

Problems Incident to the Production and Use of Homogenized Milk*

G. M. TROUT

Michigan Agricultural Experiment Station, East Lansing, Michigan

WHILE homogenized milk has been readily accepted by the consumer almost beyond comprehension, the processing and distribution of homogenized milk has not been without its problems. These problems, troublesome as they may seem at times, are not without solution. It should be emphasized, however, that homogenized milk is not alone in respect to problems. In fact, any product has its own peculiar problems incident to production, processing, and distribution.

Too often we think of the process of homogenization only as one reducing the size of the fat globules to the extent that they no longer rise to form a cream layer and that that is all which does occur as a result of the process. The very fact that the fat globules are rendered much smaller in size thus creating new and increased surface area and dispersing the fat uniformly throughout the milk, results in a product which no longer behaves in many respects as milk normally does. These problems may be roughly classified as follows:

1. Processing
2. Packaging
3. Distribution
4. Laboratory control
5. Cooking
6. Utilization of returns

PROCESSING

In the field of processing there are at least five problems to which the attention of the production manager should be called. These are:

1. Rancidity
2. Sedimentation
3. Increased bacterial counts
4. Inefficient homogenization relative to standards
5. Cream line

Fortunately, practically all the problems incident to the production and processing of homogenized milk may be readily solved. However, if the plant manager is not aware of the problem, difficulty may be encountered. Probably the chief problem in homogenizing milk is that of the development of rancidity. Unless the milk is processed at a temperature sufficiently high to inactivate the enzyme lipase causing lipolysis, all homogenized milk soon becomes so rancid, bitter, and soapy, that it cannot be used for edible purposes. Thus, if milk is to be homogenized, it must be pasteurized prior to homogenization or immediately following the process. Furthermore, homogenized, pasteurized milk must not be contaminated with raw non-homogenized milk. The introduction of a small percentage of raw milk to the homogenized product induces lipolysis, or fat splitting, about as rapidly as though the milk had been homogenized raw. This problem has been successfully solved by recognizing the behavior of raw milk resulting from homogenization and heat-treating the milk accordingly.

Another problem in processing milk of quite some concern, which is not entirely eliminated in the homogenized milk industry today, is that of sedimentation. Despite the fact that the milk may have been filtered, the

* Address delivered before State College of Washington Institute of Dairying, at Pullman, Wash., February 26, 1942.

homogenized product may show a flocculent, smudgy precipitate in the bottom of the bottle after 24 hours standing regardless of the pressure used. Particularly at some seasons of the year is sedimentation in homogenized milk troublesome. An analysis of this sediment shows it to be composed largely of milk cells, milk solids, colloidal dirt, and some milk fat. In other words, it compares quite favorably with that of separator slime. Sedimentation of homogenized milk has been successfully eliminated by subjecting the milk to centrifugal force as in clarification. While clarification may be more efficient following homogenization, experiments have been demonstrated that sedimentation of homogenized milk may be overcome by clarifying the milk prior to homogenization. If sedimentation is to be overcome in part without submitting the milk to clarification, then special attention must be made to securing a clean milk supply and to processing the milk through a scrupulously clean machine.

Increased bacterial counts have been a matter of some concern to those distributing homogenized milk. Actually, increased bacterial counts in homogenized milk over the same milk non-homogenized is largely a matter of fancy rather than one of reality. True, the homogenizing process breaks up the clumps of bacteria so that in plate-counting the milk, higher counts may be obtained. However, such higher counts are apparent rather than real. It must not be overlooked that the modern homogenizer which is completely demountable may be as readily sanitized as any piece of equipment with which the milk comes in contact. Furthermore, the increased temperature above that of pasteurization resulting from the pressure of homogenization may be a factor responsible for further destruction of the bacteria of the milk, thereby tending to keep down the bacterial count of the homogenized product. The very fact that homo-

genized milk is put on the market today by many plants with no higher bacterial count than experienced in pasteurized milk shows conclusively that this problem is apparent rather than real.

At the present time much concern is being felt over homogenized milk not meeting the standards set up for the product. Some evidence is available showing that some commercial milk thus processed is not quite meeting the standards for homogenized milk. Apparently, either the standards for the product are too stringent or else it may be necessary to subject the milk to somewhat higher operating pressures. Generally, at least 2,500 pounds pressure per square inch are necessary if homogenized milk is to meet the standards for the product.

Another problem in processing which occurs from time to time is that of cream line or a cream plug. Such a problem would seem never to be associated with homogenized milk, yet the problem occasionally manifests itself. Two causes may be mentioned. Either the milk is insufficiently homogenized or else the homogenized milk is contaminated with non-homogenized milk. In the latter case the homogenized milk may have been put through the bottler after non-homogenized milk had been bottled without previously having washed the equipment. In some cases a dead-end pipe filled with non-homogenized milk may feed such milk into the line later on during bottling of homogenized milk, thus giving a cream line or a cream plug to the homogenized milk. As long as the entire lot of milk is properly homogenized and bottled without subsequent contamination with non-homogenized milk the trouble with cream plug should not exist.

PACKAGING

In the packaging of homogenized milk one major problem exists. This problem is that of foaming so that difficulty is experienced in properly

filled bottles. This problem has not been successfully solved to the satisfaction of all. To our present knowledge the best procedure is to carry a high head of milk in the cooler trough and the bottling supply tank, making certain that no air leaks are in the line and that the bottler is operated at slow speed. Probably vacuum filling of bottles at a comparatively high temperature offers some remedy. Also homogenization prior to pasteurization in the lipase-active zone may overcome foam in part. However, this is a dangerous procedure to follow in most cases.

DISTRIBUTION

In the field of distribution three problems manifest themselves: First, an unattractive appearing bottle due to seepage, particularly in the summer months when the bottles are not properly refrigerated enroute; second, seepage of the homogenized milk either around the cap seat or through the staple holes of the cap itself; and third, a watery appearance resulting from partial freezing of the milk in the northern climates during the winter months.

The unattractive bottle occurring sometimes during the summer months may be overcome by controlling the seepage. In overcoming seepage the 56 mm. cap milk bottle may be filled to one-quarter inch of the cap seat. This fill allows sufficient volume for expansion that seepage does not occur. The real solution to seepage of homogenized milk is adequate refrigeration from the plant to the consumer's refrigerator. Also during the winter months bottles of homogenized milk may be unattractive. When homogenized milk freezes it does not force up the cap as it does in non-homogenized milk. Instead of the frozen homogenized milk gradually pushing the cap up, the milk is first forced out from under the cap seat where it runs down over the sides

of the bottle forming a candle-drip appearance.

When frozen homogenized milk is defrosted, the upper portion of milk appears quite watery as though it had actually been diluted with water. Strange as it may seem the fat does not rise to the surface in frozen homogenized milk to form a cream layer, but actually settles out to a greater or less extent, depending largely upon the rate of defrosting.

LABORATORY CONTROL

The plant or health laboratory frequently has encountered difficulties in laboratory control of homogenized milk. These laboratories are chiefly concerned with the legality of the fat test of the milk and whether the milk attains the standard set for homogenized milk. Many experiments have shown conclusively that homogenized milk may be readily tested by the Babcock procedure, provided some modifications are made. The use of sulphuric acid having a specific gravity of 1.815 to 1.820 is to be recommended in making the fat test of homogenized milk. Precaution should be taken to know that the temperatures of both the milk and of the acid are about 70° F. Also the acid-milk mixture should be rotated gently at first and then agitated longer before the test bottles are placed in the centrifuge. Despite some little difficulty at times in making a clear fat test of homogenized milk, data show that homogenized milk may be tested readily with the results checking within 0.1 percent of that obtained on non-homogenized milk. This variation is within the tolerance provided for the fat percent of non-homogenized milk as specified by the American Dairy Science Association.

In checking the efficiency of homogenization, the upper 100 ml. are tested for fat and compared with the fat test of the remainder after the 100 ml. has been removed. The definition for homogenized milk given by the U. S.

Public Health Service is used as a standard. This definition is as follows:

"Homogenized milk is milk which has been treated in such manner as to insure breakup of the fat globules to such an extent after 48 hours storage no visible cream separation occurs on the milk and the fat percentage of the top 100 c.c. of milk in a quart bottle, or of proportionate volumes in containers of other sizes, does differ by more than five percent of itself from the fat percentage of the remaining milk as determined after thorough mixing."

Unfortunately, variations in the manner of securing the 100 ml. portion of milk results in wide variations in the test of that portion. Generally, methods involving the siphoning off of the upper layer without disturbing the under layer comes nearer giving a true picture of fat migration in the homogenized milk than do methods in which the underlayers are disturbed. Microscopic examination is very frequently employed also in checking the efficiency of homogenization. It is generally recognized that in properly homogenized milk the fat globules should not exceed two microns in diameter.

COOKING

In view of the fact that within a decade homogenized milk has become a standard food item in many homes, it seems strange that a problem should arise relative to its use in the home. However, its use in cookery particularly, has given rise to some problems. The problems are chiefly concerned with the curdling of the milk. Appar-

ently homogenized milk is more sensitive to heat, especially when the milk is used in cookery involving relatively high calcium values. On the other hand, this curdling of homogenized milk in cooking may be of distinct advantage in several types of cookery, custard for example, rather than a disadvantage. However, the problem should be recognized and our customers educated to it.

UTILIZATION OF RETURNS

When homogenized milk was first introduced to the public the matter of the utilization of returns was of very vital concern. However, at the present time little is heard of this particular problem. In the first place, the amount of milk homogenized above that of the route demands is kept at a minimum. Studies have shown that that which is returned may be successfully utilized in making of buttermilk and cottage cheese. Separation of the returned homogenized milk would seem to be a questionable procedure to follow, particularly when the milk met the public health standards as to fat dispersion.

CONCLUSION

While homogenized milk apparently gives rise to numerous problems, these problems fortunately may be solved. Let it be recognized that problems exist in the processing and distribution of any product and homogenized milk is no exception. The general acceptance of homogenized milk indicates that the problems are not insurmountable.

Thirty-first Annual Meeting
October 30 and 31
Headquarters: Hotel Jefferson
St. Louis, Missouri