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Abstract

The consumption of various types of fermented milk is common in all countries in which milk is available. The food value of such products is unquestioned and their desirability, especially in the case of certain intestinal disorders, is insisted on by many persons. The recent necessity for food conservation has emphasized the possibility of preparing nourishing beverages as well as liquids to be used in cookery from skim milk, buttermilk and whey, which would otherwise be discarded or used for animal feeding.

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Fermented Milk

By B. W. Hammer and A. J. Hauser.

The consumption of various types of fermented milk is common in all countries in which milk is available. The food value of such products is unquestioned and their desirability, especially in the case of certain intestinal disorders, is insisted on by many persons. The recent necessity for food conservation has emphasized the possibility of preparing nourishing beverages as well as liquids to be used in cookery from skim milk, buttermilk and whey, which would otherwise be discarded or used for animal feeding.

BUTTERMILK

Buttermilk obtained by churning cream which has undergone a clean lactic acid fermentation is a product that is very pleasing to many people. Such a product is not, however, widely available and can be secured at its best only where the cream received is of very good quality and is properly handled. Many of the creameries at present receive sour cream and much of this is pasteurized before it is made into butter; the combined action of heat and acid during pasteurization tends to harden the casein so that the buttermilk secured from such cream very soon shows a layer of whey at the top, due to the settling of the casein, and is in general somewhat undesirable. If the cream is pasteurized while still sweet, the buttermilk secured when the cream is soured and churned does not show this tendency to "whey off." The very best quality of buttermilk is secured when cream is pasteurized while sweet and then properly soured with lactic acid bacteria, because in this way the most desirable type of acid fermentation is secured.

On account of the difficulty of securing buttermilk of a high quality from the type of cream delivered to many creameries, various products are made from skim milk, whole milk, etc., and sold under names such as "culture buttermilk," "artificial buttermilk" or special names (e. g. Morilac, Fermilac) adopted by the manufacturing concern. In general, cultures of bacteria which sour milk rapidly are used in the preparation of these products.

The starter used by the buttermakers is employed in the manufacture of most prepared buttermilks. Starter is added by the buttermakers to cream to be made into butter, for the purpose of souring the cream if it is sweet and also to produce a desirable flavor in the butter.

Starters are of two general types, commercial and natural.

Commercial starters, which are simply cultures of *Bact. lactis acidi*, are sold by a number of firms and a description of the method of use is ordinarily supplied with each purchase. The general method of handling commercial starters is as follows:

A quart milk bottle is filled three-fourths full of milk, either skim or whole, and covered with a cap, or an inverted tumbler. The milk bottle is then placed in a container, surrounded with water to a height greater than the height of the milk and heat applied. In this way the milk is heated to from 180° to 200° F. for from 20 to 40 minutes for the purpose of destroying the majority of the bacteria that are in it, and then cooled to about 75° F. The cooling can best be accomplished by running cold water into the hot water surrounding the bottle. The cold water should be added very slowly at first or the bottle will crack. As soon as the cooling is completed the commercial starter or culture is added. The milk should then be kept as near 75° F. as possible until it coagulates, when it should be cooled by placing it in a refrigerator or surrounding it with ice, unless it is to be used at once. By the use of an insulated can containing a considerable volume of water in which the bottle can be held, the temperature of the milk can be easily maintained. Another bottle of milk is then pasteurized and cooled and inoculated with a small

amount of the milk already soured, and this procedure is repeated each day. The second bottle of milk and all following it should be cooled to 70° F. and held at this temperature for growth.

The first few bottles of milk are usually not as good as those secured later on. When a larger volume of milk is desired, it is pasteurized in a metal container such as a starter can or ripening vat, cooled and inoculated with milk carefully soured in a bottle or other small container. It is better to dip milk for inoculating purposes from the bottle with a thoroly scalded spoon than to pour it over the lip of the bottle, since the lip may be a source of foreign bacteria. The discarding of the upper portion of the soured milk is common among starter experts, when the milk is to be used for inoculating. As a general rule, the milk that is being fermented should be cooled soon after it is curdled to prevent the continued growth of the bacteria. If this is not done the milk becomes so sour that it is less pleasant to the taste and moreover the bacteria are less active after being exposed to a high acidity. The length of time required to curdle can be regulated quite closely by carefully controlling the amount of material used for inoculating. If the starter goes off in flavor or develops gas or any other objectionable feature, it is best to secure a new culture as defects are sometimes overcome only with a great deal of difficulty.

A natural starter can be secured by allowing samples of good clean milk to sour and then selecting, for inoculating purposes, one with a desirable flavor and no defects. This sample should be carried from day to day as outlined under commercial starters. Good clean buttermilk or whey can also be used for the initial inoculation into pasteurized milk.

Starter is commonly sold as "culture buttermilk" and to many people it has a very pleasing taste. It should be thoroly agitated so that it will have a good, smooth body before it is bottled. The milk made into starter may be skimmed, partly skimmed, or whole milk. The type of milk to use is determined almost entirely by the trade supplied; if the price that can be secured justifies it, a certain amount of fat should be left in the milk. The condition of the starter is very materially influenced by the acidity to which it is ripened. An acidity of .65% (calculated as lactic acid) is very satisfactory to many people and the product then is quite thin. Usually, however, a higher acidity is developed.

By taking starter and adding a good quality of sweet cream to it a very pleasing product can be prepared. The amount and fat content of the cream is determined very largely by the expense that can be incurred in making the product. By adding 20% cream to the extent of 20% of the volume of the sour milk a very good product is obtained. The advantage of adding cream over having the fat present in the milk before souring is that a smoother product can be secured; when the fat is present during the souring it rises to the surface and is apt to be in masses which are more or less difficult to entirely break up.

Starter is objected to by certain people, especially those that are unfamiliar with it, because it is much thicker than the buttermilk to which they are accustomed. By mixing skim milk or whole milk with starter the thickness can be very materially reduced and a product that to many people is more desirable can be secured. A very satisfactory ratio is one part of skim milk or whole milk to two or three parts of starter, but this can be varied to suit the individual taste. The skim milk or whole milk and starter should be thoroly mixed by pouring from one can to another or by agitating them for a few minutes in a churn.

In certain localities a buttermilk containing *Bact. bulgaricum* is desired. This organism is capable of souring milk rapidly, but the flavor of such milk is not so pleasant to most people as the flavor of starter, and accordingly a common method is to add starter to milk soured by *Bact. bulgaricum* because in this way the flavor is usually satisfactory and the presence of the *Bact. bulgaricum* can be insured. The two types of milk may be mixed in any proportion; one part of milk soured by *Bact. bulgaricum* to three or four parts of starter is a satisfactory ratio. Mix by pouring from one can to another or preferably by agitating a few minutes in a churn. Attempts are sometimes made to grow *Bact. bulgaricum* and *Bact. lactis acidi* together, but they are usually not very successful because *Bact. bulgaricum* requires a much higher temperature than *Bact. lactis acidi*.

The term "Bulgarian buttermilk" should only be applied to material containing *Bact. bulgaricum* either alone or in combination with starter.

Bact. bulgaricum is carried on the same general basis as starter (*Bact. lactis aridi*), but the growing temperature should be from 95° to 105° F., since lower temperatures are much less favorable. The pasteurized milk should also be very free from bacteria because the organisms resisting pasteurization grow much more rapidly at 95 to 105° F. than at lower temperatures and are accordingly more liable to produce undesirable changes. If the original milk is very clean, the usual pasteurization may be satisfactory, but if it is not, double pasteurization is ordinarily effective. This consists of pasteurizing on two successive days with thorough cooling during the time between heatings. *Bact. bulgaricum* is much more difficult to carry from day to day than is starter, and it is frequently necessary to have recourse to a new culture. When large lots of milk are to be fermented with *Bact. bulgaricum*, double pasteurization is advisable unless the milk is very clean.

The "wheying off" of buttermilk secured from cream pasteurized after it has soured can be prevented by adding milk soured with *Bact. bulgaricum**. The amount of such milk necessary depends on the quality of the buttermilk and probably also on the condition of the milk soured with *Bact. bulgaricum*. Sometimes as much as an equal amount of milk fermented with *Bact. bulgaricum* has been necessary to entirely prevent "wheying off" and in some cases even this amount has not been sufficient. It will probably be necessary to determine the amount of milk fermented by *Bact. bulgaricum* required under the conditions existing, since the length of time the mixture stands is important. As a rule, even with small percentages of milk soured by *Bact. bulgaricum* the extent of the "wheying off" is not as great as where no such milk is employed.

Prevention of "wheying off" in buttermilk secured from cream pasteurized when sour is also possible by adding starter. Probably here also the amount to be added depends on a number of factors such as the buttermilk worked with and the length of holding.

The addition to buttermilk of milk fermented with *Bact. bulgaricum* or of starter effects, in general, some improvement in flavor and because starter has the more desirable flavor it is preferable. In using either starter or milk fermented by *Bact. bulgaricum* it is desirable to agitate thoroughly the material after the mixture is made; churning is a very satisfactory method. The amount of starter or milk fermented with *Bact. bulgaricum* to add is usually kept as low as possible, as in general these are much more expensive than the buttermilk it is desired to improve.

In deciding on the percent of fat to put into buttermilk, it is desirable to put in just as much as the price received justifies.

KEFIR

By securing both an acid and a yeasty fermentation in milk, a product can be obtained that is very acceptable to many people. In general, it is best to get the acid development first and for this reason it is common to use either starter or buttermilk. The yeasty fermentation must be carried out in a thoroughly sealed bottle or jug. The type of bottle having a patent stopper that is easily opened and sealed is very satisfactory, but an ordinary bottle or jug can be used if the cork is wired or otherwise fastened so that the development of gas will not force it out.

For the manufacture of kefir, approximately 4% (a trial may result in a change) of sugar should be added to the starter or buttermilk (figure 2.15 pounds to the quart) and thoroughly dissolved; the sugar must be added because the yeast used cannot ferment the lactose. One-sixteenth to one-thirty-second of a cake of compressed yeast (small cake usually selling for 3c) is used for each quart of starter or buttermilk; the yeast is thoroughly mixed with a very small amount of water until a uniform suspension is secured and the suspension then distributed thru the starter or buttermilk. If desired, the distribution of the yeast and the dissolving of the sugar can be accomplished with the same agitation.

The bottles or jugs are then sealed and held at about 70° F. If the room is about this temperature, the starter or buttermilk can be adjusted

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to about 70° F. and the bottles or jugs allowed to stand in a can or box, preferably of metal. If the room varies considerably from 70° F. the bottles or jugs can be held (preferably surrounded by water at 70° F.) in insulated cans. In any case the bottles or jugs should be enclosed, as the development of gas occasionally causes them to break very violently.

The fermentation is allowed to proceed for from 16 to 24 or more hours. No attempt should ever be made to open the bottles or jugs until they are thoroly cooled. By holding the bottles or jugs in metal containers during fermentation by the yeast, ice and water can be easily placed around them when they are ready to cool; this is a good procedure to follow since it is best not to touch the bottles or jugs until they are cooled. Even when the bottles or jugs are surrounded with ice and water they require from two to three hours for cooling. Before attempting to open a bottle or jug, wrap it in a cloth, as violent breaking sometimes occurs during the opening. It is also advisable to hold a tin container over the mouth of the bottle or jug. The bottles or jugs should never be shaken until after they are opened.

Starter yields a kefir that is rather thick and a more satisfactory product may be secured if skim milk is mixed with the starter before the yeasty fermentation is started. The proportion can be varied, but two parts of starter to one of skim milk is generally satisfactory. Buttermilk can be used for the manufacture of kefir, but it is apt to yield a product that is somewhat lumpy.

When a bottle or jug of kefir is only partially used, it should be tightly corked and held in ice water. Unless this is done, much of the gas will be lost and the flavor given by the gas will partly or entirely disappear.

Almost any of the sugar substitutes, such as glucose and corn sugar, can be used to partly or entirely replace sugar in the manufacture of kefir, altho in general they affect the flavor to some extent. The amount to use varies with the product and can best be determined by trial. Very small amounts of these are sufficient for the production of the gas required, so the taste desired determines the amounts to add.

WHEY KEFIR

By inducing a yeasty fermentation in whey secured in the manufacture of cheese, a product can be obtained which is more palatable to many people than the regular kefir. The method of manufacture is essentially the same as for kefir, with the exception that the whey is used instead of the starter or buttermilk. There is less likelihood of breaking the containers with the whey.

LACTADE

Starter can be combined with sugar and lemon extract to make a very pleasing drink. About two teaspoons of sugar and three to four drops of lemon extract or a tablespoon of lemon juice to an ordinary glass of starter are good proportions to use, but these amounts will be varied in different ways if individual preference is considered. By using an egg (or a portion of an egg) to each glass and stirring it in thoroly the product can be improved. Other juices can be used along with the lemon juice if it is desired.

HOLDING FERMENTED MILK DRINKS

After they reach their best condition, practically all fermented milk drinks deteriorate rapidly unless well cared for, by keeping them cold. At ice box temperatures, buttermilk and other fermented milk drinks are apt to deteriorate rapidly and if the product is to be kept for any length of time temperatures below 40° F. are necessary.

Particular attention is necessary in the holding of kefir, since if the product is not cooled rapidly at the proper time the containers are likely to be broken. Because of the difficulty in holding kefir and shipping it under suitable conditions, as well as the inconvenience of opening properly fermented bottles, it is likely that this product can never be put on a thoroly commercial basis.