Developments in the Market-Milk Industry During World War II

C. J. Babcock *


NEVER before in our history has the market-milk industry supplied so great a quantity of fluid milk to so many people. Of the nearly 120 billion pounds of milk produced annually on United States farms, more than 40 billion pounds, or more than one-third of the total, is consumed as fluid milk and cream in the cities and villages. The market-milk industry is therefore the most important branch of the dairy industry in value of products, investment in buildings and equipment, and the number of men required to do the work. Indications are that it will remain so. In fact, its importance may be expected to increase because the consumption of fluid milk, abetted by improved quality and economies of distribution, will increase. Furthermore, the industry is now in a better position than it has ever been before to expand and furnish an ample supply of safe and palatable fresh milk throughout the continental limits of the United States and its possessions.

In these developments the Army, which during the war made fresh milk a regular item in the soldier's diet for the first time in the history of any nation, had a significant part. The fact that one of the first desires of a soldier on returning to the States was a glass of fresh milk shows that a habit was formed which will not soon be forgotten or abandoned. Such a habit, if properly promoted by the market-milk industry, will extend to the soldiers' families and further increase the per capita consumption of milk.

INDUSTRIAL PRACTICES

The conditions under which milk for fluid use is produced and handled are regulated to a greater extent than are those under which milk is produced for any other purpose. State and local control officials deserve credit for the part they have played in assuring consumers a safe milk supply. Sanitary regulations governing the production and handling of market milk are strict, but the Army's milk buying and inspection program revealed that much needs to be done in the enforcement of the regulations, that many regulations ought to be simplified, and that more uniform milk ordinances with uniform enforcements are needed.

Throughout the emergency there was a downward trend in the quality of the milk received at market milk plants, largely because of the competitive demand for dairy products other than fluid milk—cheese, evaporated milk, dried milk, etc. In many localities the price of milk for manufacturing purposes so nearly approached that of milk for direct consumption that the producer of market milk frequently was unwilling to burden himself to meet the stricter sanitary regulations of the fluid milk market. When this condition prevailed the fluid milk plants either had to accept milk of a lower quality than that formerly accepted, or go out of business. The industry, how-

* Lt. Colonel Babcock served three years as Officer in Charge of Milk and Milk Products Inspection, Veterinary Division, Office of the Surgeon General, Washington, D. C.
ever, has become more conscious of the need to sell a product that is safe, clean, and of good flavor, with consumer appeal. Plans formulated by members of the industry to establish laboratories for the sanitary control of their products and to promote research work indicate that the downward trend will be reversed.

The introduction of improvements and the extension of previous developments were hampered by war conditions. In the field of production, the use of detergents for cleaning utensils, chemical agents for destroying germs, and mechanical milkers increased, but mechanical cooling and refrigeration of milk on the farm were not expanded normally. In the field of processing, there was a trend toward the greater production of homogenized milk and, especially where large volumes of milk were processed, toward short-time high-temperature pasteurization.

The advantages of stainless steel in equipment for processing milk have been firmly established. More and more equipment with which milk comes into contact on the farm and in the plant is being made of stainless steel.

Public health officials agree unanimously on the value of pasteurization (1). The public is fast becoming aware that pasteurization does not harm the flavor or food value of milk and that it is the only suitable measure known which, if properly applied to all milk, will prevent milk-borne diseases. The proportion of milk that is pasteurized before delivery to the consumer is increasing steadily. All milk for our armed forces and approximately 85 percent of the fluid milk supply in United States cities with populations over 10,000 is now pasteurized, and the number of cities that require that all milk be pasteurized is increasing. A large proportion of the cases of milk-borne diseases reported each year occur in small communities and are caused by consumption of raw milk. No case has been traced to the consumption of milk which has been properly pasteurized and handled. Indications are that, before long, pasteurized milk will be available in all communities. Reliable and accurate automatic time and temperature controls are replacing the manual control of pasteurizing equipment; the automatic controls help to insure that the milk is pasteurized properly.

The substitution of every-other-day for every day delivery was an outstanding innovation in the market milk industry. Its first objective was to conserve equipment, rubber, gasoline, and manpower. It was successful mainly because of improved refrigeration in the home and the improved keeping quality of market milk. It effected economies in distribution that the industry and the consumer want to maintain. There is now a trend toward delivery three times a week that omits delivery on Sundays. This trend is furthered by the use of square containers, which require less refrigerator space.

The sale of milk through stores has increased. Many dealers report that their sales through stores exceed those of retail routes. This development is bringing about the sale of milk through industry-owned stores located in suburban areas and handling only market milk and milk products. The establishment of a uniform bottle deposit system applicable throughout the country will accelerate the practice.

Tests for Quality

The Army introduced new phases of inspection and promoted useful tests and practices. It established that the methylene blue reduction test cannot be relied upon for determining the bacterial quality of milk. Some experimental evidence indicates that the method of conducting the test can be altered so that the results will more nearly show the true bacterial quality of milk, but now control officials and
the industry tend to rely upon the direct microscopic count and the standard plate count for determining the bacterial quality of milk before pasteurization.

The use of the phosphatase test to determine whether milk is properly pasteurized has been extended. Civilian control officials were adopting it when the Army applied it widely, demonstrated its usefulness under practical conditions, and proved that, without it, a safe milk supply cannot always be assured. Workers in the Bureau of Dairy Industry of the United States Department of Agriculture (2) improved the phosphatase test, so that more precise results can be obtained. Control officials can rely on it to determine whether milk has been properly pasteurized and the industry will use it increasingly to prevent under-pasteurized milk, or pasteurized milk contaminated with raw milk, from being delivered to consumers.

Many health departments have not considered the coliform test sufficiently important to require its use. Its most extensive application has been by the Medical Department of the Army. It is applied to all milk received at Army installations throughout the country. It was seldom used in milk plant laboratories before the war, but some plants began to use it during the war, mainly because the repeated presence of a significant number of coliform organisms in milk supplied to the Army was considered sufficient cause for disapproving the pasteurizing plant as a future source of milk. Its use is becoming more widespread, not as a test for proper pasteurization, but as a test for contamination after pasteurization.

This extensive use showed that the coliform test has a definite place in a milk control program, not only from an enforcement standpoint, but within the plant. Coliform bacteria found in pasteurized products probably entered after the product was pasteurized. Their presence usually indicates that greater care should be taken in cleaning and sterilizing equipment and containers, and protecting them and the pasteurized products from subsequent contamination. Its use by the Army further showed, however, that the presence of coliform organisms in a pasteurized product is not always due to contamination after pasteurization. At times their presence, in detectable numbers, was found to be due to improper pasteurization, presence of heat-resistant strains, or growth, and there were indications in a few instances that they were apparently due to gross contamination of the raw milk. These facts must be taken into consideration whenever the results of this test are used for enforcement purposes. It was also learned that there is no correlation between the results of the coliform test and the standard plate count of pasteurized milk. Positive and negative coliform results are obtained on both low- and high-count milk. Also, except in rare instances, whenever coliform organisms are found in pasteurized milk as delivered, the condition can be corrected by a thorough cleaning of the plant equipment. The test, therefore, is an ideal means of checking the clean-up operations in a plant (3).

Control officials and the industry are making greater use of the coliform test. Its use by the Medical Department of the Army showed, however, that to be of the greatest value, definite standards should be set up as to the number of organisms permissible in a sample of milk and the frequency of their appearance permissible in samples of milk processed by a plant. The regularity with which the organisms are found in the milk processed by a plant has as much significance as the number of organisms found in any one sample. Furthermore, uniformity should be established in the method of conducting the routine laboratory determinations for coliform organisms in milk and of interpreting the results.

The Army milk program also estab-
lished that fresh fluid milk can be supplied to any place in the United States or its possessions. Pasteurized milk packaged in quart paper containers was shipped from Minnesota and other northern states to Florida, Texas, and other southern states. The milk was shipped in refrigerator cars and kept cold by suspending dry ice in burlap bags from the ceiling of the car. The milk was of excellent quality upon arrival at its destination.

There were instances, however, when the milk had a high titratable acidity due to the absorption of carbon dioxide. Although the containers were packaged in corrugated fiber cartons, the carbon dioxide at times became so concentrated in the car that it penetrated both container and carton and was absorbed by the milk. When the milk was heated or aerated, the titratable acidity returned to normal. Whenever the acidity exceeded 0.25 percent, the milk was not palatable and the soldiers refused to drink it. It was found later that tight and efficient refrigerator cars could be used successfully without resorting to dry ice, provided both cars and the milk were sufficiently cooled before loading.

For troops stationed in areas where milk was scarce, the Army bought concentrated milk. Instead of attempting to ship whole milk long distances before pasteurizing, the milk was concentrated to one-half its volume by evaporation under vacuum. The milk, after concentration, was not sterilized, and therefore did not have a cooked or caramelized flavor. The concentrated milk was shipped under refrigeration to milk plants located in the area of consumption. There it was reconstituted and, wherever possible, blended with the available fresh milk before pasteurization and bottling. At times, however, only the reconstituted milk was used. This milk was not only acceptable to the Army but to civilians. Where the reconstituted milk was blended with fresh milk before pasteurizing and bottling, complaints based on the lack of depth of the cream line were received unless the product was homogenized. The reconstituted milk was a satisfactory means of supplementing local milk supplies in time of shortage. Concentrating it before shipment lowered carrying charges and improved the keeping quality. But such milk is not sterile, and is subject to contamination like fresh milk. Furthermore, lactic acid organisms are largely destroyed during processing with the result that the concentrated milk does not sour readily, thus eliminating a useful indicator of the age and quality of the milk. Furthermore, proteolytic organisms, which may be present in the concentrated milk, are capable of multiplying in it and causing decomposition. Therefore, whenever concentrated milk is used in the preparation of reconstituted milk for fluid-milk consumption, it must be handled in a sanitary manner and used while fresh.

**Frozen Milk**

During the war, with the evacuation of the sick and wounded from the theatres of operation, there arose a demand for fresh milk on hospital ships. Properly homogenized milk was frozen and used by the Army, Navy, and War Shipping Administration. The homogenized milk was packaged and frozen in square paper containers having a capacity of not more than one quart. It could, therefore, be thawed as needed and served from the original container without danger of contamination. Freezing caused separation of the fat phase in unhomogenized milk to the extent that the milk was not acceptable. Frozen concentrated milk was tried, but it did not maintain its flavor long enough and was difficult to reconstitute in a sanitary manner aboard hospital ships.

Milk for freezing was processed and frozen by milk dealers mainly on the east and west coasts. Much of it was frozen by placing the filled containers
in ice cream hardening rooms or other low-temperature storage rooms; some was frozen in wind tunnels. The milk was usually thawed aboard the hospital ships by setting it out at room temperature, usually in the diet kitchen. This milk usually kept well for 3 months, and occasional reports were received that it remained palatable for 6 months or more.

Sometimes the frozen milk was not acceptable after being held in the frozen state for even less than 3 months because the casein had flocculated. In other instances the milk developed an oxidized flavor. From all practical observations this unsatisfactory milk was processed, handled, and frozen in the same manner (in some instances by the same plant) as milk that was satisfactory. Research work has been conducted at the Army Medical Center in Washington, D. C., to ascertain why some frozen milk develops an inferior body or an oxidized flavor. The studies have shown that storage conditions largely govern the stability of the product. The lower the temperature of freezing and storing the longer it remains of a satisfactory quality. A rise in the temperature of storage is very detrimental to frozen homogenized milk (4) (5).

References