

Fermenting Yogurt at Home

Brian A. Nummer, Ph.D.

National Center for Home Food Preservation

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Introduction

Yogurt is made by adding *Streptococcus thermophilus* and *Lactobacillus bulgaricus* into heated milk. After this inoculation the milk is held at 110°F ± 5°F until firm. The milk is coagulated (thickened) by an increase in acidity from lactic acid produced by the bacteria. With its slightly sour taste, creamy texture, and good nutrient content, skim or whole milk yogurt remains a healthy food itself and one that can be used in recipes from appetizers to desserts.

History

Yogurt is thought to have originated many centuries ago among the nomadic tribes of Eastern Europe and Western Asia. Milk stored in animal skins would acidify and coagulate. The acid helped preserve the milk from further spoilage and from the growth of pathogens (disease-causing microorganisms).

Ingredients

to make 4-5 cups of yogurt:

- **1-quart milk** (cream, whole, low fat, or skim) — In general the higher the milk fat level in the yogurt the creamier and smother it will taste. *Note:* If you use home-produced milk it **must** be pasteurized before preparing yogurt.
- **Nonfat dry milk powder** — Use 1/3-cup powder when using whole or low fat milk, or use 2/3-cup powder when using skim milk. The higher the milk solids the firmer the yogurt will be. For even more firmness add gelatin (directions below).
- **Commercial, unflavored, cultured yogurt** — Use ¼-cup. Be sure the product label indicates that it contains a **live** culture. Also note the content of the culture. *L. bulgaricus* and *S. thermophilus* are required in yogurt, but some manufacturers may in addition add *L. acidophilus* and/or *B. bifidum*. The latter two are used for slight variations in flavor, but more commonly for health reasons attributed to these organisms. All culture variations will make a successful yogurt.
- (*Optional*) 2 to 4 tablespoons sugar or honey.
- (*Optional*) For a thick, firm yogurt swell 1 teaspoon unflavored gelatin in a little milk for 5 minutes. Add this to the milk and non-fat dry milk mixture before cooking.

Tools

- Double Boiler, preferred or regular saucepan 1-2 quarts in capacity larger than the volume of yogurt you wish to make.
- Cooking or Jelly Thermometer. A thermometer that can clip to the side of the saucepan and remain in the milk works best. Accurate temperatures are critical for successful processing.
- Mixing spoon
- Yogurt containers, e.g. cups with lids or canning jars with lids.
- Incubator: a yogurt-maker, oven, heating pad, or warm spot in your kitchen. To use your oven, place yogurt containers into deep pans of 110°F water. Water should come at least halfway up

the containers. Set oven temperature at lowest point to maintain water temperature at 110°F. Monitor temperature throughout incubation making adjustments as necessary.

Processing

1. Pasteurization for any non-commercial milk.

Heat water in the bottom section of a double boiler and pour milk into the top section. Cover the milk and heat to 165°F while stirring constantly for uniform heating. Cool immediately by setting the top section of the double boiler in ice water or cold running water. Store milk in the refrigerator in clean containers until ready for making yogurt.

2. Combine ingredients and heat.

Heating the milk is a necessary step to change the milk proteins so that they set together rather than to form curds and whey. Do not substitute this heating step for pasteurization. Place cold, pasteurized milk in top of a double boiler and stir in nonfat dry milk powder. Adding non-fat dry milk to heated milk will cause some milk proteins to coagulate and form strings. Add sugar or honey if a sweeter, less tart yogurt is desired. Heat milk to 200°F, stirring gently and (a) hold for 10 minutes for thinner yogurt or (b) hold 20 minutes for thicker yogurt. Do not boil. Be careful and stir constantly to avoid scorching if not using a double boiler.

3. Cool and inoculate.

Place the top of the double boiler in cold water to cool milk rapidly to 112-115°F. Remove one cup of the warm milk and blend it with the yogurt starter culture. Add this to the rest of the warm milk. The temperature of the mixture should now be 110-112°F.

4. Incubate.

Pour immediately into clean, warm container(s); cover and place in prepared incubator. Close the incubator and incubate about 4 - 7 hours at 110°F ± 5°F. Yogurt should set firm when the proper acid level is achieved (pH 4.6). Incubating yogurt for several hours past the time after the yogurt has set will produce more acidity. This will result in a more tart or acidic flavor and eventually cause the whey to separate.

5. Refrigerate.

Rapid cooling stops the development of acid. Yogurt will keep for about 10-21 days if held in the refrigerator at 40°F or lower.

Yogurt Types

- **Set yogurt:** A solid set where the yogurt firms in a container and not disturbed.
- **Stirred yogurt:** Yogurt made in a large container then spooned or otherwise dispensed into secondary serving containers. The consistency of the "set" is broken and the texture is less firm than set yogurt. This is the most popular form of commercial yogurt.
- **Drinking yogurt:** Stirred yogurt to which additional milk and flavors are mixed in. Add fruit or fruit syrups to taste. Mix in milk to achieve the desired thickness. The shelf life of this product is 4-10 days, since the pH is raised by fresh milk addition. Some whey separation will occur and is natural. Commercial products recommend a thorough shaking before consumption.
- **Fruit yogurt:** Fruit, fruit syrups, or pie filling can be added to the yogurt. They are placed on top, on bottom, or stirred into the yogurt.
- **Yogurt cheese:** Line a large strainer or colander with cheesecloth. Place this over a bowl and then pour in the yogurt. Do not use yogurt made with the addition of gelatin. Gelatin will inhibit whey separation. Let it drain overnight covered with plastic wrap. Empty the whey from the bowl. Fill a strong plastic storage bag with some water, seal and place over the cheese to weigh it down. Let the cheese stand another 8 hours after which it is ready to use. The flavor is similar to a sour cream with a texture of a soft cream cheese. A pint of yogurt will yield approximately 1/4 lb. of cheese. The yogurt cheese has a shelf life of approximately 7-14 days when wrapped and placed in the refrigerator and kept at less than 40°F. For uses, recipes, and more information on yogurt cheese see the "Resources"; section below.
- **Frozen yogurt:** Follow directions given with most home ice cream makers.

Trouble-shooting

If your:

- Milk forms some clumps or strings during the heating step. Some milk proteins may have jelled. **Take the solids out with a slotted spoon or in difficult cases after cooking pour the milk mixture through a clean colander or cheesecloth before inoculation.**
- Yogurt fails to coagulate (set) properly. Milk proteins will coagulate when the pH has dropped to 4.6. This is done by the culture growing and producing acids.
 - Adding culture to very hot milk (+115°F) can kill bacteria--**Use a thermometer to**

carefully control temperature.

- Too hot or too cold of an incubation temperature can slow down culture growth--**Use a thermometer to carefully control temperature.**
- The starter culture was of poor quality--**Use a fresh, recently purchased culture from the grocery store each time you make yogurt.**
- Yogurt tastes or smells bad.
 - Starter culture is contaminated--**Obtain new culture for the next batch.**
 - Yogurt has over-set or incubated too long--**Refrigerate yogurt immediately after a firm coagulum has formed.**
 - Overheating or boiling of the milk causes an off-flavor--**Use a thermometer to carefully control temperature.**
- Whey collects on the surface of the yogurt. This is called syneresis. Some syneresis is natural. Excessive separation of whey, however, can be caused by incubating yogurt too long or by agitating the yogurt while it is setting.

Food safety, spoilage and shelf life

Yogurt provides two significant barriers to pathogen growth: (a) heat and (b) acidity (low pH). Both are necessary to ensure a safe product. Acidity alone has been questioned by recent outbreaks of food poisoning by *E. coli* O157:H7 that is acid-tolerant. *E. coli* O157:H7 is easily destroyed by pasteurization (heating). Therefore, always pasteurize milk or use commercially pasteurized milk to make yogurt.

Discard batches that fail to set properly, especially those due to culture errors. Yogurt generally has a 10-21 day shelf life when made and stored properly in the refrigerator below 40°F. Molds, yeasts and slow growing bacteria can spoil the yogurt during prolonged storage. Ingredients added to yogurt should be clean and of good quality. Introducing microorganisms from yogurt add-ins can reduce shelf life and result in quicker spoilage--"*garbage in, garbage out*". Discard any yogurt samples with visible signs of microbial growth or any odors other than the acidity of fresh yogurt.

Always use clean and sanitized equipment and containers to ensure a long shelf life for your yogurt. Clean equipment and containers in hot detergent water, then rinse well. Allow to air dry.

Kitchen Notes

When making this recipe in our test kitchen we used a saucepan instead of a double boiler. Despite constant stirring we still had some minor scorching. We took care not to stir or scrape the scorched area. During the cooking step milk proteins formed strings that we scooped out with a slotted spoon. We inoculated our entire batch of milk with starter and poured the mixture into separate containers. To some containers we added different amounts of honey or sugar stirring to dissolve the sweetener, while others we left plain. Our yogurt reached pH 4.7 in approx. four hours, pH 4.6 in approx. five hours and pH 4.5 in approx. six hours. The yogurt set was firm after six hours and the taste was mild. The yogurt was immediately refrigerated until the next day. On the following day we processed the yogurt into some of the variations listed above under "Yogurt Types".

Resources

The following information is provided as a courtesy to the reader. No endorsements are made or implied for commercial products and none have been tested in our labs or kitchens. For commercial products other makes, models, or alternatives are almost certainly available.

Cultures and Probiotics

- Yogurt Bacterial Culture. Scimat 2000. <http://distans.livstek.lth.se:2080/yog-cult.htm>. Accessed 26 Mar 2004.
- Probiotic Bacteria Associated with Fermented Foods (An Ohio State University Food Science publication). <http://www.fst.ohio-state.edu/People/HARPER/Functional-foods/Probiotics.html>. Accessed 13 Apr 2004.

Commercial Yogurt Sites

- About Yogurt. <http://www.aboutyogurt.com>. The website of the National Yogurt Association. Accessed 26 Mar 2004.
- Dannon <http://www.dannon.com>. Accessed 26 Mar 2004.
- For uses, recipes, and more information, Dannon, a commercial yogurt maker, has created a brochure on yogurt cheese <http://www.dannon.com/pdf/yogurtCheese.pdf>. Accessed 26 Mar

2004.

- Yoplait (General Mills Co.)<http://www.yoplait.com>. Accessed 26 Mar 2004.

Yogurt Makers (Incubators).

- Salton Electric Yogurt Maker. approx. \$14.99 <http://www.esalton.com/store/...> Accessed 26 Mar 2004.
 - Yogourmet Electric Multi Yogurt Maker by Lyo-San Co. approx. \$60. <http://www.lyo-san.ca/english/yogourmet.html>. Accessed 26 Mar 2004.
 - Donvier Electronic Yogurt Maker. approx. \$44.95 <http://www.donvier.com/products/yogurt.html> Accessed 26 Mar 2004.
 - Miracle Yogurt Maker Model JC70. approx. \$49.95. http://www.miracleexclusives.com/Yogurt_Makers.html Accessed 26 Mar 2004.
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Reviewed by Joseph Frank, Ph.D., Department of Food Science and Technology University of Georgia and Elizabeth Andress, Ph.D. and Elaine D'Sa, Ph.D. for the National Center for Home Food Preservation.

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