum*
- ❖ Sweeter and milder flavors
 - Thermophilic cultures
 - Mesophilic cultures and curd washing
- ❖ Nutty and savory flavors
 - *Lactobacilli* and Propionic bacteria



Texture and Flavor



- ❖ Sharp and picante and strong biting flavors
 - Higher acidity: lactic, butyric, and propionic free fatty acids
 - Type of rennet and lipase
 - Feed: butyric, propionic and acetic free fatty acids
- ❖ Peppery and spicy flavors
 - Goat and sheep milk
- ❖ Terpinenes and zesty flavors
 - Blue mold veining and mold culture selection
 - Time of needling
- ❖ Sweet flavors and crystalline texture
 - Aging time and temperature
 - Less acid cheese to start with



Body and Rind

- ❖ Body describes the hardness of the cheese
 - Milk protein:fat ratio
 - Moisture removed as whey
 - Aging time

- ❖ Rind characteristics come from affinage
 - Salting method
 - Washing solutions and techniques
 - Ripening cultures
 - Temperature and relative humidity aging



Research

Literature Review

○ History

○ Recipes

○ Milk



History

- Origins: where was this cheese first made? What was the geography and climate like?
- Who were the people that originated it? What was their purpose for making this particular cheese?
- What kind of community did they have? How did they work together to make this cheese?
- How old is this cheese when it is usually eaten?
- What was the milk like? Which microbes were dominant?

Recipes

- Find as many as possible
- Find descriptions of this cheese being made in the original place
- Compare the recipes for accuracy
- Note of the aging conditions and techniques
- Clues about milk type and standardization are important



MILK



- Sheep and Goat milk can be made into many types of cheese without standardization
- Cow milk often has to be standardized to a specific protein:fat ratio to make very hard cheeses and those with eyes
- Blending sheep milk with cow milk makes the texture softer
- Cheese flavor is influenced by blending milk
- Some cheeses have only been made from one type of milk

Research Interviews

- Cheesemakers
- Cheesemongers



Recipe Development

- Type of Milk
- Milk Production
- Starter
- Adjunct cultures
- Rennet
- Coagulation Time
- Curd Firmness
- Cutting curds
- Cooking: Time & Temperature
- Draining whey: curd firmness, knitting, and pH
- Curd Handling
- Salting Technique
- Rind Drying
- Affinage
- Aging Time

Milk Type and Production

- Selection is critical to the recipe
- Need to know the properties of milk and how these influence the cheese
- Feed may be the most important consideration for a good result: change the feed, change the cheese
- Standardization may be required
- Storage temperature and time can be critical
- Preripening may be required



Starter and Adjunct Cultures

- The choices may be different for pasteurized milk and raw milk cheesemaking
- Raw milk cheese mostly requires a starter to make acid because native species will grow during the make
- What temperature will it be in the vat? Will the culture be meso, thermo, or mixed?
- What microbes will be needed for rind development?
These cultures can be added to the vat

Rennet, Coagulation Time, Curd Firmness and Cutting the Curds

- What type of rennet is used?
- If lipolytic activity came from the rennet then a paste rennet or lipase powder may be needed.
- Short coagulation and soft curd for hard cheese and vice versa
- May need to curd curd into very small pieces
- May need to ladle or first cut vertically and then ladle

Stirring and Cooking: Time and Temperature

- Which bacteria should grow best in the vat?
 - How much acid production is needed
 - Levels of Lacobacilli and heterofermentative mesophiles
- How much curd firming is needed?
- To cook or not to cook: how much temperature increase?
- Curd washing?
 - Rate of whey removal and water addition affects acidity and texture
- Settling curds: how long?



Draining whey: curd firmness, knitting, and pH

○ Curd firmness relates to moisture control

- How much whey should be removed?
- How dry are the curds? What is the grip
- Determining this takes practice

○ Curd knitting: how much?

- Under the whey = prepressing for smooth texture
- Forming a loose curd pack for Cheddar-types
- Well drained curds for open texture

○ pH at Drain is very important!

- Affects texture and flavor
- Sets the stage for aging



Curd Handling

- Forming
- Turning
- Pressing
- Curd knitting
- Acidification
- Until salting or cooling begins



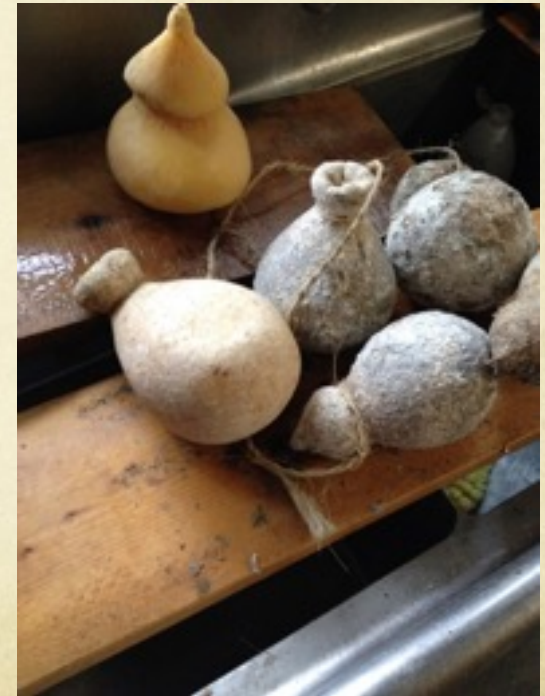
Salting Technique

- Type of Salt
- Direct to curds
- Surface
- Brine
- Combinations
- Time
- Temperature



Affinage

- Rind drying
 - Time, temperature and %RH
 - Bloomy rinds are special
 - Combined with salt diffusion for Swiss types
- Warm room
 - Extent of eye development
- Cave conditions
 - Temperature, relative humidity
 - Ventilation
- Techniques
 - Washing solutions
 - Scrubbing and polishing
- Stages and changing conditions
 - Blue cheeses: hastening, needling, and storage time
 - Hard Alpine: colder for longer term
 - Bloomy and Washed Rind: colder and drier after packaging to preserve shelf-life



Gruyere 1655 AOP



Sensory Evaluation

- Body: hard
- Texture:
 - smooth with an occasional round pea-sized eyes
 - becoming slightly grainy with age (12 months and older)
- Flavor:
 - Younger: 5 months: sweet, nutty, tropical fruit
 - Older: 12 months: savory, meaty, toasty, earthy
- Appearance:
 - Rind: straw-colored, slightly tacky
 - Paste: ivory to pale golden



Research: Historical

- Named after the town of Gruyeres in Switzerland and made in the cantons of Fribourg, Vaud, Neuchatel, Jura, and Berne
- Made since the 12th century
- Made exclusively from raw milk produced by cows fed on natural grass and local hay, excluding fermented feeds
- Made in chalets May to September, exclusively for alpage varieties, or in fruitieres that collect milk from several small-scale farms where it can be made year-round
- Made in wheels that are 16-25 inches in diameter and 3.5-5.5 inches thick and weigh 40-90 pounds

Research: Recipes

- Setting at 90-93 F
- Homemade rennet preparations are used:
 - made from minced cured vells steeped in dealbuminated whey at 100 F for 20 hours to reach pH 3.80-4.00
 - Contain Lactobacilli and Streptococcus thermophilus
- Native milk starters and liquid calf rennets are also used
- Shorter coagulation: 25-30 minutes
- Cutting curd to pea-sized and even smaller pieces
- Cooking curds and whey to 128-131 in 30-45 minutes and continued cooking to firm the curds
- Settling and dipping curds from vat in a large cheesecloth

Research: Recipes

- Pressed in cloths in adjustable, open-ended hoops
- Pressure is gradually increased over 4-6 hours and left under pressure overnight
- Brined one day and then dry salted or only dry-salted
 - Using long term salting technique to promote smear growth
- Aging in a climate that is close to a natural cave: 55-57 F and 94-98 %RH to promote smear growth and prevent the cheese from drying out. Turning and wiping with brine.
- Aging at 50-54 F for lower quality cheese
- Le Gruyere Premier Cru is aged for 14 months at 56 F and 95 %RH

Research: Milk

- Grass-based production on native pastures in summer and feeding dry hay in winter
- Lower volume: higher solids milk producing cows for cheesemaking milk
- Skimming evening milk to blend with morning milk or skimming whole milk to get protein:fat ratio of 1.0-1.2
- Milk is collected within 24 hours of milking except in inclement weather when 36 hours is allowed
- Milk cannot be stored below 50 F, typically stored at 52 except if the evening milk is delivered to the fruitieres it is stored at 59-64 F
- Modern hygenic standards have reduced number of Propionic bacteria and cheeses have fewer eyes

Recipe Development

- Fresh (only use two milkings), pasture-based raw milk skimmed to have protein:fat ratio of 1.1, e.g. 3.5% protein:3.2% fat
- Starter: TA60 for acid production at higher cook temperatures + LH100 for aging in a ratio of 1 part TA60 to 2 parts LH100
- Rennet: liquid calf to get a 15 minute flocculation
- Cutting to very small pieces after 25 minute coagulation
- Cooking to 128 F in 40 minutes and stirring for 40 more minutes
- Settle curds under whey for 15 minutes, press together to form pack
- Drain whey to a few inches above curds, cut out blocks of curd, and place in hoops. Curds with pH 6.30-6.40
- Press with 1 lb. pressure per pound of curd in the hoop, turn after 30-60 minutes, increase to 2 lb. after 3-4 hours and leave overnight

Recipe Development

- Brining for 24 hours followed by dry salting for 2-4 weeks depending on the thickness of the wheels
- During salting the wheels are sprinkled with a scattering of coarse salt and turned every 2-3 days to develop a smear
- Aging at 55-57 F and 94-98 %RH to simulate a climate close to that of a natural cave
- Wheels are turned and rubbed with brine to maintain the smear
- Aging for at least 5 months for raw milk and longer for pasteurized milk



Dairy Foods Consulting & Westminster Artisan Cheesemaking

Peter Dixon is a dairy foods consultant and artisan cheesemaker who has been making cheese for over 35 years and consulting for 25. With his wife Rachel Fritz Schaal, Peter runs Dairy Foods Consulting & Westminster Artisan Cheesemaking in Westminster West, Vermont

Their work is guided by the demonstrable connection between risk reduction practices and high quality cheese and dairy foods.



In 2013 Peter started Parish Hill Creamery, a small cheese business where he produces seasonal, handmade, raw milk cheeses with his wife Rachel and sister Alex Schaal.

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