

3-1951

EC9990 Simple Equipment for the Pasteurization of Milk

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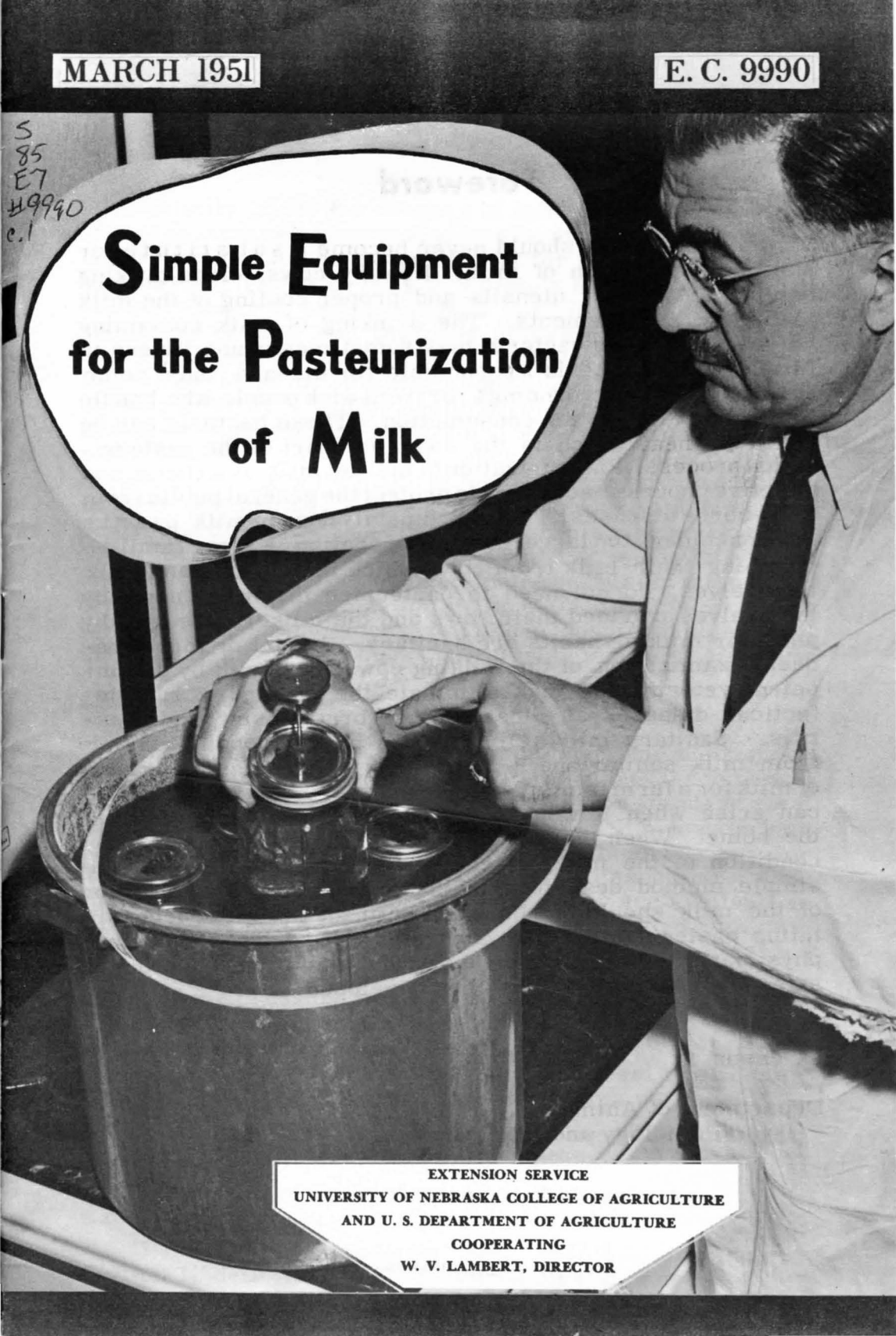
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Simple Equipment for the Pasteurization of Milk



EXTENSION SERVICE
UNIVERSITY OF NEBRASKA COLLEGE OF AGRICULTURE
AND U. S. DEPARTMENT OF AGRICULTURE
COOPERATING
W. V. LAMBERT, DIRECTOR

Foreword

Pasteurization should never become a substitute for sanitary production of milk. Healthy cows, clean milking habits, clean milk utensils and proper cooling of the milk are basic requirements. The drinking of milk containing disease producing bacteria may sometimes cause illness in people. The bacteria responsible for disease may come from the cow, surroundings or from sick people who handle the milk prior to its consumption. These bacteria can be killed by heat which is the essential part of the pasteurization process. Pasteurization of market milk is a cheap and effective process necessary to protect the general public from milk-borne diseases. This is ordinarily done in milk plants with machinery too large for home operation. Farm families obtaining their milk from cows which they handle and milk themselves, do not need to pasteurize the milk used by themselves provided their cows and the milkers are healthy and their milking habits are sanitary. Annual or more frequent examination of the milking cows for health by a competent veterinarian can eliminate the hazard of such infectious diseases as tuberculosis, brucellosis, and mastitis. Sanitary milking habits can be developed with help from milk sanitarians. Even though daily pasteurization of milk for a farm family is an unnecessary chore, occasions can arise when it would be desirable to pasteurize milk in the home. When there is doubt as to the safety or sanitary condition of the milk, it can be readily pasteurized by the simple method described in this circular. Pasteurization of the milk should be continued until the situation necessitating pasteurization has been discussed with a competent physician or veterinarian and a sound plan for production of safe, wholesome milk has been developed.

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Simple Equipment For The Home Pasteurization Of Milk

A. E. Baragar¹ and P. A. Downs²

Publicity about the dangers of milk-borne diseases has caused an increasing interest among farmers and homemakers regarding the pasteurization of milk for home consumption. The pasteurization of milk is a simple heating process. It is unnecessary to pasteurize milk used for cooking, but you should be certain that milk for drinking is safe. Heating every particle of milk to at least 143° F. and holding it at this temperature for 30 minutes constitutes pasteurization according to the U. S. Public Health Service definition for batch pasteurization of milk.³ With some of the pasteurizing equipment now used in the home, such as the open pan, double boiler, and some of the electric home milk pasteurizers, the milk is overheated. Although safe for consumption, the pasteurized product has some undesirable characteristics. Often there is a scalded flavor, cream does not rise to the top, and the milk can be recontaminated because of the manner of storing after pasteurization. The method described in this circular utilizes equipment available in most farm homes and the heating method produces a desirable product.

Equipment Needed

The equipment needed for the pasteurizing method described here is simple. It consists of quart Mason jars, two-piece closures, a Weston laboratory-type stainless steel thermometer or its equivalent attached to a lid, a waterbath canner with a rack, a stove to furnish heat, and a clock for timing the pasteurizing period. Quart Mason jars were chosen for the milk containers because they are available in almost every home. These jars should be sealed with two-piece closures, such as are used for sealing jars of canned food, because pressure will be built up in the jar during heating and if the pressure becomes too high this type of lid will vent and release the excess pressure. It is best to have a thermometer with a temperature range of 0-180° F. for easy reading. It should be made of stainless steel to eliminate breakage, and should be accurate to within a degree.

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³Public Health Bulletin 220, 1939 Edition, page 23, Section 1, definition 1, U. S. Public Health Service.

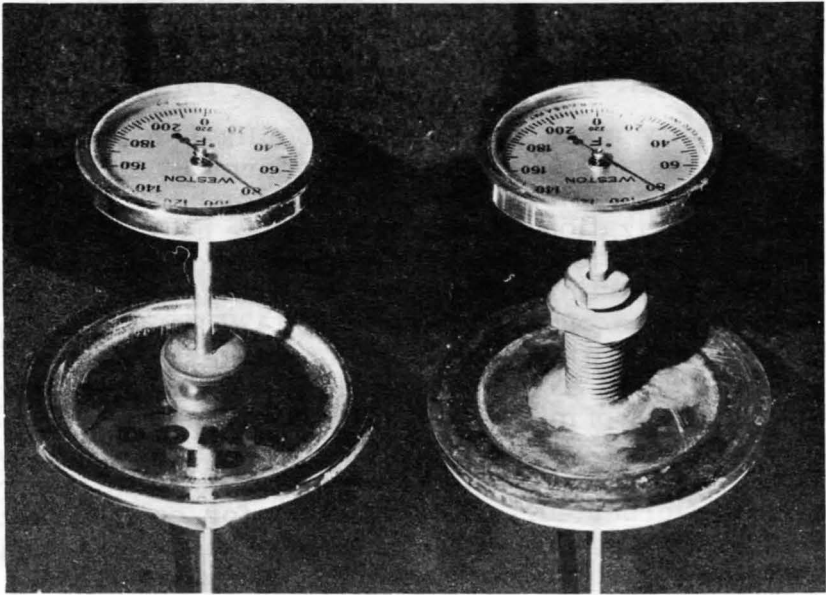


Figure 1
Two methods for fastening thermometer to lid. Left: Weston laboratory thermometer or its equivalent inserted in a number 0 single-hole rubber stopper and placed in a one-half-inch hole punched in the lid of a two-piece closure. Right: Weston laboratory thermometer or its equivalent fastened to a special brass lid of a three-piece closure by means of a packing nut.

The thermometer should be securely fastened to the lid of one jar so that the water from the bath cannot enter the jar. A simple method is to insert the thermometer in a size 0 one-hole rubber stopper and then place the rubber stopper in a one-half-inch hole punched in a two-piece lid. This method



Figure 2

Complete assembly of thermometer, two-piece lid and quart Mason jar for rubber stopper insert.

is shown at the left in figure 1. One disadvantage is that after repeated use, the rubber becomes cut and may not make a tight seal between the stopper and the lid. However, this method is inexpensive and the hole in the lid can be made at home with a suitable punch.



Figure 3

Complete assembly of thermometer, three-piece closure and quart Mason jar.

A better method of securing the thermometer to the lid is shown at the right in figure 1. Here a packing nut has been fastened to a brass disc having the same dimensions as the

glass lid in a three-piece closure. An ordinary three-piece closure rubber ring gasket is used to make a tight seal. The complete installation of the thermometers in the glass jars is shown in figures 2 and 3.

A waterbath canner that will hold at least 7 quart jars is recommended so that at least 7 quarts of milk can be pasteurized at one time. To prevent possible breaking of the jars there should be a rack at the bottom of the canner so that the jars of milk do not rest directly upon the bottom of the canner. Use the stove that is available in the home. It may be electric, gas, gasoline, kerosene or coal and wood. A clock is necessary to correctly time the pasteurization of the milk. An alarm clock is convenient, but any good clock or watch is satisfactory.

Pasteurizing Technique

Preparing the milk.

Fill the jars with milk to within 3/4 inch of the top of the jar. This 3/4-inch headspace is necessary to allow for the expansion of the milk as it heats. Then tightly seal the jars with two-piece closures. Place the jars on the rack in the waterbath canner on the stove. Fill the canner with water so that there will be at least one inch of water over the top of the jars. Place the jar of milk with the thermometer in the lid in the center of the canner. You are now ready to start the pasteurizing process.

Heating the milk with an electric range.

During the heating-up period the waterbath will heat more rapidly than the milk. If the temperature of the milk were allowed to rise to 144° F. before the heat under the canner was decreased, the milk temperature would eventually reach approximately 150° F. This would be too high to produce a desirable product.

Table 1 shows the milk temperature at which the heat under the canner should be decreased in order to bring the final milk temperature to 144° F. For instance, if you are using a 5- or 7- heat, 2,000-watt unit on an electric stove to supply the heat, decrease the temperature setting to "Low" when the milk temperature reaches 132° F. This will bring the milk to a final temperature of about 144° F.

Table 1. Predicted milk temperatures at which heat under waterbath should be decreased, in terms of heat input for various stoves.

Type of stove	Heat input for cooking- top unit	Time to raise	Predicted milk
		waterbath from 60° F. to 144° F.	temperature at which heat under waterbath should be decreased
		Minutes	Degrees F.
Gas			
Giant burner	12000 Btu/hr	33	126
Regular burner	9000 Btu/hr	43	132
Electric	2200 watts	40	130
Electric	2000 watts	44	132
Electric	1300 watts	69	138
Electric	1100 watts	86	140
Gasoline			
Master burner	8000-9000 Btu/hr	58	136
Other burners	8000-9000 Btu/hr	66	138
Kerosene			
Standard, long chimney wick	11000 Btu/hr	60	137
Giant, long chimney wick	15000 Btu/hr	52	135
Standard, short chimney	8200 Btu/hr	61	137
Giant, short chimney	10000 Btu/hr	54	135

Coal-Wood: Use Chart 1 as guide.

During the first few times that the pasteurization is done in the home, it will be necessary for you to determine which of the low heats on your range will supply the proper amount of heat. On most ranges the setting of "Low" should give enough heat to maintain the milk at 144° F. It will take about 26 to 28 minutes for the milk to reach 144° F. When the milk reaches 143° F., begin counting the pasteurizing time. Hold the milk at 144° F. for 30 minutes and it will be pasteurized.

Heating the milk with a gas range.

Most cooking tops on gas ranges are equipped with three regular burners and one giant burner. The regular burners are adjusted for a heat input of 9,000 British Thermal Units (Btu) per hour and the giant burner is regulated for an input of 12,000 Btu per hour. The regular burner is comparable to the 2,000-watt electric unit in rate of heating but the giant burner heats more rapidly. Either the regular burner or the giant burner may be used to heat the waterbath. As with the electric unit, during the heating-up period the waterbath will heat more rapidly than the milk, and it will be necessary to decrease the heat before the milk temperature reaches 144° F. According to table 1, you should decrease the heat when the milk temperature reaches 132° F. if you are using the regular burner. If you are using the giant burner, decrease the heat when the milk temperature reaches 126° F. Even though the giant burner heats the waterbath more quickly than the regular burner, it may be best to use the regular burner because of the low heat needed when the heat is decreased. The giant burner might deliver too much heat to keep the milk at a steady value of 144° F. during the pasteurizing period.

Heating the milk with other types of stoves.

The heating process for gasoline and kerosene stoves is similar to that for the gas stove. The milk temperatures at which the heat should be decreased may be determined from table 1.

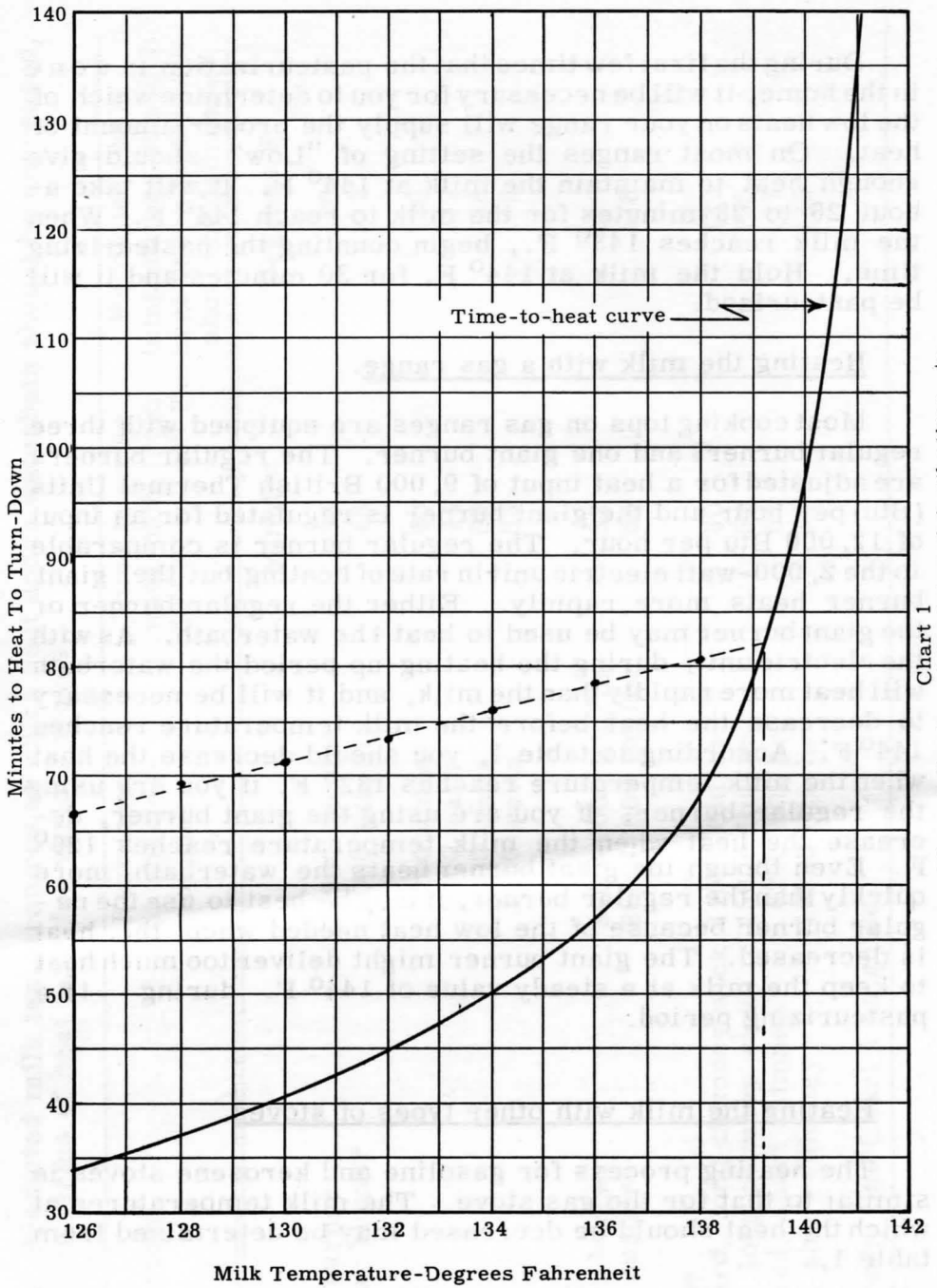


Chart 1
Time-to-heat graph for determining the time to decrease the heat under the waterbath canner.

With the coal and wood range where the heat delivered is so variable and depends upon the type of fire, another method must be used to determine the milk temperature at which the heat under the waterbath should be decreased. This milk temperature can be predicted by using the time-to-heat curve in chart 1. When the milk temperature reaches 126° F., begin to take milk temperatures every minute and plot the time versus the milk temperature on this chart. Draw a line through the points, and the intersection of this line with the curve will be the milk temperature at which the heat should be decreased for this particular rate of heating. The dotted line in the curve is a sample showing a slow rate of heating.

Cooling.

After the milk has been pasteurized it should be cooled immediately. This may be done by the batch method or the continuous flow method. The batch method consists of placing the jars of milk in a container filled with cold water (the canner may be used as the cooling container). The water will absorb the heat and eventually become warm. Replace this warm water with fresh cold water and continue this process until the milk reaches a temperature near that of the water or of the room. This method will be slow; from 50 to 65 minutes will be required to cool the milk to a room temperature of 70° F. The continuous flow method is much faster. By this method, water is allowed to run into the canner and overflow into the sink so that the waterbath is always near the temperature of the incoming water. About 22 minutes will be required to cool the milk to 60° F. If the continuous flow method is used, it will be necessary to have running water.

Storage.

After the milk has been cooled, place it in the refrigerator where it will be maintained at refrigerating temperatures until the time of use.

Merits Of This Pasteurization Method and Equipment

Disadvantages.

The principal disadvantage of this method is that it is not automatic. It will be necessary for you to observe frequently the milk temperature and determine the time when the heat

under the waterbath must be decreased so that the milk does not become overheated. However, after you have become accustomed to the process it will not be necessary for you to watch the milk temperature continuously. By setting an alarm clock for an approximate time that the milk will reach the turndown temperature, you can be doing something else around the house until the alarm reminds you that the heat should be decreased.

Advantages.

If the milk is heated according to the procedure outlined in this circular every particle of milk will be pasteurized.

Another important feature is that at a pasteurization temperature of 144° - 145° F., as much cream will rise on the pasteurized milk as on raw milk. However, as the milk temperature is increased to higher values, the amount of cream that will rise on the pasteurized milk decreases. Compared with the amount of cream that will rise to the top on raw milk, only 91 per cent of the cream will rise to the top when the milk is heated to 147° F. Similarly the rise in cream will be 77 per cent for a milk temperature of 149° F.; 44 per cent for a milk temperature of 153° F., and negligible for a milk temperature of 158° to 160° F. In these cases the cream has been distributed throughout the milk and the milk will have characteristics of homogenized milk.

By using the two-piece closures, tightly sealed, there will be no influx of water from the waterbath into the milk. The pressure in the jar will not build up to a high value that would cause the jar to break because the jar lid raises slightly and allows the excess pressure to be released. This release of the vapor in the jar has the added advantage that when the jar is cooled, the jar will be under a vacuum, thus assuring that the lid will be tightly clamped. For this reason the ring around the jar can be removed when the jars are stored in the refrigerator with only the thin cap covering the jar.

Finally in terms of equipment needed and the economic cost involved this method is relatively inexpensive because equipment usually available in the home is used. The only purchase necessary is a good thermometer fitted into a two-piece closure or into a special lid for securing the thermometer.