

Producing

Sheep Milk Cheese

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There are approximately 6.14 million sheep in the United States (NASS 2005); however, only approximately 11,000 are dairy ewes (Thomas 2004). In 2003, the estimated U.S. sheep milk production was 1.2–1.8 million kg, most of which was used for cheese production (Thomas 2004).

Cow and goat milk cheeses have been produced in Oregon for decades. No sheep milk cheese is currently produced in Oregon, although sheep milk cheeses are popular around the world. Sheep milk cheeses originated primarily in countries surrounding the Mediterranean Sea. Some of the cheeses made exclusively from sheep milk are listed in Table 1 (page 2). Many more cheeses are made from sheep milk mixed with goat or cow milk.

The composition of sheep milk is quite different from milk of other species (Alichanidis 1996). The average composition is outlined in Table 2 (page 2). Sheep milk not only contains more fat, but its fat contains higher levels of short-chain fatty acids (Posati 1976), which contribute to the characteristic flavor of the cheese.

The high solid content in sheep milk promotes a high cheese yield. For example,



from 100 lb of sheep milk it is possible to produce approximately 17 lb of Manchego, 18 lb of Feta, 20 lb of Romano, or 22 lb of Blue cheese (Wendorff 2003). The higher the moisture content of the cheese, the higher the yield.

Sheep milk composition depends on the breed. Milk from many different breeds can be used for cheese production. Dairy sheep generally are selected based on the quantity of milk produced; a good dairy ewe can produce up to 1,100 lb of milk per year.

The interest in making sheep milk cheese in Oregon is growing. An OSU food science student recently participated in

a 9-month internship in Libya to learn more about sheep milk cheese production. Libya is one of the world's leading producers of sheep milk cheese, and cheeses have been made there for thousands of years. This publication describes the manufacturing process for eight Libyan sheep milk cheeses, many of which are made in other countries as well.

Some of these cheeses resemble cheeses on the European and U.S. market, and

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Table 1.—Country of origin of sheep milk cheeses.

Country	Cheese
France	Roquefort, Abbaye de Belloc, Perail
Italy	Canestrato Pugliese, Fiore Sardo, Pecorino Romano/Sardo/Toscano
England	Friesla, Olde York
Ireland	Orla
Spain	Castellano, Idiazabal, Manchego, Roncal, Zamorano
Portugal	Serra da Estrela
Greece	Kefalotiri, Myzithra, Feta*
Turkey	Beyaz Peynir, Mihalic Peynir
Czech Republic	Abertam
Romania	Brinza
Bulgaria	Katschkawalj
Hungary	Liptoi
Libya	Al Zahra, Jibnet Grus, Al Naseem

*Can also be made from goat or cow milk.

Source: *A Complete Illustrated Guide to the Cheeses of the World* (Harbutt 1999).

Table 2.—Average composition (%) of milk from different species.

Animal	Genus/species	Solid content	Fat	Casein	Serum protein	Carbo-hydrate	Ash
Cow	<i>Bos Taurus</i>	12.7	3.9	2.6	0.6	4.6	0.7
Goat	<i>Capra hircus</i>	13.3	4.5	3.0	0.6	4.3	0.8
Sheep	<i>Ovis aries</i>	18.8	7.5	4.6	1.0	4.6	1.0

Source: Walstra et al. 1999.

the common names are used when possible. The cheeses described here are Cottage cheese, Ricotta, Feta, Al Zahra, Blue-veined cheese, Jibnet Grus, Jibna Mkhultah, and Al Naseem.

Cottage cheese curd

This cheese, along with Ricotta, is the most widely produced and consumed cheese in Libya. It is popular for breakfast, when it is eaten with olives and breadsticks, accompanied by hot tea. It also is eaten as a light

meal with bread or toast. The mild flavor complements both savory and sweet additions. The cheese can be produced by the acid method or by the rennet method.

Acid method

Heat whole ewe's milk to at least 145°F for at least 30 minutes in a batch-type pasteurizer, or to at least 162°F for 15 seconds in a high-temperature, short-time pasteurizer. Allow the milk to cool slowly in a stainless steel vat to 109°F.

After the milk has cooled, inoculate it with

5% (culture-to-milk ratio) starter culture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* plus 1% of *Leuconostoc citrovorum*. This treatment gives a firm curd in about 4–5 hours.

When pH reaches 4.3–4.5, the curd is ready for cutting. Cut the coagulum with a wire frame cutter to a curd diameter of 12–15 mm. Stir the curds gently, either mechanically or by hand, using a stainless steel paddle. Stir for no more than 30 minutes. Next, over a period of 90–100 minutes, slowly heat the curds to 140–149°F, stirring constantly.

The curd is now ready for a first washing with warm water (around 110°F). While adding the wash water (approximately 50% of the initial milk volume), stir the curds for 10–15 minutes. Next, drain off the whey and apply a second wash. The water for the second wash (approximately 100% of initial milk volume) should be ice cold to cool and firm up the curd quickly. Stir constantly during washing. Repeat the cold water rinse several times.

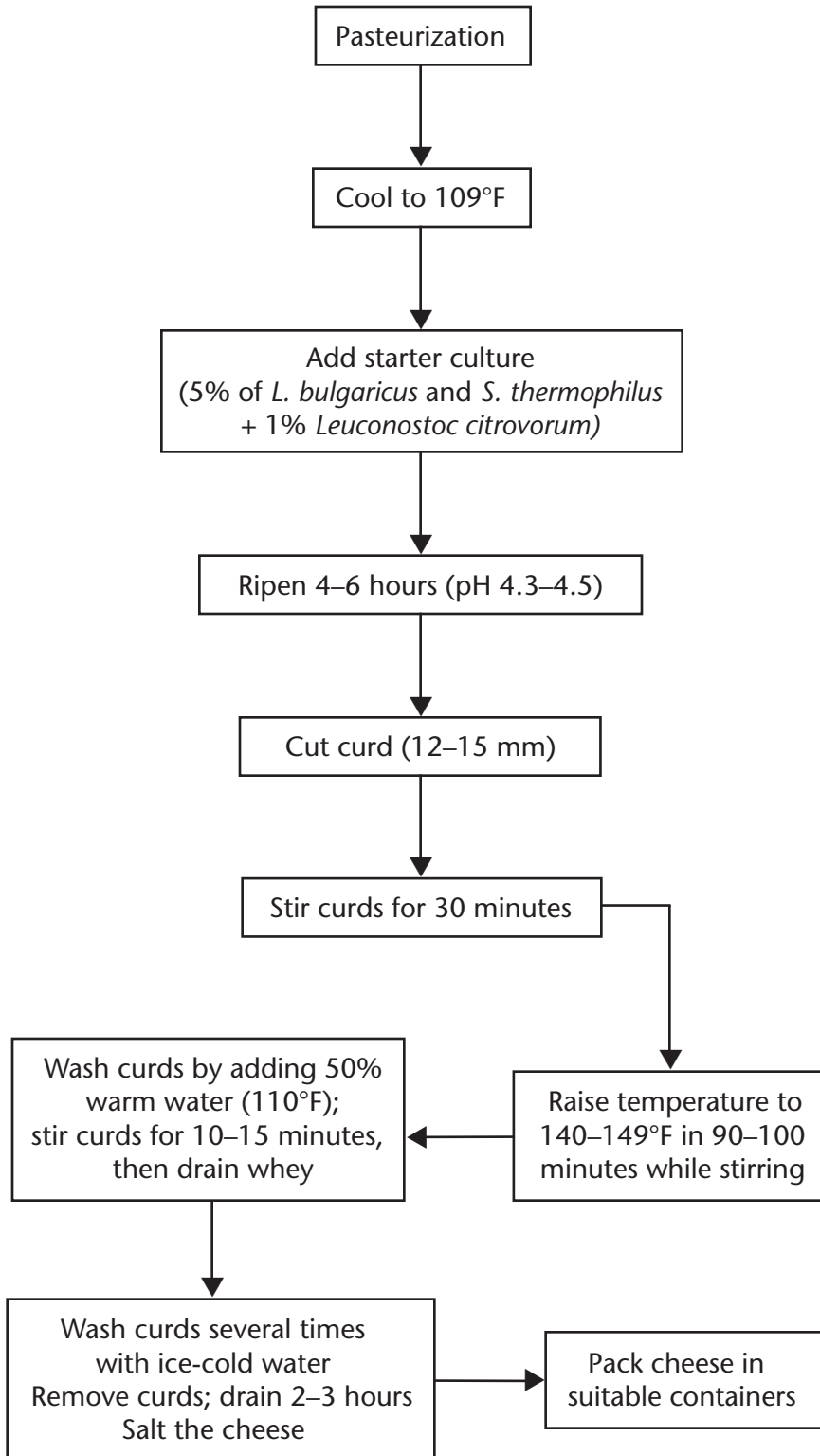
Following washing, remove the curds from the vat and spread them over wooden frames with nylon cloth centers (1 mm mesh size). Allow the curds to drain for 2–3 hours. Next, lightly sprinkle coarse sea salt over the curds. Some producers sprinkle dry herbs over the curds for flavoring. Package the curds in plastic tubs for sale.

A flowchart for the production of this cheese is presented in Figure 1.

Rennet method

Heat and then cool the milk as described above for acid-type curd. Then, there are two

Figure 1. Cottage cheese production flowchart (acid type)



options for acidulating the milk:

- (1) Inoculate the milk (at around 110°F) with an active 5% starter (culture-to-milk ratio). Then add a paste made from fresh, clean lamb abomasum (see page 10) at the concentration of 0.028%. A firm curd should form in 5 hours.
- (2) Alternatively, following pasteurization, temper the milk to about 86–90°F. Then add 1½ cups lemon juice and 0.03% lamb abomasum paste.

The rest of the process is the same as for acid-type curds.

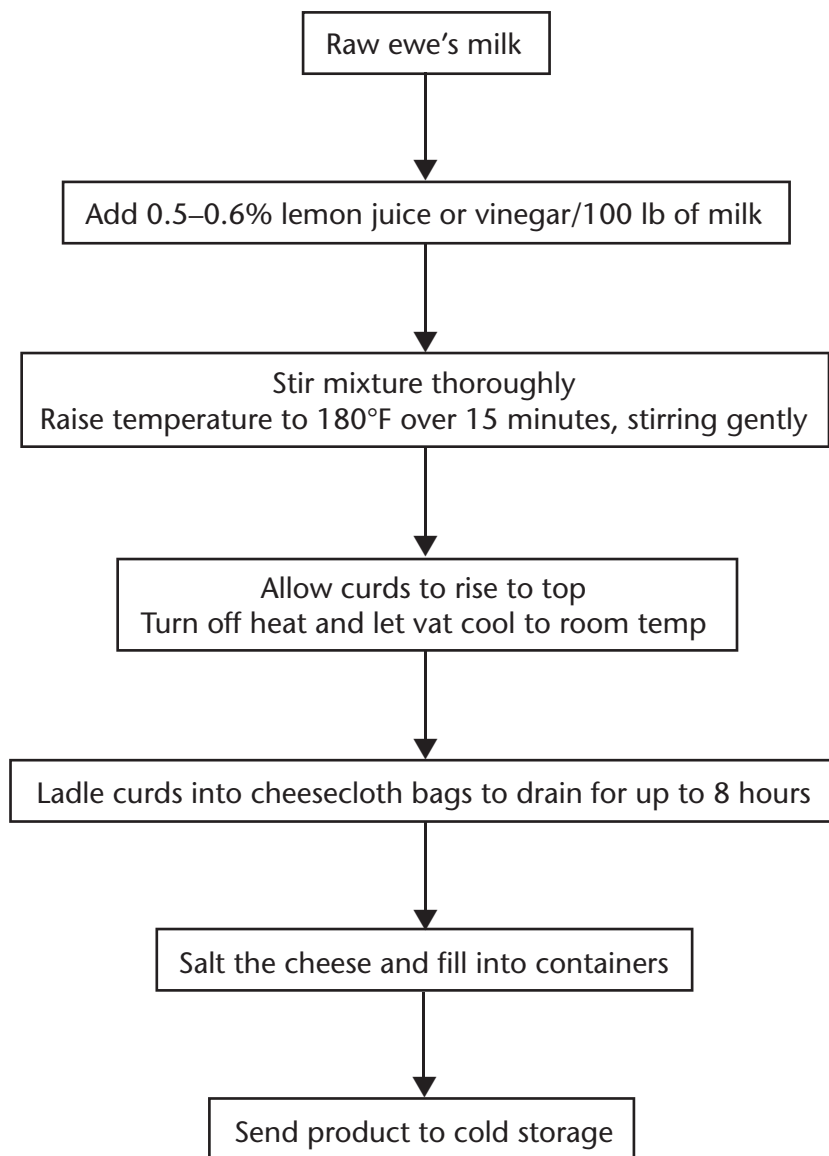
Ricotta cheese

This cheese is also produced in large quantities. It tends to be more of a light meal or snack item, as it lends itself to a variety of flavors, both subtle and exciting. This cheese usually is made by an acid coagulation method using lemon juice or white vinegar. At least one Libyan producer uses herb- and spice-infused vinegars to add flavor to the cheese.

Production method

Whole, raw, fresh ewe milk is used for this cheese; the subsequent heating replaces pasteurization. Add either lemon juice, white vinegar, or flavored vinegar to the milk at the concentration of 0.5–0.6% (acid-to-milk volume) and stir thoroughly. Gradually heat the milk to 180°F over 15 minutes while stirring gently until curd particles start to form and rise to the surface. Stop stirring and allow additional curds to rise to the surface. Turn off the heat

Figure 2. Ricotta cheese production flow chart (lemon juice/vinegar)



and allow the vat to cool to room temperature.

Remove the curds from the vat, place them in cheesecloth bags, and allow the curds to drain. The draining process can take up to 8 hours. After the cheese is drained, salt it and package in containers for market.

A flowchart for the production of this cheese is presented in Figure 2.

Feta

This is an excellent cheese for various culinary uses. It is salty and sharp with a distinct flavor. It usually is eaten with green salads but also is used as a topping or filling for pasta dishes, along with other ingredients such as ground meat or poultry. This cheese usually is produced from raw milk, although pasteurized milk is used in several of the larger plants.

Production method

Whole, raw, fresh ewe milk is normally used, although pasteurized milk can be used as well. Heat the milk to about 90°F and add 0.03% of lamb abomasum paste. Allow to rest. A good curd should form in about 2 hours. Turn off the heat and let curd stand for 30 minutes.

Cut the curds into 10-mm cubes with a wire frame cutter and immediately remove them from the vat with a large metal ladle. Place the curds in cheesecloth bags and allow to drain for 8-12 hours. Next transfer the curds to 16" x 16" x 12" cheese molds and press them by applying 22-lb weights to each box for 4 hours. Following pressing, immerse the cheese in a

20% brine (NaCl) solution for 8 hours.

Next, make a marinade by preparing a 15% brine solution. Add ¼ cup lemon juice or vinegar and ½ cup extra virgin olive oil per 26 gal and mix thoroughly. Cut the cheese into rectangular blocks measuring 4" x 4" x 6" and place the blocks in large metal or earthenware containers filled with marinade.

Age the cheese for 30–90 days at 50°F. Pasteurized milk cheese can be consumed following 30 days of ripening, while raw milk cheeses must be aged for at least 60 days. The cheese now is ready for consumption, although many people prefer to ripen the cheese an additional 30 days for a stronger flavor. The cheese is commonly stored in brine or packed in olive oil.

The production method for this cheese is outlined in Figure 3.

Al Zahra

This cheese traditionally is made from raw whole ewe's milk but can also be made from pasteurized or heat-treated milk. The cheese is soft and is aged from several weeks to several months.

Production method

Heat whole ewe's milk to at least 145°F for 30 minutes and then cool to around 88°F. Add 0.03% lamb abomasum paste. Stir briefly and then leave undisturbed. A firm curd should be ready to cut in 60–90 minutes.

Cut the curd into 10-mm cubes and ladle curds into rectangular molds measuring 8" x 4" x 2". Allow the curds to drain for 3 hours. Remove curd from molds, rub the cheese with salt on all sides, and place it in a ripening room.

Figure 3. Feta cheese production flow chart

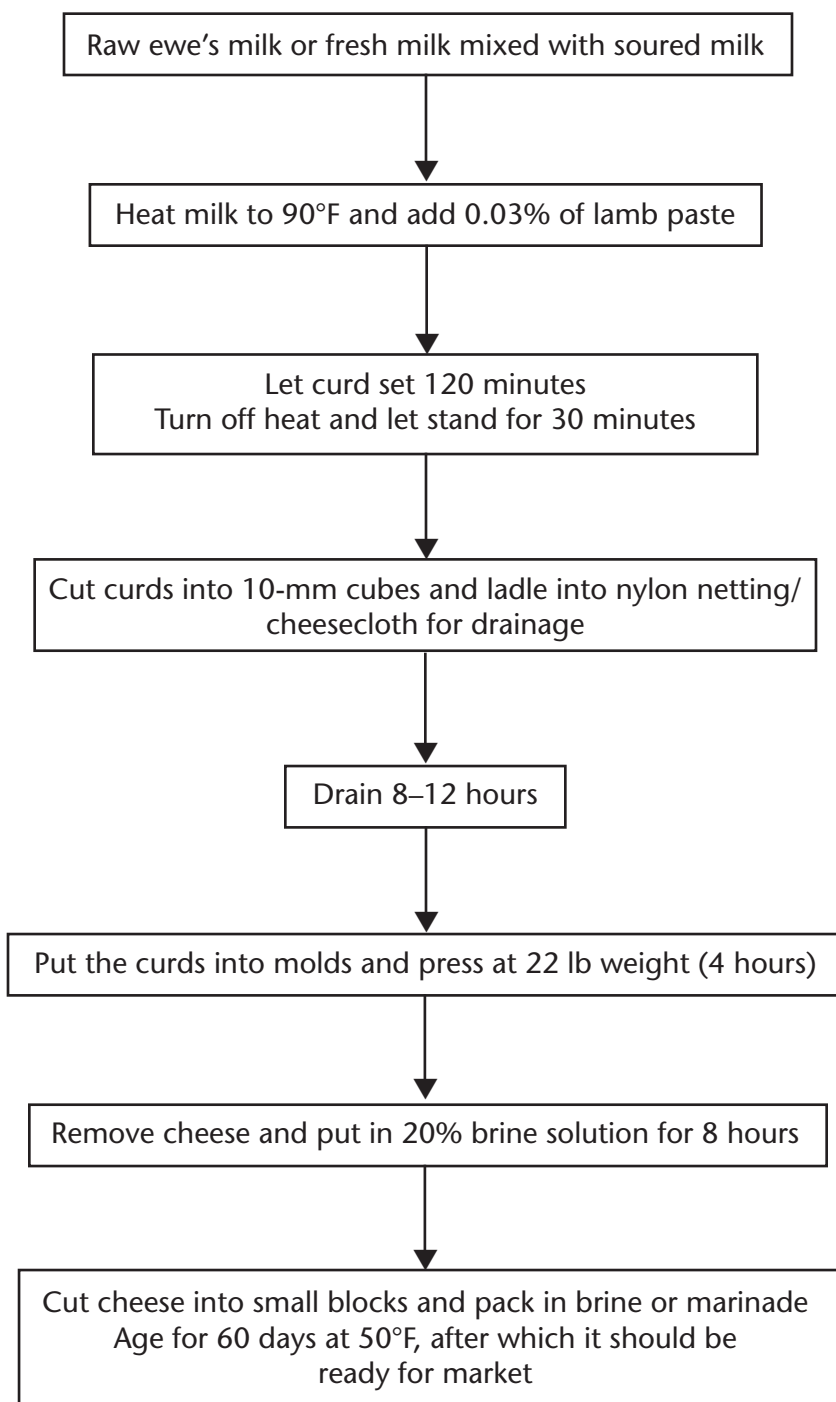
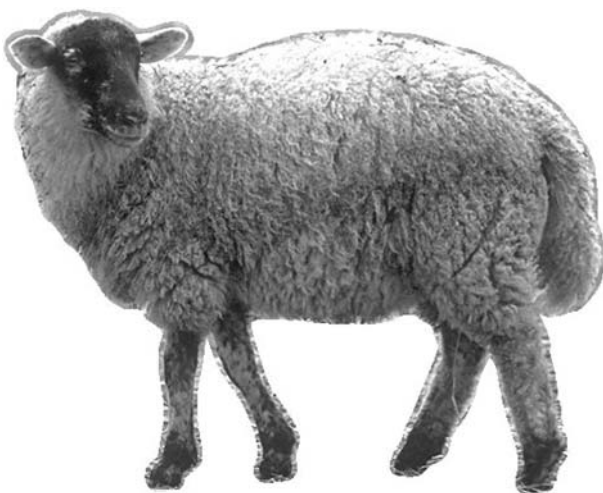
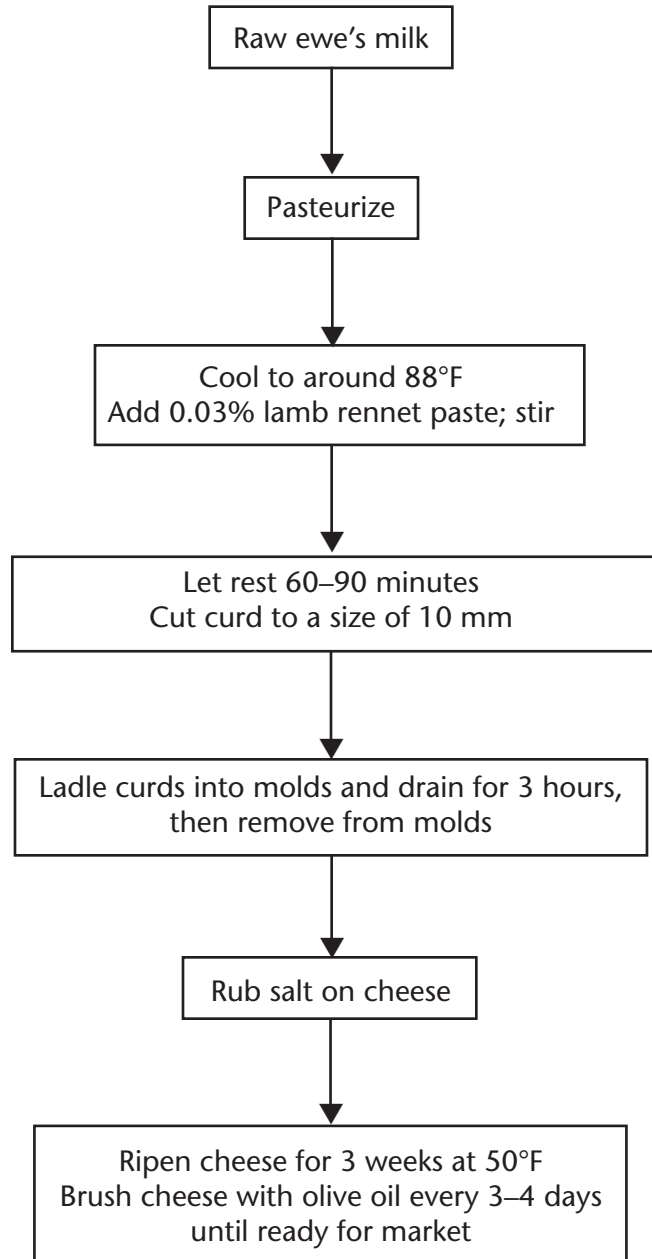


Figure 4. Al Zahra cheese production flow chart



Ripen for about 3 weeks at 50°F. Brush the cheese with olive oil every 3–4 days. After the ripening period, the cheese is ready for market.

A flowchart for the production of this cheese is presented in Figure 4.

Ewe's milk blue-veined cheese

This is a local Libyan blue cheese that has been produced for only a few years.

Production method

Whole fresh ewe's milk is used. Heat the milk to around 95°F. Add 0.02% lamb abomasum paste, along with a powder containing spores of *Penicillium roqueforti*, and stir thoroughly. A good firm curd should form in 100–120 minutes.

Cut curds to 12–15 mm. Remove the curds from the vat and place in 12" x 12" x 4" cheese molds. Allow the curds to drain for about 24 hours.

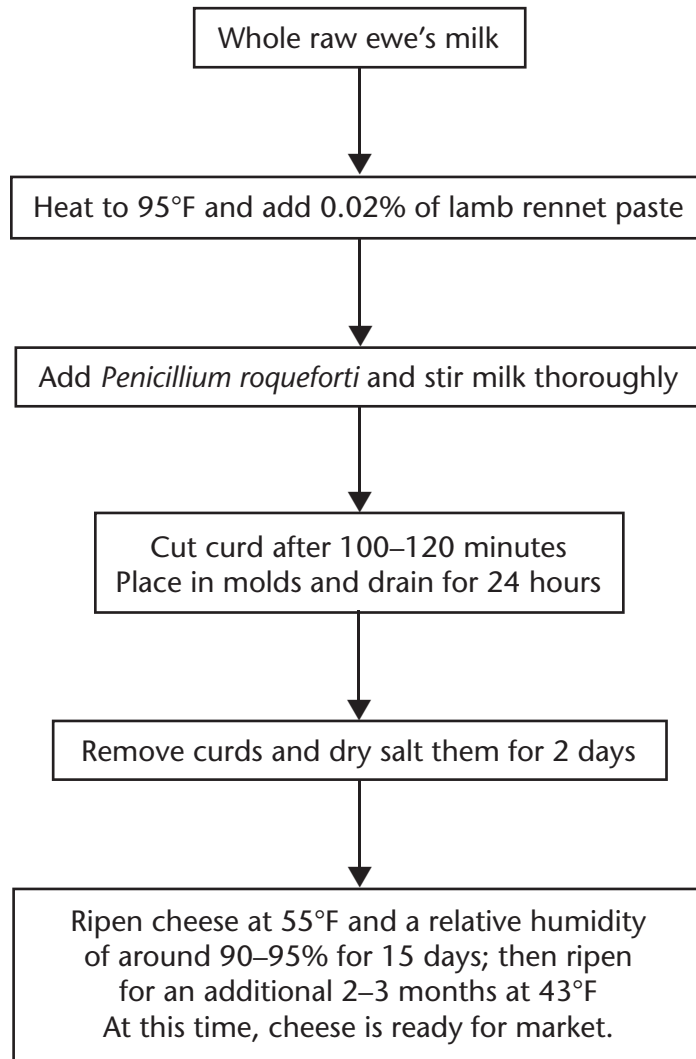
Following draining, remove the curds from their molds, rub salt on each side, and leave for 2 days. Then, place the curds in ripening rooms at a temperature of about 55°F and a relative humidity of about 90–95% for 15 days. Ripen an additional 2–3 months at 43°F.

A flowchart for the production of this cheese is presented in Figure 5.

Jibnet Grus

Grus is the plural of Gursa in Arabic, which means a thick disc or wide cylinder. This cheese is a semihard cheese. It is good as a table cheese when fairly young, when it lacks the somewhat overpowering bite that older ewe's milk cheeses

Figure 5. Blue-veined cheese production flow chart



have. Since the demand for it is so high, producers often blend ewe's milk with cow's milk to reduce production costs.

Production method

Over 30–40 minutes, gradually heat whole ewe's milk to a temperature of 108°F. Add 0.015% liquid rennet (microbial). Curds should form in less than 60 minutes. Cut the curd into 15-mm cubes and heat for 15 minutes as the temperature increases to 130°F.

Drain the whey and place the curds in cylindrical metal or plastic molds that are 12" in diameter and 12" high. Press the curds by applying 11-lb weights for 4–5 hours.

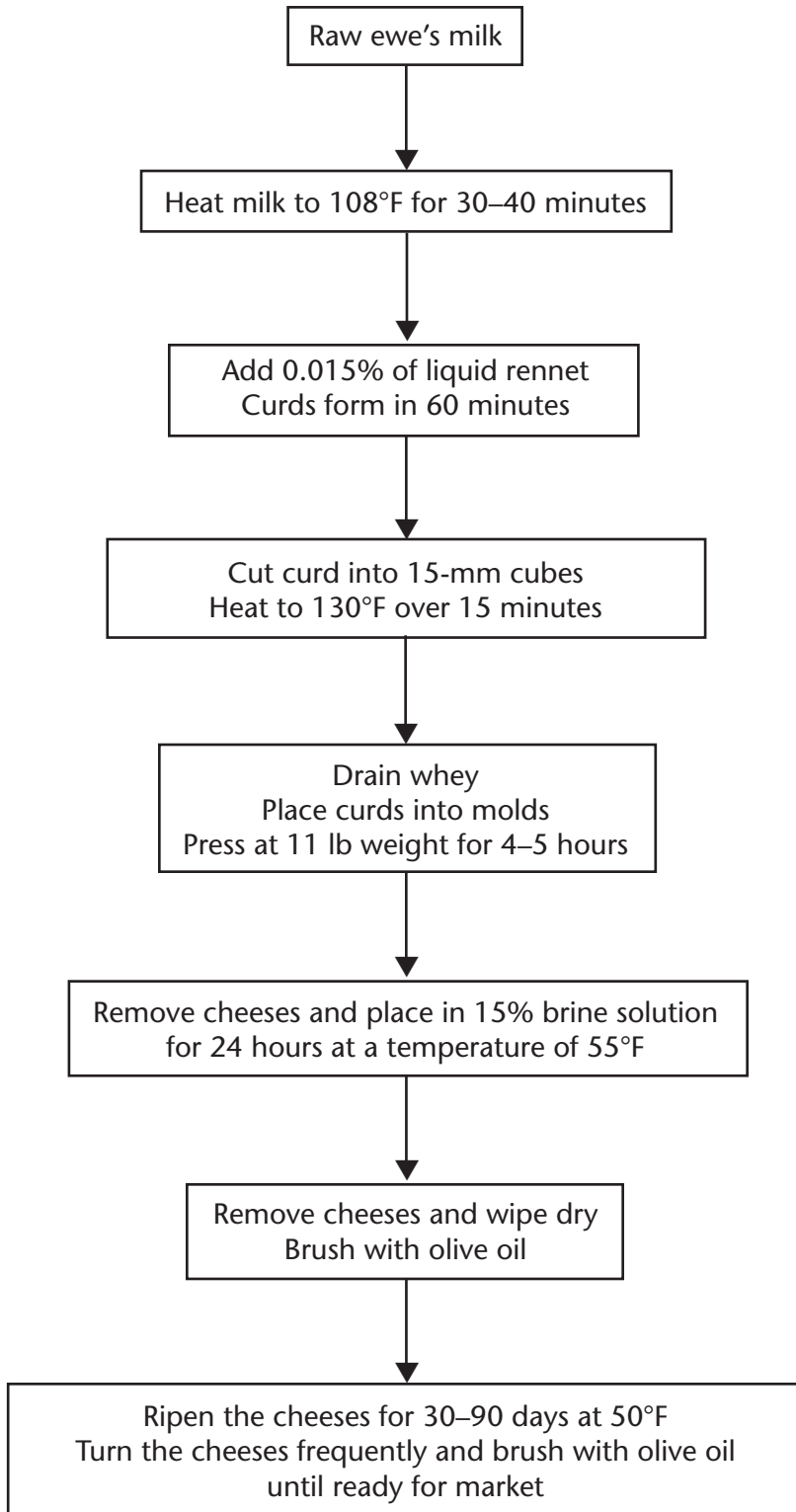
Next, place the cheeses in a 15% brine solution for 24 hours at a temperature of 50°F. Remove the cheeses, wipe dry with a cloth, and apply a coat of olive oil. Ripen the cheese at 50°F for 30–90 days. Raw milk cheeses must ripen for at least 60 days, while pasteurized milk cheeses can be consumed after 30 days. During ripening, turn the cheeses frequently and brush them with olive oil.

A flowchart for the production of this cheese is presented in Figure 6, page 8.

Jibna Mkhultah (mixed)

This cheese is made by mixing raw ewe's milk with raw goat's milk in equal proportions. Mkhultah is a soft, white cheese encased in fennel and roasted sesame seeds. It is formed by hand in the shape of a long cylinder and has a strong taste.

Figure 6. Jibnet Grus cheese production flow chart



Production method

Mix together equal proportions of raw ewe's milk and raw goat's milk. Stir the mixture for 3–5 minutes and pasteurize at or above 145°F for 30 min. Cool the milk to 86°F and stir in 0.015% lamb abomasum paste. Leave the milk undisturbed; a good curd should form in 60–90 minutes.

Cut the curds into 12-mm cubes and stir gently for 30 minutes. Drain off the whey, collect the curds, and press together by hand. Shape each cheese by hand into a cylinder that is 2" to 3" in diameter and 8" long. Place the formed cheeses on a rack with nylon netting and allow to drain for 8 hours at room temperature.

Sprinkle coarse sea salt on the cheese and leave for an hour. Apply a coat of olive oil and roll the cheeses in a mixture of fennel seeds and roasted sesame seeds. Ripen at 43°F for 1–2 weeks, or optionally up to 60 days.

A flowchart for the production of this cheese is presented in Figure 7.

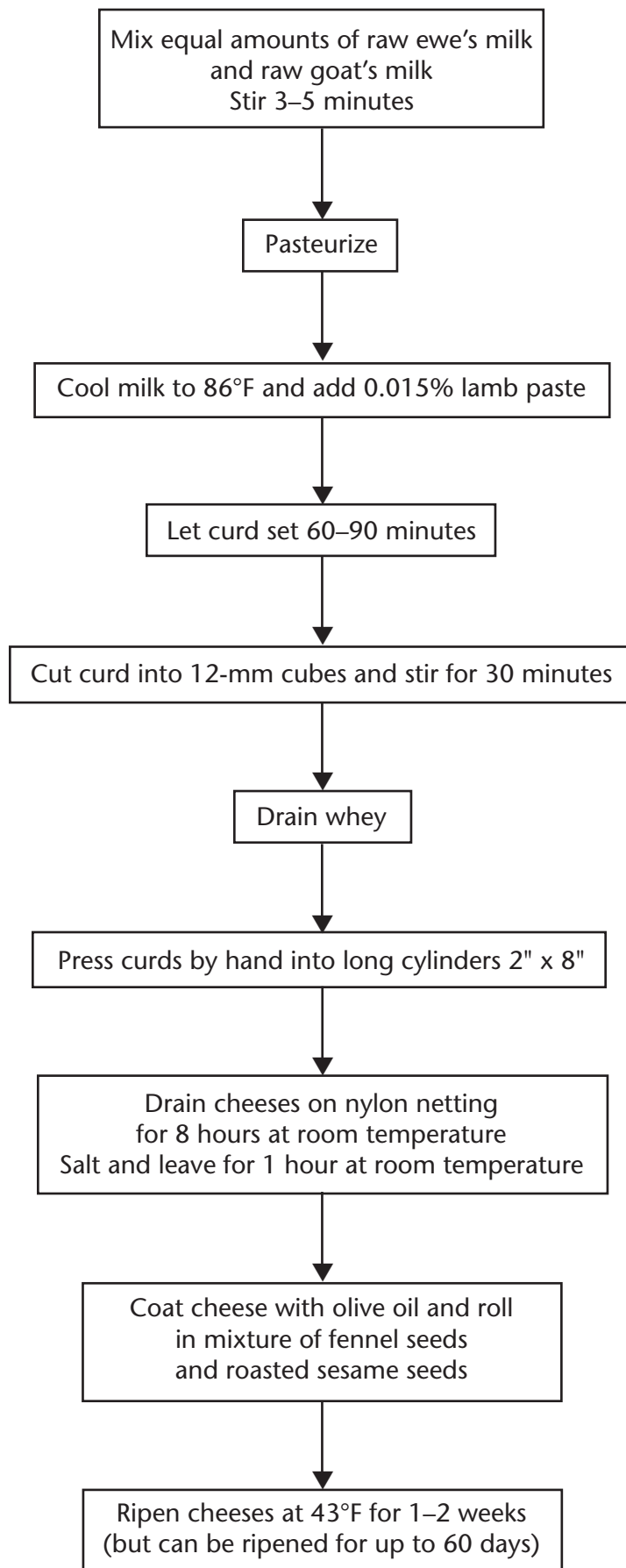
Al Naseem

Al Naseem is a large, semihard cheese made from pasteurized milk. The cheese is cylindrical in shape and measures 16" in diameter and height. The curd is cooked, and the flavor is indicative of ewe's milk but subtle.

Production method

To pasteurize milk, heat whole ewe's milk to at least 145°F for at least 30 minutes in a batch-type pasteurizer, or to 162°F for 15 seconds in a high-temperature, short-time pasteurizer. Allow the milk to

Figure 7. Jibna Mkhultah cheese production flow chart



cool slowly in a stainless steel vat to 110°F. Add an active starter culture consisting of 1% (culture-to-milk ratio) mixture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. Allow the milk to rest for 30–45 minutes. Add 0.02% lamb abomasum paste. A curd should be ready in 45–60 minutes.

Cut the curd into 10-mm cubes and heat the curds for 10 minutes as the temperature increases to 160°F while stirring constantly. Drain the whey and place the curds in metal or plastic molds. Press the cheeses by applying 33-lb weights. Allow to drain for 12 hours at room temperature and then move the press to a cold room for another 36 hours of pressing.

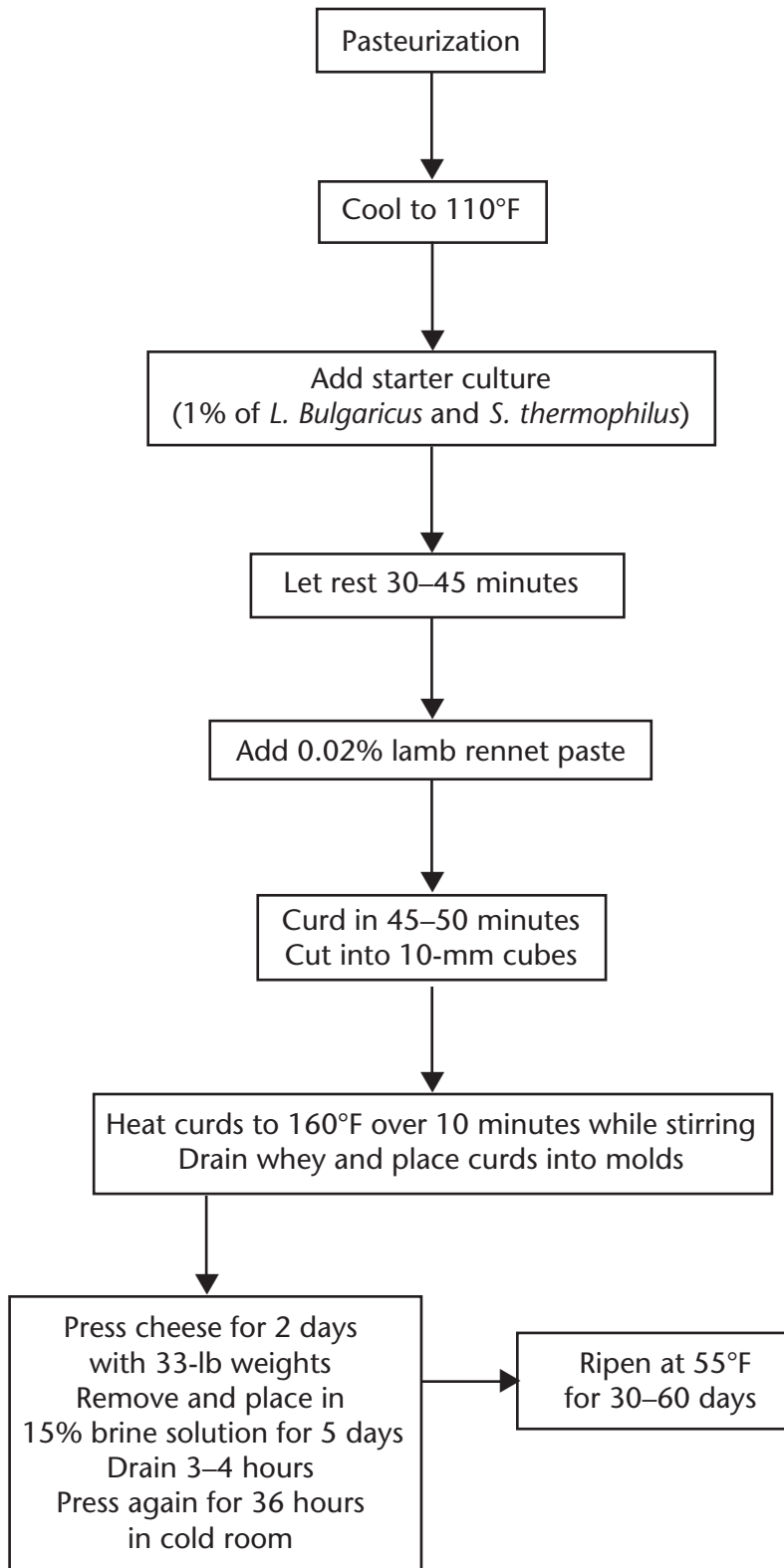
Remove the cheeses and place in a 15% brine (salt) solution for 5 days. Brine temperature should be 60°F. Following brining, allow the cheeses to drain for 3–4 hours and place in the ripening room. Ripen at 55°F for 30–60 days, depending on the market.

A flowchart for the production of this cheese is presented in Figure 8, page 10.

Lamb and kid rennet extracts and pastes

When lambs, kids, and calves are butchered for meat purposes, the fourth stomach (the abomasum, also known as the vells) is a valuable by-product. This is the primary source of animal rennet used in Libya when making artisan cheeses. In the U.S., prepared rennet is available from several suppliers.

Figure 8. Al Naseem cheese production flow chart



Lamb and kid vell paste

To make rennet yourself, use freshly harvested abomasa of milk-fed lambs and kids. Clean the vells with cold water and a solution of sodium carbonate. Then drain and cool them as quickly as possible. Cut the vells into squares and place in a common household food blender. To each 3.6 oz of cut-up vell, add 1 teaspoon of table salt and 1 teaspoon of olive oil. Grind the mixture into a thick paste. Better dispersion of the material can be achieved by adding a bit of water and blending again. The dose of this paste ranges from 0.015% to 0.03% paste in the cheese milk.

Lamb and kid vell extract

Prepare the raw material as for paste and then add 1 cup of 102°F water to each 3 oz of cut-up vell. Soak the vell for 1 hour. Then add citric acid or lemon juice at the rate of 0.18 oz per cup of water, along with 1 teaspoon of salt per cup of water. Blend the mix thoroughly. Filter it through regular filter paper and use the liquid as a curdling agent. This method is not as common as the solid paste method because of the longer preparation time.

Safety considerations

When making these cheeses in Oregon, it is important to follow U.S. safety requirements. Milk for cheese making must be pasteurized at a minimum of either 145°F for 30 minutes or 162°F for 15 seconds. The only exception is raw milk cheeses; these cheeses must be ripened at least 60 days at a temperature above 35°F prior to sale.

In Libya, some cheeses are naturally fermented by leaving the raw, warm milk overnight at room temperature. This is not a safe procedure. Equally good cheese can be made by adding lactic acid bacteria culture, which accomplishes the fermentation in approximately 5 hours. Besides improving safety by lowering pH, these bacteria also out-compete potential pathogens.

The primary pathogen associated with cheese is *Listeria monocytogenes*. This pathogen is ubiquitous and is present on dairy farms and in some raw milk. The best procedure for eliminating *Listeria* is by pasteurizing the milk and preventing recontamination of the cheese through stringent cleaning and sanitation processes.

Processing time is another important factor. Traditionally, Al Naseem is pressed at room temperature for 48 hours. This method is not safe because potential pathogens have too much time to develop at optimum temperature. An alternative is to press at room temperature for 12 hours and then move the press into a cooler.



In Libya, wooden utensils and cheese molds are still used. In the U.S., stainless steel is considered the best material because of ease of cleaning.

Fresh herbs and spices frequently are contaminated by bacteria and other disease-causing pathogens. The only safe method for cleaning spices is irradiation. As for fresh herbs, soak them for at least 5 minutes in a chlorine

solution (~100 ppm) prior to use. Rehydrate dry herbs in hot water (above 185°F).

Sheep milk cheeses are appreciated for their sharp, bold flavors. They were among the earliest cheeses to have been produced more than 4,000 years ago. By adhering to standard good manufacturing practices, it is possible to produce these cheeses safely without compromising quality.

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