Introduction to Cheesemaking

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What is Cheese?

Cheese is coagulated milk which has been separated from the whey. The first cheeses were produced around 6500 BC in the Middle East after humans domesticated goats, sheep, and cows and developed pottery for use in separating curds from whey. These cheeses were highly prized as a way to preserve the nutritious milk.

There are two main types of cheeses: soft and hard. Most cheese is produced when beneficial bacteria convert the lactose (milk sugar) into lactic acid. This causes the solids (primarily fat and protein) in the milk to coagulate into curds. Removing the curds from the whey and allowing them to drain will result in a soft cheese. For hard cheeses, a stronger coagulation agent is added to produce drier curds, and the curds will be cooked, pressed together, and often aged to expel more of the whey.

> When making cheese, most of the lactose in milk is either converted to lactic acid or removed with the whey, making cheese a food that is more digestible for many adults than liquid milk.

Cheese in History

Cheese is an ancient food which was produced by the shepherds and dairy maids who kept the milk animals. Like beer, bread, and other common foods, there were not many details recorded on exactly how cheese was made. Several Roman agricultural treatises describe cheesemaking and indicate that both soft, fresh cheeses and dry, aged cheeses were produced. Varro describes the process of coagulating milk with rennet, fig sap, or vinegar. Columella describes the production of a pressed cheese using a method that was likely used through the medieval period.

The Middle Ages is when various cultural changes led to the diverse types of cheeses we know today. Northern French peasants turned milk from their small herds into bloomy-rind cheeses resembling Brie de Meaux, lactic goat's milk cheeses such as Crottin, and washed-rind cheeses like Pont-L'Eveque. The dairymaids in English manor houses had large herds at their disposal and were able to produce butter and cheese, including cooked curd Cheddar-style cheeses, with remarkable efficiency. The people of the Alpine region of central Europe perfected production of large wheels of drier cheeses such as Gruyere and Emmentaller. These cheeses could be made in the mountains in the summer and stayed fresh until they were brought to market in the fall. In south-central France, the caves of Rouqefort produced mold-ripened blue cheeses we still prize today. In northern Italy, the great wheels of Parmesan were born.

Finding the Right Milk

Milk is the most important ingredient in cheese, and not all milks are equal when it comes to creating cheese. Cheese can be made from milk many different animals, but cow, goat, and sheep cheeses are the most common. Today, the vast majority of cheese is made from cow's milk.

Cow's milk is mostly water (87%) with the remaining solids being roughly equal amounts of protein (primarily casein), fat, and sugar (lactose). Goat's milk has a similar structure, but the fat particles are smaller resulting in a different curd consistency. Sheep's milk has only 80% water and is very rich in fat.

Raw milk is straight from the animal and has had no treatments or processing done (other than perhaps refrigeration). It has been used for millennia to produce flavorful cheeses. Since it contains microorganisms (good and bad) it should be only be acquired from a very trusted source, handled properly, and used quickly (within 3-5 days). The FDA requires that any cheeses made from raw milk be aged at least 60 days before they're sold to reduce the possibility of pathogens in the cheese.

Pasteurization is a heat treatment intended to reduce the number of microorganisms in milk so that it can be kept longer before spoiling.

> Both raw and pasteurized milk can be used to make cheese.

Very high temperature pasteurization kills most microorganisms (both good and bad) but also denatures proteins in the milk. This means that milk treated at very high temperatures can have a shelf life of months, but essential components for cheesemaking have been damaged.

> Milk which has been Ultra Pasteurized (UP) or Ultra Heat Treated (UHT) ***cannot*** be used to make cheese. The high temperature treatments break down the proteins in the milk such that curds will not form properly.

Homogenization is a process used to physically break up fat particles in the milk so that they remain suspended and evenly distributed. Milk that has *not* been homogenized is often referred to as "Cream Top" and should be shaken before use.

> Both homogenized and non-homogenized milk can be used for making cheese.

Most cheese recipes call for whole milk, but some will call for lower fat milk (Parmesan) or the addition of cream (triple creme brie). You can substitute higher and lower fat milks in recipes. Lower fat milks will reduce the amount of cheese made by the recipe and produce a drier cheese.

Finding a milk that works well for making cheese requires doing research, reading labels, and/or experimentation. I have had success with:

- Alta Dena Whole Milk (cow's milk, pasteurized, homogenized, widely available)
- Clover Organic Half-and-Half (cow's milk, pasteurized, homogenized, available at Lazy Acres and Whole Foods)
- Straus Creamery Whole Milk (cow's milk, pasteurized, non-homogenized, available at Lazy Acres and Whole Foods)
- Summerhill Dairy (goat's milk, pasteurized, non-homogenized, available at Trader Joe's).

Coagulants

Milk begins to coagulate as it is acidified. This acidification process is typically done by bacteria in the *Lactobacilus* and *Lactococcus* families. These bacteria are naturally present in the environment and will cause fresh milk to eventually sour naturally, but most cheesemakers add a starter culture containing the specific strains of bacteria they want to use. The different strains have different flavor profiles, ripening times, and temperature requirements.

There are two main groups of starter cultures: mesophilic (cool temperature) and thermophilic (warm temperature). Thermophilic strains are the "active cultures" found in yogurt. Mesophilic strains are found in cultured buttermilk.

A detailed list of cultures and the cheeses they're used for can be found at:
www.artisancheesemakingathome.com/pdfs/cultures.pdf

Some cheese recipes do not rely on beneficial bacteria to create an acidic environment for curd formation and instead just call for adding acid to the milk. These direct acid cheeses will call for citric acid, acetic acid (vinegar), or tartaric acid.

Cheeses that will be aged need to start with relatively dry, firm curds so that the cheese does not spoil from the inside out. Relying on bacteria alone to produce this type of curd would produce a very sour product. Instead, rennet, a stronger coagulation agent, is added. Rennet is a substance consisting primarily of the enzyme chymosin that is found in the stomach lining of unweaned calves, kids, and lambs. Traditionally small pieces of salted and dried animal stomach were added to the milk after the bacteria had started coagulation to produce the firmer curds.

There are two other types of rennet: vegetable and microbial. Vegetable rennet is extracted from plants such as fig, thistle, and safflower. The use of fig sap as rennet is described in several Roman agricultural treatises. Microbial rennet is produced by several different types of fungi, *Rhizomucor miehei* being the most common. Most modern rennet labeled as "vegetarian" or "vegetable" is actually microbial rennet.

Other Ingredients

Always use cool, non-chlorinated *water* whenever you need to dilute an ingredient before adding it to milk when making cheese. Chlorine can cause problems with the enzymatic action of rennet. Bottled water is an easy to find source of non-chlorinated water.

Salt is used in nearly all cheese recipes as both a flavor enhancer and a preservative drying agent. Kosher salt and other non-iodized salts are best for cheesemaking.

Lipase is an animal product that is used as a flavoring agent in some cheese recipes to add a tangy flavor. The calf version of the enzyme (Italase) is milder than the one from goats (Capalase).

Calcium chloride is used to replace some of the calcium that is lost during pasteurization and cold storage of commercial milk. While not required for all soft cheeses, it is used in most hard cheese recipes to ensure firm curd formation. It is not needed if you use raw milk.

The yellow color of many cheeses comes from *annatto*, a natural coloring agent from the seeds to the achiote tree.

Cheesemaker's Toolbox

Most of the tools needed for making cheese can be found in your kitchen. Here's what you need for the recipes we'll be making:

- Large, non-reactive pot
- Thermometer
- Long metal or plastic spoon
- Long knife or spatula
- Strainer
- Butter muslin / very fine cheesecloth
- Large food-safe container for catching whey (optional)
- Microwave-safe bowl

Recommended Suppliers

The Home Wine, Beer, and Cheesemaking Shop
22836 Ventura Blvd, Woodland Hills, CA
www.homebeerwinecheese.com

The Beverage People
Santa Rosa, CA
www.thebeveragepeople.com

Valley Brewers
515 Fourth Pl, Solvang, CA
www.valleybrewers.com

New England Cheesemaking Supply Company
www.cheesemaking.com

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Recipe: Quick Mozzarella
Makes ¾-1 pound.

Ingredients

- 1 gallon pasteurized whole milk
- 1½ tsp citric acid, dissolved in ½ cup water
- ¼ rennet tablet or ¼ tsp liquid rennet, diluted in ¼ cup water
- 1½ tsp salt

Directions

1. Using low heat, warm milk to 55°F. Stir in citric acid solution and mix thoroughly.

2. Continue slowly heating milk to 90°F, stirring constantly. Remove pot from heat. Add diluted rennet and stir for about 30 seconds, ensuring it's evenly distributed throughout the liquid. Cover and leave the pot for 5 minutes.

3. There should now be a clear separation between the curd and whey. If the curd is too soft or whey too milky, let it sit a few minutes longer. Cut the curd using a blade long enough to reach the bottom of the pot.

4. Return the pot to the stove, and heat the curds to 100-105°F, stirring gently. Remove from heat and stir for up to 5 minutes. The higher the temperature you heat to and the longer you stir, the firmer the curds will be.

5. Scoop out the curds, draining off as much whey as you can, and place them into a microwave-safe bowl. Reserve the whey for making ricotta if desired.

6. Microwave the curds on High for 1 minute. Drain off expelled whey. Gently fold the curd, like kneading bread, to distribute the heat.

7. Microwave twice more, for 30 seconds each, draining the whey and kneading to distributed the heat each time. Add salt after the second heating.

8. Knead quickly until smooth and elastic, like taffy. If the curds break instead of stretch, they need to be reheated.

9. The cheese should now be smooth and shiny. Form it into small balls and eat while warm or place into a bowl of ice water for 30 minutes to cool rapidly (this ensures a consistent texture in the cooled cheese). Cover and store in the refrigerator any that you don't eat immediately.

Recipe: Melca (Curds)

Geoponika 18.21 - Compendious Preparation of Melca

> What is called melca will be readily prepared and of a superior quality, if you pour sharp vinegar into fresh earthen vessels, and set them on hot cinders, or over a gentle fire, that is, on coals; and when the vinegar has boiled a little, take it off the fire, that it may not be absorbed by the vessels: put the milk into the same vessels, and set them in a cupboard or a closet, where they may remain unmoved; and on the day following you will have a good quantity of melca, much better than what is prepared with much art. Change the vessels after the first or second using.

Makes about 1 cup.

Ingredients

- 1 quart whole milk or half-and-half
- ¼ cup white wine vinegar
- ⅛ tsp salt

Directions

1. Warm milk over low heat to 100-110°F.
2. In a separate pot, heat vinegar to just boiling.
3. Transfer hot vinegar to a warm, non-reactive bowl. Add warm milk. Cover and let sit until curds form, approximately 20-30 minutes.
4. Line a colander with butter muslin. Pour the curds and whey through the muslin and colander, catching the whey if desired.
5. Tie the corners of the muslin together around the curds and hang to drain for at least 15 minutes and up to overnight.
6. After cheese has stopped draining, untie and place in a bowl. Fold in salt.
7. Refrigerate, covered, for up to 1 week.

Recipe: Whey Ricotta
Makes 1-2 cups.

Ingredients

- 2 gallons fresh whey
- ¼ cup cider vinegar
- ½ tsp salt

Directions

8. Heat whey to 200°F. Remove from heat.

9. While stirring, add the vinegar. Tiny white clumps of precipitated protein will start forming. Let sit for a couple of minutes.

10. Carefully scoop out or pour the curds into a colander lined with butter muslin. Drain.

11. When the muslin is cool enough to handle, tie the corners together and hang to drain for at least 15 minutes and up to several hours.

12. After cheese has stopped draining, untie and place in a bowl. Fold in salt.

13. Refrigerate, covered, for up to 1 week.

Recipe: Basic Goat Cheese
Makes 1 pound.

Ingredients

- 1 gallon pasteurized goat's milk
- 1 packet (½ tsp) powdered C20G mesophilic starter culture
- ½ tsp salt

Directions

1. Heat milk over low heat to 86°F. Remove from heat.

2. Sprinkle the starter over the surface of the milk and let it rehydrate it for 5 minutes.

3. Stir thoroughly using an up and down motion to distribute the starter throughout the milk.

4. Cover. Maintaining a temperature between 72°F and 78°F, let milk ripen for 12 hours. The curds will form a solid, custard-like mass surrounded by clear whey.

5. Ladle curds into a strainer lined with damp butter muslin. Allow to drain for a few minutes, then fold in the salt. Tie the corners of the muslin together and hang the pouch over a bowl. Let drain for 6 to 12 hours; longer draining results in a firmer, drier cheese.

6. Once desired texture is achieved, remove from cheesecloth. Refrigerate, covered, for up to 1 week.