The Basic Science (It’s Magic!) Behind Cheese Making

Sources: *One-Hour Cheese* by Claudia Lucero; Edgewood Creamery website; Science.HowStuffWorks.Com;

Instructional video available on Driftwood Public Library’s new YouTube Channel: https://www.youtube.com/watch?v=OY39X-eSLLI&t=144s

“Cheesemaking is the controlled process of removing water from milk. This process concentrates the milk’s protein, fat and other nutrients and increases its shelf life. Cheesemaking is one of the earliest examples of biotechnology.” – Edgewood Creamery

Like sourdough bread, making cheese is one of the earliest forms of microbiology.

The transformation of milk into cheese is one of the most extraordinary of all human discoveries. No one knows exactly when, but it is believed to have happened at about the same time as the domestication of animals such as goats in the fertile crescent region of the Middle East, around 6,000-7,000BC. It is unknown when the first cheese was made, but the legend goes that a nomad was carrying milk in a pouch made of a calf’s stomach lining. Over time (and at the right temperature) the milk fermented. Not wanting to waste the chunky milk, the nomad tried it and liked it. This legend about the first cheese is not unlike that of the first sourdough leavened bread.

The components of Cheese:

**Milk:**

Made up of water, fats, proteins, bacteria, lactose (a sugar), minerals and more. Unpasteurized milk also contains the enzyme lactase, which helps you digest milk.

**Salt:**

Besides adding flavor, “salt is also a great preservative and, under the right conditions, can help turn a previously highly perishable substance (milk) into a stable cheese that doesn’t require regular refrigeration.”

**Note:** When making one-hour cheese, we only use salt for flavor and to control the amount of whey we leave in the curds for texture. As you can see, cheese-making is complicated. It produces a product that preserves milk proteins and sugars with acids and salt.

**Rennet:**

Rennet is an enzyme that was originally found in the stomachs of unweaned animals. There is both animal and vegetable based rennets. “The enzymes ... in vegetarian rennet are derived from the fungi family.”
Acid:

Acid added to hot milk creates curdling or coagulation. Vinegars and citrus juices are all you need for the acid. “By adding vinegar or citrus juice, we mimic the acidification that occurs spontaneously – to some extent – if you let fresh raw milk sit at room temperature for several hours. Naturally occurring friendly bacteria within the milk eat the sugar (lactose) and produce lactic acid.” Lactic acid bacteria is what makes sourdough sour. Acidifying (souring) milk helps to separate the curds and whey and control the growth of undesirable bacteria in cheese. Usually special ‘starter’ bacteria are added to milk to start the cheese making process. These bacteria convert the lactose (milk sugar) to lactic acid and lower the milk’s pH.

There are two types of bacteria used for this process:

**Mesophilic bacteria** thrive at room temperature but die at higher temperatures. They are used to make mellow cheeses, such as Cheddar, Gouda and Colby.

**Thermophilic bacteria** thrive at higher temperatures, around 55 °C, and are used to make sharper cheeses such as Gruyère, Parmesan and Romano.

Cheese Making

![Cheese Image]

**Easier to make than you might think**

Cheese is way of preserving milk for long periods of time. In the process, the milk in cheese becomes something completely unlike milk, but cheese has its own interesting and delicious properties. Cheese-making is a long and involved process that makes use of **bacteria**, **enzymes** and naturally formed **acids** to solidify milk **proteins** and **fat** and preserve them. Once turned into cheese, milk can be stored for months or years. The main preservatives that give cheese its longevity are salt and acids. The basic steps in cheese making go something like this (for most common cheeses like cheddar):

First, milk is inoculated with lactic acid bacteria and **rennet**. The lactic acid bacteria convert the sugar in milk (lactose) to lactic acid. The rennet contains enzymes that modify proteins in milk.
Specifically, rennet contains rennin, an enzyme that converts a common protein in milk called **caseinogen** into **casein**, which does not dissolve in water. The casein precipitates out as a gel-like substance that we see it as **curd**. The casein gel also captures most of the fat and calcium from the milk. So the lactic acid and the rennet cause the milk to curdle, separating into curds (the milk solids, fats, proteins, etc.) and whey (mostly water). A gallon of milk (about 8 pounds) yields only about 1.25 pounds of cheese -- the weight that is lost is all the water in milk. The curds and whey are allowed to soak until the lactic acid bacteria create a lactic acid concentration that is just right. At that point, the whey is drained off and salt is added. Now the curds are pressed in a cheese press -- lightly at first to allow the escape of the remaining whey, then severely (up to a ton of pressure) to solidify the cheese. Finally, the cheese is allowed to age (ripen) for several months in a cool place to improve its taste and consistency. A sharp cheddar cheese has been aged a year or more. During this time, enzymes and bacteria continue to modify proteins, fats and sugars in the cheese. The holes in Swiss cheese occur during ripening -- Swiss cheese is ripened in a cool place for several weeks, then put in a warm place (70 degrees F, 21 degrees C or so) for four to six weeks, where special bacteria ferment the remaining lactose and produce carbon dioxide bubbles in the cheese.

**Fun Facts and a Cheese Tasting Exercise**
(from Urbancheesecraft.com)

**Lactose**: Milk sugar! Sugars end in *ose*

**Lactase**: Milk enzymes! Enzymes end is *ase*

Do you know your ABCs, what about your Ose and Ase?

These work together to help us digest milk. Isn’t nature cool?!

What does lactose intolerant mean?

You’ve heard that some people are allergic to lactose? That means they have trouble digesting the sugar in milk. They might get a stomach ache when they eat ice cream for example.

Some people say they can drink raw milk, just not pasteurized milk.

What is Pasteurization?

This is from the website, www.realmilk.com

“It set out to accomplish two things: Destruction of certain disease-carrying germs and the prevention of souring milk. These results are obtained by keeping the milk at a temperature of 145 degrees to 150 degrees F. for half an hour, at least, and then reducing the temperature to not more than 55 degrees F.”

It's true, it does kill harmful germs but unfortunately, it also kills helpful bacteria and it is thought that those helpful bacteria create lactase in the stomach and help us digest milk. You should know that
people can really argue about the safety of raw milk (not pasteurized) and it is not even legal in all states. That’s because dirty or contaminated milk can make people very sick. Learn more and find recipes and videos on www.urbancheesecraft.com That is true of a lot of food, isn’t it?

Some of you may live on a dairy farm and drink raw milk every day. Some of you might be scared to try it. You do have to be careful when it comes to raw milk but it is safe when clean and from healthy animals. Best of all, raw milk becomes cheese very easily! Don’t worry though, our recipes are tested with pasteurized milk too and they work just fine.

If you are allergic to ALL milk and you still want cheese, we can help you make dairy-free cheese!

How can there be “cheese” without dairy?

Well, technically it’s not really cheese but there are some nuts, beans and veggies that can taste and look like cheese if prepared properly. It’s pretty incredible. When recipe testing at Urban Cheesecraft, we taste real dairy cheese, close our eyes and try to detect all the different flavors so we can make our dairy-free cheese taste just as good.

HOW DO WE CREATE A CHEESY TASTE, LOOK AND TEXTURE WITHOUT DAIRY?
We like to think of our dairy free cheeses as great creamy sauces and soups first. That way they are filled with real food and delicious flavors anyone would like.

Then we make them thick and creamy with nuts, beans, and tapioca (similar to a potato).

Cheese is fatty and satisfying so it’s important to add healthy fats. The nuts or seeds can help with that along with some olive oil, coconut, or avocado oil. They also help the cheeses melt like real cheese!

Finally, the flavor balance...this is the tricky part that requires a lot of tasting and recipe experiments! Try the tasting exercise on the next page so you can experience and practice part of our process.

CHEESE TASTING EXERCISE:

Try this with any cheese, dairy or dairy-free.

Create a small platter of cheese cubes- just a snack-sized amount. It can be one cheese or several. All homemade or a combination with store-bought. It’s up to you.

Allow the cheese to sit at room temperature for 15 minutes (out of the fridge). The fat softens in the warmer environment. That makes it easier to taste details once the cheese is in your mouth. It’s a great way to enjoy cheese too!

Add some plain bread or crackers like baguette or saltines. You will use these to “cleanse your palate” in between tastes. This essentially moves all the cheese bits left on the roof and rest of your mouth down your throat (water helps). This way, they do not flavor your next bite.

Pour a tall cup of water for yourself. Drink some with the bread or crackers in between cheese bites. You want your cheese tastes to be as pure as can be.

Grab a pencil and get ready to taste and detect details!

1. Eat a cracker and a drink some water so we can start with a fresh palate.

2. Take a small bite of cheese and chew slowly allowing it to melt in your mouth.
3. Close your eyes. What do you taste first? Place a number next to the flavor below and then write down any thoughts that come to mind.

Salty- Describe it. Did it make your thirsty? ______________________________________________________

Tangy- Describe it. Did it make your mouth water? ___________________________________________________

Bitter- Describe it. Is it in the back of your throat? __________________________________________________

Sweet- Describe it. Is it kind of like butter or cookies? _______________________________________________

Umami- This is a nice flavor that doesn’t fall under the categories above. Just yummy! _________________

_____________________________________________________________________________________

Other flavors? Spicy, grassy- did you add any herbs or spices? Write them here:________________________

_____________________________________________________________________________________

_____________________________________________________________________________________

It’s a fun challenge to taste in such detail, isn’t it? You can try it with fruit, soup, or any other food!

**Now you have earned your badge as an Official Cheese Taster. Have fun!**
Cheese Making Resources Available From the Library

One-hour cheese: ricotta, mozzarella, chèvre, paneer—even burrata, fresh and simple cheeses you can make in an hour or less! / by Claudia Lucero, founder of Urban Cheesecraft and Creator of DIY Cheese Kit
Lucero, Claudia.

Home cheese making: recipes for 75 homemade cheeses / Ricki Carroll; [foreword by Laura Werlin]
Carroll, Ricki.
BOOK | 2002

Artisan cheese making at home: techniques & recipes for mastering world-class cheeses / Mary Karlin; photography by Ed Anderson; foreword by Peter Reinhart
Karlin, Mary.
BOOK | 2011

The beginner’s guide to cheesemaking: recipes and lessons to make your own handcrafted cheeses / Elena R. Santogade
Santogade, Elena R.,
BOOK | 2017

The joy of cheesemaking: the ultimate guide to understanding, making, and eating fine cheese / Jody Farnham and Marc Druart
Farnham, Jody.
BOOK | 2011

Kitchen creamery: making yogurt, butter, and cheese at home / Louella Hill, The Milk Maid; photographs by Erin Kunkel
Hill, Louella.
BOOK | 2015
Everyday cheesemaking: how to succeed making dairy and nut cheese at home / K. Ruby Blume
Blume, K. Ruby,
BOOK | 2014

Home cheese making: from fresh and soft to firm, blue, goat's milk, and more: recipes for 100 favorite cheeses / by Ricki Carroll; additional recipe development by Jim Wallace
Carroll, Ricki,
BOOK | 2018

Vegan cheese: simple, delicious plant-based recipes / by Jules Aron
Aron, Jules,
BOOK | 2017

One-hour dairy-free cheese: make mozzarella, cheddar, feta, and brie-style cheeses using nuts, seeds, and vegetables / Claudia Lucero
Lucero, Claudia,

https://science.howstuffworks.com/innovation/edible-innovations/food-preservation7.htm
https://www.theguardian.com/science/blog/2010/jan/05/science-cheesemaking-cheese
https://www.sciencefriday.com/educational-resources/get-cheesy-make-curds-and-mozzarella/
https://www.urbancheesecraft.com/
Cheese Recipes to Try
(all recipes from Claudia Lucero’s website urbancheesecraft.com or her book One-Hour Cheese)

Simple Creamy Goat Cheese

How Easy Is It?
Level: Easier
Ready to Eat In: 45 minutes
Makes: a Little less than ½ pound
Biggest Pain: Old or low quality pasteurized goat’s milk can be difficult to coagulate
Uses: Filling for tarts and quiche, crumbled over roasted veggies or salad, or just as a spreadable cheese

Ingredients
Half gallon goat's milk, 2 quarts (not ultra pasteurized)
1 tsp citric acid (included in our kit)
1 tsp cheese salt, to taste (included in our kit)
1 tsp fresh herbs (optional)

Yield
About 1/2 lb

Instructions

STEP 1.
Measure the citric acid into 1/4 cup of water and stir.

STEP 2.
Heat the milk to 185°F (do not allow to boil) stirring often to prevent scorching. Add citric acid solution with 5-7 strokes and stop stirring.

Supplies
Large pot- at least 3 quart
Fine cheesecloth
Colander
Large Slotted spoon
Cheese Molds
Measuring cups and spoons
STEP 3.
The curd will be smaller and more fragile than that of cow’s milk cheeses. Handle it gently when checking for coagulation.

STEP 4.
Take the pot off heat and allow the curd to set undisturbed and off the heat for 5 minutes.

STEP 5.
Line a colander with the cheesecloth and gently pour or scoop your curds into the colander to drain out the whey. Once most of the whey has drained out, sprinkle in your salt and blend in gently. Mix in your herbs (or you can coat the shaped log later instead) and stir minimally.

STEP 6.
You can make a bag out of the cloth and hang it to drain for 10-30 minutes or to your desired consistency. This is ready to eat as a soft, spreadable cheese as is!

STEP 7.
You can easily shape the soft cheese into a log with the help of wax paper. Roll in fresh herbs for a nice presentation!

Storage guidelines
Cover and store in the refrigerator
Use within 1 week
CHIVO FRESCO

Ingredients:

- 1 quart (4 cups) whole cow’s milk (not ultra-pasteurized)
- 1 quart (4 cups) goat’s milk
- ¼ cup apple cider vinegar
- 1 teaspoon flake salt, or to taste
- 1 teaspoon chili pepper flakes, or to taste (optional)

Supplies:

- Large colander or mesh strainer
- Fine cheesecloth
- Large heat-resistant bowl or platter (optional, for whey collection)
- 3-quart stockpot
- Cooking thermometer
- Large mixing spoon
- ⅛ cup
- 1 teaspoon
- Cheese mold of choice, to shape a wheel (optional)
- Clean 16-ounce jar or bottle, for pressing cheese

Recipe:

1. Line the colander with cheesecloth.
2. Place a bowl underneath if you want to collect the whey, otherwise, place the lined colander in your clean sink.
3. Pour both quarts of milk into the pot and heat the milk, on medium, to 200°F.
4. Stay close and monitor the heat, stirring every few minutes to prevent a skin from forming on the surface of the milk.

How Easy Is it?

Level: Easiest
Ready to Eat In: 40 minutes
Makes: 10 ounces
Biggest Pain: High temperatures require attention to avoid scorching and boiling over.
Uses: Crumbled or sliced onto most anything, especially latin dishes. Use warm and just drained off to stuff roasted veggies or pasta shells.
Recommended Milk: 1 quart cow’s milk and 1 quart goat’s milk.
Worth Mentioning: Press it for 15 minutes for a firm cheese or use/store it immediately after draining for a semi-creamy cheese.
5. Check for sticking milk at the bottom of the pot. (Reduce the heat if you feel any milk sticking.)
6. When the temperature reaches 200°F, add the apple cider vinegar and stir it in thoroughly.
7. Coagulation should happen within seconds.
8. Take the pot off the hot burner and very gently stir the curds for 1 minute (don’t break them up, just move them around as they shrink and release more whey).
9. Pour the curds and whey into the cloth-lined colander.
10. Let the curds drain for 2 to 5 minutes, stirring gently to release whey, until the curds resemble thick oatmeal.
11. Add the salt and the chili pepper flakes to the curds (you may do this in the colander, or transfer the curds to a bowl).
12. Stir thoroughly to further cool and dry the curds.
13. The salt and exposure to air both promote whey release, so being quick will still result in a soft enough curd that can be tightly compressed.
14. But, if you want dry crumbles, stir as much as you’d like!
15. Gather the corners of the cheesecloth to create a tight bundle.
16. You can press the cheese right in the colander.
17. Squeeze the bundle into any one of the molds mentioned in the Equipment section.
18. Here, I use a plastic ricotta basket to create a wheel shape.
19. Press the curd bag into the mold, and fold the cloth neatly on top.
20. Firmly place a clean, water-filled 16-ounce jar or bottle on top, for about 15 minutes. More whey will drain from the mold.
21. Remove the press and unwrap your beautiful wheel.
22. Your Chivo Fresco is ready to crumble onto tacos or to eat with cucumbers or tortilla chips and guacamole right away. The longer it cools, however, the easier it will be to slice.
Fromage Facile

Ingredients

- 1 quart (4 cups) whole cow’s milk (not ultra-pasteurized)
- 1 cup cultured buttermilk
- 2 tablespoons fresh lemon juice
- 1/4 teaspoon flake salt (or to taste)
- Herbs (to taste; optional)

Supplies

- Medium colander or mesh strainer
- Fine cheesecloth
- Large, heat-resistant bowl (optional, for whey collection)
- 2-quart stockpot
- Cooking thermometer
- Large mixing spoon
- 1 cup
- 1 tablespoon
- 1/4 teaspoon
- Parchment paper

Directions

1. Line the colander with cheesecloth, wet or dry. Place a bowl underneath if you want to collect the whey; otherwise, place the lined colander in your clean sink.
2. Pour the quart of cow’s milk into the pot. Then heat the milk at medium to 175°F.
3. Stay close and monitor the heat, stirring every few minutes to prevent a skin from forming on the surface of the milk. Check, too, for sticking milk at the bottom of the pot. (Reduce the heat if you feel any milk sticking.)
4. When the milk temperature hits 175°F, add the buttermilk and lemon juice and stir thoroughly. You should start seeing some coagulation!
5. Once you’ve completely stirred in the buttermilk and lemon juice, take the pot off the heat. Leave it undisturbed for 5 minutes.
6. Return to the cooling pot. You will clearly see a separation between curds and whey now. Stir the curds gently for a few seconds just to check out the change in texture. Then pour the curds and whey into the cloth lined colander.
7. Allow the curds to drain until they resemble thick oatmeal; it should take just 1 to 2 minutes. Stir in the salt.
8. Pack the cheese into a paper-lined dish to form it into a wheel.
9. Flip the dish onto the serving platter and peel away the paper.

Your Fromage Facile is ready to eat!
Variations + Substitutions

- Mix in fresh herbs, sun-dried tomatoes (no oil), or pickled jalapeños to make a nice bagel spread.
- Add currants, diced dried apricots, or any other dried fruit you enjoy.
- Cool the cheese in a jar and gift it! Store in the refrigerator and use within a week.
Ale-Washed Squeakies

Ingredients:
- ½ tablet vegetarian rennet
- ½ cup dechlorinated water
- 1 gallon low-fat cow’s milk
- 3 tablespoons lemon juice
- 16 ounces cold ale
- 2 cups ice cubes
- 1 teaspoon flake salt or to taste
- 1 teaspoon dry or fresh dill
- ½ teaspoon white pepper

Supplies
- ½ cup measuring cup
- Measuring spoons
- Large colander or mesh strainer
- Fine cheesecloth
- Large, heat resistant bowl (for whey collection), optional
- 5-quart stockpot
- Large whisk
- Cooking thermometer
- Knife
- Large mixing spoon
- Large slotted spoon or wire spider
- Large bowl for ice bath
- Paper towels
- Large bowl for drying curds, optional

Directions:
1. Dissolve the ½ tablet of rennet in the ½ cup of water and set aside
2. Line the colander with cheesecloth. Please a bowl underneath if you want to collect the whey, otherwise place the lined colander in your clean sink.
3. Pour the milk into the pot and whisk or stir in the lemon juice.
4. Heat milk on medium to 95 degrees.
5. Add the rennet solution and mix it in with 20 strokes to make sure it is incorporated evenly.
6. Continue to heat the milk on medium to 110 degrees so that the rennet is activated and coagulation occurs.
7. You should have a full pot of curd that looks like yogurt, or you could have many pieces of yogurt-like curd floating in whey – both are great coagulation results.

How Easy Is it?
Level: Easy
Ready to Eat In: 1 hour
Makes: Just under 1 pound
Biggest Pain: Reheating the whey for the hot whey bath which takes time
Uses: Snacks, replacement for pasta or gnocchi
Recommended Milk: 1 gallon low-fat cow’s milk
Worth Mentioning: Beer/Ale is not required for the icy bath – cold wine or plain water work great too.
8. Use a knife to chop the curd into 1-inch chunks. If the entire pot of milk is semi-solid. Cut the curd by making slices vertically and horizontally, tic-tac-toe style.

9. Then slice in at an angle to chop all the way down to the bottom of the pot so that if you had x-ray vision, you would see 1-inch cubes of curd floating in whey.

10. Gently move the pieces of curd around while continuing to heat them to 115 degrees. The curbs will release more whey and shrink as they cook in the hot whey.

11. Lower the heat to maintain the temperature at 115 degrees. Check that all the curds have changed from yogurt texture to a scrambled egg texture. They will look more rounded (having lost their sliced edges) and will not dissolve as easily when pinched.

12. Spoon the curds with a slotted spoon or wire spider into the cheese-lined colander and allow the whey to drain for a few minutes.

13. Use your hands to flatten and press the curds into a slab. You can fold it or flip it over a couple of times to release more whey.

14. Use your hands (or a knife) to break (or cut) the whole slab into snack-size pieces, and set them aside for a few minutes to release a bit more whey.

15. Re heat the whey to 165 degrees. Gently and without breaking them apart any further, drop the curds into hot whey. Heat the curds for 5 to 10 minutes, stirring very little, and monitoring the heat to keep it as 165 degrees.

16. Prep the cold ale bath while the curds heat: place the ice in the bowl, pour the bottle of ale over the ice and stir to chill evenly.

17. After the curds are heated, cold-shock them by spooning them into the ale bath using the slotted spoon or wire spider.

18. Move the curds around in the ale bath until they are completely cool. Pinch and taste them. The texture should be very springy and you will feel a squeak on your teeth when you bite into one.

19. Spoon the curds into the paper towel-lined bowl to drain, about 2-minutes.

20. Blot the curds dry.

21. Remove the paper towels from the curds.

22. Add the salt, and the dill and the pepper.

23. Toss the curds to evenly coat.

24. Ale-washed squeakies are complete!