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Cultured Buttermilk and Acidophilus Milk

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by

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BUTTERMILK as obtained when cream is churned has the following average composition†:

	Per cent
Water	90.7
Protein	3.5
Fat	0.5
Ash	0.7
Sugar	4.6

The fuel value per pound is 165 calories.

Cultured buttermilk made from skim milk has the following average composition†:

	Per cent
Water	90.5
Protein	3.5
Fat	0.2
Ash	0.8
Sugar	5.0

The fuel value per pound of this product is 160 calories.

The amount of buttermilk sold in the cities of Oregon that is obtained from the churning of cream is infinitesimal. Practically all of the buttermilk sold is prepared from skim milk in the market milk plants and is sold as cultured buttermilk. This product should not be confused with Bulgarian milk and acidophilus milk. These two products will be discussed later.

In brief, the preparation of cultured buttermilk consists in adding a culture of desirable bacteria to high quality pasteurized skim milk followed by incubation at a temperature suitable for the growth of the bacteria with the production of lactic acid and flavoring compounds. The addition of cream and the churning or agitation of the cultured milk improves the palatability of the product.

Value of buttermilk as a food

The composition of cultured buttermilk containing no added cream shows that it is a highly nutritious food because it contains approximately one-tenth by weight of desirable milk solids. The addition of butterfat from added cream will of course increase the nutritive value.

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† Source: United States Department of Agriculture.

Milk is not only man's first drink but it remains a staple article of diet throughout his life. Milk, even though it is the most nearly perfect food, has been subjected to many modifications in order to please the taste of man. The souring of sweet milk was one of the first and simplest methods to be employed. The Bible mentions the use of sour milk.

When milk is allowed to sour naturally, many different types of bacteria may be present. A uniform product cannot be maintained and objectionable flavors are likely to develop if certain types of undesirable bacteria are present in the milk.

Nutrition authorities state that the casein of cultured milk is easier to digest than that of fresh uncultured milk. The lactic acid precipitates the casein into a soft coagulum. The curd formed is easy to digest in the stomach because there is no danger of the curd being formed into large, rubbery aggregates. For this reason cultured buttermilk can be used by patients suffering from certain gastric disorders.

Preparation of Cultured Buttermilk

For the successful preparation of cultured buttermilk it is necessary that proper equipment be available and that the following points be observed:

1. Use fresh, high quality skim milk.
2. Pasteurize the milk efficiently.
3. Obtain at intervals a desirable bacterial culture from a reliable laboratory. The culture contains the organism *Streptococcus lactis* together with *Streptococcus citrovorus* or *Streptococcus paracitrovorus*, or both.
4. Prepare daily the necessary culture in accordance with directions.
5. Inoculate the pasteurized skim milk with the proper amount of culture and incubate at the proper temperature for the required length of time.
6. Cool and agitate the coagulated milk.
7. Add cream as desired.
8. Store the product at a temperature just above the freezing point of water.

The preparation of starter is fully discussed in Oregon Agricultural Experiment Station Bulletin 379. Copies can be obtained from the Experiment Station.

The skim milk used for the buttermilk should preferably contain only a small number of bacteria. The milk should be as fresh as possible. Old, stale, or returned milk should not be used. The milk should be pasteurized in a stainless-steel-lined pasteurizer by heating to a temperature of 190° F. It should be held at this temperature for at least 30 minutes. The milk should then be cooled quickly to the incubation temperature, or if it is to be held for some time before it is inoculated, the temperature should be reduced to below 50° F. The pasteurizing vat should preferably be insulated in order that the temperature during incubation will remain uniform. Water-jacketed pasteurizers may be equipped with electric heating coils and thermostats for maintaining a uniform temperature during incubation.

Inoculation consists of adding from $\frac{3}{4}$ to 1 per cent of culture to the cooled, pasteurized milk. Care should be exercised that contamination during inocula-

tion is prevented. Stir the inoculated milk for a few minutes and adjust the temperature to 71° F. Allow only a maximum deviation from this temperature of 1° F. It is of utmost importance that the temperature be properly maintained during the incubation period.

A higher flavored product can be obtained if citric acid is added to the pasteurized, cooled milk. Add citric acid at the rate of 0.15 per cent, which

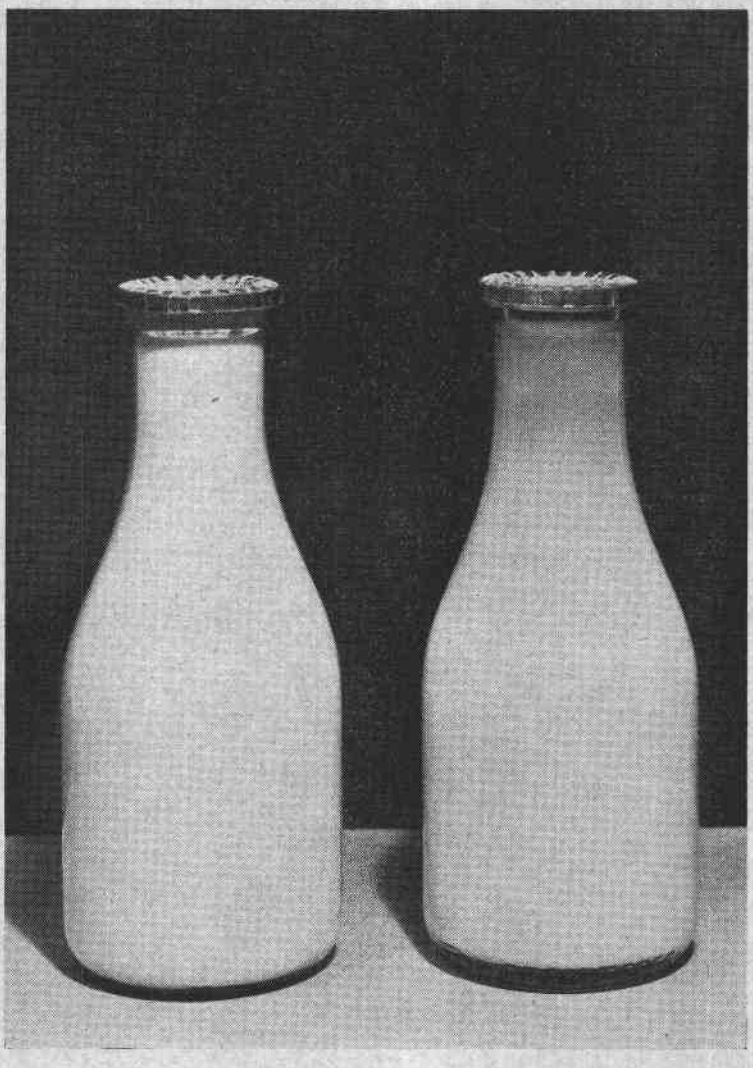

Figure 1. CULTURED BUTTERMILK.
Bottle at left: Showing desirable body.
Bottle at right: Showing undesirable wheying off.

is 2 ounces for 10 gallons of milk. To ½ pint of water add 2 ounces of crystals. Bring to a boil in order to kill bacteria present and then cool. Add this solution slowly to the milk while stirring.

The length of the incubation period is normally from 14 to 16 hours. A smooth curd that shows no wheying off should have formed during this period. The acidity should be the same as that of high quality culture—namely, from 0.75 to 0.80 per cent calculated as lactic acid. If the acidity is higher or lower the buttermilk will be less palatable. It may show wheying off and small specks of coagulated curd may be visible.

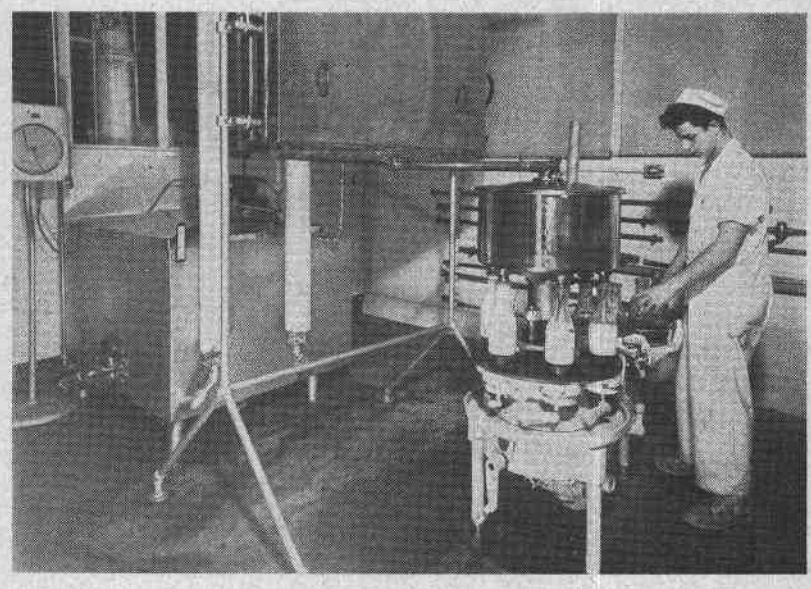

Figure 2. BOTTLING CULTURED BUTTERMILK.

The cultured milk may be cooled and bottled without churning or further processing. A more palatable product, however, with better body and texture and better keeping quality can be obtained if the cultured milk is either churned or agitated as described below.

To increase the fat content, add to the cooled cultured buttermilk sufficient high quality, pasteurized cream so that the finished product will contain approximately 1 per cent fat. This percentage may be slightly raised or lowered.

If the coagulated milk is to be churned, transfer it to a clean churn and agitate it for approximately 10 minutes or until butter granules become visible. Do not overchurn, because large granules are undesirable. During the spring and summer months it may be necessary to churn at a temperature from 2° to 4° F. below the incubation temperature. The finished buttermilk should then be cooled to a temperature slightly above the freezing point of water. When this method is used, add three-fourths of the cream before churning and one-fourth after churning.

A new method of treating the coagulated milk by pumping was described recently by Dr. C. L. Roadhouse, of the California Agricultural Experiment

Station, who demonstrated the method during the annual convention and short course of the Oregon Dairy Manufacturers' Association. The method of agitation of the milk consists of circulating it through a centrifugal pump and returning it to the same vat through a discharge pipe that terminates a foot or two above the surface of the vat. The agitation through the pump and the fall

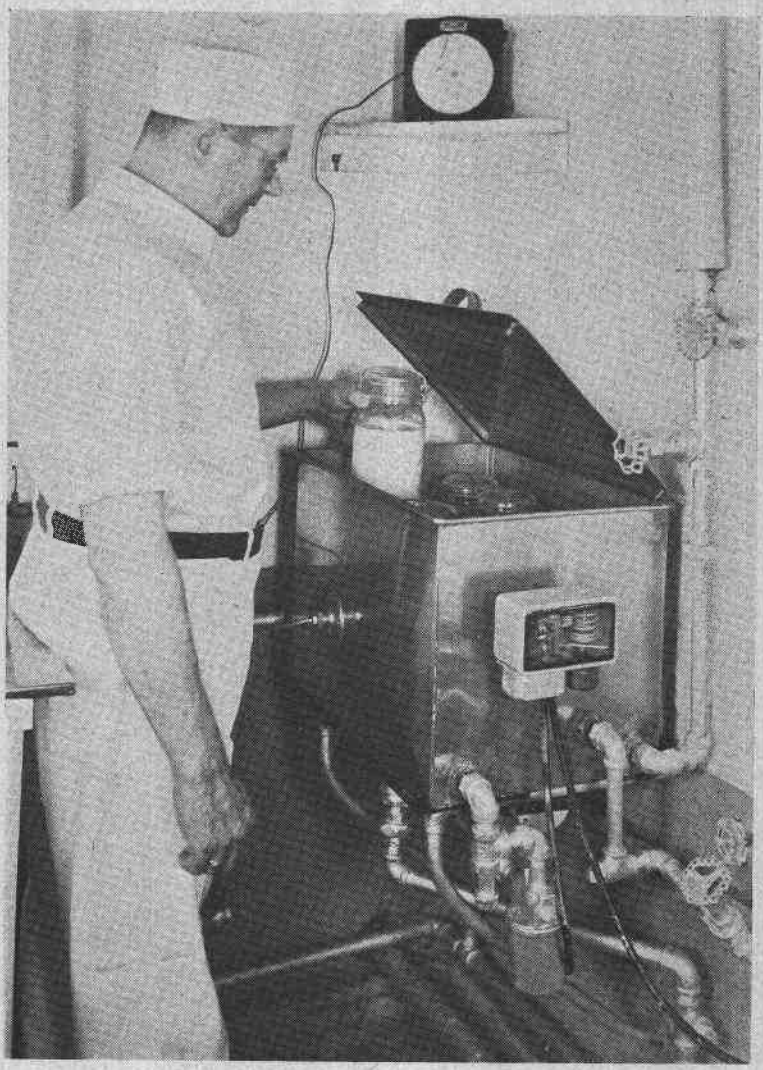

Figure 3. PREPARING MOTHER CULTURE UNDER CONTROLLED CONDITIONS.

of the milk into the vat accomplishes the churning of the cream by the formation of small butter granules.

The churning attachments necessary for milk pasteurizing vats can be obtained from dairy equipment manufacturers.

Add 2.2 ounces of salt for each 100 pounds milk to the buttermilk before pumping. During the winter months add 4.2 cubic centimeters of butter color per 100 pounds of milk. Add three-fourths of the required amount of pasteurized cream. Granules of the desired size usually will be obtained if the milk is pumped during the summer months at 68° F., and during the winter months at 72° F. By regulating the amount of cultured milk churned the viscosity of the finished product can be controlled. A much less viscous and more desirable product is obtained if all the buttermilk is pumped during a period of 40 minutes, whereas a greater viscosity is obtained when only one-half of the milk is pumped during about one-half of this time. After the proper-sized granules are obtained, the addition of cream to increase the fat content by 0.25 per cent, so that the finished product will contain 1 per cent fat, is recommended. The entire batch of buttermilk may then be cooled to 40° F., and held at this temperature *for a few hours,* after which it can be bottled or placed in cans.

It is important to keep the finished product at a temperature slightly above the freezing point until it is to be consumed.

BULGARIAN BUTTERMILK

The term Bulgarian milk or Bulgarian buttermilk is often misused. Unless the organism *Lactobacillus bulgaricus* is present in the product in large numbers, it would be fraudulent to sell the milk under one of these names. Oftentimes cultured skim milk, also known as starter, or cultured buttermilk as described above, is sold as Bulgarian milk.

It has been shown that a milk culture containing *Lactobacillus bulgaricus* has no greater therapeutic value for human beings than a milk culture containing the common *Streptococcus lactis.* The product obtained when *Lactobacillus bulgaricus* is grown in skim milk generally has a sharp acid and objectionable flavor, and because of the high acidity that is normally produced this cultured milk is definitely unpalatable. The growth conditions of the organism are different from those of *Streptococcus lactis* and associated flavor-producing organisms.

A discussion of the preparation of Bulgarian buttermilk seems unnecessary in this publication.

ACIDOPHILUS MILK

Acidophilus milk is a cultured milk that definitely has a therapeutic value. The bacterium *Lactobacillus acidophilus* may be readily implanted in the intestinal tract if adequate amounts of the cultured milk are consumed over a period of time. Many experiments have been made to study its effect on persons suffering from constipation. In all of the cases studied, from 80 to 100 per cent of the patients were relieved by consuming adequate amounts of acidophilus milk. The administration of acidophilus milk is just as valuable for the treatment of diarrhea. Excellent results have been obtained in treating newborn lambs and calves by feeding acidophilus milk.

Preparation of acidophilus milk

Acidophilus milk is prepared by inoculating sterilized skim milk with a pure culture of *Lactobacillus acidophilus* and incubating at a suitable temperature. The culture can be obtained from a commercial laboratory. As the organism grows slowly, precautions must be taken to keep out foreign organisms.

Preparation of mother culture

Fill two 1000 cc. Erlenmeyer flasks half full with skim milk and plug tightly with cotton. Sterilize in a pressure cooker or in a steam autoclave for 30 minutes at 15 pounds pressure. The sterilized milk should show a slight brown color and should have a caramelized odor. As a check on the efficiency of sterilization, keep the sterilized milk at room temperature for several days after it has been removed from the sterilizer. During this period there will be growth of bacteria that were not killed by the heating, with the result that an undesirable fermentation will take place in the milk.

For inoculation of the milk use a wire needle that has been sterilized in a flame. The mouth of the flask containing the sterilized milk and the mouth of the flask containing the culture should be sterilized immediately after removing the cotton plugs by passing them through an open flame. Care must be taken to avoid contaminating the cotton plugs. The inoculated milk is incubated at 98.6° F. for about 36 hours. At the end of this period a solid coagulum should have formed, free from any gas holes.

Preparation of the bulk culture

Use high quality skim milk containing a minimum number of bacteria. Place the milk in 5-gallon stainless steel cans. The cans should be filled to within 6 inches of the top. A straight-sided, shotgun type of can is convenient. The lid should be of the overhanging type. A sheet of parchment paper may be placed over the top of the can before the lid is placed in position.

A pressure cooker of a size large enough to accommodate three or four 5-gallon cans is convenient to use for sterilizing the milk. Before sterilization the milk should be preheated to a temperature of approximately 100° F. Sterilization consists of heating for a period of from 13 to 15 minutes after the air has been expelled from the cooker, at 15 pounds per square inch gauge pressure. This gives a temperature of 249.8° F. The sterilized milk should have a slightly brown color and a caramelized flavor.

The sterilized milk should be placed in a tank of water and cooled to a temperature of 100° F. It then can be inoculated with mother culture, using approximately 2 ounces for 4½ gallons of milk. A steam-sterilized metal rod may be used for stirring the milk briefly after inoculation, or this stirring may be omitted.

The water in the tank should be maintained at 98.6° F. ± 1° F. by means of an electric heater thermostatically controlled. Normally the milk will show a good coagulation without wheying off after 36 hours of incubation.

Cool the acidophilus milk by means of cold running water to a temperature of 50° to 60° F. It is now ready for marketing. Agitate the coagulum vigorously, using a sterilized stirring rod, until it is of a creamy consistency. Place the milk in bottles, jars, or lacquered tin cans. The milk may be stored at room temperature for a period not exceeding 14 days. If stored longer there will be a marked decrease in the number of bacteria present.

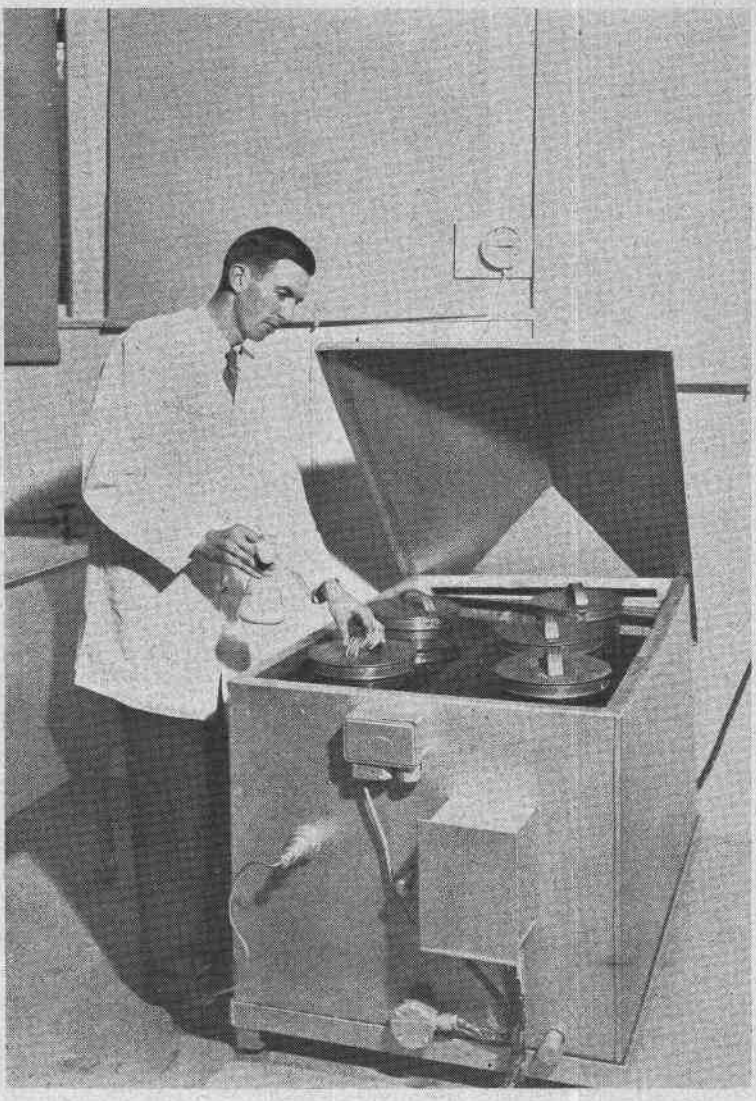

Figure 4. Inoculating Sterilized Milk with a Pure Culture of *Lactobacillus Acidophilus*.

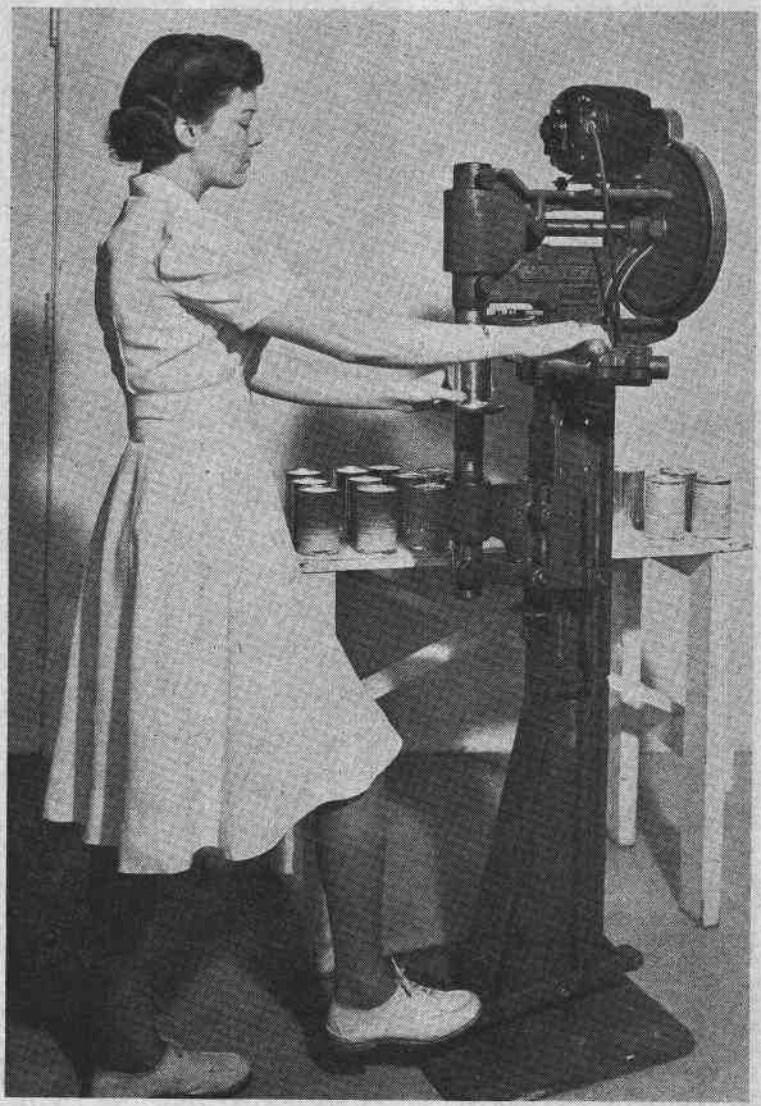

Figure 5. Canning Acidophilus Milk.

ADDITION OF FRUIT JUICE TO BUTTERMILK AND ACIDOPHILUS MILK

Some persons prefer to flavor buttermilk or acidophilus milk with fruit juice. The following are examples:

ORANGE BUTTERMILK

Orange juice ..... 1 qt.
Buttermilk ..... 3 qts.
Sugar to taste

LEMON ACIDOPHILUS MILK

Lemon juice ..... ½ pt.
Water ..... ½ pt.
Acidophilus milk ..... 4 qts.
Sugar to taste

APPLE CIDER BUTTERMILK

Apple cider ..... 1 qt.
Buttermilk ..... 3 qts.
Sugar to taste

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