Making Cheese at Home

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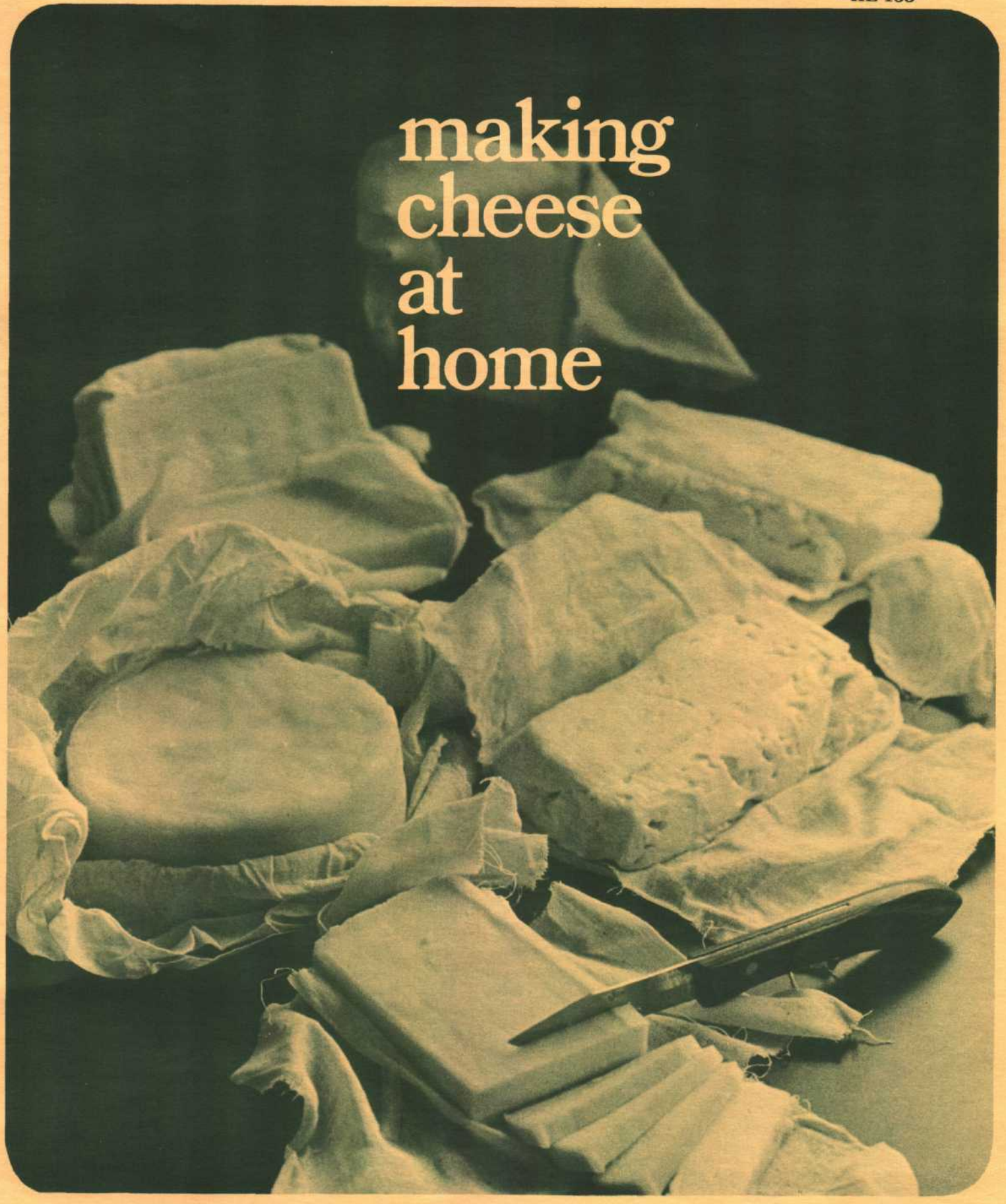

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Omar Khayyám once suggested that pleasure consisted of "a loaf of bread, a jug of wine and thou." He should have added "a piece of cheese" to make that suggestion complete, for cheese is as delectable and as old as both wine and bread and is made in a similar way. It is made through a fermentation process whereby the curds (solid portion) of the milk are removed from the whey (water portion) and changed into a delightful food.

Legend tells us that cheese was first made many centuries before Christ in the warm Mediterranean sea environs. The French maintain that cheese was first made by a shepherd who forgot a container of milk in a limestone cave, only to discover it several months later transformed into a piece of cheese. The English claim that cheese was first made in Somerset County in western England when another shepherd left milk in a cave. Returning several months later, he discovered cheese which to this day bears the name of those English caves in the Mendip Hills–Cheddar.

Regardless of who was the first to make it, cheese is a mainstay in the diet of many nationalities in the world and is made in every shape, size, and form imaginable from the milk of many mammals. Despite man's attempts to make a science out of cheesemaking, the finest cheeses are still made by those who know the art, who get their hands into the curds and treat it with the care and attention needed to produce a fine-flavored piece of cheese.

The purpose of this bulletin is to introduce you to the steps involved in cheesemaking so you can practice the art in your own home. Making cheese takes time, patience, and practice, but once you have mastered the techniques it becomes easy and a way of life. Start with small amounts of milk to help you learn the techniques. Then go to bigger batches when you have developed confidence.

This bulletin points out trouble spots and ways to correct them and gives some general methods for making various kinds of cheese. Read it thoroughly before you attempt to make cheese and use it as a reference once you start. Remember that it is you the cheesemaker who will determine the fineness of the cheese you make.

Basic Steps in the Manufacture of Cheese

OBTAINING GOOD MILK

The primary requirement for making cheese is a good supply of milk. The milk should be fresh, clean, and pasteurized. It is essential that the milk come from healthy animals. Pasteurization is necessary to destroy bacteria that could cause disease or that might cause undesirable fermentation and flavors in the cheese. The milk from any mammal can be used, but usually cow or goat milk is used. In France, sheep milk is used to make Roquefort cheese, and in some areas in Italy buffalo milk is used to make Mozzarella cheese.

You can use fresh milk obtained from a farm if you pasteurize it. A method for pasteurizing milk is given in the section preceding the cheese-making methods. If you don't have access to milk from a farm, you can use milk from your local dairy. Milk that has not been homogenized is preferable for the cheese methods given in this bulletin.

Full fat milk, milk with skim milk added, and skim milk are used for the cheeses described. The higher the fat content of the milk used in making cheese, the better the flavor of the cheese will be. The composition of milk is shown in table 1.

Adding starter culture to milk.

Table 1. Gross composition of milk

Component	Approximate percentage
Water	86-88
Fat	3-5
Protein	
Casein	2.5
Others	0.7
Carbohydrates	
Lactose	4.5-5.0
Glucose	Trace

Enzymes: catalase, peroxidase, xanthine oxidase, phosphatases, aldolase, amylases, lipases, esterases, carbonic anhydrase, salolase

RIPENING THE MILK

Making cheese from milk is essentially a concentration process. A portion of the water in the milk is removed during the process. Water removal is aided by the development of lactic acid in the milk. This conversion of milk sugar (lactose) to lactic acid is caused by certain kinds of bacteria called lactic acid bacteria. As these bacteria grow in the milk they produce acid, which is the beginning of the cheesemaking process. As the process continues, acid development helps expel water from the curds. Much of the flavor that cheese develops is caused by bacteria and enzymes breaking down the milk constituents to flavor compounds.

When milk is pasteurized, any lactic acid bacteria that might be present are destroyed. So, to start the cheesemaking process, a culture of lactic acid bacteria grown in sterile milk is added to the cheese milk. Adding a starter culture has distinct advantages over depending on bacteria indigenous to the milk: fermentation is controlled, many undesirable flavors are prevented, and consistent quality cheese is obtained.

The most common type of lactic acid bacteria used are *Streptococcus lactis, Streptococcus cremoris, Streptococcus thermophilus, Lactobacillus bulgaricus,* and, in some cheeses, *Leuconostoc citrovorum.* When used in making cheese, these bacteria must be actively growing. Active growth is maintained by daily transfer into fresh milk. These procedures are explained in detail later.

The ripening period in cheesemaking is the time from addition of the starter culture to the cheese milk until the coagulating enzyme is added. During ripening, the lactic acid bacteria start to grow, increasing the acid content of the milk. The ripening time varies from a few minutes to several hours, depending on the variety of cheese being made.

This milk is not ready for cutting; the curd does not break clean from the spatula.

FORMING CURDS

Curdling and coagulation are terms used to describe the change of milk from a liquid to a semi-solid structure or gel. Curd formation, which is essential to cheesemaking, can be achieved by adding certain enzymes that act on the protein of milk, causing it to form the gel. Or it can be achieved by allowing lactic acid to develop to such a concentration that it will cause an acid precipitation of the protein. Most cheese curds are made by adding enzymes to the milk. Cottage cheese is one cheese that is made by the acid curd system.

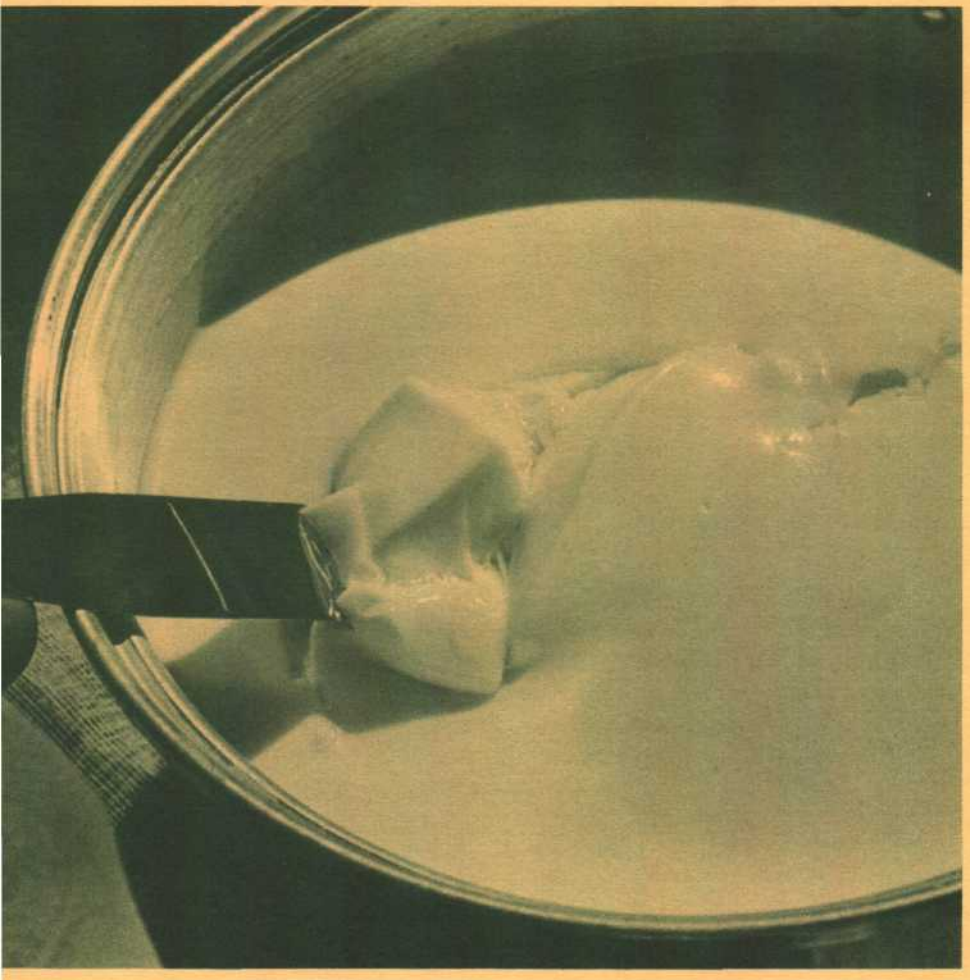
The most commonly used enzyme is called rennet, an extract of the third stomach of a suckling calf. It is used in making cheese throughout the world. Recently discovered enzymes that are produced by certain microorganisms also can be used for coagulating milk. These enzymes are available commercially. Rennet for home cheesemaking can be purchased in tablet form at most drug stores. Cheese factories may sell liquid rennet.

No matter what type of cheese is being made, the curd is forced to shrink, causing it to lose water and become firmer. The degree of shrinkage determines the moisture content of the curd and influences the final characteristics of the cheese. Curd shrinkage is enhanced by heat, lactic acid production by bacteria, and the action of the coagulating enzyme.

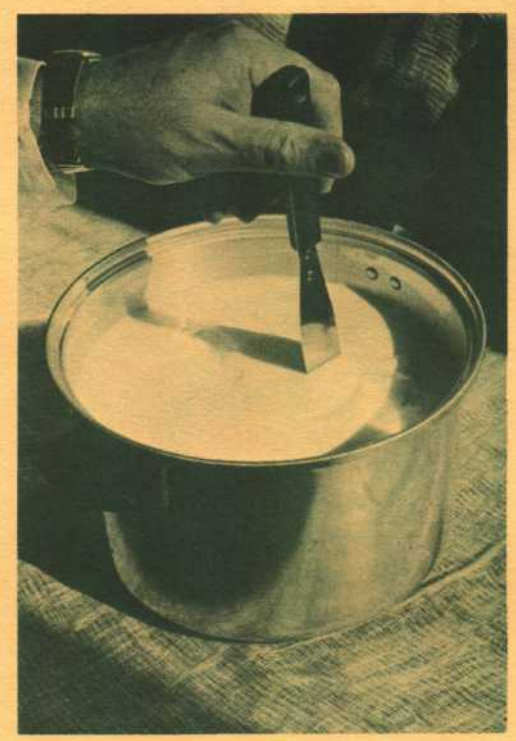
Escape of whey is facilitated by cutting the curd into small pieces, by stirring (along with a slow rise in temperature), and by applying pressure on the curd. To produce a cheese with low moisture and relatively low acid, the cheesemaker would do one or more of the following:

- heat the curd to a fairly high temperature.
- cut the curd into small pieces.
- assure rapid acid production early in the process.
- subject the curd to high pressure.

To make cheese with a high moisture content, the curd is heated very little, it is not cut or it is cut into large cubes, acid is allowed to develop in the cheese after the whey has stopped draining, and the curd is not pressed.



Coagulated milk at the point when it is ready to be cut. Note how the curd breaks clean from the spatula.



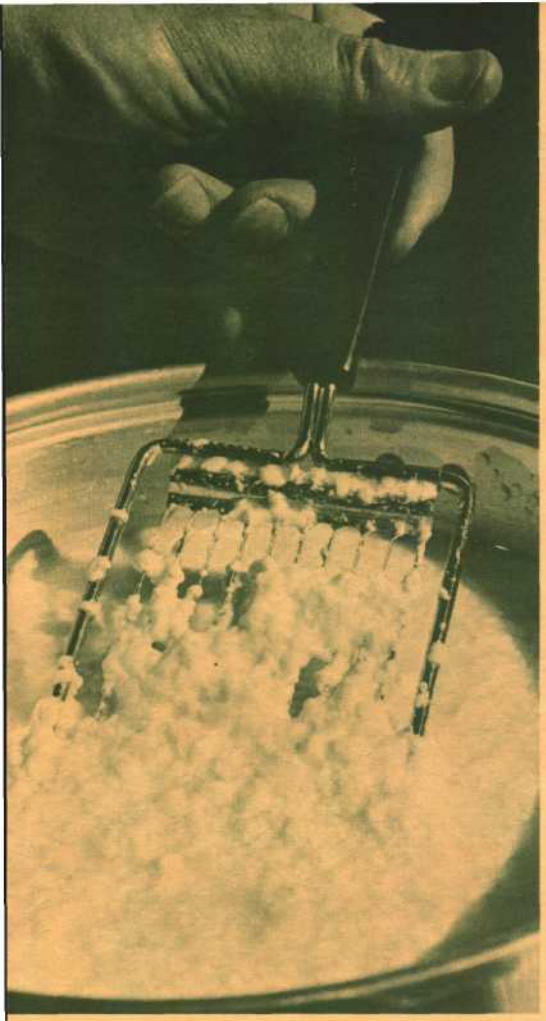
Cutting the curd into 1-inch cubes with a spatula and cutting more finely with a wire cutter.

COOKING THE CURD, DRAINING THE WHEY, FORMING THE CURD MAT

In cheesemaking, the term cooking refers to a slow heating of the curd while it is slowly stirred. The slow heating encourages the growth of the lactic acid bacteria, increasing acid production. The heat and the acid both contribute to curd shrinkage and water expulsion. This step in the cheesemaking process varies, depending on the type of cheese being made and the moisture content desired. Many methods are used to adjust moisture content. Several possibilities are:

1. The coagulated curd is carried directly from the vat into perforated molds or forms that hold the curd but allow the whey to escape. No pressure is applied. This technique produces cheese with high moisture, high acidity, and soft body. Brie and Camembert are two cheeses made in this manner.

2. The curd is cut into cubes and part of the whey is allowed to separate. Usually some stirring is involved, but no heat is applied. After a specific time



Cutting the curd to the desired final size with a wire cutter.

period the curd is transferred to forms as in method 1. Light pressure may be applied. This method produces cheese with high moisture, high acidity, and a firmer body than cheese made by method 1. Blue-veined cheeses are usually made in this way.

3. The curd is cut as in method 2. It is then heated and stirred slowly until it reaches the desired firmness. Curds are dipped into forms, where pressure may be applied. A high cooking temperature and high pressure on the curd result in cheese with low moisture and low acid. Brick and Muenster are typical of the cheeses made by this technique.

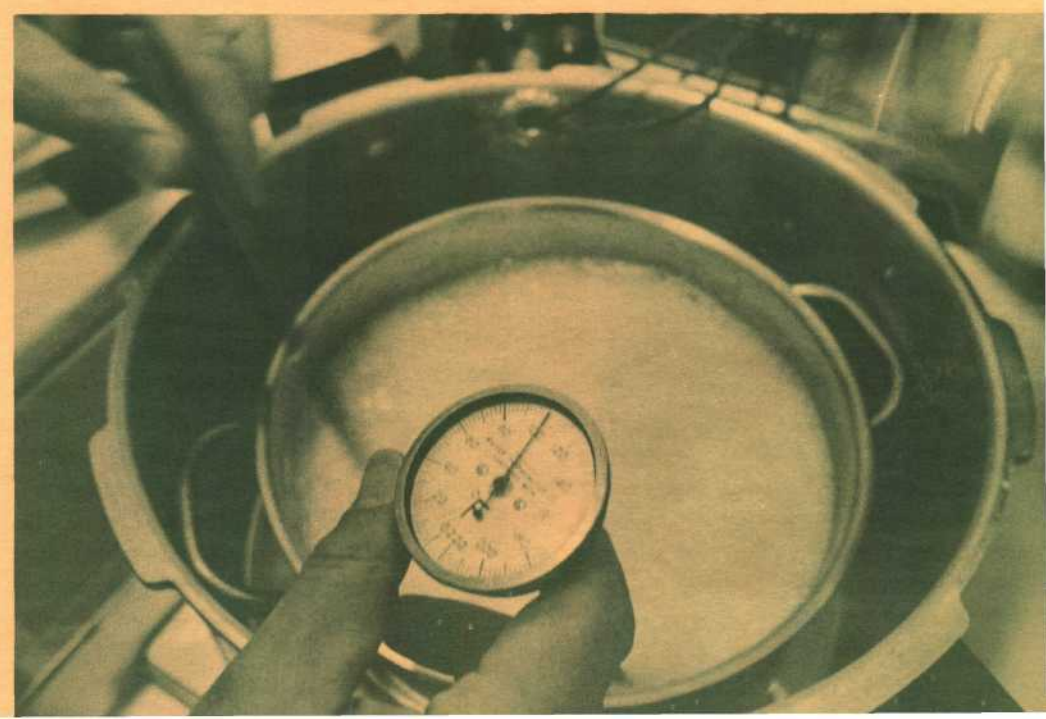
4. The curd is cut and cooked as in method 3, but it is left in the vat while the whey is drained off. The curd particles may be kept distinct by stirring, or the curd may be allowed to mat together. The mat may be cut into pieces that will fit into the forms, or it may be milled or chopped into smaller pieces, salted, and then packed into forms, where pressure is applied. The curd mat also may be formed under the whey and removed intact, cut into pieces, and placed in forms under high pressure. Cheddar and Colby are examples of cheese made by the first method; Gouda and Swiss are examples of cheese made by the latter technique. Most hard cheeses are made by this method.

SALTING THE CHEESE

Salt (sodium chloride) is added to almost all varieties of cheese at some point in their manufacture. Salt has several functions: it contributes flavor; it aids in whey expulsion, thus helping to control moisture and acid content; and it helps control the growth of undesirable microorganisms that might cause off-flavors in the cheese.

Salting usually occurs at the end of the cheesemaking process but prior to curing. Salt can be applied directly to the curd particles before the curd is put into the forms and pressed. Cheeses made by method 4 usually are salted in this way. Salt also can be incorporated by floating the cheese in salt brine or by rubbing the surface of the cheese with dry salt. The amount of salt taken up with these latter two methods depends on the concentration of the brine, the time and temperature of exposure, the ratio of surface to volume of the cheese, and the moisture content of the cheese. With these latter two methods, salt is at first concentrated near the surface, but it diffuses evenly throughout the cheese as it cures.

Checking the temperature of curds and whey during cooking.



RIPENING OR CURING THE CHEESE

Up to this point, the techniques for producing various cheeses are similar. What happens during ripening determines the kind of cheese you will get.

The fresh curd has a bland, somewhat salty, sour taste and is tough and rubbery. Most cheeses are cured until they acquire a more desirable flavor and texture. The transformation of fresh curd into cured cheese is brought about by enzymes from three main sources: from the enzyme used to coagulate the milk, from microorganisms that grow within the cheese or on the cheese surface, and from the milk itself. The composition of the fresh curd and the conditions under which the cheese is held during curing determine the nature of the changes that take place. In general, cheeses with high moisture, high acidity, and soft body are cured under high temperature, high humidity conditions or are not cured at all. Cheeses with low moisture and low acid content may be cured for a longer time at lower temperatures and humidities.

Curing conditions for each type of cheese are explained later in this bulletin. A separate refrigerator or a cool, dry spot in the basement will serve as an adequate area for ripening cheese. It is important that you find a proper curing area, particularly if you want to make hard cheeses. Proper curing conditions will reduce undesirable mold growth and waste and will help develop the desired cheese flavor.

After the cheese has been cured, it should be refrigerated to slow down further ripening. Soft cheeses generally can be kept in a refrigerator for several weeks; hard cheeses can be cured for long time periods and refrigerated even longer.

Adding salt to the curd.

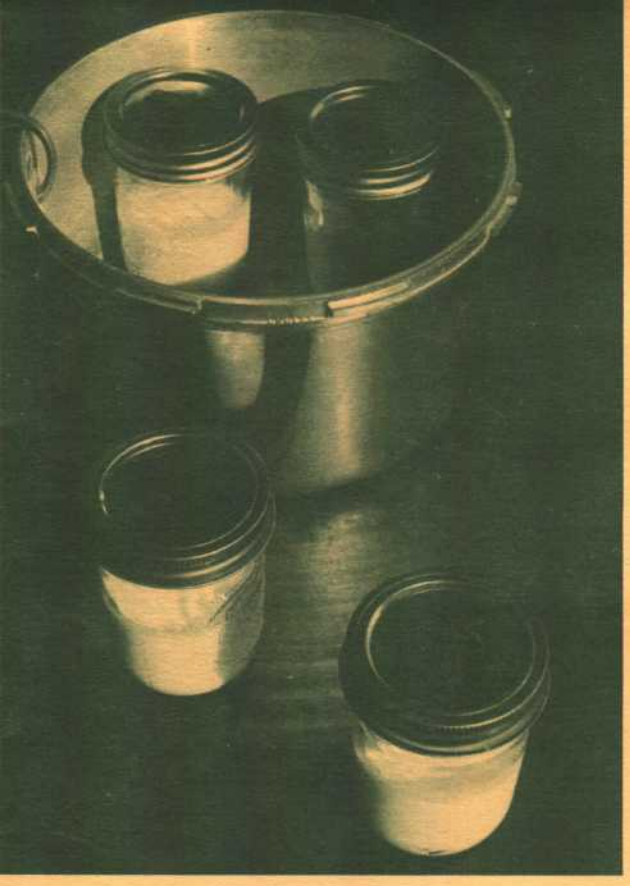
Classification of Cheeses

In general, cheeses are classified according to their moisture content, with soft cheeses having high moisture content and hard cheeses lower moisture content. Cheeses also can be classified by the microorganisms that bring about specific changes such as eye formation in Swiss cheese, mold growth in blue cheese, surface growth of mold on Brie cheese, or bacterial growth on brick cheese. Table 2 delineates these classifications. It also contains federal definitions and standards of identity for several varieties of natural cheese.

Table 2. Federal definitions and standards of identity for natural cheeses

Cheese	Maximum percentage moisture	Minimum percentage fat		Minimum ripening time (months)	Remarks
		In dry matter*	In total mass		
Class standards					
Hard grating	34	32		6	
Hard	39	50			
Semi-soft	50	50			
Soft	--	50			
Individual varieties					
Unripened (soft) cheeses					
Cottage	80		--		
Creamed cottage	80		4		
Cream	55		33		
Neufchatel	65		20		
Ripened cheeses					
Parmesan (Reggiano)	32	32		14	Primarily grating cheese
Asiago old	32	42		12	
Romano	34	38		5	
Asiago medium	35	45		6	
Sapsago	38	--		5	
Cheddar	39	50			
Granular (stirred-curd)	39	50			Similar to Cheddar
Colby	40	50			
Washed-curd	42	50			
Caciocavallo Siciliano	40	42		3	
Provolone	45	45			
Edam	45	40			Contain eyes
Gouda	45	46			
Swiss	41	43		2	
Gruyere	39	45		3	
Gorgonzola	42	50		3	Mold ripened
Roquefort	45	50		2	
Blue	46	50		2	
Gammelost	52	--			
Monterey	44	50			Smear ripened
High moisture jack	49	50			
Asiago fresh	45	50		2	
Brick	44	50			
Muenster	46	50			
Limburger	50	50			

*Fat remaining in the cheese after the water has been removed.



The Care and Handling of Starter Cultures

A primary problem for the home cheesemaker is finding adequate starter cultures and then maintaining them in a viable condition.

Local cheese factories may be willing to sell you some of their starter. Follow the directions given below to maintain the culture in a viable condition.

Commercial buttermilk, which is made by growing lactic acid bacteria in skim milk, can be used for a starter culture. Unfortunately, many dairies add salt to their buttermilk, making it unsuitable for cheesemaking. If you can obtain unsalted buttermilk, you can use it as a cheese starter.

Commercial yogurt is made by growing the lactic acid bacteria *Lactobacillus bulgaricus* and *Streptococcus thermophilus* in milk. Plain yogurt (no fruit or sugar added) can be used as a source of these organisms when they are needed to make the desired cheese.

MAINTAINING THE STARTER CULTURE

Starter cultures should be grown in antibiotic-free milk. Cows and goats often are treated with antibiotics for udder infections, and the antibiotics get into the milk. Their presence prevents the growth of lactic acid bacteria. All milk and milk products sold commercially are tested to make sure no antibiotics are present, so it should be safe to use such milk for maintaining starter cultures. If you buy or obtain milk directly from a farmer, however, be sure you ask whether he has recently treated his cows with antibiotics.

Milk to be used for starter cultures has to be given a high heat treatment. This treatment destroys all microorganisms that might grow and cause problems; it also makes the milk more nutritious for the lactic acid bacteria. Two different methods are used for growing the cultures. The method to use depends on the type of lactic acid bacteria in the starter culture.

To heat-treat milk, you will need a boiling water bath canner or similar container and several ½ pint mason jars and lids.

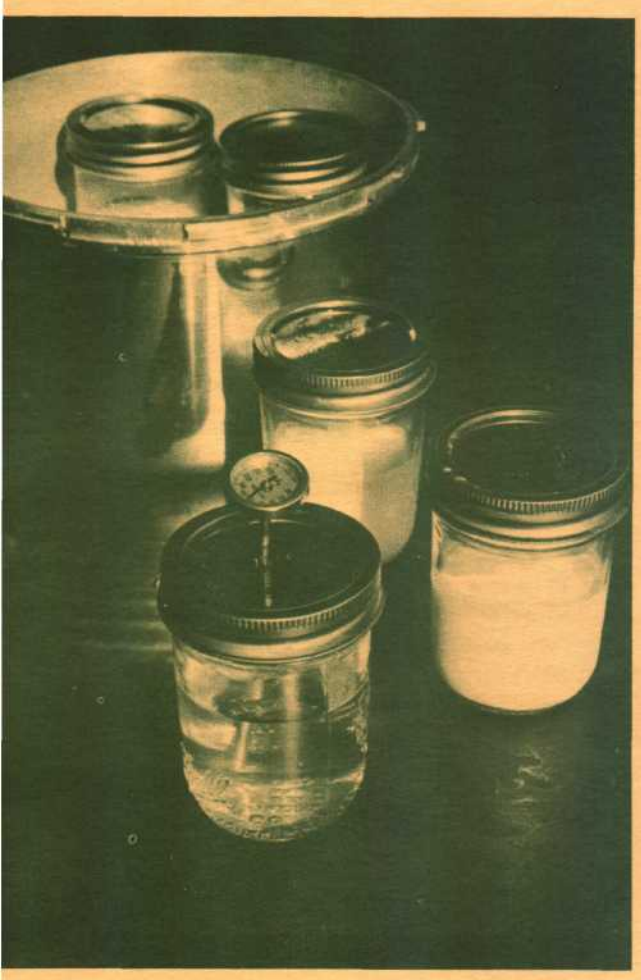
METHOD A

Starter organisms:

Streptococcus lactis,
Streptococcus cremoris,
Leuconostoc citrovorum,
buttermilk or sour cream cultures.

These are referred to as starter culture A in the cheesemaking section.

1. Clean the ½ pint mason jars and lids with hot soapy water and rinse them with hot water. Allow them to drain dry. (You can reuse the lids, since a seal is unnecessary after heating.)
2. Fill the jars with 6 ounces of milk. (You can use whole milk, skim milk, or reconstituted nonfat milk.) After filling, tighten lids.
3. Place filled jars in a water bath canner or similar pot and fill the pot with water until the jars are covered by about 1 inch of water.
4. Place pot on heat source and turn on the heat. When the water starts to boil gently, reduce the heat to maintain a gentle boil for 30 minutes. The desired heat treatment is 185°F. for 30 minutes. If the water is gently boiling, the temperature of the milk will be close to 185°F.



Equipment needed for preparing milk to be used for maintaining starter cultures. Note the thermometer in a jar filled with water for checking temperature.

Transferring starter culture to fresh milk.

5. After 30 minutes, remove pot from the heat source. Put it in a sink and run cool water into the pot to cool the jars of milk. Run water over them until the jars are cool enough to handle. Then remove them from the pot and put them in the refrigerator. Milk for the starter cultures treated in this way will keep for at least 2 weeks in the refrigerator. You can prepare milk ahead for transferring culture.
6. Prior to inoculation, remove the heated milk from the refrigerator and warm it to 70°F. You can do this by putting the jar of milk in a pan of water at 75°F. After a short time, the temperature of the milk will be close to 70°F. Do not put a thermometer into the milk to determine temperature; it may contaminate the milk. Instead, use a second jar filled with water to determine temperature.
7. Incubate these cultures at 70°F.(about room temperature). Locate in the kitchen or another room a spot where this temperature can be maintained. Using an unheated oven is one possibility.
8. To transfer the culture, carefully open the tempered jar of milk to be inoculated. Lay the lid on the jar. Open the jar of culture that you want to transfer. Lift the lid off the first jar and hold the lid in one hand so it doesn't get contaminated. With the other hand, pour a small amount of old culture into the new milk. Replace and tighten the lid and swirl the milk gently to mix it.
9. Set jar in the area you have chosen for incubation at 70°F. Allow it to incubate for 15-18 hours or until the milk has set. If the whey has started to show, the culture has been incubated too long. If the milk is thin and not coagulated, it has not been incubated long enough.
10. Place the culture in the refrigerator when it has reached the desired firmness. Always prepare fresh culture for cheesemaking the night before you want to make cheese.
11. To maintain viability, transfer cultures in this manner three to four times a week. Overincubation weakens a culture. If a culture has not set up in 24 hours, discard it and start a new one. After the new culture has set, you can use the old culture for buttermilk pancakes or other foods, or you can drink it as cultured buttermilk. Always keep a fresh culture on hand for future use.

METHOD B

Starter organisms:

Streptococcus thermophilus,
Lactobacillus bulgarius,
yogurt cultures.

These are referred to as starter culture B in the cheesemaking section.

Proceed as in method A, with the following exceptions.

Step 4. Heat the milk for 1 hour in boiling water or use a pressure cooker and heat it at 10 pounds per square inch for 20 minutes or 15 pounds per square inch for 10 minutes.

Steps 7 and 9. Incubate these cultures at higher temperatures than the cultures used for method A. They should be incubated at 100°F. ± 5° for 12-15 hours. You may want to use a water bath in an oven set at a very low temperature. You also can use home yogurt making equipment.

All other steps are the same as in method A.

Yield of Cheese

Milk is composed of approximately 87 percent water and 13 percent solids (see table 1). In general, cheesemaking results in a yield of 10 percent. Not all the milk solids are recovered nor is all the water removed. A good rule to follow is that 10 pounds of milk should yield 1 pound of cheese. Yields will be greater with high moisture cheeses and less with low moisture long cure cheeses.

Cost of Making Cheese at Home

Incidental costs in making cheese at home will be for a good thermometer, rennet, and culture. Most of the equipment needed is available in the average kitchen or can be improvised from materials around the home. These costs extended over several lots of cheese will be minor compared to the cost of the milk and have been omitted in the following calculations.

(If you are unable to find a suitable thermometer, you can purchase a stainless steel dial thermometer with an 8-inch stem directly from:

Hercules, Inc.
Lincoln Sales Division
2285 University Avenue
St. Paul, Minnesota 55114

Ask for Weston model number 4200. Specify a temperature range of either 0° to 220°F. or 25° to 125°F., and specify plastic or glass lens. The cost is approximately $15.)

The main cost will be for milk. Since cheese yield is related to the amount of milk used, you can calculate the cost of cheese by simple mathematics. For example, let's say you have made Queso Blanco, a high moisture cheese that yields about 1 pound per gallon of milk. The cost of this cheese (excluding labor and power usage) would be the cost of a gallon of milk. If the milk cost $1.25 per gallon, the cost of the cheese would be $1.25 per pound.

If you have made Romano, which is a low moisture long cure cheese, the cost would be different. One gallon of milk will make about 3/4 of a pound of cured Romano cheese. So, if the gallon of milk cost $1.25, the cost of the cheese would be $1.67 per pound.

Uses of Whey

Whey is the watery part of the milk that is removed from the curds during the cheesemaking process. It has several uses, so don't discard it, particularly if you make cheese regularly in any quantity. Collect the whey and store it in the refrigerator. If whole milk was used to make the cheese, cream will rise to the top of the whey. Skim off this cream and heat it to destroy the rennet, which will otherwise cause the cream to turn rancid. Use the cream to make butter or sour cream, or use it in cooking as heavy cream.

You can use the remaining whey in several ways. Use it to replace milk in recipes calling for milk, such as bread, soups, etc. Try flavoring it with fresh fruit to make a refreshing beverage. If you live on a farm, you can feed whey to chickens and pigs as part of their daily ration.

COLOR

Most of the popular cheeses consumed in the United States are colored with a harmless vegetable dye called annatto. The addition of color makes the cheese more appealing in the eyes of some consumers, but adding color is not an important part of the cheesemaking process. If you want to

color your cheese, you can obtain liquid cheese color from a cheese factory or you can obtain color in tablet form from the culture manufacturers listed previously. You also can make your own color by using carrots. Peel and grind up carrots mechanically, separating the juice from the carrot pieces. You will have to determine the amount needed to get the color you want. Add the color to the milk before adding the rennet and after adding the culture.

How to Pasteurize Milk

Use a double boiler to pasteurize milk. Don't heat milk directly over a burner; the milk will scorch and have a strong cooked or burned flavor and it won't clot very well. To pasteurize milk in a double boiler, follow these directions:

1. Fill the bottom section of a double boiler with water.
2. Add milk to the top section and cover it.
3. Heat milk to 160°F. using an accurate thermometer to check the temperature. Learn to estimate the time needed to bring the milk to 160°F.
4. As soon as the milk temperature reaches 160°F., cool it immediately by placing the top section of the double boiler in cold running water or ice water. Quick cooling minimizes the development of a cooked flavor and the growth of spoilage bacteria that might survive the heat treatment. If you plan to make cheese immediately, cool the milk to setting temperature.
5. If you need a second container for storing milk in the refrigerator, use glass jars (with covers) that have been sanitized in a boiling water bath or in a mechanical dishwasher. Keep your fingers out of the jars when filling them.
6. Store milk in the refrigerator. Properly handled home pasteurized milk should keep under refrigeration for 7-10 days.

Procedures for Making Several Different Varieties of Cheese

When cheese is made commercially, a continuing determination is made of the amount of acid in the milk or whey that has been produced by the growth of the lactic acid bacteria. Because most homemakers don't have the equipment necessary for determining acidity, the procedures listed here are based on average times required to obtain desired acidity. As you develop your cheesemaking techniques, you may want to change the times involved. The procedures given here are only guidelines to help you get started.

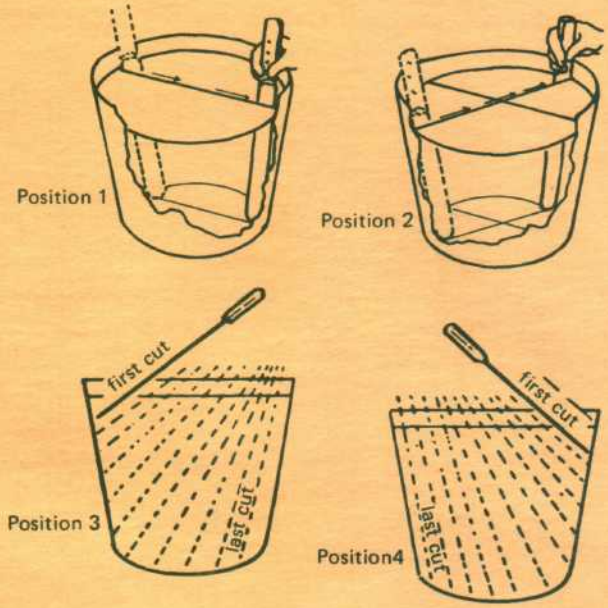
Times are listed from 0 time, which is when you add the starter culture to the milk. If you start your cheesemaking on the hour, the times given would be minutes after that hour. For example, in making Queso Blanco, if you add the starter at 9:00 a.m., then the setting temperature of 92°F. should be achieved by 9:30, rennet added at 9:35, and stirring stopped at 9:40. The curd would then be cut at 10:10 and so on.

Amounts of materials used are for 1 U.S. gallon (1 U.S. gallon of milk weighs 8.5 pounds). To increase the amounts used, multiply the amounts given by the number of gallons of milk you are using. For example, if you are using 5 gallons of milk, you would multiply the quantities given by 5.

The procedures described below were developed using Hansen's Cheese Rennet Tablets. If you are using another source of rennet, the amounts needed may not be the same as given here. Follow the directions that came with your rennet.

Cheese	QUESO BLANCO (white cheese)
Starter culture	A or B
Milk	Pasteurized whole, 2 percent, or skim milk
Time (hours, minutes)	
0.0	To 1 gallon of milk, add 8 ounces of buttermilk or 4 ounces of yogurt.
0.30	Stir and warm slowly to 92°-94° F.
0.35	Add ¼ tablet rennet dissolved in 4 ounces of cold, clean water. Stir gently for 3-5 minutes.
0.40	Stop stirring. Allow milk to stand until it coagulates (about 30 minutes).
1.10	Cut curd into 1-inch cubes. Stir gently for 30 minutes. Maintain temperature at 92°-94° F.
1.40	Remove whey; allow curd to settle to bottom.
1.50	Add salt according to personal taste. Mix 3 teaspoons into the curd in three portions 5 minutes apart (1 teaspoon three times).
2.05	Divide curd into two equal piles, line two forms with cheesecloth, and place curd in each. Fold cloth over curd.
2.15	Press for 3 hours with light pressure.

Follow your original cuts as nearly as possible; holding knife at angle as in position number 3—then as in position 4.



5.15	Remove cheese from forms and remove cheesecloth. Wrap the cheese in plastic wrap and refrigerate it. You can use this cheese immediately.

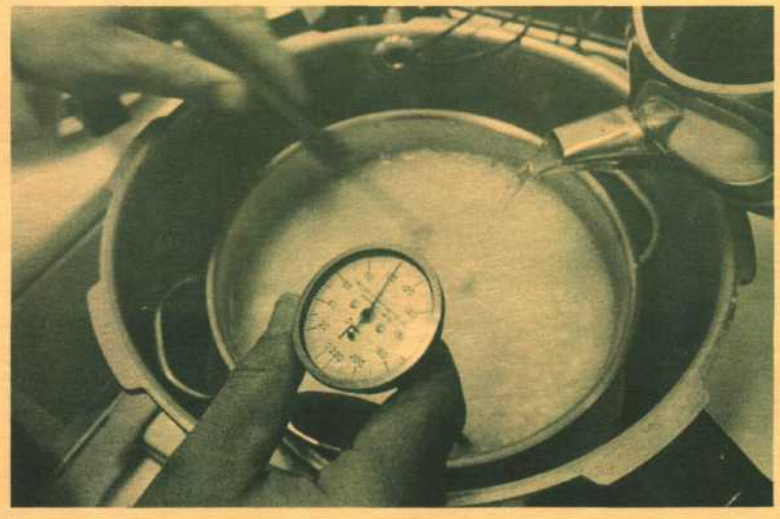
Cheese	COTTAGE CHEESE
Starter culture	A
Milk	Pasteurized skim milk or reconstituted nonfat dry milk
Time (hours, minutes)	
0.0	To 1 gallon of milk at 88° F., add 10 ounces of starter culture. Stir slowly for 30 minutes.
0.30	Cover and let milk remain quiet for 5 hours (keep milk at 88°-90° F.) or until curd is formed and whey begins to cover the curd.
5.30	Cut the curd to approximately ½-inch cubes. Leave the cubes undisturbed for 30 minutes.
6.00	Stir curds gently and add about 2 quarts of water at 110° F. Start cooking the curd by slowly increasing the temperature of the pot until the temperature reaches 125°-130° F. (3-degree increase in 10 minutes). Maintain this temperature until curd reaches desired firmness (about 90 minutes).
7.30	Drain whey off curd to point where curd is just barely covered. Add tap water until temperature is 80°- 90° F. Stir curd slowly in water-whey mixture to cool.
7.40	Drain water off curd and add cold water to chill curd thoroughly.
7.50	Drain water off curd by lining colander with cheesecloth and putting curd in colander. Allow to drain for 30 minutes.
8.20	Store in refrigerator as is, or add cream to the curd to make cottage cheese. To salt, mix in 1-3 teaspoons of salt to taste. Use half & half, coffee cream, or whipping cream for the creaming mixture. Add about 4 ounces per pound of dry curd.

Cheese	CREAM CHEESE
Starter culture	A
Milk	3½ quarts pasteurized whole milk
	1 pint pasteurized whipping cream
Time (hours, minutes)	
0.0	To 1 gallon of milk-cream mixture, add 6-8 ounces of culture. Warm to 85°F.
0.30	Add ¼ rennet tablet dissolved in 4 ounces of cold water. Stir gently for 3-5 minutes.
0.35	Cover and let milk set at 85°F. for about 1 hour until whey covers the curd and breaks clean from the side of the pot.
1.35	Cut curd into 1-inch cubes. Let cut curd set 5 minutes undisturbed.
1.45	Pour mixture into a muslin bag or colander lined with cheesecloth. Allow to drain overnight. Save whey, as it will contain considerable cream.
Next day	Work in 1½ teaspoons of salt. Package and store cream cheese in the refrigerator.

Removing or dipping whey from the curd.

Cheese	NEUFCHATEL
Starter culture	A
Milk	1 gallon pasteurized whole milk
	Proceed as with the manufacture of cream cheese.

Cheese	EDAM OR GOUDA
Starter culture	A
Milk	For Gouda: 1 gallon pasteurized whole milk
	For Edam: 1 gallon pasteurized 2 percent milk or 2 quarts whole milk mixed with 2 quarts skim milk
Time (hours, minutes)	
0.0	Adjust temperature of milk to 88°F. Add 2 ounces of starter culture. Stir in well.
0.05	Add ¼ rennet tablet dissolved in ½ cup cold, clean water and stir for 5 minutes.
0.10	Cover milk, keeping temperature at 88°F., and let milk set undisturbed until it coagulates (about 30 minutes).
0.40	Cut curd into ¼-inch cubes. Allow curd to stand for 5 minutes, then stir gently. Continue stirring gently for 30 minutes.
1.10	Stop stirring and allow curd to settle. Remove half of the whey.
1.20	Slowly add hot water (180°F.) to the curds and whey to raise



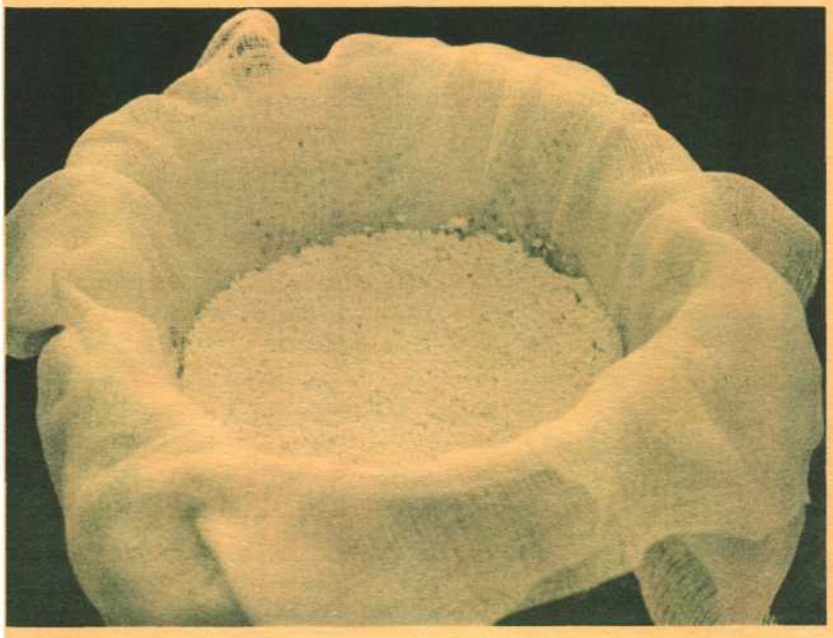
Adding hot water to cook Gouda curd.

	the temperature to 100°-102° F. Continue stirring slowly for an additional 45 minutes.
2.05	Stop stirring and allow curd to settle to bottom. Push curd to one side of the pot to make the curd mat the same thickness as you want the cheese.
2.10	With curd still under the whey, press curd slightly using a perforated plate and a quart jar full of water. Press for 10 minutes.
2.25	Drain off all whey and remove plate and pressure. Allow curd to mat for an additional 10 minutes.
2.35	Cut curd into two pieces the approximate size of the form. Place curd in unlined forms. Place one form on top of the other for 10 minutes, then reverse the forms for an additional 10 minutes.
2.55	Remove cheese from forms, line them with wet cheesecloth or muslin, and replace cheese in lined forms. Press lightly for 1 hour.
3.55	Release pressure, remove cheese from form, turn it over, and replace it in the cloth-lined form. Press at slightly higher pressure for an additional 3 hours.
6.55	Remove pressure, remove cheese from form, and hold cheese at 60° F. overnight.
Next day	Place cheese in saturated salt-brine solution at 60° F. Immerse cheese totally or cover the exposed surface with salt. Turn cheese daily and leave it in the brine for 2 days. (Brine time can be varied according to individual taste). Leave larger cheeses in the brine longer.
Curing	Remove cheese from brine and drain it for 1 day. Place cheese on clean, dry wooden shelves in a 50°-55° F. dry area. Turn cheese daily to maintain its shape and to achieve even drying, which will help prevent the growth of mold. After 3 days, wax the cheese and coat it with vegetable oil or apply a larded bandage to prevent further drying. This cheese can be aged for 1 year if desired.

Cheese	**ROMANO**
Starter culture	B
Milk	1 gallon pasteurized whole milk
Time (hours, minutes)	
0.0	Adjust temperature of milk to 88° F. Add 2 ounces of starter B to 1 gallon of milk. Stir gently for 30 minutes.
0.30	Add ¼ rennet tablet dissolved in ½ cup cold water. Stir for 3-5 minutes.
0.35	Cover, maintain milk temperature at 88° F., and let it set until the milk coagulates (about 30 minutes).
1.05	Cut curd into ¼-inch cubes. Allow curd to stand for 5 minutes before stirring.
1.10	Increase temperature slowly to 115° F. while stirring gently. Take 1 hour to reach this temperature.
2.10	When curd is firm, allow it to mat under the whey. Remove whey after a mat has formed.
2.30	Place curd in a cloth-lined form. Allow it to drain for an additional 20 minutes.
3.00	Press cheese in forms lightly for 1 hour.
4.00	Remove pressure, turn cheese in form, and press cheese for an additional hour.
5.00	Remove pressure. Leave cheese in the form overnight.
Next day	Immerse cheese in saturated brine solution for 1 day.
Curing	Drain cheese after removing it from the salt brine. Place it on a shelf in a dry room at 50°-60° F. and cure it for 5-12 months. Rub salt into the surface once per day for 2-3 days. Turn cheese frequently. Clean it by rubbing it with vegetable oil each week.

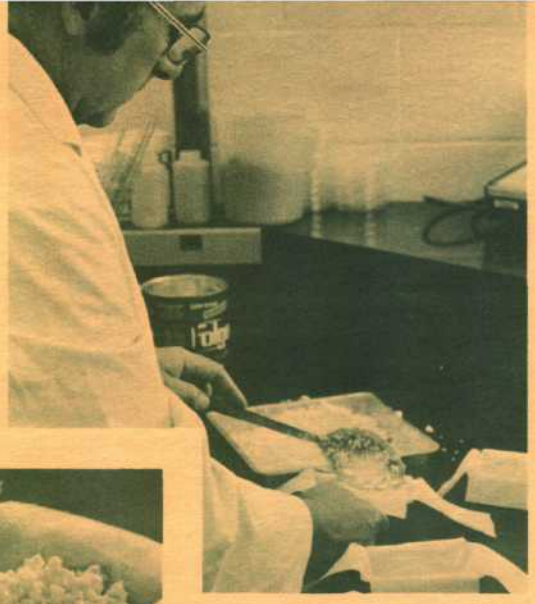
Cheese	**FETA**
Starter culture	B
Milk	1 gallon pasteurized whole milk
Time (hours, minutes)	
0.0	Adjust temperature of milk to 88°-90° F. Add 2 ounces of starter culture and stir slowly for 1 hour. Maintain temperature at 88°-90° F.
1.0	Add 1/8 rennet tablet dissolved in ½ cup cold, clean water. Stir for 5 minutes.
1.05	Cover and maintain temperature at 88°-90° F. Allow milk to set quietly until curd forms (about 1 hour).
2.05	Cut curd into 1-inch cubes. Allow it to set for 10 minutes undisturbed.
2.15	Stir curd gently every 10 minutes for 1 hour. Maintain temperature at 88°-90° F.
3.15	Transfer curd to open-ended forms on a perforated plate or in a muslin-lined colander. Allow curd to drain for 1 hour.
4.15	Invert curd in form so the top is on the bottom. Continue inverting it at 30-minute intervals for 3 hours.

Curd draining in a colander lined with cheesecloth.



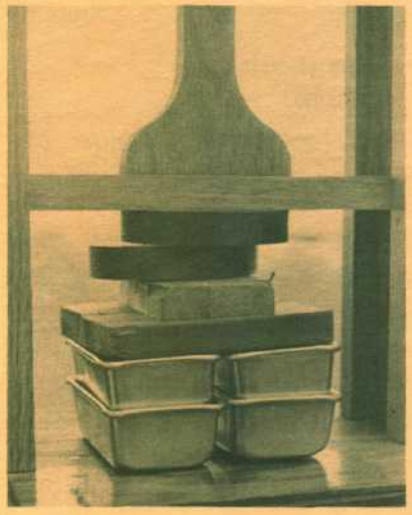
7.15	Sprinkle a layer of salt on all surfaces of the cheese and allow it to drain in the forms overnight.
Next day	Cut cheese into strips 3 by 3 by 6 inches. Loosely pack the pieces of cheese in a watertight container and cover them with cold, clean water containing 4-8 percent salt (according to taste). Seal the container and store it at 40° F. This cheese can be used immediately or stored for up to 2 months.

Cheese	**COLBY**
Starter culture	A
Milk	1 gallon pasteurized whole milk
Time (hours, minutes)	
0.0	Adjust temperature of milk to 88°-99° F. Add 4 ounces of starter culture and stir mixture slowly for 30 minutes.
0.30	Add ¼ rennet tablet dissolved in ½ cup cold water. Mix well for 3-5 minutes.
0.35	Cover milk. Maintain temperature at 88°-90° F. and allow milk to set quietly until coagulation occurs (about 30 minutes).
1.05	Cut curd into ¼-inch cubes. Allow curds to remain undisturbed for 5 minutes.
1.10	Stir curds slowly for 5 minutes.
1.15	Slowly increase temperature to 102° F. (2-degree increase in 5 minutes). Take about 40 minutes to reach this temperature. Maintain this temperature until the curd reaches desired firmness. Total time will be 1½-2 hours.
3.15	Drain whey to the point where the curd just shows at the top of the whey. Add cool water to decrease the temperature to 90° F. Stir for 20 minutes.
3.35	Remove the whey-water mixture, piling the curd on the bottom of the pot. Stir curd every 10



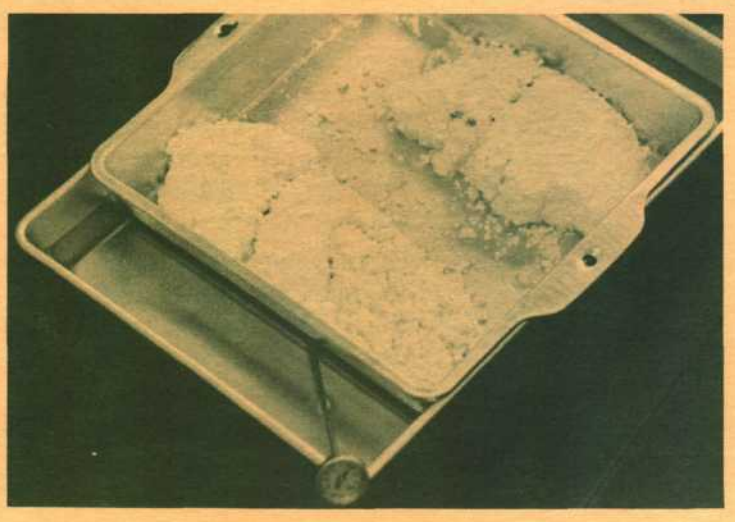
Transferring salted curd to muslin-lined forms.

Salted curd in a muslin-lined form, ready to be pressed.



Cheese in a press.

Curd in a "cheddaring" pan.



minutes to prevent matting. Drain curd by dumping it into a colander lined with cheesecloth. Then return it to the pot and salt it.

3.45 Add 3 teaspoons of salt to the curd in three applications (1 teaspoon of salt three times), stirring for 5 minutes after each application.

4.00 Place curd in a cloth-lined form and press it overnight.

Next day Remove cheese from press, remove the liner, and apply a larded bandage (see pages 20 and 21). Place the cheese in a dry, cool room (60°F.). Turn the cheese once a day to facilitate even drying. Cure this cheese for at least 2 months before you eat it. Curing should improve the flavor.

Cheese CHEDDAR

Starter culture A

Milk 1 gallon pasteurized whole milk

Time (hours, minutes)

0.0 Adjust temperature of milk to 88°-90°F. Add 2 ounces of starter culture. Stir slowly for 1 hour.

1.0 Add ¼ rennet tablet dissolved in ½ cup cold water and mix for 3-5 minutes.

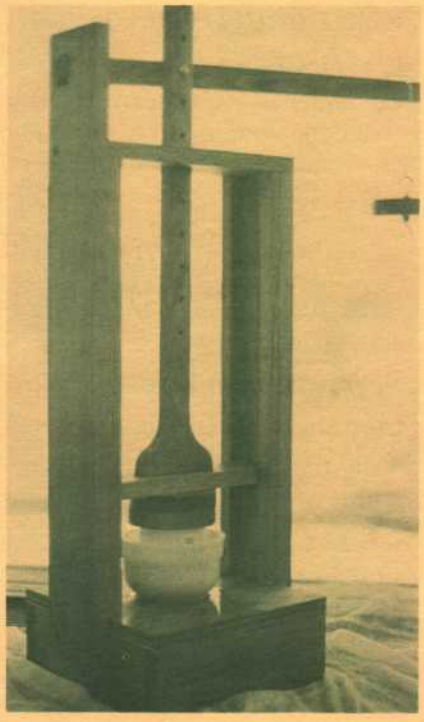
1.05 Cover, maintaining temperature of 88°-90°F., and let milk set undisturbed until coagulated (about 30 minutes).

1.35 Cut curd into ¼-inch cubes. Allow curds to remain undisturbed for 5 minutes.

1.45 Stir curds slowly. Start increasing the temperature slowly to 102°F. (about a 2-degree increase in 5 minutes). Take about 40 minutes to reach this temperature. Maintain this temperature until the curd reaches desired firmness. Total time will be about 1½-2 hours.

2.45 Stop stirring and allow the curd to settle to the bottom. Remove

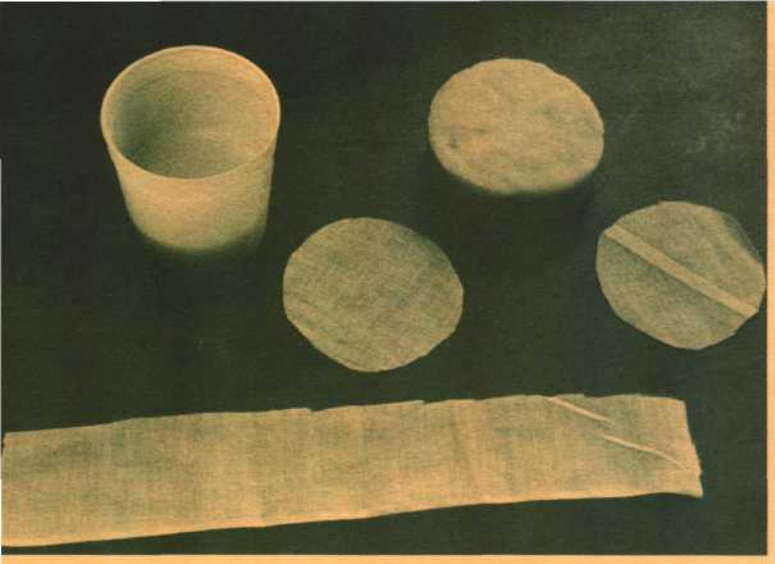
	the whey and transfer the curd to a flat bottom pan for cheddaring. The pan must be kept warm while the curd is being cheddared.
3.00	Cut curd mass into strips 3 inches wide and turn strips over. Continue turning strips every 15 minutes for 2 hours or until the curd forms a uniform mass which when pulled apart looks like cooked chicken breast.
5.00	Cut strips into ½-inch cubes. Add 3 teaspoons of salt in three increments (1 teaspoon three times) 5 minutes apart, stirring curds well each time. Salt is well worked into the curd when it has a shiny appearance and is rubbery.
5.20	Place curd in a cloth-lined form and press it overnight.



Cheese in a press.

Next day	Remove cheese from press, apply a larded bandage (see pages 20 and 21), and repress it an additional 8-12 hours to set the bandages.
Curing	Cure the cheese in a dry room at 50°-60° F. Turn it daily for 3 weeks to facilitate even drying and to help prevent mold growth. Turn it weekly thereafter. This cheese should be cured for at least 2 months.

Cheese,	**PIZZA**
Starter culture	B
Milk	1 gallon 2 percent milk or 2 quarts whole milk mixed with 2 quarts skim milk
Time (hours, minutes)	
0.0	Adjust milk temperature to 90°F. and add 4 ounces of starter. Stir slowly for 15 minutes.
0.15	Add ¼ rennet tablet dissolved in ½ cup cold water. Stir well for 3-5 minutes.
0.20	Cover, maintaining the temperature at 90° F., and let milk set until coagulated (about 30 minutes).
0.50	Cut curd into ½-inch cubes. Let curds set for 15 minutes with occasional stirring.
1.05	Slowly increase the temperature to 118° F. in 45 minutes. Hold this temperature for an additional 15 minutes.
2.05	Allow curd to settle under the whey. Remove whey and transfer the curd mat to a flat bottom pan that can be kept warm (as for Cheddar cheese). Do not cut mat. Turn mat over every 15 minutes for 2 hours. Mat should be well knitted when finished.
4.05	Cut mat into long strips (not cubes). Put curd in hot water (180° F.) and tumble and stretch it under the water using wooden spoons. It will become elastic after about 15 minutes.
4.20	Remove curd from hot water and shape it by hand into the desired form (ball or loaf). Place cheese in cold water (40° F.) for approximately 1 hour.
5.20	Remove cheese from cold water and put it into a saturated salt solution. Cover any exposed areas with dry salt. Leave cheese in the brine for 24 hours.
Curing	Remove cheese from the brine and let it dry for several hours. Wrap it in plastic wrap and refrigerate it. This cheese can be used immediately.



Materials needed for applying a larded bandage: cheese, a muslin bandage, and warm lard.

Miscellaneous Methods

MAKING BRINE SOLUTION

To make saturated salt solution for brining cheese, use 2 pounds of salt per gallon of water. Keep the brine cold (40°-50° F.) while cheese is in it. Saturated salt solution will always have excess salt that does not go into solution; there is no need to add more water. Even if you don't use it continually, change the brine no less than once a month. Saturated salt brine is corrosive, so be sure you put it in a heavy plastic or glass container.

MAKING AND APPLYING LARDED CHEESE BANDAGES

Applying cheese bandages with warm lard is an old method of sealing the surface of the cheese and helping prevent mold growth. Molds that do develop grow on the bandage, not on the cheese, and the cheese can be cleaned easily once curing is complete.

To make a larded cheese bandage, you will need lard that is slightly warmed but still solid, not liquid, and clean white muslin or similar cloth cut to the size of the cheese you want to bandage. Cut the cloth for the sides about 2 inches larger than the cheese. Make the circles for the top and bottom the same size as the cheese.

Follow these steps in applying the bandage:

1. Remove the cheese from the press and remove the form and cloth liner.
2. Smear warm lard on the top surface of the cheese. Put a muslin circle on the lard, working out any wrinkles. Use additional lard if necessary.
3. Turn the cheese over and smear lard on the sides. Carefully roll the muslin bandage around the side of the cheese, working out wrinkles as you go. The bandage should overlap the top and bottom about 1 inch.
4. Put lard on the bottom of the cheese and apply a muslin circle, working out any wrinkles as before.
5. Fold the side bandage overlap onto the top and work out any wrinkles carefully. Use additional lard as needed.
6. Turn the cheese over and fold the bandage overlap as in step 5.
7. Return the cheese to the form and press it for an additional 8-12 hours. The additional pressing will help set the bandage.
8. Remove the cheese from the press and store it in a cool, dry room.

As the cheese cures, use a stiff bristled brush to remove any mold growth from the bandage. When curing is complete, simply pull the larded bandage off the cheese. Always remove the bandage before cutting the cheese.

Laying the bandage over the lard on the side of the cheese; working out air bubbles and wrinkles.

Completing application of the larded bandage by working the corners smooth.

Applying the bandage to the bottom of the cheese.

WAXING CHEESE

Cheese can be coated with cheese wax after the surface is dry. It is difficult, however, to obtain cheese wax with the desired elasticity. A local cheese factory may have cheese wax they will sell. Or you can try making your own cheese wax by mixing vegetable oil and paraffin in various proportions. Start with a 50-50 mixture and vary the proportions as necessary.

To wax cheese, the cheese should be cold and the wax hot. Heat the wax slowly and carefully. If it gets too hot it may catch fire. Dip half the cheese into the wax for 30 seconds. Let the wax drip. Then turn the cheese over and dip the other half for 30 seconds. Return the cheese to the curing area. Turn it weekly.

Problems You May Encounter

MOLD

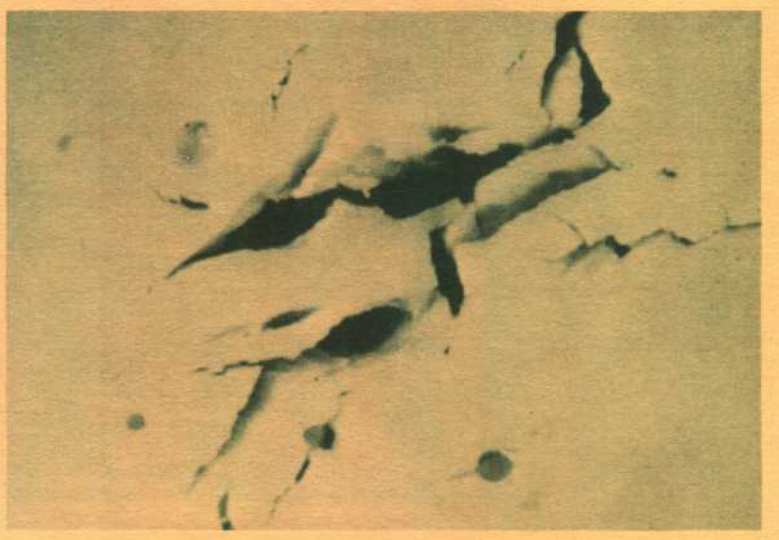
One of the most constant problems affecting cheesemaking is the growth of undesirable mold. Besides affecting the aesthetic value of the cheese, mold growth may also have an adverse effect on the flavor. Musty and other objectionable flavors can be imparted to the cheese by mold growth, so make every effort to prevent mold from growing on your cheese.

Unfortunately, the molds that like to grow on cheese are also able to grow in the areas used for curing it, such as on wooden shelves, walls, and ceilings. One primary requirement for a cheese curing area is a rigid cleaning program. (The same holds true if you attempt tó cure cheese in your refrigerator rather than in a separate location.) Cleaning the shelves and other cheese contact surfaces frequently is one method of reducing mold growth. Painting (after cleaning) the walls and ceilings frequently with mold resistant paint also will help.

Molds need moisture and air to grow, so keep cheese surfaces dry and prevent air from reaching the cheese. The underside of a cheese on a curing shelf will collect moisture, encouraging mold growth. Turn your cheeses frequently to keep all surfaces dry. Covering the cheese with wax, larded bandages, or other air-impermeable material also helps reduce the spoilage due to mold growth. If the covering material splits or cracks or if it is not sealed properly, mold will grow.

Once cheese has molded it is very difficult to prevent further mold growth. The best thing to do is cut away the molded areas and consume the cheese as quickly as possible.

Cheeses with small gas holes caused by undesirable fermentation.



Splits or large holes caused by undesirable gas fermentation.

GAS FORMATION

Occasionally an undesirable fermentation caused by unwanted microorganisms will occur, producing bloating or swelling of the cheese. The cheese will contain many small gas holes after such fermentation. Usually this gas is produced by a fairly common type of bacteria called coliforms. These bacteria like to grow in milk, converting lactose to acid and gas. Coliform organisms are common inhabitants of raw milk and thrive under unclean conditions. Control of this undesirable type of fermentation is generally achieved by using pasteurized milk and by making sure that all cheesemaking equipment is clean and sanitary.

RIND ROT

Excessive moisture on the surface of hard cheeses may allow yeasts, molds, proteolytic bacteria, and other microorganisms to grow and cause softening, discoloring, and undesirable odors. This condition is called rind rot. To prevent it, keep cheese surfaces dry.

CHEESE MITES

Cheese mites are extremely small spider-like creatures that will invade cheese surfaces and cause some undesirable changes. They appear as brown spots on cheese surfaces. Their presence indicates unsanitary and improper storage conditions. Control them by keeping your cheese curing area clean. Remember that frequent cleaning is essential to maintaining a good cheese curing room.

FLAVOR DEFECTS

Flavor defects in cheese can result from a variety of causes. Some off-flavors come directly from the milk the cheese is made from. Others may result from undesirable microorganisms that grow in the milk during cheesemaking or curing. Most of these defects can be avoided by using pasteurized milk and sanitary equipment and by keeping work and curing areas clean at all times.

Potential Hazards

Milk is a natural food for many organisms large and small. During cheesemaking, the growth of certain types of desirable bacteria is encouraged to develop characteristic cheese flavors and textures. Unfortunately, several kinds of pathogenic (disease-producing) bacteria also are capable of growing during the cheesemaking process. Many of these pathogenic bacteria can be in the milk, particularly if the milk comes from an animal that is or has been sick or from one that has mastitis. Pasteurization of milk destroys pathogenic bacteria, so it is absolutely essential that any milk used for home cheesemaking be pasteurized.

The importance of using pasteurized milk and keeping everything clean can't be overemphasized. If you are careful about these two points, you can be sure the cheese you make is tasty and healthful.

References

The references listed below were used in preparing this bulletin. Consult them if you want further information.

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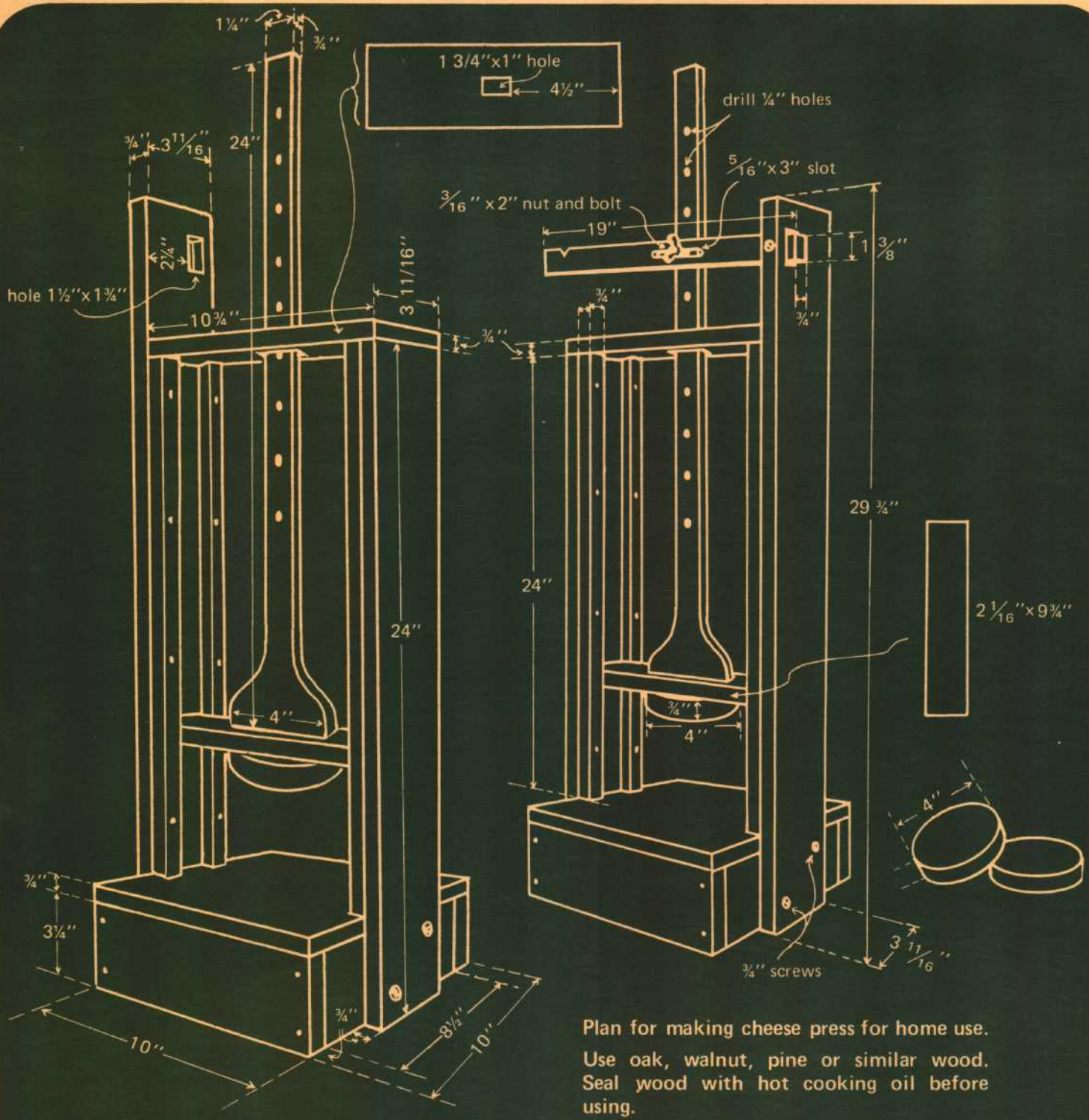
Kosikowski, F. V. 1970. *Cheese and Fermented Milk Foods.* Edwards Brothers, Inc., Ann Arbor, Michigan.

Wilster, G. H. 1964. *Practical Cheesemaking.* O.S.U. Bookstores, Corvallis, Oregon.

U.S. Department of Agriculture. 1969. *Cheese Varieties.* Agriculture Handbook 54. Government Printing Office, Washington, D.C.

You can obtain a copy of the last reference listed, *Cheese Varieties,* by writing to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The charge for this booklet is 65 cents; include payment with your order.



Plan for making cheese press for home use.

Use oak, walnut, pine or similar wood. Seal wood with hot cooking oil before using.

Notch on arm is for hanging weights to apply pressure.

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