

Dairy Industry Research

brief progress report outlines current work aimed at improving the major dairy products of California

The following report of current research was prepared by the members of the staff of the Division of Dairy Industry under the chairmanship of Professor E. L. Jack, Davis

The research program of the Division of Dairy Industry covers studies on the improvement of each of the major dairy products in California. It includes also studies on the basic properties of the individual milk constituents as guiding principles in product improvement and development.

Market, Homogenized Milk

Improvement in the flavor of market milk can be obtained by the elimination of oxidized flavor which is the most troublesome defect of cream-line pasteurized milk. Studies on the cause and mode of development of this difficulty are in progress and advancement is being made. A chemical test which permits the detection of the compounds responsible for the off-flavor has been developed and is being used as a research tool. The need for a chemical measurement of this kind has been one of the limitations on research progress in this product in the past, and more rapid progress should result.

Light having the wave lengths of daylight and of most fluorescent lights affects the flavor of milk adversely. Experiments using lights of the different wave lengths show that incandescent lights do not produce the flavor-injurious wave lengths to nearly the same extent as does exposure to daylight and the usual fluorescent lights. Milk should not be allowed to remain on the doorstep, nor be offered for sale in cabinets where prolonged exposure to fluorescent light prevails.

Clarification of homogenized milk is a satisfactory method of preventing sediment deposits in bottled milk. Experiments have shown that clarifying milk cold is just as effective as hot clarification if done before homogenization, but that hot clarification is superior if done after homogenization.

A cream separator can be used almost as effectively as a clarifier in small plants up to about 10,000 pounds per day.

Feeds and Milk Flavor

Dried citrus pulp and dried orange pulp, when each was fed in quantities up to four pounds per cow 1½ hours before milking—at which time any flavor that might pass into the milk would be at a maximum—did not impart an objection-

able flavor to the milk. When the dried orange pulp was fed under these conditions a slight but not objectionable feed flavor was identifiable.

These feeds are becoming important sources of concentrates to California dairymen and are usually fed as 30% to 40% of the concentrate mixture. Thus under normal feeding conditions the maximum limits as affecting flavor are not exceeded.

Ice Cream

The milk-solids content of ice cream can be increased without the development of a sandiness if the ice cream mix is seeded with large numbers of lactose crystals just before freezing.

Sandiness results from the growth of lactose crystals in the ice cream to such a size that they are detected by the tongue. This difficulty has limited the percentage of milk solids that could be used in ice cream by requiring the amounts to be below those at which sandiness occurred. The upper limits have usually been at about 12% milk solids-not-fat. Experiments with seeding indicate that it is possible to go at least to 15% without detectable sandiness. The seeded ice cream has a richer flavor than the unseeded control, and it is not necessary to refrigerate the ice cream under as rigid conditions. Somewhat higher temperatures can be used without difficulty.

Evaporated Milk

Evaporated milk that will remain homogeneous in composition—without fat separation under storage—can be produced by controlled changes in the physical properties of the milk proteins. Experiments in which incipient changes in the milk proteins are brought about as a result of controlled enzyme action have produced evaporated milk in which fat separation was not evident after four months storage at 92° F. This is the development of a new principle in the technology of evaporated milk, and the results may be far-reaching as the applications of this principle are studied. Inability to control the body of evaporated milk by known methods has been one of the main limiting factors in the application of methods to improve color and

flavor of evaporated milk. The new principle—by permitting better control of the consistency of the milk—may make possible the adoption of these methods of improvement.

Cheese and Buttermilk

The use of added non-fat milk solids, either in the form of condensed or of dry milk to raise the solids content of skim milk produces cottage cheese of excellent quality. Solids have been added to raise the composition from the normal of approximately 9% solids-not-fat to 12%, 15% and 18% with satisfactory results at all levels. The manufacturing procedures do not entail any difficulties, and the time of manufacture is not extended. Cottage cheese of superior nutritional value because of its higher protein content results.

Active bacterial cultures can be maintained if bacteriophage—a substance which destroys the organisms—can be controlled. One of the most troublesome difficulties in cheese or buttermilk production is the occasional failure of the culture to set the milk. This is frequently due to the presence of bacteriophage. A bacteriophage is specific for each strain of organism, and control has been limited to using mixed strain cultures and to frequent changes of culture. Experiments are underway to determine the action of bacteriophage on mixed strain cultures and to investigate the possibility of using organisms other than *streptococcus lactis* in the culture setting.

Dry Milk

The Micro-Mixograph can be used to determine the absorption characteristics of non-fat dry milk solids for use in bread manufacture.

The ability of non-fat dry milk solids to take up water and hold it without causing a sticky dough is one of the properties of importance to a baker in using milk solids in bread. A test—wherein a dough containing two parts of flour to one part of non-fat dry milk solids is mixed in a Micro-Mixograph—has been developed which shows the water-absorption capacity of the milk solids. The mixing characteristics of the dough are

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Mastitis Control

proper management of herd most important in successful program

O. W. Schalm

Mastitis in dairy herds can be significantly reduced by proper management.

Mastitis, an inflammation of the mammary gland, is not a specific entity but a name for a disease-complex. Clinical mastitis usually is caused by a combination of bacterial infection and faulty milking practices.

Eight separate bacterial species, potentially capable of causing inflammation of the udder, have been identified as causes of mastitis in California herds. The two most important organisms are *Streptococcus agalactiae* and *Staphylococcus pyogenes*. Major occurrences of mammary infection with any of the other six bacterial types have appeared only as special problems in a few herds.

To control mastitis it is essential to know certain facts about the bacteria most commonly associated with that disease-complex.

Str. agalactiae lives in close association with the udder or milk, and can not survive, except under special circumstances, away from the udder for longer than a few days to a few weeks. This characteristic makes possible complete eradication of this organism from self-contained dairy herds.

When *Str. agalactiae* invades the udder, it usually remains there throughout the life of the cow unless removed by the intramammary injection of a medicinal agent such as penicillin. There are indications that this organism damages the udder by altering the milk in some way so that the milk itself becomes the irritant. It has been demonstrated that leaving the milk in an udder—strippings—infected with *Streptococcus agalactiae* will be followed in a few days by the occurrence of symptoms of mastitis—garget—in the infected quarters, while noninfected quarters remain normal. On the other hand, frequent stripping-out of quarters that have become inflamed, due to activity of *Str. agalactiae*, usually leads to disappearance of symptoms and a return to the production of a visibly normal milk. *Str. agalactiae*-infected cows, therefore, must be milked-out completely at each milking to keep an active inflammation from developing.

Staph. pyogenes differs from *Str. agalactiae* in that it is a tissue invader. Staphylococci produce powerful poisons which destroy tissue directly. Incomplete

milking does not lead to inflammation in udders infected with staphylococci, but conditions which favor tissue stresses appear to be important. Tissue stress can be caused by physical blows upon the udder, by employing too high vacuum with milking machines, and perhaps, by leaving machines on the teats after milk flow has ceased. Tissue stresses occur in the udder at time of freshening, and this might explain the fact that acute gangrenous mastitis—blue bag—which is caused by staphylococci, occurs most frequently in cows shortly after calving.

Both *Str. agalactiae* and *Staph. pyogenes* are shed in the milk from infected quarters, usually at every milking. Milk containing the mastitis organisms will contaminate objects with which it comes in contact such as milking machine cups, milkers' hands, floors and corrals. The organisms may be carried to the teats of other cows by such contaminated objects.

The incidence of mammary infections caused by streptococci and staphylococci increase with age of the cows. Heifers, at first freshening, are generally free of mammary infections. Unless precautions are taken to prevent infection after heifers are placed in the milking herd, invasion of their udders by mastitis organisms soon takes place. As high as 25% of animals have been found infected by the end of their first lactation in some herds. Certain herds in California averaged 33% infection at the end of the third, and 75% or higher in the fourth.

The major effort in a mastitis control program should be directed toward preventing the spread of mastitis organisms from infected to clean cows. Heifers should be milked first, mature mastitis-free cows next, and mastitis-positive cows last. Milking machines must be thoroughly disinfected between milkings. Disinfecting the teats of all cows after each milking is of great value. A chlorine solution of about 250 parts per million of available chlorine is recommended, and must be freshly prepared at each milking period. With a metal cup about 2½ inches in diameter and five inches in depth, a fresh cupful of chlorine solution is applied to every cow and each teat is dipped for its full length.

The milker must be conscious of the fact that germs can survive on his hands

from one milking period to the next. The bacteria also may survive on clothing, boots, milking stools, for many hours, and even days. It is even remotely possible that flies may be responsible for minor spread of the mastitis germs by feeding on infective milk and immediately afterwards feeding on residual milk at the teat openings of clean cows.

Until a dairyman has solved the problem of attaining good herd management, he is not in a position to make best use of information provided by laboratory diagnosis, and of application of specific treatments such as penicillin, streptomycin, and aureomycin. The use of mastitis treatments without regard for recommended control procedures is costly and inefficient. A sound mastitis control program requires first of all an interested and co-operative dairy personnel. Then the other two requirements, a supervising veterinarian, and laboratory diagnosis to identify the type of infection, will help make the mastitis control program successful.

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recorded on a chart which can be interpreted in terms of water-absorbing capacity of the milk solids. Commercial laboratories have confirmed the validity of this test. Experiments are being conducted to discover ways of increasing the absorption value of milk solids.

Studies are also underway to discover the mode of action of milk solids as they affect the baking qualities of bread. The experiments indicate that when milk solids have had the proper heat treatment previous to drying—180° F to 185° F for 20 to 30 minutes—they enter into a structural combination with the flour proteins, but when the proper heat treatment has not been applied the milk proteins do not become an integral part of the structure but can be easily separated from the other dough constituents.

Cleanup operations in dairy plants account for from 20% to 40% of total labor involved in processing. Improved methods of cleaning and sanitizing will not only effect a reduction of labor but should also improve the quality of the products and prolong the life of the equipment. Experiments designed to accomplish these results were undertaken in 1950 in co-operation with the Division of Agricultural Engineering. Apparatus to establish the basic principles underlying circulatory cleaning was assembled and is used in a study of the problem.