

# AGRICULTURAL EXPERIMENT STATION

KANSAS STATE AGRICULTURAL COLLEGE  
MANHATTAN, KANSAS

DEPARTMENTS OF BACTERIOLOGY AND DAIRY HUSBANDRY

## HOW TO PRODUCE ICE CREAM WITH A LOW BACTERIAL CONTENT<sup>1</sup>

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### IMPORTANCE OF BACTERIA IN ICE CREAM

The ice cream maker is entrusted with the production of one of the most nutritious and delicious foods in the American diet. The increasing popularity of ice cream as a food for children and for the sick makes it imperative that the ice cream maker follow every possible precaution to produce a clean and a safe product. He should use every effort to increase the popularity of his product by offering the public ice cream that merits their confidence. This means that ice cream not only must contain the proper proportion of ingredients and have a smooth texture and pleasing flavor, but it must be made from the best grade of raw products and handled with all sanitary precautions. Ice cream that is made from clean products, properly pasteurized and aged, and in thoroughly sterilized utensils will almost invariably have a low bacteria count. In contrast, ice cream that has been improperly handled with respect to any of the items mentioned will contain excessive numbers of bacteria. Such a product will be undesirable from a sanitary point of view, not necessarily because of any detrimental effect of the bacteria, but because of the careless methods which their presence indicates. The entrance and multiplication of excessive numbers of bacteria occur under conditions that make possible the entrance and development of the dangerous types of bacteria as well as the harmless types.

It is the purpose of this circular to discuss briefly the proper control of each manufacturing process to exclude as many bacteria as possible. The strict observance of each detail suggested has been shown by experimental work in the Kansas Agricultural Experiment Station to result in the production of ice cream under commercial conditions containing less than 25,000, and in many cases less than 10,000, bacteria per gram.

### WASHING AND STERILIZING OF UTENSILS

**Vats.**—All vats used in compounding or aging the mix are first rinsed with lukewarm water and this is followed by washing with hot water containing washing powder and scrubbing thoroughly with a brush to remove all traces of milk products. The vat is then rinsed with hot water followed by live steam.

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For effective destruction of bacteria the steam hose must be left in the closed vat until the temperature reaches 200° F. and the vat remain closed for 10 minutes. While still hot the covers are raised to permit rapid drying.

**Ice Cream Cans, Pails, Etc.**—Metal utensils are thoroughly washed with warm water and washing powder and then steamed until they become hot enough to dry from their own heat. It is very important to leave all dairy utensils in a perfectly dry condition to prevent the growth of bacteria.

**Homogenizers or Emulsifiers.**—These machines are likely to be an important source of contamination unless special attention is given to their washing and sterilization. The detachable parts of the machine that come in contact with the mix should be taken apart, thoroughly washed in water and washing powder, and then submerged in water and steamed for 10 minutes. It is advisable to steam them again before use. The nondetachable parts of the machine should be thoroughly washed and then steamed for 10 minutes. It is advisable to steam for 5 minutes again before using.

**Pipelines.**—Sanitary pipe and fittings can be very effectively cleaned by using a brush with warm water and washing powder followed by a liberal use of steam. It is good practice to hang the pipe in a vertical position to permit the escape of steam and the drainage of water of condensation.

**Freezers.**—In washing the freezer immediately after use, it is advisable to warm the drum by a gradual increase in the temperature of several successive rinsings. It may then be washed for 5 minutes with a hot solution of washing powder followed by another rinsing with clear, hot water. In steaming the chamber the hose is inserted in the outlet gate. With some types of freezers the brine thermometer must be removed before the steaming operation begins. Recent experiments in which the freezer was washed as described and steamed for 3 minutes gave very satisfactory results. Less than 2500 bacteria were found in the entire freezer after this method of washing was used.

#### RAW MATERIALS

**Cream and Milk.**—Cream and milk which are sweet, clean, free from taints and odor, and as fresh as it is possible to obtain them ought to be used in the manufacture of ice cream. Cream is probably the most important source of bacteria in ice cream. Insist upon daily delivery of cream from producers and keep it cold until ready for use. The same precautions should be observed with the skimmed or whole milk used in compounding the mix,

**Butter.**—The finest ice cream is always made from fresh sweet cream. When necessary to use unsalted butter only a good sweet product free from taints and mold will be used by the maker who is zealous of the quality of his ice cream.

**Powdered Milk and Condensed Milk.**—The powdered and condensed forms of milk have been found to vary considerably in bacterial count. The purchase of a good quality of either of these products will minimize the contamination from this

source. Powdered milk must be kept in a cool, dry place. Condensed products must be given the same care as fresh milk.

**Gelatin.**—The bacterial content of gelatin may or may not be an important factor in contributing bacteria to the mix. Some gelatins have been found to offer a material source of contamination even though they constitute a small percent of the mix. Contamination from this source is particularly noticeable in cases where the gelatin is added after pasteurization.

**Sugar.**—In the experimental work carried on at this station, sugar, when stored under proper conditions, has never been found to be of any consequence in the addition of bacteria to the ice cream mix.

**Water.**—The water, if added, should be taken from a supply that is known to be free from sewage pollution. This may be determined by having it analyzed at the Kansas State Agricultural College bacteriology laboratories.

### MANUFACTURING PROCESSES

**Pasteurization.**—Under ordinary conditions there is no factor in the manufacturing process of ice cream that is so important in controlling the bacterial count of the finished product as thorough pasteurization. The saving of a few minutes time or a few degrees of temperature in pasteurization may result in the survival of many thousands of bacteria per gram of mix. The state laws of Kansas stipulate that all milk products used in the manufacture of ice cream shall be pasteurized by heating at not less than 145° F. for not less than thirty minutes. An ice cream maker who is endeavoring to produce ice cream with a very low bacteria count can spend his time no more profitably than by paying strict attention to the pasteurizing process. If 150° instead of 145° is used much more efficient reduction in the bacteria count will be assured. Too much emphasis cannot be placed on the thoroughness of pasteurization as a means of lowering the bacteria count on the finished product.

**Homogenizing or Emulsifying.**—The process of homogenization or emulsification of the mix almost invariably results in an increase in the bacteria count. This is due partly to contamination from the machine, but more particularly to the breaking up of clusters of bacteria. A cluster of a dozen bacteria will produce only one colony on the agar plate from which the bacteria count is made. The mechanical force of the homogenizer or emulsifier tends to break some of these clusters so that each of the individual cells liberated may produce a separate colony on the plate and thereby increase the count. It is obvious, therefore, that the increase is more apparent than real. The extent of this increase will of course depend upon the tendency of the bacteria in the mix to exist in clumps and also on the pressure and force of the machine. The average increase in bacteria count following this operation is about 25 percent.

**Aging.**—The control of the temperature during the aging process is very important in keeping down the bacteria count

of the mix. A low bacteria count in the finished product cannot be expected if the temperature of the mix during the aging process exceeds 45° F. for any length of time. Failure to control the temperature of the mix during the aging process may mean an increase of many thousand or even many millions in the bacteria count of the finished product. Keep the mix below 45° F. throughout the aging period and as near 35° as much of the time as possible. Even this low temperature will not entirely prevent some of the bacteria from growing, but the increase in number will not be appreciable in 24 to 48 hours. If the temperature is properly controlled no increase in count will be noted in a 24-hour aging period.

**Freezing.**—The whipping of the mix by the dasher in the freezer usually results in an increase in the bacteria count, due, perhaps, to the breaking up of clumps of bacterial cells. This increase in count is not very marked and is frequently too small to be detected.

**Hardening and Storage.**—During the first few days after placing the ice cream in the hardening room or packing in ice or brine there is usually a marked decrease in the number of bacteria. This decrease may vary from none to as much as 75 percent in the first two days. It is probably due to the destruction of some of the less resistant bacteria by the low temperature. After the first week the reduction in numbers continues but at a much slower rate. After about a month there is frequently a slow increase in the number of bacteria, due to the slow growth of some bacteria even at such a low temperature.

#### OTHER SOURCES OF CONTAMINATION

**The Ice Cream Maker.**—Every effort should be made to prevent contamination of the ice cream mix from the clothes, hands, and hair of the operator. The bacteria of human origin are most likely to be the dangerous types. The operator should wear clean clothes, have clean hands and wear a cap to bind his hair. There is no necessity of his hands touching the mix or its ingredients. An ice cream maker who has been ill should secure a physician's certificate before returning to work.

**Flies.**—The necessary exposure of the ingredients during the mixing process makes it very important to keep flies out of the plant. The bacteria which flies carry on their bodies are frequently pathogenic for man.

#### SUMMARY

The production of ice cream of a low bacteria count is very important because of the increased safety and desirability of the product. Ice cream can be produced under commercial conditions having a bacteria count of less than 25,000, and in many cases less than 10,000, per gram if the following directions are followed explicitly: (1) Use only the best grade of raw products. (2) Keep all cream, milk, and skimmed milk cold until ready to compound the mix. (3) Thoroughly wash all vats, cans, pipes, freezers, and machinery with water and washing powder followed by steam. They should be steamed again just before using. (4) Give very close attention to the pasteurization process and be sure that all of the mix is heated to at least 145° F., preferably 150° F. for not less than 30 minutes. (5) Keep the temperature of the mix during the aging process below 45° F., preferably 35° F.