VOLUME 18 NO. 10
OCTOBER, 1955

Journal of

MILK and FOOD TECHNOLOGY

Official Publication

International Association of Milk and Food Sanitarians, Inc.

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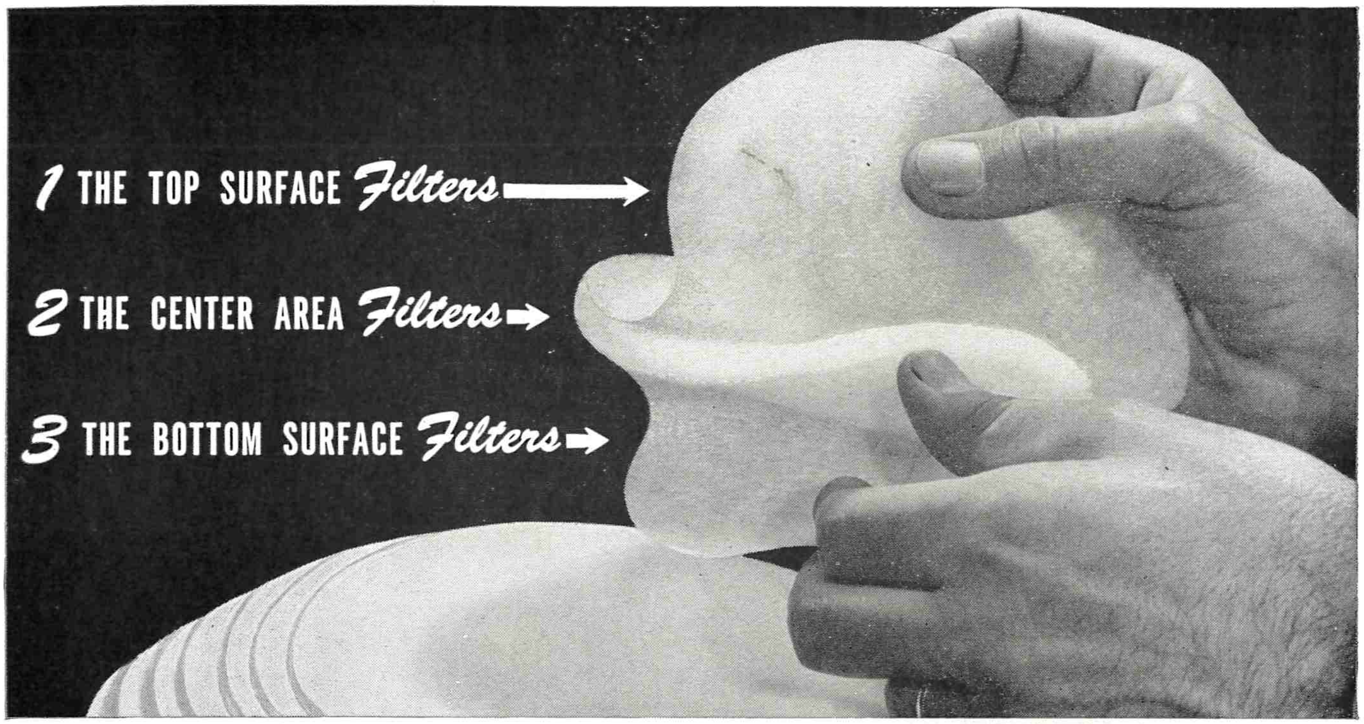

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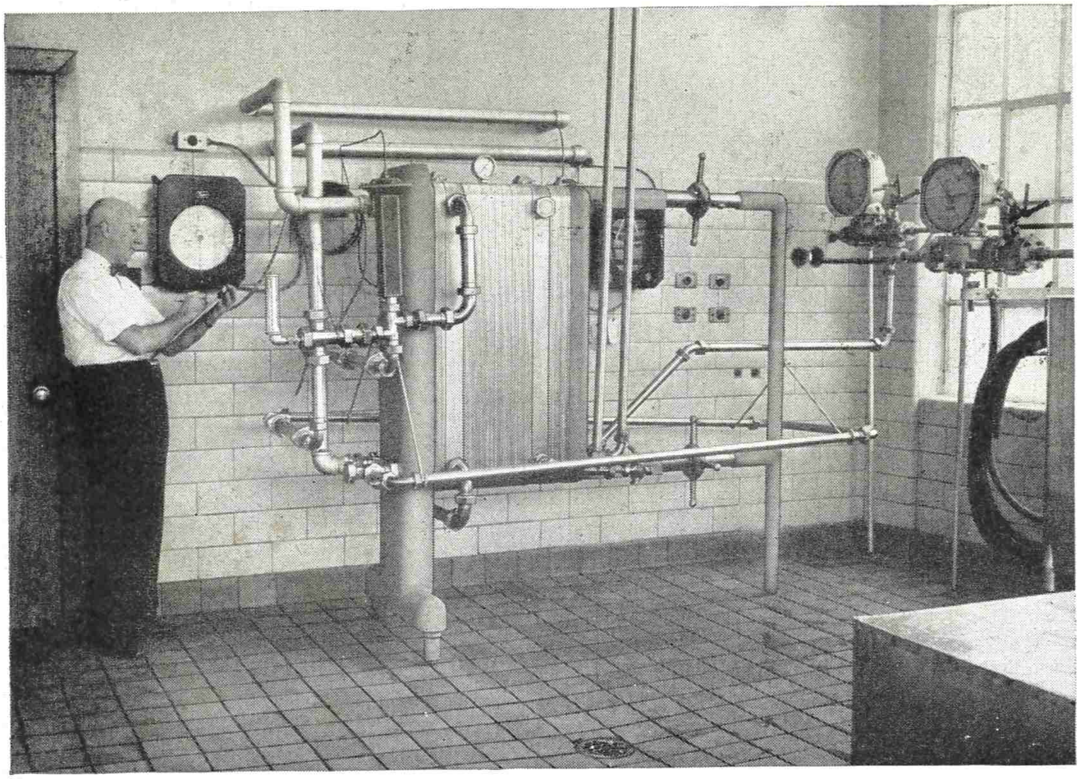

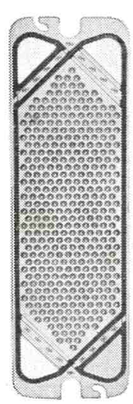

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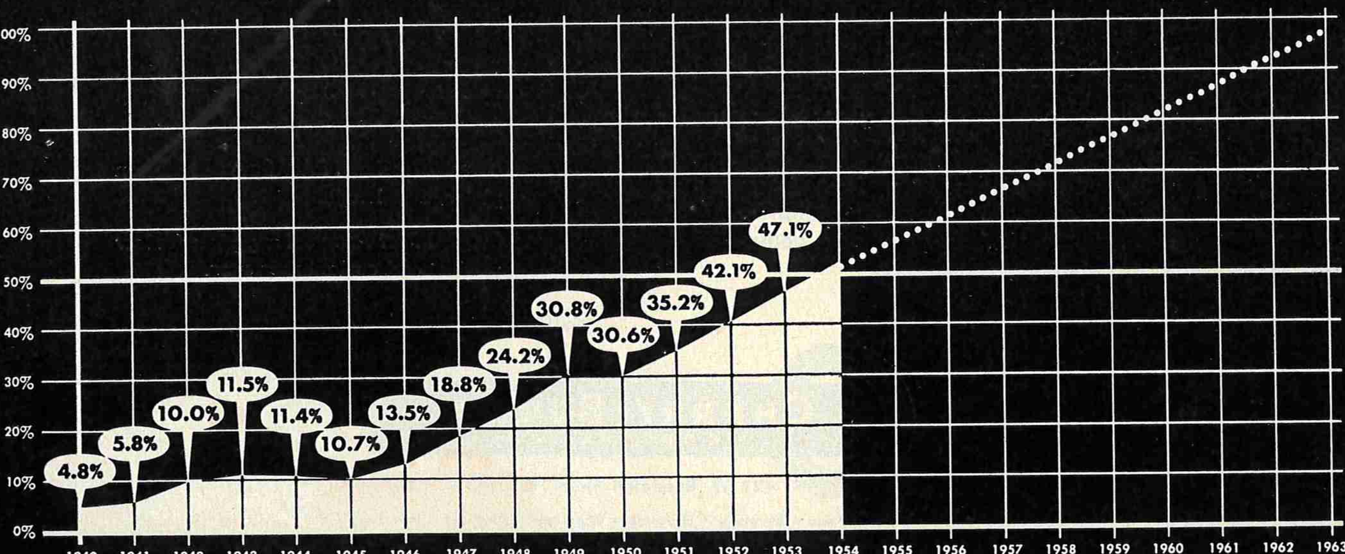

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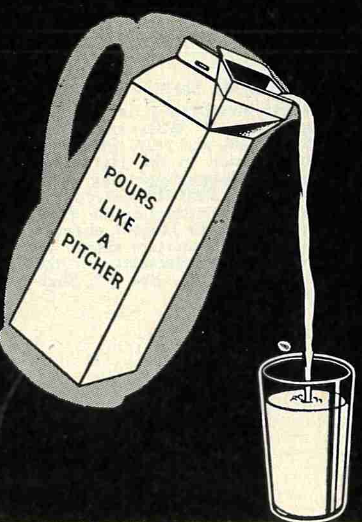

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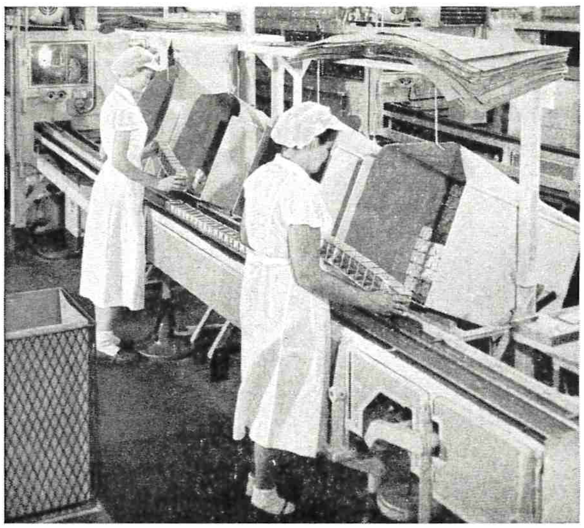

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CLASSIFIED ADS

DAIRY WASTE TREATMENT[1]

R. Rupert Kountz

Pennsylvania State University, University Park

"Just seven years ago the Dairy Industry Committee laid a foundling upon the doorstep of the United States Department of Agriculture, and quietly went home to see what would be done with it. It was decided that the problem of handling this offspring was mainly a biochemical one, and only secondarily one of sanitary engineering. As all new parents do, we went around to older and more experienced friends to ask for help. Many were reluctant to give advice, or even say they knew anything about it, but one man of courage, Dr. H. A. Trebler, admitted acquaintance with the infant, knew how it came into being, and stated its tempermental problems."

The preceeding is a paraphrase of the introduction to a paper presented recently by Dr. Sam R. Hoover, who, assisted by Dr. Nandor Porges, determined the fundamentals of the biochemical and biological oxidation of dairy wastes at the Eastern Regional Research Laboratory (Philadelphia) of the U.S. Department of Agriculture. Using these fundamentals, and supported by a research contract from the United States Department of Agriculture, the Pennsylvania State University constructed and operated a treatment plant for 20 months to prove the laboratory work of Hoover and Porges could be applied to full scale operations. Through the efforts and interest of Dr. David Levowitz, Director, New Jersey Dairy Laboratories, New Brunswick, N.J., the author designed the first commercial prototype of this research for the Port Murray Dairy Co., Port Murray, N.J. This plant has been operating satisfactorly since April 12, 1954. The second prototype has just started operation at Flemington, N.J., for the Johanna Farms, Inc. dairy. Three more are under way in Pennsylvania and will prove themselves by next summer. These are privately owned and operated plants which are in addition to the two successful test plants at the University, and at the Harrington Dairy Company in Dushore, Pa.

Bio-oxidation of dairy wastes is a technique of applied microbiology utilizing the biochemical oxidizing ability of an acclimated culture under *aerobic* conditions. Bio-oxidation of dairy wastes, *per se*, is not new but a treatment plant employing design values based on biological data is new. A treatment plant properly designed can satisfactorily reduce the milk solids content in waste water to prevent stream abuse, and do it without excessive costs or nuisances.

Mr. R. R. Kountz received the B.S. and M.S. degrees from the University of Iowa in 1936 and 1941, respectively. He has had wide experience in waste disposal problems and has published numerous papers on this subject. He is active in several professional and scientific societies and presently is Professor of Sanitary Engineering at the Pennsylvania State University, University Park, Pennsylvania.

The sanitary engineering profession must design dairy waste treatment plants as microbiological oxidation units and not as miniature sewage treatment plants. Developments in plant design to date have attempted to eliminate previous errors, but without any systematic approach to the problem. The University pilot plant, the Harrington Dairy Co. plant, and the Port-Murray plant, as well as those under construction are milestones in sanitary engineering because the theory and the design data were known fully prior to construction, and the established waste treatment inhibitions were ignored.

Hoover, *et al.* found in their research that each pound of milk solids in the waste water required 1.2 lbs. of dissolved oxygen for complete bacterial oxidation. The supply of the proper amount of oxygen prevents odors and eliminates the need for sludge removal. Of each pound of dissolved oxygen supplied, 37 per cent is used for immediate milk solids oxidation and removal from the waste. The remaining 63 per

[1]Presented at the 41st Annual Meeting of the International Association of Milk and Food Sanitarians, Inc. at Atlantic City, New Jersey, October 21-23, 1954.

cent is used to oxidize the sludge produced and thus eliminate the need for sludge removal and disposal.

To produce efficient economical treatment rapidly it is necessary to have a high *concentration* of bacterial cells and the correct supply of dissolved oxygen. In either continuous or fill-and-draw treatment, it must be possible to separate the bacterial cells by gravity sedimentation and thus yield a clear effluent.

Work at the University pilot plant and that now going on at Harrington Dairy Co., Dushore, Penna., as well as observations of existing plants, dictates the preferred use of a fill-and-draw or batch type of treatment whenever possible. If a continuous flow plant is needed, the aeration tank must be baffled to secure a true displacement flow and allow the incoming waste to contact only completely oxidized sludge. In a single unbaffled aeration tank there is not true displacement flow and the sludge is in a continual low density stage and floats rather than settling in the sedimentation tank. The batch process eliminates this by having an eight-hour period of milk solids removal, an eight-hour period of sludge oxidation (to obtain a high density), and an eight-hour period for settling and decanting of the clear liquid. It is possible to baffle existing treatment plants to insure sludge settling, provided sufficient dissolved oxygen supply is available for the waste load.

Size of the batch plant is determined by the compacted volume of cells, and the incompressibility of water. The pilot plant operation showed the "sludge index" to lie between 40 and 50, which means that, when settled, one pound of cells occupies 0.8 cu. ft. This value allows a "clear liquid depth" to be selected for the sedimentation process, and upon this depth depends the entire size of the treatment plant. The total weight of cells is a fixed amount because a unit weight of milk solids produces half its weight in new cells. Pilot plant data show these cells (both old and new) to be oxidized endogenously at a rate between 20 per cent per day (90° F) and 10 per cent per day (70° F). This means that total weight of cells is equal to 2.5 to 5.0 times the average weight of milk solids received per day in the waste volume.

How to Figure Plant Size

Assume a 100,000 lb. per day dairy plant that loses 2.5 per cent of the milk received, or 2,500 lbs. Also assume a total waste volume of 25,000 gal. in 8 hrs. or an average flow of 50 gpm with an average BOD value of 960 ppm. Daily loss of 2,500 lbs. of milk corresponds to an equilibrium total sludge weight of 750 lbs. in the treatment system.

Waste treatment tank volume is based on the volume of compacted cells and volume of waste to be treated per day. The equilibrium weight of 750 lb. of cells occupies 600 cu. ft. when settled. This volume of 600 cu. ft. plus one foot of freeboard (to prevent entrainment when draining) is the sedimentation portion of the treatment tank, and will be assumed in this example to be 1,200 cu. ft. To this is added volume of the day's waste, namely 3,300 cu. ft., giving a total treatment tank volume of 4,530 cu. ft., or 34,000 gal. Effluent pipe is located at the 9,000 (1,200 cu. ft.) gallon level.

In this type plant, oxygen supply is suspended for 6 hr. to allow cells to settle and after which the 25,000 gal. of clear supernatant drains out. Contrary to present ideas and opinions, the bacterial flora is not harmed by this 6-hr. period without oxygen being supplied.

Calculating Oxygen Demand

Having thus designed the volume of the treatment plant the only remaining item is the supply of dissolved oxygen. Rate for endogenous oxidation is uniform and is determined from weight of cells oxidized per day. In this case 150 lbs. are oxidized per day which will require 9.4 lb. dissolved oxygen per hour. One pound of cells (sludge) requires 1.5 lbs. of dissolved oxygen for complete oxidation.

Assimilation phase is based on a milk loss of 315 lb. per hr. (37.5 lb. milk solids per hr.) which will require dissolved oxygen at the rate of 17 lb. per hr. Each pound of milk solids require 0.45 lbs. of dissolved oxygen to allow the bacteria to remove it from the waste. During the 8 hr. of waste flow, dissolved oxygen must be supplied at the rate of 26.4 lb. per hr., (17 lbs. per hr. plus 9.4 lbs. per hr.) and during the remaining time at a rate of 9.4 lb. per hr. It is important that the excess air supply be stopped when the waste flow ceases or else foaming problems will be encountered.

Work is now in progress involving "delayed aeration" which will permit the higher power requirements of the oxygen supply system during inflow of the waste to be postposed until after the major activities in the dairy are completed. Preliminary results are quite favorable to this plan.

It is intentional that quantities or rates of *air* have not been mentioned as they have little meaning unless the type of air dispersing device is known. Studies in this research project have shown available devices to vary between 2 and 25 per cent efficiency in dissolving the oxygen in a volume of air.

Experiments and pilot plant data have shown an ejector designed for steam operation (Penberthy XL96, Series 1A) to have a high efficiency, to be free from clogging, and to prevent bacterial clumping by its hydraulic-shear action. Possible criticisms of a high pumping power rate can be more than offset by the negilgible maintenance and the simplicity and economy of the fill-and-draw type of treatment unit.

For the treatment plants described above, oxygen supply has been furnished by means of ejectors manufactured by the Penberthy Injector Co., Detroit, Mich., whose cooperation in supplying various units for testing contributed greatly to the final successful results. Ejector found most satisfactory was the X1-96 type size 7A (steam nozzle) which is rated at: lb oxygen/hr. $= 0.165\ V^{2.35}$ where V is the nozzle flow in cubic feet per second divided by the nozzle diameter in feet. This rate of dissolved oxygen supply is for aspiration from the atmosphere. Supply of air by means of a blower at a rate twice the water flow will increase the dissolved oxygen supplied by 50 per cent.

The use of porous air diffusers in dairy waste treatment has produced many reports of clogging and the need for monthly cleaning. If porous diffusers are used and air is supplied at a rate of 5.0 cfm per unit (with 10 ft. submergence) oxygen will be dissolved at a rate of 0.5 - 0.6 lb. per hour per diffuser. The same flow of air through 20 one-sixteenth inch holes will produce about half of the rate of dissolved oxygen as compared to the diffusers.

In comparing sources of dissolved oxygen supply the following rating may be used:

Diffusers 2.5 lbs. oxygen/hr./Horsepower

Ejector and Blower 1.3 lbs. oxygen/hr./Horsepower

Ejector (alone) 1.0 lb. oxygen/hr./Horsepower

Although two and one-half times as much power is needed with the ejector oxygen supply, the freedom from clogging is a definite asset to the dairy owner in terms of maintenance cost. In a continuous flow type plant, however, a diffuser system is required to prevent the intermixing that would occur with a recirculating pump operating the ejectors.

Cheese whey treatment has been studied in the laboratory, and in the pilot plant to a limited extent. Whey, in regard to bio-oxidation, differs from milk only in its lower protein content. The protein deficiency can be made up by adding ammonium sulfate, ammonia or urea to the waste to be treated. One pound of ammonia is equivalent to 10 pounds of caesin for the purpose of lactose oxidation. Laboratory studies show that when 280 lbs. of sludge are present in the tank for each 1000 lbs. of whey to be treated, no process difficulties will exist. The whey itself cannot produce this sludge due to its protein deficiency, but the sludge can be developed by using skim milk to start up the system and develop the required weight of sludge. In a dairy which makes cheese occasionally, the use of an ammonia supplement will permit satisfactory operation and treatment of the whey.

Whey itself has no property that affects treatment, but the treatment problem with whey is really a problem of oxidizing a 6% lactose solution. Bacteria do not oxidize lactose just to be doing something. They oxidize the lactose for an energy source to enable them to convert protein or ammonia into new cell material. If no protein is present the lactose remains untouched by the bacteria, and thus no treatment occurs.

In summary, the simplest type of treatment plant is a single tank having a volume 150 per cent of the daily waste volume. The screened waste flows into the suction line of the pump powering the ejector-air-diffusers. During the night the air supply ceases automatically and then the tank drains off the clear liquid which contains less than 5 per cent of the milk lost in the day's operation. When drained the air supply resumes and the waste flows in for the next day, and the cycle repeats. Personnel time is 30 minutes per day to clean the screen and grease the pump. There is no odor, no sludge disposal, no personal decisions nor lab tests. Milk wastes are the simplest, easiest wastes to treat because milk is the perfect food — for man, or for bacteria.

Acknowledgment

A report of work done under contract with the U. S. Department of Agriculture and authorized by the Research and Marketing Act of 1946. The contract is being supervised by the Eastern Utilization Research Branch of the Agricultural Research Service.

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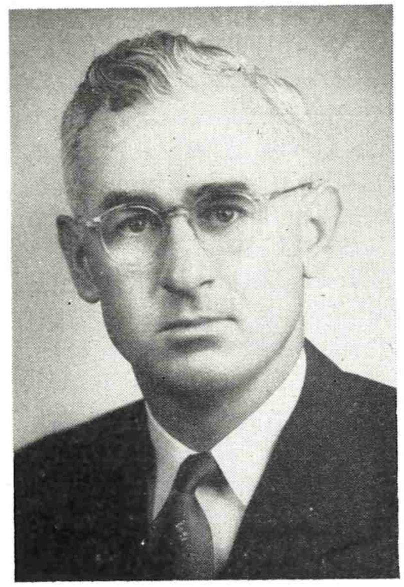
PROGRESS ON QUALITY CONTROL IN THE EVAPORATED MILK INDUSTRY

J. C. Flake

Evaporated Milk Association, Chicago, Illinois

Accomplishments of the Sanitary Standards program of the evaporated milk industry are reviewed. Success of this program is indicated by acceptance by other agencies, quality of field work, farm sanitation, milk quality, plant sanitation, and support of the industry. The Sanitary Standards Code is under continuous review, and amendments are adopted as needed. The program is supervised by a Sanitary Standards Committee, composed of industry officials, and is administered by a staff of trained sanitarians.



Dr. J. C. Flake joined the Sanitary Standards staff of the Evaporated Milk Association upon completion of his graduate work in Dairy Industry at the University of Wisconsin in 1940. He is a graduate of the University of Tennessee, received his M. S. degree from Purdue University and Ph. D. degree from the University of Wisconsin. He did milk sanitation work for USPHS during World War II and at present is Administrator of the Sanitary Standards program of the evaporated milk industry.

After fifteen years of intensive work on farm and plant sanitation and milk quality in the evaporated milk industry, it is appropriate to take a look at the results and the direction in which this industry-wide program is moving. Details of the program have been reported in two previous issues of this Journal, March-April, 1945 and September-October, 1948. The two papers were entitled "Sanitary Standards Program of the Evaporated Milk Industry" and "Quality Control in the Evaporated Milk Industry," respectively.

In brief review, the evaporated milk industry adopted in 1939 a Sanitary Standards Code and an industry-wide program for implementing the Code. This Code is under continuous review, and amendments are adopted as needed. The program is supervised by a Sanitary Standards Committee, composed of policy making officials of a number of the companies in the industry. It is administered by a staff of trained sanitarians in the Evaporated Milk Association.

The Code covers all phases of plant, milk, and farm sanitation; prescribes testing and inspection procedures and standards to be followed by all plants and receiving stations; and establishes a record system for each unit on milk quality tests and farm sanitation work.

Sanitarians from the industry office periodically visit all plants and stations to evaluate the quality and efficiency of work, and to audit the records at each unit on all phases of the program. Records are maintained in the industry office to measure progress year by year, and to provide comparisons on a plant, state, and national basis. The records enable intelligent evaluation of the various phases of the work, show where changes in emphasis are needed, and afford a powerful stimulant for all plants and companies to comply with the Code. The latter is a result of competition in the industry and the fact that reports and records are transmitted directly to company officials as well as being discussed with plant management.

What have been the accomplishments of the program? This will be discussed under the following headings:

1. Acceptance of the program by other agencies.
2. Quality of field work.
3. Farm sanitation.
4. Milk quality.
5. Plant sanitation.
6. Interest and support of the industry.
7. Recommendations on the elements of a sound

and effective industry program as a result of experience in the quality control work of the evaporated milk industry.

Acceptance By Other Agencies

The Sanitary Standards program has been widely accepted by city, state, and federal regulatory officials, and the Code has been incorporated in whole or in part into the regulations of some of the states. The Code is used by the Army Veterinary Corps as a basis for evaporated milk inspection. The program has been approved by various state departments of agriculture and health and the U. S. Department of Agriculture. Officials of the U. S. Food and Drug Administration have indicated approval of the industry efforts in a unified sanitation program. The principles of the Code and many aspects of the program have been adopted by other branches of the dairy products industry.

The sediment testing methods and standards that were developed by the industry early in the program have been widely adopted, with twenty-three states using the standard grading chart. The off-bottom method, using a tester with a filtering area of one and one-eighth inches, is almost universally used on milk in producers' cans and has been incorporated into APHA Standard Methods.

The industry early took the lead in developing sanitary standards for dairy equipment. The storage tank standard was a forerunner for the 3A Sanitary Standards program and the standards for plant and farm equipment that have been promulgated by the 3A Sanitary Standards Committees. The evaporated milk industry has furnished the general chairman for this program since its organization, and evaporated milk industry leadership has contributed substantially to the success of the work.

Quality of Field Work

Perhaps the most important individual in a quality program is the plant fieldman. It is his job to make intelligent use of milk quality records in selling farmers on improvements in farm sanitation and milk production methods. He must do this while maintaining an adequate volume of milk for operation of his plant. The effective fieldman also sells farmers on improvements in economy and efficiency of milk production so as to make them better and more prosperous dairymen. This incourages them to produce more milk and better milk. This work plus high standards in the selection of fieldmen and continual training on the job have resulted in a greater professional status for the fieldmen. Farmers welcome the efforts of such fieldmen, and the results of their work are evident in continually improving milk quality, farm sanitation, and milk production efficiency. Also the fieldman is accepted as a leader in the rural area in which he works.

Most plant fieldmen in the evaporated milk industry have been trained in agricultural colleges. This background plus continual in-service training in dairy production, farm and milk sanitation, and sales principles and methods have resulted in high caliber fieldmen in the industry. Training schools are developed and held by individual companies and by the sanitarians on the industry staff. Group participation in solving field and quality problems is an important feature of the schools.

Sanitarians on the industry staff work with several hundred fieldmen during the course of the year. This enables them to evaluate the work of individual fieldmen and to advise the fieldmen by actual demonstration on how they can improve the effectiveness of their field work.

Industry records show that the accuracy and effectiveness of field work have improved constantly. This is also indicated by improved producer acceptance and interest in the work and by progress in farm sanitation and milk quality. The success of the program is also indicated by a strong demand for the industry sanitarians and plant fieldmen for other positions. Many have filled important positions in educational, regulatory, and business organizations.

Farm Sanitation

No milk or milk product quality program is complete without effective work on farm sanitation. The Sanitary Standards Code includes minimum standards for methods and facilities on farms for the production of high quality milk. Fieldmen make periodic farm inspections on all producers, plus reinspections where required, and additional farm calls as the need is indicated by substandard platform test results. The farm standards are based on fundamentals, and they have served their purpose well in milk quality improvement, producer acceptance of the program, and improvement in methods and facilities on farms.

Sanitarians on the industry staff include a survey of producing farms in each plant and station visit. This survey is made in company with the local fieldman who also inspects the farms selected and talks with the producers on improvements that are needed. Thus the survey serves a three-fold purpose. It measures conditions and progress in the field; it provides an opportunity to observe and judge the quality and effectiveness of the work of the fieldman; and it affords a statistical comparison of the accuracy of the fieldman's work on identical farms as well as in his previous reports when working alone. Accuracy of farm inspection reports by fieldmen has been found to be of great importance in the quality and sanitation work.

The results of the surveys are tabulated for the entire industry. The records show that farm conditions which affect milk quality and the accuracy of fieldmen's reports have improved year by year. For the most part the reports by plant fieldmen can now be taken as a true reflection of the conditions existing on farms.

MILK QUALITY

The Code prescribes organoleptic examination, and bacterial and sediment testing standards and procedures which are designed to insure wholesome, high quality milk and to eliminate farms that have poor production practices. Milk which does not meet organoleptic and sediment standards is rejected, and producers who do not comply with the bacterial and farm sanitation standards received due attention of fieldmen on their problems.

Each plant maintains complete records on periodic platform tests, rechecks on substandard milk, and farm service calls by fieldmen on each producer. Milk quality is carefully checked by industry representatives on each visit to measure progress and to verify plant records.

Industry records show that sound, substantial progress has been made on milk quality. The percentage of substandard milk has decreased, and favorable results are also indicated by elimination of processing problems and improvement in quality of finished products.

The basic bacterial test used on milk from individual producers is the methylene blue test. This is a simple and reliable test for detecting poor quality milk and pointing out farms with poor methods, particularly unsatisfactory cleanliness of utensils and milking machines and poor cooling. While other tests may be needed to measure minute differences in high quality milk, the methylene blue test serves its purpose admirably in the hands of plant quality control men, and supplies adequate information for intelligent field work.

Methylene blue tests are made at least monthly on weigh tank samples of milk from each producer, and rechecks are made on substandard tests. Standard Methods are followed, and the technique is carefully checked for accuracy in all plants and stations. In one major producing state where regulatory officials make direct microscopic tests routinely and plants make methylene blue tests the two have been found to be in close agreement on detecting substandard milk.

The sediment test has also proved of great value in the milk quality and farm sanitation work, although it is recognized that farm straining of milk nullifies much of its value. However, filtering milk is a universal practice on all types of dairies and for several reasons appears likely to remain so. Nevertheless, it has been found that unsatisfactory sediment test results are one of the best means of convincing farmers to improve methods of production and handling of milk. While experts may argue about the relative merits of different bacterial tests, and farmers may misunderstand them, the sediment test disc speaks a universal language in milk sanitation and production circles. Experience in a wide variety of milk sheds and types of milk sanitation efforts, regulatory and in industry, indicates that the sediment test is worthy of much more attention and more extensive use than it receives in many areas.

PLANT SANITATION

One of the best manifestations of an effective quality control program and the nucleus on which other phases of the work can be built is a strong plant sanitation program. A high degree of plant sanitation emphasizes to employees, haulers, producers, and consumers that management is sincere in its efforts, and it promotes interest in all phases of the quality work. A clean, well-operated plant also builds employee morale and efficiency.

Fieldmen who sell farm sanitation and milk quality to farmers need to be armed with the conviction that the milk will be processed in the cleanest, best operated plant that management can provide.

Emphasis on plant sanitation has resulted in continual improvement in plants and receiving stations throughout the evaporated milk industry. Sanitarians from the industry office make a detailed inspection of the plant or station for general sanitation and housekeeping and for repair and cleanliness of equipment on all visits. Each unit is rated on the basis of its relative excellence on housekeeping (general appearance and sanitation) and equipment cleanliness. The range of ratings is excellent, very good, good, fair, and poor.

The ratings are tabulated for the industry as a whole each year. The percentage of plants and stations earning the higher ratings has increased year by year until in 1954, 78 percent of all units were rated excellent or very good on housekeeping, and 80 percent were rated excellent or very good on equipment cleanliness. Competition for the higher ratings has been an important factor in promoting plant sanitation to the point where it can safely be said that there is no branch of the dairy industry with plants that are superior to those in the evaporated milk industry.

INTEREST AND SUPPORT OF THE INDUSTRY

From its inception the Sanitary Standards Code and program have had the support and active participation of practically the entire evaporated milk industry. This includes every company presently in the industry.

With sound progress has come pride in accomplishment and leadership by the industry. Interest and enthusiasm of the industry have increased continually, from company officials to plant personnel. This comes from knowledge that the job is being well done, that leadership is being exerted in milk quality work for the entire dairy products industry and from inter-plant and inter-company competition to excel in the program.

Industry-wide participation is important to the success of a program and to consumer confidence in the product. Industry leaders know that consumer complaints and adverse publicity are harmful to an entire industry and not merely to the brand involved.

ELEMENTS OF A SOUND AND EFFECTIVE QUALITY CONTROL PROGRAM

In conclusion, it is believed that experience in the evaporated milk industry warrants certain recommendations on the elements of a sound and effective quality control program for any branch of the dairy industry.

Industry-wide recognition of the need for the program as well as its acceptance and support are highly important. This places all of the companies on a similar basis on the cost of such work. It is also a sound basis for building consumer confidence in the product and for maintaining free flow of the product throughout the trade channels of the country.

The program must have the active interest and support of top management of the various companies. This is necessary to maintain pressure on all plants to do the job and to bring lagging plants into line. If management delegates the job to plant superintendents without supervision and follow-through, each plant will have a different program, and industry efforts at unified quality control will fail.

Industry-wide adoption and support of a comprehensive, workable sanitation code are essential. The code should cover all phases of the sanitation job, plant sanitation, milk quality, farm sanitation, processing and handling of the product. The standards should be workable, yet high enough to accomplish the job and should incorporate sound milk sanitation principles as recognized by regulatory officials and other authorities.

In addition to supervision within individual companies, it is most important to have an unbiased system of evaluating progress at all plants across company lines. This is necessary to convince management of one company that other companies are doing the job and is important to give management of large nation-wide companies an accurate picture of conditions at their own plants. The advantages of having such reports go directly to top management rather than being snarled in intra-company channels are obvious where criticism of plant or personnel may be involved and where remedial action is required.

Complete industry-wide records are needed on all phases of the program. The records should be used to measure progress on a plant, state, company, and industry basis. The records show the status of individual plants and areas in comparison with the industry as a whole and thus serve as a powerful incentive for each company and each plant to keep up with the industry progress. Each plant must maintain complete records on periodic platform tests, rechecks on substandard milk and farm service calls by fieldmen on each producer.

OBSERVATIONS ON THE PRESENCE OF FACULTATIVE PSYCHROPHILIC BACTERIA IN MILK PRODUCED UNDER THE FARM TANK SYSTEM[1]

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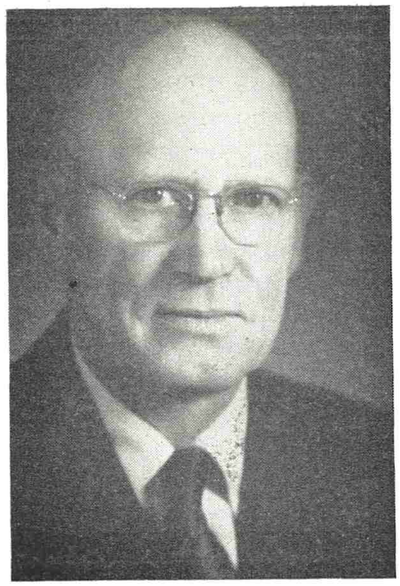
A study was made, using plate counts at 17° C. of the prevalence of facultative psychrophilic bacteria in raw milk produced under the farm tank system, together with the observations on the subsequent growth of these bacteria during storage for periods of 24 and 48 hours at 37° - 39° F. At the initial plating period the facultative psychrophilic types were not present at high enough levels to induce the presence of abnormal flavors and odors. As the samples were held in storage, the facultative psychrophilic types increased more rapidly than did the organisms enumerated by the standard plate method.



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With the introduction of farm tanks for the bulk handling of milk and the every-other-day practice of pick-up and delivery to the processing plant, questions have occured concerning the prevalence and role of the psychrophilic bacteria in milk produced under this system in the development of abnormal flavors and odors.

Erdman and Thornton (4) found raw milk and cream, produced under a system of daily delivery to the processing plant, to contain appreciable numbers of bacteria capable of growing on plate cultures at incubation temperatures of both 4.5° and 10° C. Similar observations were made by Rogick and Burgwald (8). They found psychrophilic counts ranging from 4000 to 130,000 per ml. of raw milk. They noted that the higher psychrophilic counts were present in the samples having the higher mesophilic counts and that the mesophilic counts were approximately three times greater than the psychrophilic counts. Kaufmann and Andrews (5) obtained psychrophilic counts on raw milk ranging from 10,000 to 3,000,000 per milliliter.

A relatively wide range of incubation temperatures and periods have been used for estimating the psychrophilic bacteria by the plate method. Nelson and Baker (7) reviewed the methods used in a number of these studies. Resulting from their own findings, they recommended the incubation of plate cultures at 21° C. for 4 days for estimating the bacteria that grow in milk held at refrigeration temperatures. They also found that an incubation temperature of 35° C. for 2 days failed to detect most of the bacteria capable of growth at the lower temperatures. Boyd *et al.* (3) found that an incubation temperature of 10° C. resulted in the inclusion of an additional group of organisms which were not included in the counts when the incubation temperature of 5° C. was used.

Rogick and Burgwald (8) pointed out that the so-called psychrophilic bacteria are facultative rather than true psychrophiles. Likewise Nelson and Baker (7) stated that the term "psychrophilic" is not a true descriptive term since many of the bacteria growing in milk held under refrigeration temperatures will grow better at 21° C. or above than at the lower temperatures. They suggested the term "facultative psychrophilic" as being more descriptive. Further evidence that these bacteria are facultative psychrophiles rather than obligate psychrophiles was presented by Lawton and Nelson (6).

For the purpose of gathering information on the prevalence of facultative psychrophilic bacteria in

[1]Scientific Paper No. 1403, Washington Agricultural Experiment Station, Pullman.

raw milk produced under the farm tank system, together with information concerning the growth of these bacteria during additional storage, a limited survey study was conducted during the period of June 15 to August 15, 1954. This study was carried out in a major dairy area of the state in which farm tanks are used extensively.

METHODS

Samples were collected from the farm tanks after the fourth milking was added. At this time the first added portion of milk was 40 to 46 hours old. The samples were placed directly into a refrigerated container for transportation to the laboratory. Plating was carried out within a period not to exceed 5 hours.

The temperature of the milk at the time of sampling ranged from 36° to 40° F. Following the initial plating, the samples were held in storage at 37° to 39° F., in an effort to simulate the often-time commercial necessity of holding milk for additional periods of time before processing it, and plated again after both 24 and 48 hours.

In this survey, only the dilution of 1: 1000 was used in the preparation of plate cultures. Duplicate plate cultures were made at each plating period using Bacto-Plate Count Agar and the prescribed methods (1). One set of plates was incubated at 17° C. for 5 days, the results of which will be referred to as the facultative psychrophilic count. This incubation temperature of an intermediate level was used for two reasons. First, it permitted the use of a relatively short incubation period and the release of equipment for subsequent samples without requiring a large supply of petri dishes and extensive incubator space for the conduct of the study. Secondly, it appeared more desirable than the higher temperature suggested by Nelson and Baker (7) for the reason that the possibility of including strictly mesophilic types would be minimized, yet typical psychrophiles would not be inhibited. The other set of plates was incubated at 35° C. for 48 hours and served for the standard plate count. It is recognized that the inclusion of plates having fewer than 30 and more that 300 colonies is a deviation from Standard Methods, yet it was felt that their use in this survey was permissible in view of the rather limited facilities available at the place of study.

Observations also included the presence of abnormal flavors and odors in the fresh and stored samples.

RESULTS AND DISCUSSION

Facultative Psychrophilic and Standard Plate Count Distribution at Time of Initial Plating

Table 1 shows the numerical and percentage distribution of both the facultative psychrophilic and standard plate counts of 628 samples of milk at the time of the initial plating.

TABLE 1 – DISTRIBUTION OF FACULTATIVE PSYCHROPHILIC AND STANDARD PLATE COUNTS AT THE INITIAL PLATING PERIOD.

Range of count	Facultative Psychrophilic Count 17° C.		Standard Plate Count 35° C.	
	No. of samples	Per cent	No. of samples	Per cent
(per ml)				
0-10,000	251	40.0	213	34.0
10,000-25,000	133	21.0	154	24.5
25,000-50,000	106	17.0	97	15.5
50,000-100,000	75	12.0	82	13.0
100,000-300,000	48	7.6	71	11.3
over 300,000	15	2.4	11	1.7
Total	628	100.0	628	100.0

In general the facultative psychrophilic and standard plate counts paralleled one another rather closely. Low facultative psychrophilic counts were usually accompanied by low standard plate counts and vice versa. In 379 samples the standard plate count was the higher, in 24 the two types of counts were the same and in the remaining 225 samples a higher facultative psychrophilic count was obtained. Rogick and Burgwald (8) reported a higher average standard plate count than psychrophilic count in fresh raw milk.

In 40.0 per cent of the samples the facultative psychrophilic count did not exceed 10,000 per ml. as compared with 34.0 percent for the standard plate count. Ten percent of the samples had a facultative psychrophilic count exceeding 100,000 per ml. as compared with 13.0 per cent for the standard plate count.

Of the 213 samples, having a standard plate count of less than 10,000 per ml., 175 had a facultative psychrophilic count of the same magnitude and only two were in excess of 50,000 per ml.

No sample, with a standard plate count of less than 50,000 per ml., was found in which the facultative psychrophilic bacteria were present in excess of 100,000 per ml. As the standard plate count increased beyond the level of 50,000 per ml. an increasing percentage of these samples had facultative psychrophilic counts in the higher brackets. In a few of these samples slight odor and flavor defects were noted. These defects, if associated with bacterial activity, probably were the result of total bacterial activity rather than that associated with any one group of organisms.

An occasional sample was encountered in which the standard plate count was in excess of 100,000 per ml., yet the facultative psychrophilic count fell into one of the lower count-ranges.

Of the 251 samples in which the facultative psychrophilic count was 10,000 per ml. or less, 186 had a standard plate count in the same range. Only 5 samples of this group had a standard plate count in excess of 50,000 per ml.

The Facultative Psychrophilic and Standard Plate Count Distribution after 24 Hours

The facultative psychrophilic and standard plate count distribution after 24 hours of storage at 37° to 39° F is shown in Table 2.

TABLE 2 — DISTRIBUTION OF FACULTATIVE PSYCHROPHILIC AND STANDARD PLATE COUNTS AFTER 24 HOURS OF STORAGE AT 37° TO 39° F.

	Facultative Psychrophilic Count 17° C.		Standard Plate Count 35° C.	
Range of count	No. of samples	Per cent	No. of samples	Per cent
(per ml)				
0-10,000	181	31.5	191	32.9
10,000-25,000	118	20.5	136	23.5
25,000-50,000	100	17.5	99	17.0
50,000-100,000	72	12.5	64	11.0
100,000-300,000	74	12.9	70	12.1
over 300,000	29	5.1	20	3.5
Total	574	100.0	580	100.0

These data include 574 facultative psychrophilic and 580 standard plate counts. A slight change occurred in the distribution of the two types of counts as compared with the initial plating period. A decrease, from 40.0 per cent in the fresh to 31.5 per cent after 24 hours of storage occurred in the samples having a facultative psychrophilic count of less than 10,000 per ml. The samples in which the facultative psychrophilic count was above the level of 100,000 per ml. increased from 10.0 to 18.0 per cent.

A smaller degree of change occured in the distribution of the standard plate counts. Above the level of 100,000 per ml. these increased from 13.0 to 15.6 per cent.

The Facultative Psychrophilic and Standard Plate Count Distribution after 48 Hours

The facultative psychrophilic and standard plate count distribution after 48 hours of storage at 37° to 39° F. is shown in Table 3.

These data on 558 milk samples show a further shift of the facultative psychrophilic counts toward the higher count ranges. A small change occurred in the distribution of the standard plate counts. Many of the samples retained facultative psychrophilic and standard plate counts in the lower count ranges. Compared with the plating results of the 24-hour period of storage, the facultative psychrophilic counts above 100,000 per ml. increased from 18.0 to 25.5 per cent. The standard plate counts above this level increased from 15.6 to 19.0 per cent. At the end of the 48-hour storage period 12.4 per cent of the samples had a facultative psychrophilic count in excess of 100,000 per ml. In some of these the facultative psychrophilic count was in excess of 1,000,000 per ml. and may have contributed to slight flavor and odor defects noted in numerous samples at this observation period.

Babel (2) found high quality raw milk, generally, to show a significant increase in total bacteria after 24 to 48 hours of storage at 40° F., and that the flora was made up largely of psychrophilic bacteria. Some of the samples he studied showed marked increases in the standard plate count at 32° C. after 48 hours of storage, whereas in others excessive increases in the standard plate count did not occur even after five days of storage.

Observations on the Milks from Three Different Dairy Farms

An interesting observation of this study pertained to the results secured on the samples collected from three farms designated as A, B, and C.

The initial standard plate and facultative psychrophilic counts on the samples from A were consistently low, having a logarithmic average of 8,000 and 5,000 per ml. respectively. After being held in storage for the additional periods of 24 and 48 hours the logarithmic averages of the respective counts remained unchanged.

Counts from dairy farm B were invariably high at the initial sampling period. The logarithmic averages for the standard plate and facultative psychrophilic counts were 185,000 and 147,000 per ml., respectively. After 24 hours of storage these had increased to 275,000 and 210,000. During the next 24 hours of storage no increase occurred in the average standard plate count and the average facultative psychrophilic count had increased to only 230,000 per ml.

TABLE 3 — DISTRIBUTION OF FACULTATIVE PSYCHROPHILIC AND STANDARD PLATE COUNTS AFTER 48 HOURS OF STORAGE AT 37° TO 39° F.

	Facultative Psychrophilic Count 17° C.		Standard Plate Count 35° C.	
Range of count	No. of samples	Per cent	No. of samples	Per cent
(per ml)				
0-10,000	156	28.0	178	32.0
10,000-25,000	106	19.0	114	20.5
25,000-50,000	78	14.0	92	16.5
50,000-100,000	75	13.5	67	12.0
100,000-300,000	74	13.4	71	12.7
over 300,000	69	12.1	36	6.3
Total	558	100.0	558	100.0

The initial standard plate and facultative psychrophilic counts from dairy farm C were relative low, having logarithmic averages of 21,000 and 34,000, respectively. These had progressed to 32,000 and 90,000 after 24 hours of storage and to 68,000 and 410,000, respectively, after 48 hours.

Careful attention was given on dairy farm A to the production of high quality milk. Such, however, was not the case on dairy farm B, and this lack of attention to satisfactory methods was evident by the high initial counts. In the case of the samples from dairy B it was surprising that the facultative psychrophilic counts did not increase to higher levels over the 24 and 48 hours of additional holding. This is especially true when the results from dairy farms B and C are compared. The initial average facultative psychrophilic count of the samples from dairy farm B was approximately four times higher than that of the samples from dairy farm C. After 48 hours of storage, however, the average facultative psychrophilic count of these samples was approximately only half of that of the samples from dairy farm C.

These studies did not include any observations as to the types of facultative psychrophilic bacteria present in the milks from the three dairy farms. Differences in the growth responses of the facultative psychrophilic flora in these milks may have been due to the presence of different types in each.

SUMMARY

A survey study was made of the prevalence of facultative psychrophilic bacteria, as determined by plate counts at 17° C., in raw milk produced under the farm tank system, together with observations on the subsequent growth of these types during additional storage periods of 24 and 48 hours at 37° to 39° F. In addition, standard plate counts at 35° C. were made at each observation period.

At the time of sampling the facultative psychrophilic and standard plate counts paralleled one another rather closely. Low facultative psychrophilic counts were accompanied by low standard plate counts and vice versa. In the majority of the samples the standard plate count exceeded the facultative psychrophilic count. At the initial plating period the facultative psychrophilic types were not present at high enough levels to induce the presence of abnormal flavors and odors.

As the samples were held in storage the facultative psychrophilic counts increased more rapidly than did the standard plate counts. In general, however, the facultative psychrophilic counts were not excessive after 24 hours of storage.

After 48 hours of storage 25.5 per cent of the samples had facultative psychrophilic counts in excess of 100,000 per ml. In some of these samples the facultative psychrophilic count was in excess of 1,000,000 per ml. and may have contributed to slight flavor defects noted at this time.

Noticeable differences were observed in the initial levels and rates of growth of both facultative psychrophilic and mesophilic types of bacteria during storage in the milks collected from three different dairy farms.

ACKNOWLEDGMENTS

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INHIBITORY SUBSTANCES IN MILK[1]

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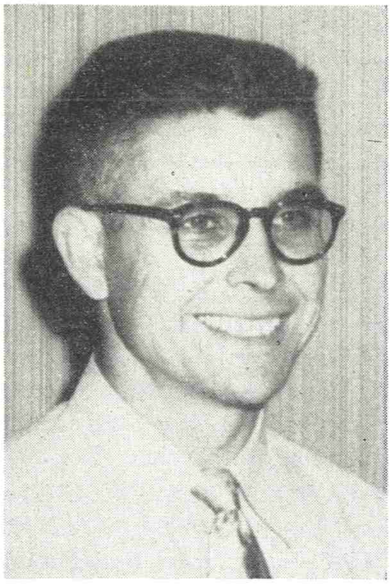
The potential bacteria growth inhibitors in milk are residues from chemical sanitizers, residues from "sulfa" drugs used therapeutically, residues from antibiotics, bacteriophages and others. The action of each of these inhibitory substances with respect to plate counts and lactic acid development are graphically illustrated and discussed with respect to related work by others, reviewed here in some detail. The presence of various inhibitory substances in milk apparently is sufficiently widespread to warrant considerable concern. It is concluded that every effort should be made to prevent the antibacterial agents from gaining entrance into milk.



Dr. Howard H. Wilkowske received his B. S. and M. S. degrees in 1940 and 1942, respectively, from Texas Technological College. He served 4 years as a Navy Officer during World War II. In 1949 he received the Ph. D. degree in Dairy Bacteriology from Iowa State College. Since that time, he has been a member of the Department of Dairy Science staff of the University of Florida and Florida Agricultural Experiment Station, now holding the rank of Associate Professor of Dairy Manufacturing. Since 1950, he has been Secretary-Treasurer of the Florida Association of Milk and Food Sanitarians and since 1952 has been Secretary-Treasurer of the International Association of Milk and Food Sanitarians. In this capacity he serves on the Executive Board, Council, and Membership, Program and Publications committees.

Standard Methods for the Examination of Dairy Products (25) lists the potential growth inhibitors in milk as residues from chemical sanitizers, residues from "sulfa" drugs used therapeutically, residues from antibiotics, bacteriophages and other unidentified inhibitors. These growth inhibitors may influence the results obtained in determinations by agar plate methods and the reduction type methods. Also, various inhibitors in milk may adversely affect the rate of lactic acid development essential in the manufacture of various fermented milk products, such as buttermilk and cheese.

The antibiotics and "sulfa" drugs (which for our purpose may be considered synonomously under the term antibiotics) may occur in milk as the result of treatment of udder diseases of dairy cows. Chemical sanitizers, such as chlorine compounds or quaternary ammonium compounds, gain entrance into milk by improper use or possibly by intentional additions. Bacteriophage gains entrance to dairy products as the result of improper sanitation or starter propagation procedures.

The presence of any antibiotic or any sanitizer in milk is objectionable and illegal. Milk containing these inhibitory substances is considered adulterated regardless of whether the materials gained entrance to milk by accidental means or by intentional additions.

When difficulties arise with respect to inhibition of bacterial growth, it is apparent that similar symptoms are caused by several unrelated inhibitors — sanitizers, bacteriophage, antibiotics, or other causes. Without further proof, other than delayed lactic acid formation or failure of colonies to grow on plates, further information should be sought for positive identification of the causitive factors.

This paper will be concerned primarily with work done at the Florida Agricultural Experiment Station dealing with the action of certain inhibitory subtances in milk as related to plate counts and to lactic acid development by dairy starters. The findings will be discussed with respect to related work by others, which is reviewed here in some detail.

[1]Florida Agricultural Experiment Station Journal Series, No. 399. Paper presented at the 11th annual conference of the Florida Association of Milk and Food Sanitarians, April 5, 1955. Gainesville, Florida.

For complete review of the many problems encountered with respect to the antibiotics in milk the reader is referred to the review articles by Calbert (4), Claybaugh and Nelson (5), Overby (21) and Trout (28).

INCIDENCE OF INHIBITORS

It has been noted that laboratory personnel had observed sudden drops in plate counts or undue lengthening of methlyene blue or resazurin reduction times, Calbert (4), Johns & Katznelson (14), with no apparent explanation. In these cases promiscuous use of inhibitory substances, primarily antibiotics might be suspected.

Silverman and Kosikowsky (23) have evaluated and coordinated methods for the systematic analysis of inhibiting substances in milk. Methods are discussed which are suitable for testing large numbers of samples from wide areas for total inhibitory substances, antibiotics, sulfa drugs and quaternary ammonium compounds. These tests are readily adaptable to a systematic laboratory procedure. They point out that no practical method exists for testing for bacteriophage in large numbers of milks over wide areas, so the importance of this particular problem to the dairy industry cannot be fully evaluated until such time when the incidence of such bacteriophage cases can be measured.

The extent of residual antibiotics in milk has been discussed by Henningson (10) for three areas; for the state of New York (16), for Ottawa, Canada (12) and for London, England (27). These three surveys seemed to indicate that there existed no grave problem in the specific areas as far as the manufacture of fermented dairy products was concerned during the years 1951 to 1954. Over 4,000 test samples were involved in these studies. Using an antibiotic assay test, the percentage of samples showing greater than critical levels ranged from 0.3 to 0.8 per cent. These results were specific for penicillin and further starter activity tests showed slightly more inhibition which may have been the result of other antibiotics or some other inhibitory substance. It was generally agreed that no serious problem existed; however, this does not preclude individual cases which may have been quite serious and costly. These troublesome cases should not be minimized. They tend to emphasize the importance of a better understanding of the problems related to inhibitory substances in milk and they demonstrate the need to be on guard against potentially greater difficulties in the future.

Despite the fact that surveys have shown no widespread difficulties due to inhibitory substances in milk, it is believed that the problems may have increased in some sections in recent years. A tabulation of certain data available from one of the Florida State Board of Health laboratories during the first quarter of 1955 (shown in Table 1) reveals that a significant number of standard plate counts were reported "less than 3,000 per ml." This is indeed desirable and reflects what would be considered excellent care in milk production. However, when almost 10 per cent of the raw samples showed counts

TABLE 1 — BACTERIAL COUNTS OF SOME FLORIDA MILK SAMPLES DURING THE FIRST QUARTER OF 1955.

	Number of samples	Per cent
Raw milk with standard plate count less than 3,000	30	9.6
Total raw samples	312	......
Pasteurized milk with standard plate count less than 3,000	1272	62.1
Pasteurized milk with less than 5 colonies on the 1:100 dilution plate (est. 500/ml.)	328	16.0
Total pasteurized samples	2048	......

of less than 3,000 and 16 per cent of the pasteurized milk samples showed counts of less than 500, either the milk is of unusually good quality, or it may be suspected of containing bacterial growth inhibitors. As no further information concerning these counts is available there may be some cause to suspect inhibitory levels of antibiotics in some of the milk.

NORMAL GROWTH CURVES

An explanation of normal growth curves is necessary in obtaining a better understanding of the problems encountered with respect to the various inhibitory substances in milk.

Figure 1 shows the relationship of plate counts, titratable acidities and bacteriophage concentrations in milk incubated at 21° C. These are typical curves obtained under approximately normal conditions of starter propagation. The data do not represent a single trial but rather a compilation of curves obtained independently. By plotting these on a single graph, an understanding of the relationship is obtained. It should be pointed out that the scale selected for the titratable acidities and the one selected for the logarithm of total plate count are arbitrary and do not necessarily coincide. The plate count illus-

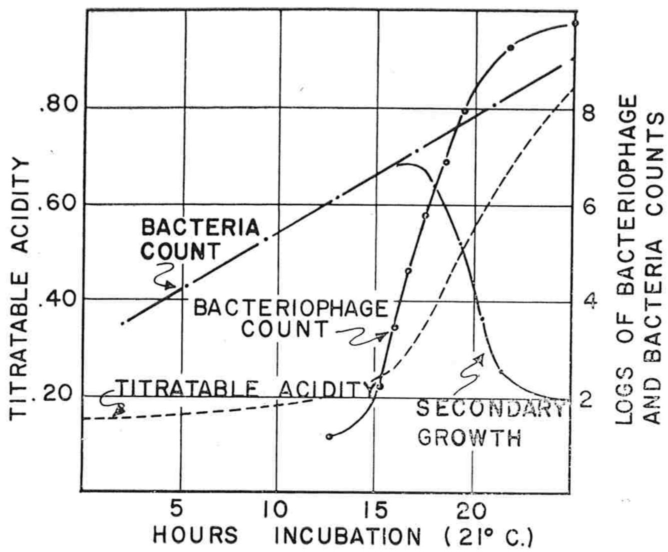


FIGURE 1. The relationship of plate counts, titratable acidities and bacteriophage development in milk.

trated was initially very low as was the initial inoculation of lactic acid organisms. This accounts for the longer period of incubation for maximum development of acidity. The important point to be noted is that the plate counts reach approximately the 10 million range before a measurable amount of acidity is developed. Thus, it can be observed that inhibitory action as measured by plate count procedures would precede by as much as 10 hours the action measured by titratable acidity determinations under these conditions.

ANTIBIOTICS VS. LACTIC ACID DEVELOPMENT

The presence of antibiotics in milk has been found to reduce the numbers of bacteria in milk as measured by standard plating procedures as well as adversely affecting the rate of lactic acid development in the manufacture of fermented milk products. Penicillin, for example, at a concentration of only 0.1 unit, can reduce the rate of lactic acid production to a degree which can be measured by titration methods. Figure 2 shows the influence of penicillin on lactic acid development. It may be noted that as milk was incubated at 30° C. the acidity developed rapidly in the control sample, reaching a maximum in about 8 hours; this is the usual activity shown by a dairy starter with 1 per cent inoculation. In the same period of time, 0.1 unit had retarded the acidity to about one-half that of the control and 0.2 unit or more practically stopped acid production.

ANTIBIOTICS VS. PLATE COUNTS

In studies (29) on the influence of penicillin in milk on total and coliform bacteria plate counts, it was found that a concentration of one unit of penicillin per ml. in raw mixed milk was sufficient to significantly retard growth during a three-day storage period at 10° C. Figure 3 shows the influence of penicillin on the standard plate counts of raw milk held in refrigerated (10° C.) storage over a period of 6 days. It is shown that 0.1 unit or more is sufficient to retard growth for over 3 days below the 200,000 per ml. level. In recent years this has become a more important consideration because many dairy farms are now using refrigerated bulk milk tanks with two-day storage on the farm between pick-ups.

Penicillin and sulfa drugs tend to reduce the numbers of bacteria found in milk by standard bacteriological examinations. The extent of reduction of counts depends upon such factors as concentration, dilution, number and types of organisms and the

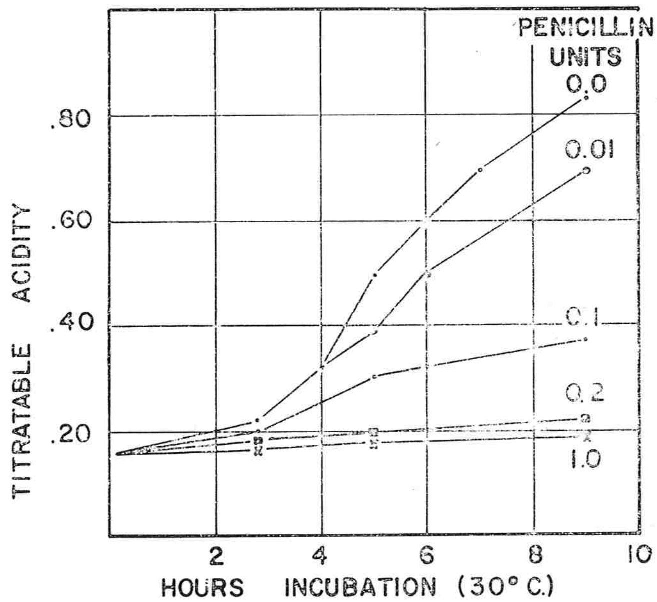


FIGURE 2. Influence of penicillin on lactic acid development in milk.

sensitivities of the various microorganisms to the antibiotics or inhibitory materials under consideration.

Additional research along these lines has confirmed and expanded the observations that plate counts (standard, coliform, psychrophilic) on raw and pasteurized products are reduced by various antibiotics (penicillin, streptomycin, tyrothricin, aureomycin) under various laboratory conditions.

Olson *et al.* (20) observed that addition of 0.2 microgram of aureomycin per ml. of pasteurized, homogenized milk generally showed slightly lower counts during storage at 45° F. when plated for psychrophilic organisms during a one-week period.

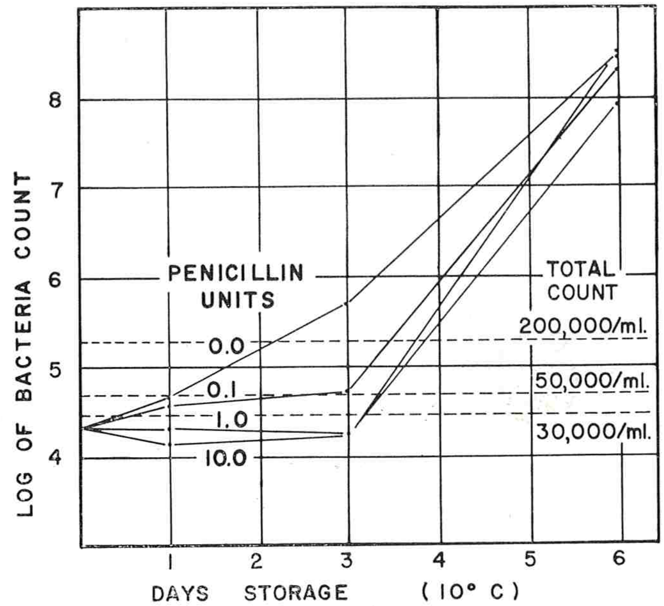


FIGURE 3. Influence of penicillin on standard plate counts of raw milk.

Stoltz and Hankinson (26) 1953, studied the antibiotics penicillin, streptomycin, aureomycin, tyrothricin, and penicillin and streptomycin in combination at levels of concentration which might be found in market milk supplies of pooled herd milk following antibiotic therapy of a few diseased animals in the herd. At such concentrations all the antibiotics studied were found to inhibit the growth of bacteria in raw milk when stored for 48 hours at 7° C. They concluded that the addition of antibiotics to raw milk would result in receiving poor quality milk as an acceptable grade of milk at the dairy plant, if judged solely by bacteriological standards.

NISIN

Researchers in New Zealand (11) and England (17) have reported that certain milk supplies were inhibitory to lactic cultures. Such milk was referred to as "non-acid" milk. The substance causing this effect is produced by certain selected strains of *Streptococcus lactis*. It is considered to be an antibiotic and has been named Nisin. This substance has been shown to significantly inhibit the production of lactic acid by other strains of starter bacteria. This is an example of an antagonistic action of one strain of bacteria upon other strains of the same species. Such phenomena are not uncommon in the dairy industry; for frequently when two different commercial starters are mixed together, the rate of acidity development and maximum acidity obtained will be less than when either one of the starter cultures is used separately. With respect to starter activity, the inhibitory action has been found to be associated with unclean milking machines, poor sanitation on farms generally and with high bacterial counts during warm weather. The addition of 5 per cent of "non-acid" milk to an active dairy starter will delay the souring by as much as 15 hours. The presence in milk of nisin-producing organisms might be expected to lower the standard plate counts of milk; however, if the antibiotic was present in sufficient concentration to have a significant effect, the total count probably would be high due to the presence of large numbers of nisin-producing organisms. Such influence, if any, has not been established and must await further research along this line.

QUATERNARY AMMONIUM COMPOUNDS

Mull and Fouts (19) studied the influence of Roccal, a quaternary ammonium compound, on plate counts of raw and pasteurized milk and on the flavor of the milk. Figure 4 shows a portion of the data obtained which illustrates the importance of their

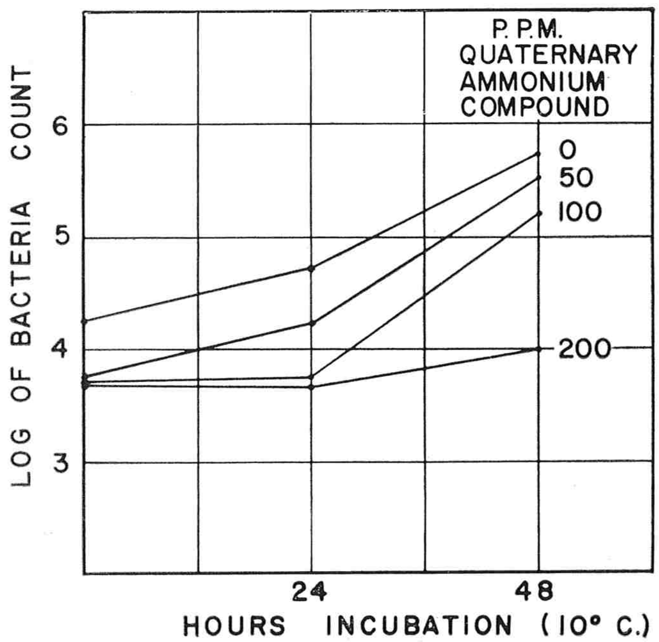


FIGURE 4. Influence of a quaternary ammonium compound (Roccal) on the standard bacteria plate count of raw milk.

findings. They concluded that the affect on plate counts was more noticeable in milk of low initial count (17,500/ml.) than in milk of high initial count (290,000/ml.). Approximately 200 p.p.m. of the Roccal were needed to bring about a significant decrease in bacteria counts, while as little as 10 p.p.m. could be detected by taste in the milk.

Babel (1) has shown that quaternary ammonium compounds inhibited lactic acid production when present in milk to the extent of 3 p.p.m., while generally from 50 to 100 p.p.m. of quaternary in milk were required to prevent acid production entirely. Because the quaternary compounds contribute to slow acid production at relatively low levels, great care should be exercised to prevent their entrance into milk intended for fermented products.

Curry and Barber (7) investigated the "inhibition" of *Streptococcus lactis* by a quaternary ammonium compound in cheese milks. They found lactic cultures were destroyed within 10 minutes by concentrations of less than 10 p.p.m. active ingredient of a detergent sanitizer containing quaternary ammonium compound. On the other hand, concentrations greater than 600 p.p.m. in milk are required for the same degree of destruction. They further reported inhibition of lactic acid bacteria by concentrations of 2.5 to 10 p.p.m. quaternary in milk to be an effect on acid production and not upon growth.

CHLORINE

In a study made to consider the chlorine contents of waters used in reconstituting nonfat dry milk for manufacture of fermented dairy products, the data shown in Figure 5 were obtained. Chlorinated waters of various concentrations were used in these trials for reconstituting followed by inoculation with commercial lactic acid cultures and incubation at 70° F. Acidity determinations were made at intervals during the incubation period. It may be noted that as much as 100 p.p.m. of chlorine did not adversely affect the growth of organisms after the reconstituting had been completed. The hypochlorite used as the source of chlorine apparently combined with the milk solids during the process of mixing the water and powder and was no longer capable of bactericidal action.

From this study it may be concluded that the very small concentrations of chlorine normally present in city water supplies (from 0.1 to 0.3 p.p.m. of free residual chlorine up to as much as 1.5 p.p.m. of combined residual chlorine) will not adversely affect the growth of organisms in starters, buttermilk and cottage cheese. The chlorine is bound by the milk solids and does not prevent lactic acid development nor does it impart objectionable off-flavors. Therefore, it appears desirable to use chlorinated waters because of the added advantage that such water will probably be free of undesirable bacteria. It is not only desirable but safe to use sanitizing solutions on equipment and utensils just prior to reconstituting powders with the knowledge that the small amount remaining on the equipment after draining will not reduce starter activity.

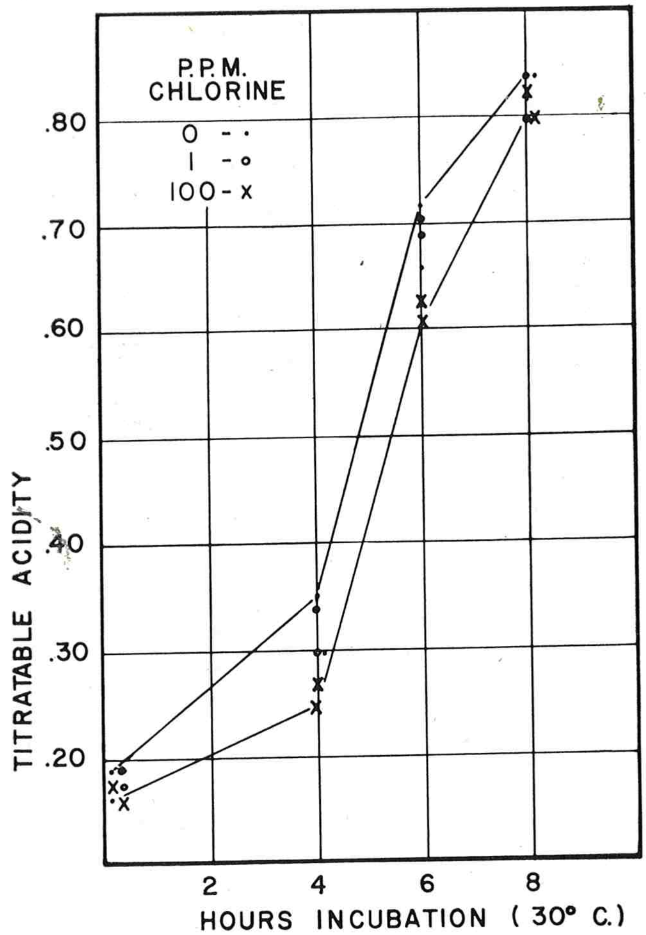


FIGURE 5. Influence of chlorine in water used for reconstitution of nonfat dry milk solids on lactic acid development.

Babel (1) observed the changes in the bacterial population of milk due to the addition of some chemical bactericides. He found that 200 p.p.m. available chlorine added as hypochlorite, or 500 p.p.m. added as Chloramine-T were needed to prevent an increase or cause a slight decrease in bacterial population of raw milk for 48 hours at 40° F. Acid production was slightly inhibited by 5 p.p.m. available chlorine and greatly inhibited by 25 p.p.m. added as hypochlorite. An iodine bactericide in concentration of 40 p.p.m. prevented growth for 24 hours and 40-100 p.p.m. prevented growth for 48 hours.

Miller and Elliker (18) showed that it was necessary to add as much as 75 p.p.m. of hypochlorite to milk after it had been reconstituted and sterilized in order to show a significant decrease of acid production in starters. They found that some inhibition apparently occurred between 100 and 200 p. p.m. of sodium hypochlorite but did not always completely stop growth at the normal incubation temperatures of dairy starters.

MENADIONE

The action of menadione, a vitamin compound, in milk may be selected as a typical example of the antibacterial action by various chemicals which might be added to milk. Since menadione is relatively insoluble in milk, levels from 0.3 to 50 mg. were dissolved in one ml. portions of ethyl alcohol before being added to 100/ml. portions of whole milk. The mixture was heated in flowing steam for one hour followed by cooling to 30° C. before inoculation. Controls with and without added alcohol were included. Trials were made using various levels of inoculation with bacteria. A typical result of this study is shown in Figure 6. The menadione could be detected in the milk at concentrations of about 3 to 5 p.p.m. as evidenced by a reduction in the rate of lactic acid development. Similar results were obtained when lower percentages of inoculation and lower incubation temperatures were used except that longer periods of incubation were required for the acid to develop. Similar results also were obtained using skimmilk. The direct addition of 10 p.p.m. of menadione to milk extended the length of time to reach 0.25 per cent acidity by approximately 3 hours; 50 p.p.m. extended it about 6 to 8 hours. To preserve milk for several days, levels greater than 100 p.p.m. would be needed. However, such practice would be of no value in the dairy industry, since at levels of over 100 p.p.m. the menadione causes discoloration of milk as well as imparting an undesirable flavor to it.

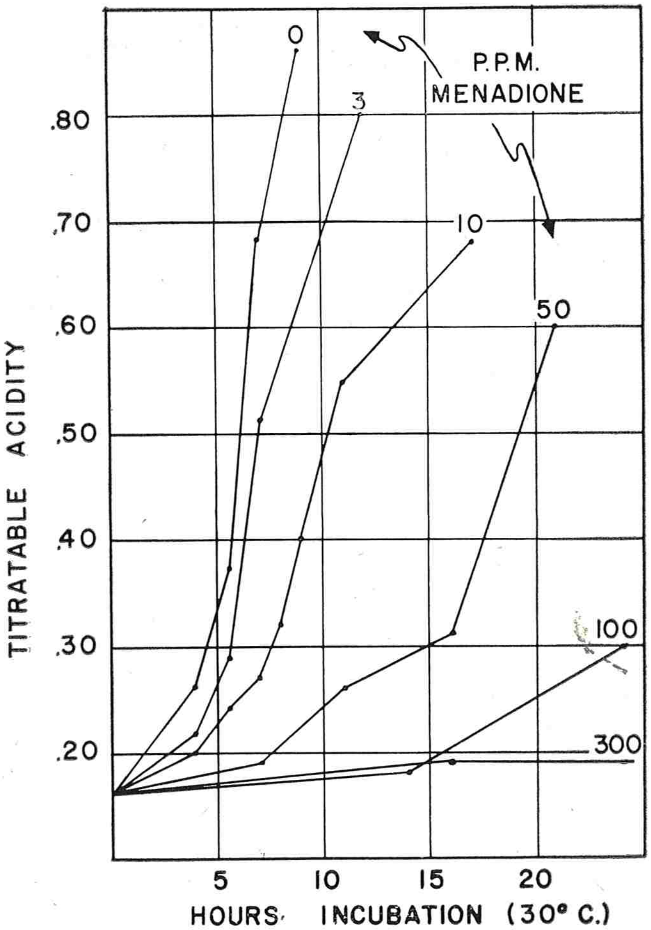


FIGURE 6. Influence of menadione on rate of lactic acid development in milk inoculated with 3 per cent dairy starter.

It has been suggested (15) that the feeding of menadione to dairy cattle had a retarding effect on the souring rate of milk but these findings have not been confirmed (2, 3, 6, 30).

BACTERIOPHAGE

Bacteriophage is the general name given to certain viruses capable of destroying bacterial cells. The "phage" multiplies by growing on the living bacterial cells which are inactivated and lysed in the process. The lactic-acid-producing organisms are susceptible to specific strains of bacteriophage; this results in failures in acid production necessary for the successful manufacture of the various fermented dairy products. Unlike the antibiotics which are produced by microorganisms and active against numerous other organisms, the bacteriophage is a living organism which exhibits very specific activity against only certain susceptible species of bacteria and usually only against those strains from which it is produced.

Bacteriophage can be counted by use of special plating procedures or by using limited-dilution methods for determining the concentration, commonly referred to as the titer. Growth curves (Figure 1) of bacteriophage resemble those of other living organisms. The phage can be destroyed by chemical agents (chlorine or quaternary ammonium compounds) and heat very much like bacteria.

Parker and Elliker (22) investigated the destruction of lactic acid streptococcus bacteriophage by hypochlorite and quaternary ammonium compounds. They found that complete inactivation of phage preparations was attained with 200 p.p.m. of either quaternary ammonium or hypochlorite germicides. This concentration was considered sufficient for normal sanitization of dairy equipment for phage destruction.

With the advent of the electron microscope in recent years it has been possible to actually see bacteriophage despite their small size. The larger part of the phage is round with a diameter some-what less than one-tenth that of the cells of lactic streptococci. A single, short tail on the phage is three or four times the length of the cell body. In addition to being able to see bacteriophage, measurement of its activity against the lactic streptococci has made possible numerous studies, notably at Iowa State College, regarding the nature of phage action. Elliker (8) has reviewed the many problems confronting the dairy industry associated with bacteriophage. Smith et al. (24) further emphasized the importance of bacteriophage as a cause of slow starters.

In commercial practice bacteriophage outbreaks occur suddenly with no apparent warning. As recent as February, 1955, the authors isolated from cottage cheese whey a bacteriophage strain causing difficulty in a Florida commercial dairy plant. At the present time, there are no practical tests which would give suitable advance information that could be used to prevent occasional failures of acid development in cheese and buttermilk manufacture. Therefore, the best practice has been to follow such procedures that are known to reduce the incidence of bacteriophage outbreak. These include rotation of cultures, proper handling and transfer of starters and thorough sanitization of all equipment and buildings.

Bacterial Inhibitors as Milk Preservatives

The addition of some kind of preservative to milk which would cause it to be free of all pathogenic organisms, not adversely affect the flavor and not be harmful to the consumer would be of interest. Such practice is permitted in some foreign countries, for example, the use of hydrogen peroxide in Italy. In this country the recommended practice is to not permit the masking of poor quality milk by use of antibacterial agents (4, 9, 23 29).

None of the inhibitors considered here, and possibly no method of preservation now known, is completely satisfactory. Research results indicate that the numerous studies we hear about cold (radiation) sterilization holds some promise in that regard but the fundamental problem of destroying the bacteria without affecting the flavor still remains.

The various antibiotics and sulfa drugs are limited in range of activity and all exhibit various degrees of specificity against certain microorganisms. While some undesirable bacteria would be destroyed, others would continue to grow. In some instances, this results in a poorer quality product than when no inhibitor is used. Similar results would be obtained in the case of utilizing bacteriophage as preservatives since bacteriophage are known to be highly specific in action. Chemical sanitizers and other chemical compounds thus far have proven of little value. Johns and Berzins (13) tested an iodophor formulation (Iosan) and found that a concentration which would be effective as a preservative in milk could be detected by taste and would be objectionable. They observed that as much as 16 p.p.m. of Iosan influenced resazurin reduction times and plate counts too little to be of practical significance since at the use-dilution of 25 p.p.m. considerably less concentration would accidentally occur in milk due to inadequate drainage of sanitized equipment.

Summary

Various bacterial growth inhibitors – sanitizers, antibiotics, bacteriophages, and others – occur in milk. These cause lowered plate counts and retarded lactic acid development. Such difficulties are sufficiently widespread to warrant considerable concern. Very small amounts of certain inhibitory substances are enough to adversely affect growth of microorganisms in milk. However, none are satisfactory as milk preservatives, since none are completely effective against all types of bacteriological spoilage. Also, milk of low bacterial count or activity due to the presence of inhibitory substances might be of poor quality because of non-bacterial defects such as rancid or feed flavors. The use of antibacterial agents as preservatives should not be permitted because such use might result in the masking of poor quality milk and poor production and processing methods.

To avoid starter difficulties due to bacteriophage action, it is important to follow all procedures recommended for proper care and handling of starters. This includes rotation of cultures, proper handling and transferring of cultures, and thorough sanitization of all equipment. Such care will reduce the chances of starter failures due to conditions other than antibiotics.

To obtain reliable plate counts, the products tested must also be free of inhibitory levels of antibiotics and sanitizing agents. The best way to avoid the accidental entry of objectionable levels of antibiotics in milk is to keep producers informed and insist they comply with the recommendations of the Committee on Antibiotics of the American Dairy Science Association and the Federal Food and Drug Administration. These recommendations state that milk from treated segments of udders should be discarded or used for purposes other than human consumption for at least 72 hours after the last treatment.

The tremendous success of antibiotics in treatment of mastitis fully justifies their use; but such products should be used only when needed and not without good reason. The wholesale use of antibiotics in treatment of entire herds when obviously not needed should be discouraged.

Little or no information exists with respect to the long range effects on human beings of small daily intakes of antibiotics or other inhibitory substances in milk over extended periods of time. Further research is needed along these lines. Until such information is available, it seems desirable to keep the milk intended for human consumption as free as practical of trace amounts of any of the bacterial growth inhibitors.

ACKNOWLEDGMENTS

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HIGHLIGHTS OF SOME FOOD CONTROL ACTIVITIES OF THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE[1]

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I have learned a great deal during my first few months as an Assistant Secretary of Health, Education and Welfare, a great many new facts about a lot of fascinating and important subjects. For example, as a newcomer to your field, I have been especially impressed with the meticulous attention paid to every drop of a fluid I have taken for granted from my first day of life. Apparently, this opalescent liquid does not merely flow from a cow into a bottle as, I suspect, many millions of my fellow Americans think it does.

I now know that before it reaches my lips, every single individual drop of milk has been strained . . . filtered . . . pasteurized . . . homogenized . . . weighed . . . cooled . . . heated . . . pumped . . . held . . . agitated . . . clarified . . . separated (from what, I haven't found out) . . . stored . . . restored . . . transported . . . and retransported. This is, no doubt, far from a complete odyssey of the trials, tribulations and travels of this wonderful natural food. And to think that I have drunk milk every day of my life with only a faint suspicion of what it has been put through by you gentlemen.

As fascinated as I am by my new knowledge of the milk industry, I shall not attempt to discuss it with you at length, realizing that to all of you this would be merely "old stuff." I cannot resist, however, expressing my own amazement at the comprehensiveness and thoroughness of the work of your group in dealing – not only with every aspect of the product itself –but with every person and every item of equipment which, in any way, come into contact with your product on its long but rapid journey from the cow to the customer.

I wish that every consumer of milk – which means, I hope, every person in this great nation – could know what you dairy-industry and public health men do to protect the sources, the contacts, and the distribution of this important food. Far from being satisfied that you are now delivering the best milk that can possibly be provided, countless professional, commercial, and governmental organizations and individuals are devoting millions of man-hours, hundreds of thousands of dollars, and inestimable brainpower to the proposition that milk can be made even better, tastier, safer, cheaper, more useful, and more nutritious than it is today.

Each of you can take justifiable pride, I believe, in the progress you have made together toward assuring that milk – perhaps the one food most necessary for proper health and growth – and the products derived from milk, are both as wholesome as modern technology can make them and as accessible to all as possible.

I have been particularly impressed, may I say, by the record of the Public Health Service in the field of milk sanitation. Its long history of close collaboration with the industries and others concerned, all of whom are represented in this room, has worked to the great advantage of the American people as a whole.

A comparatively recent, but very logical, extension of the Public Health Service's traditional role in the cooperative improvement of dairy processing and marketing is its participation in the Interstate Milk Shippers Certification Program. This program as you know, uses the model *Milk Ordinance and Code* of the Public Health Service as its basic standard.

As I understand it, the purpose of this program is to provide a satisfactory basis for the acceptance of milk shipped across State boundaries, and thus to eliminate the need for multiple inspections of sources of milk by health authorities. This, in turn, yields three significant benefits: First, it helps to move milk from areas of high supply to areas of low supply. Second, it helps to move milk more rapidly from the point of origin to the point of utilization. And third, it helps to prevent the use of pseudo-health regulations as artificial trade barriers, thus removing a costly nuisance to industry and an unjustifiable expense to the consumer.

As a new bureaucrat in Washington, I am also pleased to note that Public Health Service participation in the Interstate Certification Program was specifically invited by the parties most directly concerned, the industries and the State and local governments.

During the brief existence of the Interstate Milk Shippers Certification Program, the Public Health Service has, I understand, consistently maintained its traditional role of trusted reporter and friendly arbiter. The Division of Sanitary Engineering Ser-

[1]Presented before the joint meeting of the 3-A Sanitary Standards Committees, at the Kenwood Country Club, Bethesda, Maryland, April 27, 1955.

vices, with which you deal on milk-sanitation matters, tells me that credit for most of the progress that has been made should go to the representatives of the industry and the State Health Departments who have participated in it. I have also heard, from other quarters, that the Public Health Service is entitled to a good part of the credit. With this spirit of mutual respect and appreciation cementing the relationships, it is not difficult to see how long strides have been made in a short time, and why the future of this cooperative program is so bright.

Although I am most reluctant to speak statistically before so informal a meeting as this, the great progress that has been made in interstate milk certification can be described most quickly with figures. The figures themselves are almost astounding. Although only four short years have passed since this work began, today 32 States are actively cooperating in it. The latest certification list issued by the Public Health Service contains the names of 479 interstate shippers who obtain their milk supplies from an estimated 60,000 dairy farms.

Another outstanding example of productive cooperation between the dairy industry and this Department has been the development of equipment for whole-can testing of cream for butter manufacture.

Several years ago the Food and Drug Administration recognized that there was obvious need for a suitable device for rapidly straining whole cans of churning cream. Cooperating with the American Butter Institute in a general cream improvement program, FDA thereupon undertook to develop suitable apparatus. Several of these devices have now been supplied to our field inspectors, and the current regulatory program on butter provides that whole-can testing of churning cream be employed.

Meanwhile, many butter manufacturers have recognized the value of whole-can cream straining and have installed in-line plant equipment for this purpose. The Food and Drug Administration believes that the whole-can testing of churning cream has already become a significant factor in improving the quality of butter to the benefit of the consumers.

To turn now to another topic, I would like to say something about the possible use of ionizing radiations for the preservation and sterilization of food, including milk. One of our Public Health Service technicians recently completed two years of graduate study at the Massachusetts Institute of Technology in order to ground himself thoroughly in all of the aspects of the application of this new force to foods, including milk. This gentleman has given me a ten-minute postgraduate course on this subject, and I now find myself fully equipped to discuss it learnedly.

Both the Food and Drug Administration and the Public Health Service of the Department of Health, Education, and Welfare are following current developments in this field closely, including the studies being conducted under the auspices of the Quartermaster Food and Container Institute of the Armed Forces. We are, of course, interested in any possible application of ionizing radiation as a new means for the processing and preservation of foods. We are equally interested in learning whether processing with ionizing radiation will affect the nutritional value of the food, impart any unfavorable qualities, or otherwise produce deleterious effects.

There is no doubt now that sterility in food products can be achieved through use of ionizing radiations. Current studies include milk, meat, fish products, vegetables, and spices, all of which have been successfully sterilized by this method of treatment. The results in some instances, such as in the case of potatoes, look very promising, but in most instances, undesirable changes have occurred in the product itself. As an example, milk has been successfully pasteurized by comparatively low doses of high-energy cathode rays. However, milk and milk products appear to be extremely sensitive to ionizing radiations, and such treatment has usually provided undesirable flavor and odor characteristics.

Other potential applications of this new force in which the Department naturally takes an interest are the cold sterilization of drugs and biologicals which are adversely affected by heat, and the sterilization of human blood and of various human tissues for transplanting from one person to another. Considerable progress has been made along these lines. May I say that the Food and Drug Administration stands ready at all times to consult with any manufacturer who contemplates the use of ionizing radiation in the commercial processing of foods or drugs.

We do know, by the way, that insects are relatively sensitive to ionizing radiations. They can be killed by comparatively low doses, and their reproduction can be prevented by even lower doses. I have been especially interested to learn that the elimination of insect infestation in grain by ionizing radiations may well become economically feasible.

Much additional research needs to be done, of course, before widespread use of ionizing radiations becomes a practical commercial reality in the food industries. Many questions still remain to be resolved. But if we compare what is known today about radiation sterilization of foods with what was known only five years ago, it is obvious that considerable progress has been made and that many of the problems I have mentioned will, no doubt, be mastered in the near future.

More immediate progress is being made in other milk and milk products research and development projects. Our Department takes great pride in the contributions being made in this important field by the new Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio, which was dedicated by Mrs. Hobby just one year ago. This modern facility, which absorbed the old Environmental Health Center, is well equipped and has been especially designed to undertake research on environmental sanitation problems.

In this connection, I would like to tell you about several specific research projects which have been under way for some time.

First, many of you know that we have been concerned with the possibility that Q-fever can be transmitted to man through the consumption of milk from cattle infected with this disease. Because of this, several years ago, the Public Health Service set up a cooperative research project with the University of California to determine the thermal death curve of the Q-fever organism, and to determine beyond doubt whether this germ could survive our present methods of commercial pasteurization.

The Dairy Industries Supply Association and the Milk Industry Foundation, I should like to add, have assisted us immeasurably with technical guidance and material aid in the course of this project.

The Q-fever study is now in its final stages. In fact, the laboratory data are now undergoing statistical analysis, and field testing is in progress to confirm the results. I can assure you that the dairy industry will be given the fullest possible report at the earliest possible date – which will certainly be within the near future.

Another of our research interests over the past several years has been the investigation of new pasteurization processes. Through the Public Health Service and industry-sponsored research, we have been able to evaluate the adequacy of several of the new processes. We plan to release our recommendations soon regarding processes which heat milk and milk products to 192° F. with a minimum holding time of one second. During the last month, our advisory board accepted this method of processing as equivalent to present methods of pasteurization, subject to the installation of automatic controls which would insure proper functioning of the equipment.

I note with interest that consideration of a sanitary standard for bulk-milk dispensers appears on the agenda for this meeting. The press has reported also that the wider use of milk-dispensing devices is being advocated as a means of increasing milk consumption. It may be of interest to many of you that the Public Health Service, almost 20 years ago, recognized that the use of these dispensers was practical, with proper safeguards for the public health. This may, therefore, be a fitting point at which to recall the words of Henry David Thoreau to the effect that "*Things* do not change; *we* change."

One other research finding that will be of interest to you concerns the use of quaternary ammonium compounds for the bactericidal treatment of dairy equipment. As you know, these compounds have properties which lend themselves to this usage. A few years ago, however, the investigators at our Cincinnati laboratory discovered the disconcerting fact that the normal mineral constitutents of some water supplies interfered with the bactericidal efficiency of these compounds.

In view of this, it became necessary for State and local health officials to test a quaternary ammonium bactericide with each water supply, in order to be sure of its effectiveness. But now, more research on this problem, with the assistance of chemical manufacturers, has shown that it is possible to modify the QAC formulations to make them usable in most waters. This change probably will be included in the next printing of the *Milk Ordinance and Code* which we are trying to get into print in the next 90 days.

I have referred to these research reports not only because of their technical interest to you, but also to underscore two facts. The first is that, whether we labor on the Government or the industry side of the fence, we must keep ourselves alert concerning the necessary and proper safeguards surrounding the production, processing and distribution of milk, and we must constantly reevaluate our control procedures in the light of newer knowledge. The second thought I should like to leave with you today is that the Department of Health, Education, and Welfare is well aware that the milk industry is dynamic and that milk technology is subject to constant improvement.

We always stand ready, as you do, to evaluate promising new developments quickly and to support and promote vigorously those that are in the public interest.

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NEWS AND EVENTS

BRACE ROWLEY NEW KANSAS STATE DAIRY COMMISSIONER

Brace Rowley, Saline county agricultural agent, has been named Kansas State Dairy Commissioner. Rowley, who will assume his new duties October 1, is currently president of the Kansas County Agents Association and previously served as vice president and secretary of that organization and was a member of two national county agent committees. He succeeds Rolla Holland who has resigned to devote full time to farming and livestock operations at Cedar Vale.

Born and raised at LeCygne, Rowley, 37, son of Howard Rowley, grew up on the family livestock farm which included a Holstein dairy herd, and returned to help manage the farm after being graduated in Agriculture from Kansas State College in 1940.

Extensive experience as a county agent, beginning in May 1941 in Haskell county, was interupted by military service beginning October 1942. Rowley went first to Olathe Naval Air Base, then attended Officer's Training School, before serving in the Pacific theater. He was discharged a Lieutenant (jg) in January 1946. Returning to the extension service, Rowley then served nearly seven years as county agent in Clay county, transferring to Saline county in September 1952.

UNIVERSITY OF KENTUCKY THIRD ANNUAL SHORT COURSE

On Monday following Thanksgiving the Dairy Section of the University of Kentucky will start its Third Annual Dairy Manufacturing Short Course. The course is scheduled for November 28 to 30, 1955. Dr. T. R. Freeman, Professor of Dairying, announced.

At the request of the Kentucky dairy industry, the meeting has been extended to three days. Subject matter will cover latest information and answers to basic problems in market milk, ice cream, and cheese. The program is designed to be of interest to both managers and operating personnel of these types of plants. The Annual Banquet of the Short Course will be held on Tuesday evening, November 29.

Further information concerning the program may be obtained from Dr. T. R. Freeman, Dairy Section, University of Kentucky, Lexington, Kentucky.

HELPFUL INFORMATION

Special Federal Food and Drug Laws, Annotated. Book by T. W. Christopher and C. W. Dunn. Published by Commerce Clearing House, Inc., 214 N. Michigan Avenue, Chicago 1, Ill. One volume, 1334 pages. Price $26.50.

Proceedings, Symposium on Establishing Optimum Conditions for Storage and Handling of Semi-Perishable Substance Items. Available from Quartermaster Food and Container Institute for the Armed Forces, 1819 West Pershing Road, Chicago 9, Ill.

Folder describing use of a cleaning compound in dairy plants, food plants, bakeries, etc. Available from Oakite Products, Inc., 138C Rector Street, New York 6, N. Y.

Folder describing newly developed chelated dairy detergents. Available from Diamond Alkali Co., Cleveland, Ohio.

Proved Answers to Successful Automation. Bulletin available from Photoswitch Division, Electronics Corporation of America, 77 Broadway, Cambridge 42, Mass.

Ten Year Report, 1945-1955. 96 pages. Available from National Sanitation Foundation, University of Michigan, Ann Arbor, Michigan.

Performance of Bulk Tank Milk Coolers Under Laboratory Conditions. Bulletin by J. E. Nicholas, G. H. Watrous and R. W. Decker. Available from Pennsylvania Agricultural Experiment Station, University Park, Penn.

"Safety in Handling Solid, Liquid and Flake Caustic soda." Pamphlet available from Diamond Alkali Co., Cleveland, Ohio.

Principles of Sewage Treatment. Book by William Rudolfs. 130 pages. Published by National Lime Association, 925 Fifteenth St., N. W., Washington, D. C. 1955. Price $1.25.

Cleaning and Sanitizing Farm Milk Utensils. Farmers Bulletin 1675. Price 10 cents. Available from Supt. of Documents, Washington, D. C.

Farm Methods of Cooling Milk. Bulletin by Fred Grant. Agricultural Research Service, USDA. Catalogue No. F976. Available from Supt. of Documents, Washington, D. C. Price 10 cents.

Aluminum package protected Diversol. Brochure available from The Diversey Corporation, 1820 Roscoe Street, Chicago 13, Ill. Dept. JMFT.

Controls for plate pasteurizer. Brochure available from Taylor Instrument Co., Rochester, N. Y. Dept. JMFT. Catalogue No. 500 A.

Effect of high and low vacuum milking machines on udder health and milk removal. Bulletin No. 394. Available from New Mexico Agricultural Experiment Station, State College, New Mexico.

Milk Control Programs of the North Eastern States. 1. Fixing prices paid and charged by dealers. Bulletin available from New York State College Agricultural Experiment Station, Ithaca, N. Y. Bulletin No. 908.

Stimulating corrective health action following school examination. Bulletin available from Pennsylvania Agricultural Experiment Station, University Park, Pa. Bulletin No. 588.

Application of the Coliform test to pasteurized milk and cream. Bulletin available from Vermont Agricultural Experiment Station, Burlington, Vt. Bulletin No. 578.

ERRATUM

In your July issue of the *Journal Milk and Food Technology* it is noted that some mistakes were made in listing the members of the Executive Board of the I. M. S. C. Mr. H. E. Mills of the Washington, District of Columbia, Health Department was listed and according to my information it was Mr. Joseph S. Simms of the District of Columbia Health Department, Arlington, Virginia, who was actually elected. In addition, Mr. J. C. McCaffrey of the Illinois Department of Public Health, Chicago, Illinois, and Mr. Jack Newlin, Inter-State Milk Prod. Coop., Tyrone, Pennsylvania were also elected to this Board. I would appreciate it if you would make this correction in your next edition.

H. L. Hortman, Chairman
National Conference
Interstate Milk Shipments

NICHOLAS POHLIT RECIPIENT OF GENERAL FRED SAFAY MEMORIAL SCHOLARSHIP

The first General Fred A. Safay Memorial Scholarship for advance study of environmental sanitation was presented at the 19th Annual Educational Conference of the National Association of Sanitarians in Boston at the end of August. The recipient was Mr. Nicholas Pohlit, a sanitarian of the Tri-County District Health Department in Aurora, Colorado, and president of the National Association's Colorado Section.

The fund for the $1,500 award given for a year's study was contributed by ten sponsors from industries interested in improving national sanitation standards, with additional funds for administration contributed by two sustaining sponsors.

The sponsors are: Colgate-Palmolive Company, Hobart Manufacturing Company, Klenzade Products, Inc., Lily-Tulip Cup Corp., Linen Supply Association of America, Morse-Boulger Destructor Co., National Biscuit Company, Norris Dispensers, Inc., Steiner

Sales Company, Sterwin Chemicals, Inc. The sustaining sponsors are General Foods Corp. and Wyandotte Chemicals, Inc.

Any active member of the association is eligible for this award, which was established as a memorial to General Fred A. Safay, former association president, who died in 1952. Candidates for the award are judged on the basis of past preparation and service, a written examination, references from their health department superiors and an essay on why they wish to continue their studies in the sanitation field.

General Safay served in Florida as a sanitarian for over 30 years. His last position before his death was Sanitarian Consultant with the Florida State Board of Health. He saw combat in two world wars. In World War II General Safay took part in the Italian invasion with the Florida National Guard, of which he had been senior Major of Infantry prior to its being mobilized for active duty. By the end of the war he had advanced to the rank of brigadier general.

Named as first alternate for the scholarship, was Mr. Alphonse M. Bulliung, Jr., of New Orleans, where he is a sanitarian with the City Health Department. Second alternate was Raymond Ruff of Ontario, Oregon. Mr. Ruff is a sanitarian with the Malheur County, Oregon, Health Department.

LINVILLE J. BUSH ACCEPTS ASSISTANTSHIP AT IOWA STATE COLLEGE

Linville J. Bush, field agent in dairying, at the University of Kentucky has resigned in order that he may continue study for a Ph D. degree.

Mr. Bush has accepted a research assistantship at Iowa State College in the Dairy Husbandry Department. He will work under Dr. N. L. Jacabson.

UNIVERSITY OF KENTUCKY COLLEGE OF AGRICULTURE REVISES CURRICULLA

The University Faculty of the University of Kentucky has approved a rather extensive revision of curriculla of the College of Agriculture and Home Economics including the curriculla of Dairy Production and Dairy Manufacturing.

Both of the Dairy curriculla have been redesigned to give the student a stronger background in basic sciences and to give him opportunity to include more cultural courses in his program. During the freshman year the curriculla are identical. In the following years the curricullum in Dairy Production will include more training in nutrition, breeding, and management.

The Dairy Manufacturing curricullum has been quite radically revised. All individual products courses have been dropped. Basic and theoretical work concerning the products have been conbined on a unitized basis. Practical work and management will be taught on a unitized basis also. At the beginning of their junior year, students will be required to choose one of the following options: general dairy manufacturing, laboratory research, or administration.

The revisions of both curriculla were based upon recommendations made by the American Dairy Association and are considered to be a strengthing of the undergraduate program. Both schedules will be in effect for incoming freshmen this Fall.

WESTERN KENTUCKY MANUFACTURED MILK IMPROVEMENT ASSOCIATION FORMED

Representatives of six western Kentucky dairy firms met with members of the Dairy Section of the University of Kentucky at Bowling Green, Ky., to organize the Western Kentucky Manufactured Milk Improvement Association.

Purpose of the organization will be to further improve the milk quality in that area of the state and to meet and discuss other problems of the dairy industry and dairy producers, J. O. Barkman, Associate Professor of Dairy Manufactures, and W. L. King, Field Agent in Dairying of the University of Kentucky will work with the group in development of a program.

Officers elected by the group were, Chairman, K. F. Dietiker, Pet Milk Co., Bowling Green; Vice Chairman for western section J. B. Jones, Borden Food Products Corp., Hopkinsville; Vice chairman for eastern section, Earl Wilson, Cudahy Packing Co., Hopkinsville, Secretary-Treasurer, Howel Blair, Pet Milk Co., Bowling Green.

Regular meetings are to be held the second Tuesday of each month. The method of financing the work of the organization has been turned over to a finance committee.

MINNESOTA AFFILIATE HOLDS ANNAL EDUCATIONAL MEETINGS MILK BREAKS FEATURED

Minnesota Milk Sanitarians Association held their second annual series of statewide educational meetings July 18, 19, 25 and 26, 1955, at Duluth, Bemidji, Albert Lea and Granite Falls respectively.

Association members, employed by the University of Minnesota, State Departments of Health and

Agriculture, and the Dairy Industry, discussed topics of interest to fieldmen, dairy farmers, plant helpers and management.

The subject matter covered requirements for Grade A milking herds, barns, milk houses and water supplies during the afternoon sessions with special emphasis on proper construction and costs of milk houses.

The evening sessions dealt with fundamentals of cleaning and sanitization followed by a presentation on In-Place Cleaning and Sanitizing.

Total attendance for the four meetings was 339. Arrangements were made by local members with splendid support by industry which provided milk and milk products for the breaks.

Members and guests showed their interest by numerous questions from the floor and expressed their desire for continuance of the series during 1956.

NATIONAL SANITATION FOUNDATION, JOINT COMMITTEES ON 3-A SANITARY STANDARDS FOR DAIRY EQUIPMENT AGREE ON DEMARCATION LINES IN STANDARD WORK

Executive action by National Sanitation Foundation and the Joint Committees on 3-A Sanitary Standards for Dairy Equipment has resulted in agreement as to the areas of responsibility to be assumed by each group in setting sanitary standards for various items of dairy equipment. The official statement of agreement follows:

"The Executive Groups of the Committees on 3-A Sanitary Standards for Dairy Equipment and of the National Sanitation Foundation met in conference, at the Foundation's offices at the University of Michigan, on Friday, June 24 for the purpose of examining lines of demarcation in the preparation of sanitary standards for equipment used in the handling of milk and food. It was recommended that the criterion for determining which organization would handle preparation of standards for a specific item of equipment would be based on which industry has the responsibilty for the sanitation of the surfaces contacted by the dairy products. In other words, it was recommended that where the dairy processing plant is responsible for the sanitation of the dairy products surfaces, the 3-A Sanitary Standards Group would undertake the preparation of the standard; and that where the food handling establishment is responsible for the sanitation of the surfaces contacted by dairy products, the standards would be developed by the National Sanitation Foundation's Joint Committee on Food Equipment Standards.

"It was further recommended that closer liaison should be maintained between the two organizations by interchange of tentative drafts of standards during the formative period of their preparation, where it is evident that there is definite interest of both organizations in the details of the sanitary standards under consideration. Where necessary to achieve an adequate understanding, a conference of representatives of corresponding committees would be called.

"There was complete agreement that both organizations have a common objective in the preparation of effective sanitary standards for equipment used in the food service and dairy fields. Past accomplishments by both serve to point to the necessity of further coverage of such additional items of equipment as have known public health significance."

Those approving the agreement for the various participating organizations were:

E. H. Parfitt and Donald H. Williams, for the Sanitary Subcommittee of Dairy Industry Committee;

John L. Barnhart and G. W. Putnam, for Dairy Industries Supply Association;

John Faulkner, for U. S. Public Health Service;

C. A. Abele, for International Association of Milk and Food Sanitarians;

Walter F. Snyder and Walter D. Tiedeman, for National Sanitation Foundation.

SPECIAL CONVENTIONS ENTERTAINMENT PLANS FOR ST. LOUIS DAIRY MEETINGS ANNOUNCED BY MIF, IAICM, AND DISA

Four glamorous all-dairy-industry evening entertainment events are scheduled during the week of October 23-28 in St. Louis, when the annual conventions of Milk Industry Foundation and International Association of Ice Cream Manufacturers take place, and member firms of Dairy Industries Supply Association gather for supplementary activities.

The glittering line-up of events, planned jointly by the three associations, follows:

Sunday evening, October 23—A "Meet Me In St. Louis" Party, to be held in the Gold Room of the Jefferson Hotel. The setting will be taken from the 1904 World's Fair which was held in St. Louis, light refreshments will be served, and a German band will play for dancing and singing. A special feature will be the appearance of The Apollos, a male singing group of the Missouri Athletic Club.

Tuesday evening, October 25—A States' Dairy Rally and Awards Night, also to be held in the Gold Room of the Jefferson. The scene for this event, which will start with a banquet, is to be a "political-type" convention, at which the candidates to be nominated are students from colleges with teams entered in the Collegiate Students' International Contest in Judging Dairy Products. Executive Secretaries of state and regional associations are already urging "delegations" from their areas to attend the event to support their "favorite sons" (the state's judging team). After a short talk by a "keynoter," awards which include four graduate fellowships, silver cups, and gold, silver and bronze medals will be presented to the winning candidates, with the help of an organist, spotlights, cheers and parades in the traditional convention manner.

Wednesday evening, October 26—A "Rodgers and Hammerstein Festival" to be held at the St. Louis Opera House. Featuring the 85-piece Municipal Opera Orchestra, a 20-voice chorus, and four outstanding soloists, the program will present the great song successes from many of the stage hits of the famed musical team, such as "Oklahoma," "South Pacific," "Carousel," etc.

Thursday or Friday evenings, October 27-28—"Dairy Night at the Chase" to be held in the Chase Club of the Chase Hotel. Special arrangements with the Club's management will provide several unusual entertainment features in recognition of dairy convention week.

In addition to these four evening events, an extensive program of day-time ladies' activities has also been arranged. This includes a bus tour to outstanding St. Louis landmarks, a trip to Grant's Farm, a fashion show luncheon on Wednesday afternoon, and additionally ladies' headquarters will be set up at the three headquarters hotels where ladies can meet, visit, and plan their activities.

The pattern of entertainment cooperation among the three associations was first tried out in 1954 in Atlantic City and proved so successful that it is being repeated for the St. Louis conventions. St. Louis-area industry people have been organized into seven committees, each charged with responsibility for one aspect of the week's activities. These efforts have been guided by an overall Executive Committee of which Karl G. Meyer, Banner Creamery Co., is Chairman, and Arthur F. Kerckhoff, Jr., Pevely Dairy Co., and Carl G. Meyer, Meyer-Blanke Company, are Co-Chairmen.

JOINT COMMITTEES ON 3-A SANITARY STANDARDS TO MEET NOVEMBER 7-9 AT EVANSTON, ILLINOIS; AGENDA CONTAINS WIDE SCOPE TO BE CONSIDERED

A regular semi-annual meeting of the Joint Committees on 3-A Sanitary Standards for Dairy Equipment, to be held November 7-9 at the Georgian Hotel in Evanston, Ill., will feature an agenda covering a wide range of standards for dairy equipment, on which necessary action may be taken.

The Joint Committees are those groups or individuals appointed by International Association of Milk and Food Sanitarians, representing sanitarians; Dairy Industry Committee, representing both users and makers of equipment; and U. S. Public Health Service, which has participated in the program since 1944 in an advisory capacity. Jointly, these bodies promulgate 3-A Sanitary Standards for Dairy Equipment.

Features of the agenda, announced by Dr. E. H. Parfitt, Chairman of the Sanitary Standards Subcommittee of DIC, which by common consent plans the meetings, are:

On Monday, November 7 — In the morning, sanitarians will consider amendments to the existing 3-A Sanitary Standard on Storage Tanks, while the SSS-DIC group will take up amendments to the 3-A Sanitary Standard for Farm Holding and/or Cooling Tanks and a tentative standard on evaporators. At luncheon, the entire group will discuss a report from the sanitarians on their morning's work, as well as a report of an *ad hoc* committee on paper bottle fillers and sealers. In the afternoon, the sanitarians will review amendments to the 3-A Sanitary Standard on Farm Holding and/or Cooling Tanks, and the SSS-DIC group will study the report of an *ad hoc* committee on installation of HTST pasteurizers.

On Tuesday, November 8 — In the morning, the entire group will consider and possibly act on reports from the sanitarians on their deliberations on the Farm Holding and/or Cooling Tanks Standard amendments, and from the SSS-DIC group which considered HTST installation on the day before. Separate luncheons will be held by the sanitarians who will review the standard for separators and clarifiers, and the standard for evaporators; and by the SSS-DIC group which will also review the standard for separators and clarifiers, and which will engage in general discussion. The day will close with a social hour and banquet for all participants.

On Wednesday, November 9 — The entire group will take such action as necessary on five reports from special groups: the Committee for Numbering Standards; the Committee on Check Valves for Milking Machines; the Executive Committee; the Committee on C-I-P Lines for Farms; and the report of the sanitarians on the evaporator standard.

A large attendance of both industry representatives and sanitarians from many parts of the country is expected for the meeting.

CHOCOLATE MILK BEAUTIES – As part of the nation-wide promotion for chocolate milk and dairy chocolate, the Chocolate Milk Research Foundation entertained 100 candidates for Wisconsin's "Alice in Dairyland" title at lunch before preliminary competition in Milwaukee. Two of the lovely entrants, among 30 selected to compete for the title, are Janice Klas, Beaver Dam, Wis., left, and Pamella Lynch, Milwaukee. They are shown above drinking a chocolate milk toast to their success in the contest. The winner will serve for a year as a salaried employee of the Wisconsin Department of Agriculture, promoting dairy products throughout the nation.

DAIRY FIELDMEN AND PLANT OPERATORS CONFERENCES TO BE HELD AT PURDUE

Dates announced by Professor H. W. Gregory, Head, Dairy Department for two dairy meetings at Purdue are: November 29, Fieldmen's Conference; November 30, Dairy Plant Operation Conference. Sessions on bulk handling of milk at farms and plants will be held the afternoon and evening of the Fieldmen's meeting and on the morning of the Plant Operation meeting.

Further information may be obtained by writing: Professor V. C. Manhart, Smith Hall, Purdue University, LaFayette, Indiana.

OKLAHOMA DAIRY CONFERENCE

The annual Dairy Industry Conference will be held at the Short Course Center, Oklahoma A & M College, Stillwater, Oklahoma, November 9, 10, and 11, 1955. The program will include lectures and demonstrations on problems current in the dairy industry.

Further information may be obtained from the Dairy Department, Oklahoma A & M College.

DRIVE LAUNCHED TO PUT UP FOOD IN METAL TUBES

Collapsible Tube Ideal for Paste-Like Foods, Makers Say, And Cite Its Success in Europe

U. S. manufacturers of collapsible metal tubes, one of the oldest and most versatile of containers, have launched a nation-wide campaign to promote the packaging of food in tubes.

Jelly is the first product in the industry-wide ef-

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