VOLUME 17 NO. 5
May, 1954

Journal of

MILK and FOOD TECHNOLOGY

Official Publication

International Association of Milk and Food Sanitarians, Inc.

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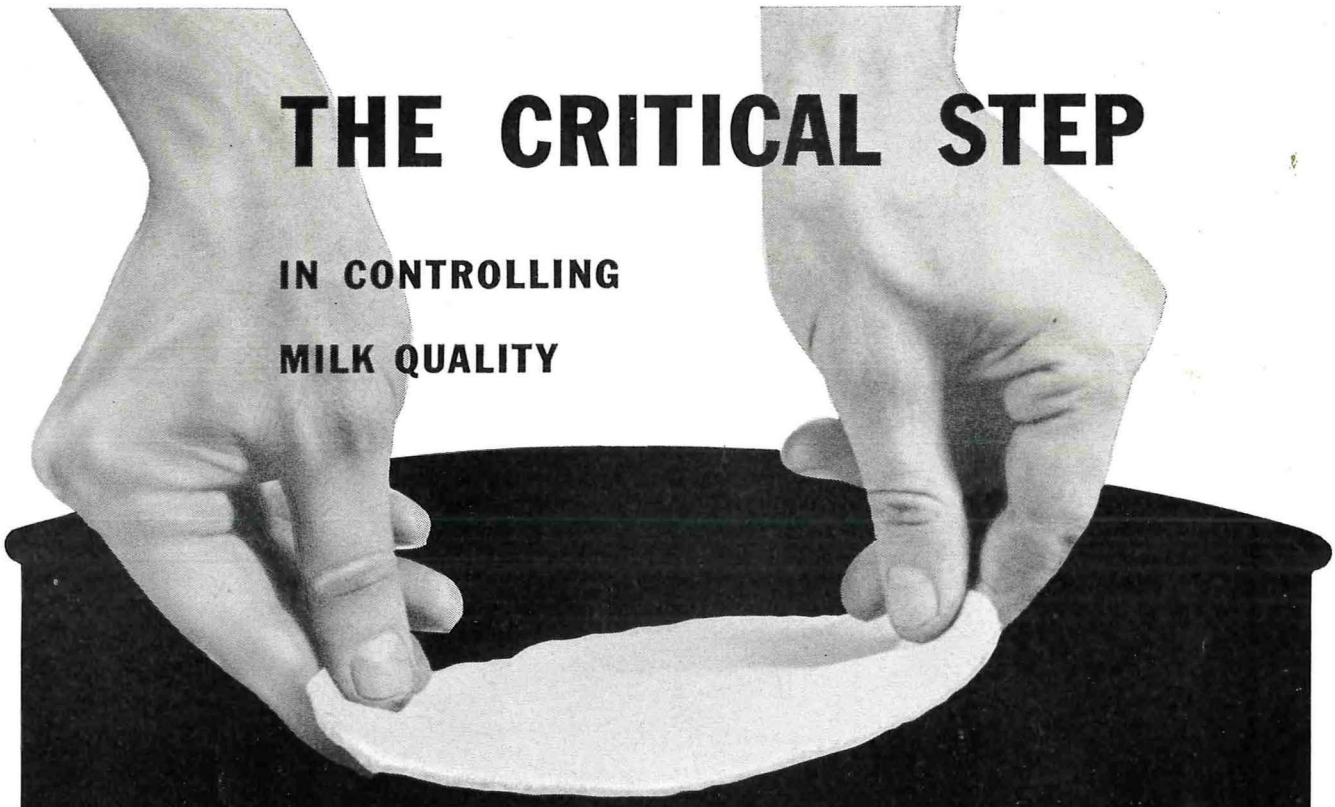

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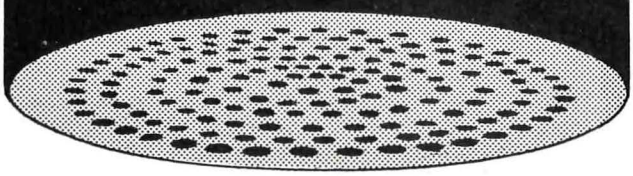

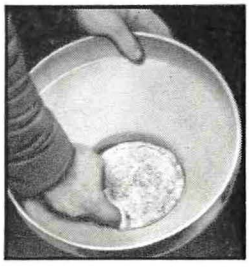

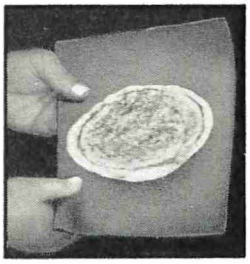

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International Association of Milk and Food Sanitarians, Inc.

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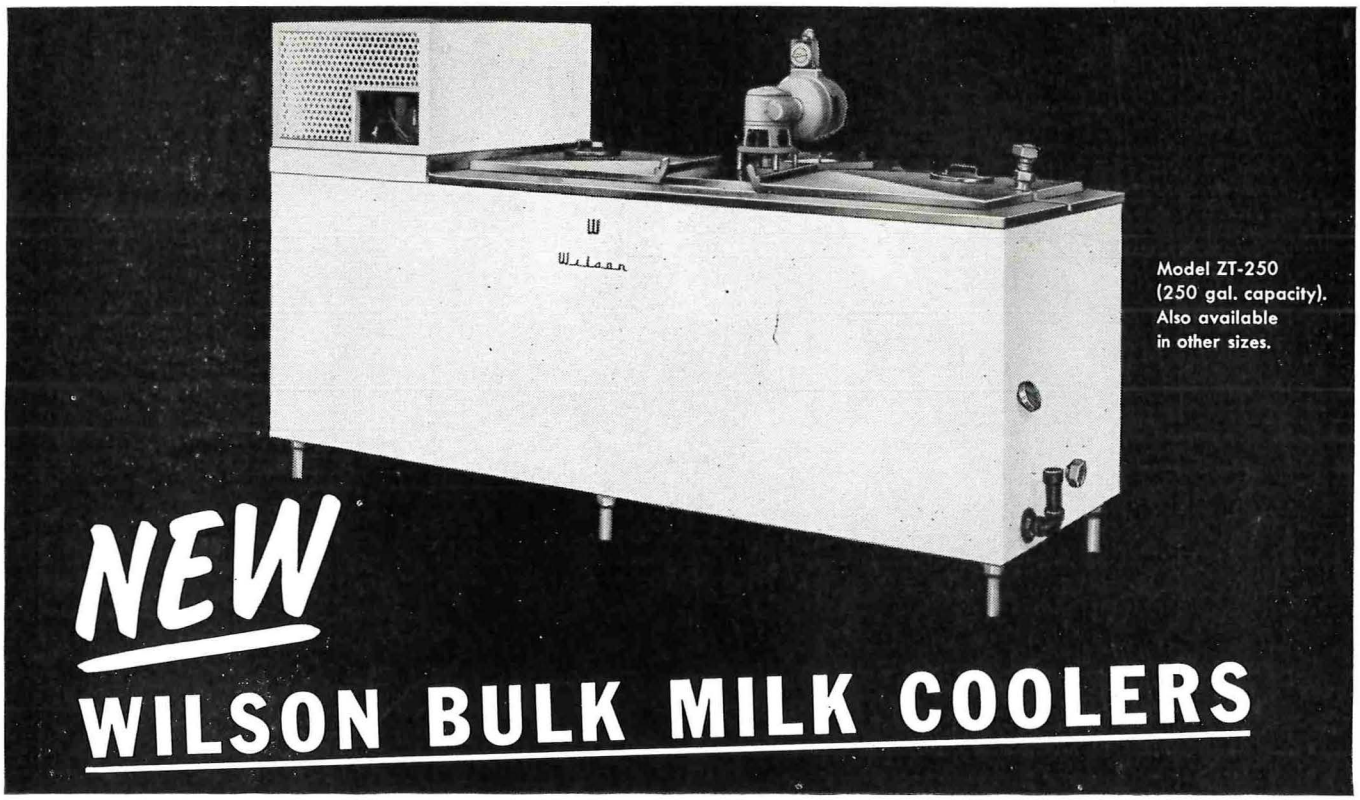

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Editorial Notes

THE REGULATORY YARDSTICK

The accomplishments of a regulatory office are not definitely measurable by any yardstick yet devised since its very nature precludes an analysis of the intangible benefits of which there are many. It is impossible to measure exactly a dollar's worth of enforcement.

In the last analysis and according to the modern conception of law enforcement practices as interpreted by dairy control officials, the index of results is not based on the number of individuals who can be forced to comply with the law against their wills, but rather on the number of individuals who can be made to realize the purpose, necessity, and reasonableness of such and such a regulation to the end that the fullest cooperation will be voluntarily obtained. We have then, compliance in purpose and in fact, in contrast with arbitrary enforcement of the letter of the law. This has not always been the situation. We can recall when results were sought through a liberal use of the big stick applied at the bar of justice, the inspector's efficiency rating being determined by the number of legal scalps he was able to annex to his belt.

Today we have a broader attitude expressed toward law enforcement. We recognize that the best results can be obtained only through the cooperation of all interests involved. This condition has been brought about in a very large measure through the adoption of the policy of tempering law enforcement with service.

As we view the question today there are two types of control problems with which we have to cope. There is the administrative legal problem and there is the trade problem or the technical problem relating particularly to the quality of the raw material or the finished product.

At times there may also be a difference between the law violator and the law evader. The one might be unintentional and accidental, while, in the other case, a studied and determined effort is made to circumvent the law. Fortunately the latter type is a rapidly diminishing minority.

There is a growing realization more and more apparent that regulation is for the protection of all interests concerned. It would seem that the more nearly we can sell industry and the public on this fundamental premise, the easier and more fruitful of results will be our position in the regulatory field.

M. E. McDonald

41st Annual Meeting
INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS
Atlantic City, N. J., Oct. 21 - 23, 1954

The 41st Annual Meeting of the International Association of Milk and Food Sanitarians, Inc., will be held at the Hotel Morton, Atlantic City, New Jersey, October 21, 22, and 23, 1954.

The Program Committee, consisting of Harold S. Adams of Indiana, Ivan Van Nortwick of Kansas, Howard Wilkowske of Florida, and Ivan E. Parkin, Chairman, of Pennsylvania, have worked hard to develop an outstanding program of current interest to both the milk and food sanitarians, and to secure eminently qualified speakers.

The speakers whose talks will high-light our General Sessions are the Honorable Miles Horst, Secretary of Agriculture of the Commonwealth of Pennsylvania; Norman Myrick, Editor of the *American Milk Review;* Ernest Kellog, Secretary of the Milk Industry Foundation; J. Roger Deas, Public Relations Expert of the American Can Company; N. A. Milone, Resident Lecturer of the School of Public Health, University of Michigan; and W. A. Wentworth of the Borden Company.

Among the topics on which papers will be presented during the separate Milk Section and Food Section program sessions are: the relationship of psychrophilic, thermophilic and thermoduric bacteria to the quality of milk; chemical additives to food; pipeline milker operation; poultry sanitation of meats; bulk milk dispensers; dishwashing machines; brucellosis; and food poisoning. Complete details on the 1954 program will be published in an early issue of this Journal.

Plan to attend the 41st Annual Meeting. Remember also that the Dairy Industry Exposition will be held in Atlantic City, October 25-30, 1954. Remember the dates—October 21, 22, and 23, 1954.

John D. Faulkner, *President*
International Association of
Milk and Food Sanitarians

FORTY-FIRST ANNUAL MEETING
HOTEL MORTON — ATLANTIC CITY, N.J., OCT. 21-23, 1954

EFFECT OF ADDED HYPOCHLORITE ON DETERGENT ACTIVITY OF ALKALINE SOLUTIONS IN RECIRCULATION CLEANING* **

D. R. MacGregor, P. R. Elliker and G. A. Richardson
Oregon Agricultural Experiment Station, Corvallis, Oregon

A laboratory apparatus was designed to simulate commonly encountered recirculation cleaning conditions. Cleaning efficiency was determined by visual examination of stainless steel strips coated with synthetic milkstone.

It was found that varying concentrations up to 100 ppm of sodium hypochlorite, added to three representative cleaners, significantly increased their cleaning efficiency. The increased cleaning efficiency is possibly due to the solubilizing action of the hypochlorite on the protein fraction of the soil.

Numerous dairy plants throughout the country during recent years have followed the practice of adding small quanties of hypochlorite to detergent solutions employed for recirculation cleaning. Field observations frequently have substantiated the report that concentrations of available chlorine in the range of 25 to 100 ppm appeared to aid in removal of milk soil from metal surfaces. This investigation represents a series of laboratory experiments to determine the effect of added hypochlorite on detergent activity of alkaline cleaning solutions.

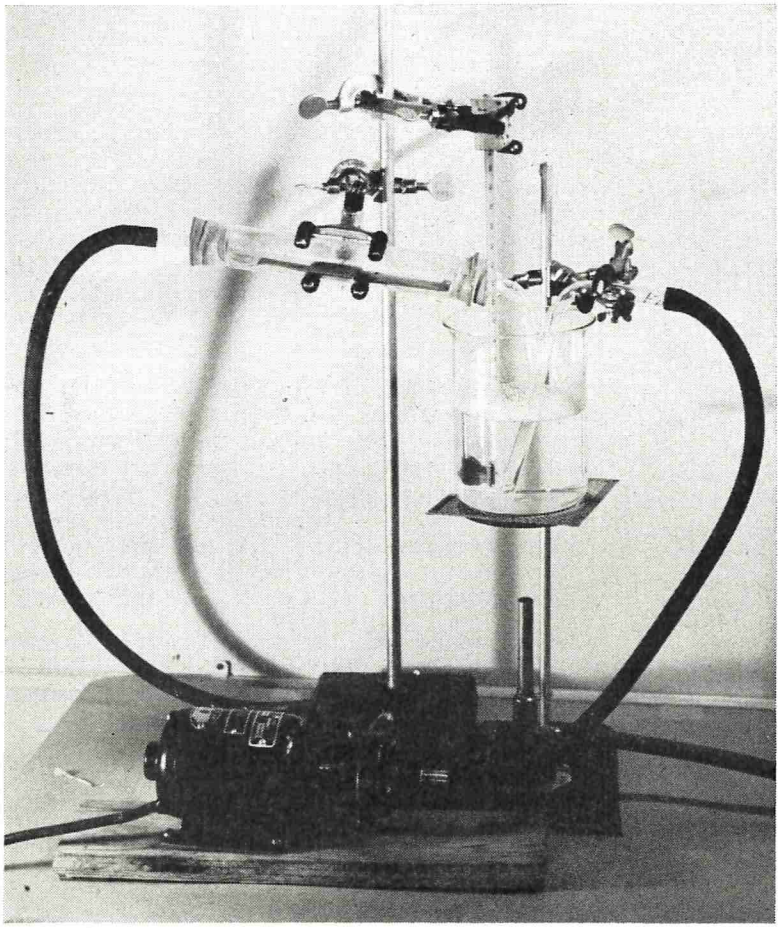
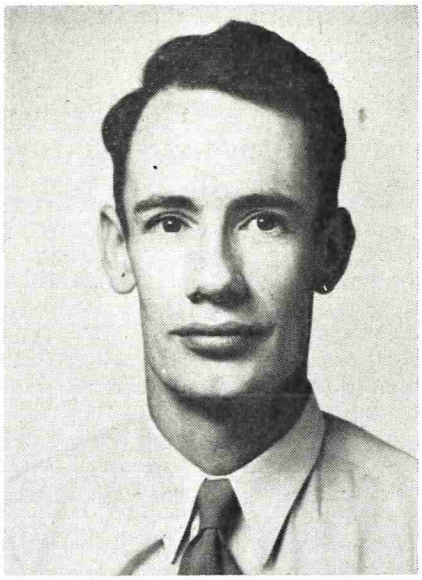


Figure 1—Laboratory recirculation cleaning unit. Stainless steel strips are exposed to flowing solution in glass tube at top of unit.



D. R. MacGregor served in the Royal Canadian Volunteer Reserve (active service) 1943-45. He attended the University of British Columbia and received a B.S.A. in May, 1950. He continued graduate studies at Oregon State College, receiving an M.S. in 1952, and is now research assistant in the Oregon State Agricultural Experiment Station. He is a member of Sigma Xi research honorary.

Experimental

In order to simulate recirculation or in-place cleaning conditions, apparatus (figure 1) was constructed in the laboratory to provide desired controlled solution temperatures, detergent concentration, rate of flow and cleaning time. With the pump used (6 gallons per minute) a maximum flow velocity of 3 feet per second in the cleaning chamber was obtained, and after preliminary trials, this speed was used throughout. The temperature used was 71° C (160° F). Cleaning efficiency was tested by visual examination of the one by three-inch stainless steel strips on which a synthetic milkstone had been deposited.

The synthetic milkstone used to coat the strips was made by thoroughly mixing 1 g. $CaCO_3$ and 1 g. $CaHPO_4.2H_2O$ with 25 g. spray-dried skim milk powder, adding water, and stirring thoroughly to form a smooth, fairly stiff paste. A thin film of this paste was spread on strips which were autoclaved for 25 minutes. After autoclaving, drying of the strips was prevented by storing in a covered dish containing a piece of wet cloth. The composition of a soil film deposited on dairy equipment varies widely according to nature and volume of product processed, temperature differen-

*Approved for publication as Technical Paper No. 805 by the Director of the Oregon Agricultural Experiment Station. Contribution of the Departments of Bacteriology and Dairy Husbandry.

**This work was supported in part by grant from Klenzade Products, Inc.

TABLE 1—RESIDUAL CHLORINE IN RECIRCULATION CLEANING SOLUTIONS

Units cleaned	Time interval after addition of hypochlorite*	Chlorine remaining in cleaning solution
	minutes	*ppm*
Raw, cold milk lines	0	40
	5	30
	10	30
	15	20
	30	10
Pasteurized, cold milk lines	0	25
	5	25
	10	20
	15	20
	30	20
Pasteurized, cold milk lines	0	60
	5	50
	10	50
	15	50
	30	40
HTST pasteurizer	0	65
	5	10
	10	10
	15	10
	30	5
HTST pasteurizer	0	180
	5	
	10	130
	15	125
	30	120

*Cleaning of units was started immediately after addition of hypochlorite to alkaline cleaning solution.

tials, physical nature of surface, and rate of flow and turbulence. The composition of the synthetic material deposited on the stainless steel strips in this study undoubtedly differed somewhat in composition from the various types of dairy soils. It appeared most suitable for test purposes from the standpoint of adhesive and cleaning properties as well as the reproducibility of several combinations studied.

A standard cleaning procedure was established in which the strips were washed for 10 minutes with 1 percent by weight of an organic acid detergent containing wetting agent, rinsed with water, and washed for a further 10 minutes with a 1 percent by weight solution of alkaline detergent preparation plus various concentrations of sodium hypochlorite. The strips then were given a final water rinse and examined. A 10-minute cleaning period was selected for experimental purposes because preliminary tests indicated that the amount of soil remaining at the end of 10 minutes was not significantly reduced by a cleaning period of 20 or 30 minutes. Similar observations have been made in some plant recirculation operations; however, for various reasons, the short cleaning period probably would be insufficient for plant conditions.

Three alkaline cleaners representing types employed for recirculation cleaning were tested in manner described. Cleaner A contained 75 percent soda ash, 13 percent caustic soda, 7 percent sodium orthosilicate, and 5 percent sodium tetraphosphate. Cleaner B contained 12 percent soda ash, 15 percent caustic soda, 30 percent sodium metasilicate, 20 percent sodium tripolyphosphate, 20 percent tetrasodium pyrophosphate, 2 percent anionic and 1 percent nonionic wetting agent. Cleaner C, a widely used commercial preparation resembled cleaner B, except that it contained less soda ash and a slightly greater concentration of wetting agents. Results presented in this paper were obtained with cleaner C and are representative of results obtained with the other cleaners tested.

Results shown in figure 2 definitely indicated that incorporation of hypochlorites in an alkaline cleaner aids in the removal of milk solids deposit. Where cleaning was not complete, a swollen light brown, somewhat transparent, gelatinous film was left on the strip. A sample of this gelatinous material was scraped from the strip and dried to constant weight at 105° C. A nitrogen analysis of the dried material by the micro-Kjeldahl method showed it to be 80 percent protein using the basis of N x 6.38. It is possible that the true protein content may have been higher since ammonia might be lost by the high pH and temperature treatment which would tend to give a low value for the protein.

The data in table 1, obtained in a commercial recirculation operation,, indicate that there is a significant lowering of the residual chlorine, as determined by thiosulfate titration, during a 30-minute alkaline cleaning period. The reduction in chlorine appeared to be proportionate to the quantity of milk solids picked up by washing solutions in the different systems cleaned. In every instance with the systems used here, there was some residual chlorine remaining at the end of the cleaning cycle. It has been postulated[3] that amino acids and proteins may form unstable chloramino derivatives which would titrate as free chlorine with thiosulfate. This reaction possibly may increase the apparent residual chlorine in the wash solution. The higher chlorine demand by the HTST unit is explained by the presence of relatively heavy milk solids deposits on the plates of the pasteurizer.

DISCUSSION

The results suggest action of the hypochlorite may be due to protein solubilization. Other workers have shown that protein reacts with hypochlorites with the evolution of nitrogen and carbon dioxide and these reactions are paralleled by an increase in solubility[1]. The reaction occurs within 30 minutes at room temperature for most proteins although the reaction of different proteins varies[2]. Wright[3] in studies on the reactions of amino acids and proteins with hypochlorite, found that the type of reaction occuring depends on the pH. At low pH levels glycine removed hypochlorite by the formation of a chlorinated addition product; at high pH it was removed by oxidation of the glycine. Cystine was oxidized at

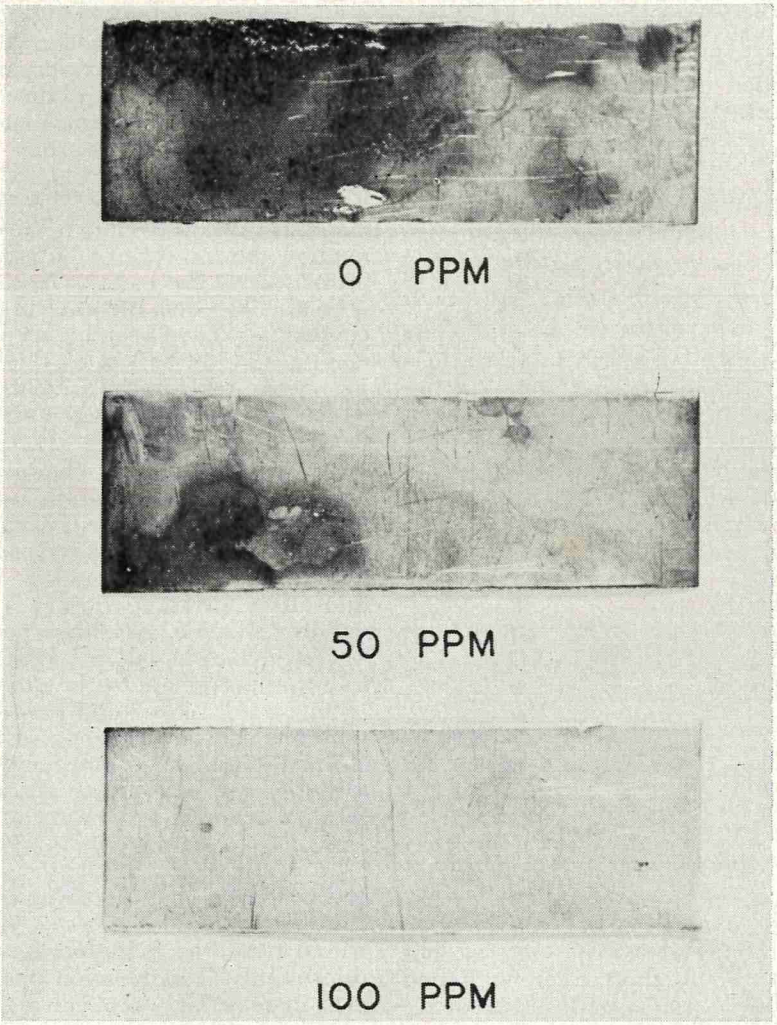


Figure 2—Residue of milkstone film remaining on stainless steel strips after cleaning with alkaline detergent containing 0, 50, and 100 ppm, respectively, of added available chlorine.

pH 12.5 with the formation of polysulfide decomposition products which gave the solution a straw yellow color. At pH 12.5 low concentrations of gelatin and casein removed all chlorine and, with the addition of more protein, the chlorine rose to about 35 percent of the original. Wright could give no explanation for this phenomenon. The compounds formed at low pH were considered chloramino derivatives of amino acids and proteins and, at high pH, oxidation products, possibly including cyanides, were formed.

Baker[4] in a study of the effect of hypochlorite on solutions of egg albumin showed that hypochlorite caused extensive rupture of the protein molecule. In one experiment for one mole (74.45 g) of sodium hypochlorite that was reduced, 33.7 g of albumin were rendered nonprecipitable by phosphotungstic acid, and the remaining 22.5 g of the sample were rendered non-precipitable by trichloracetic acid. He calculated that 2.9 molecules of NaOCl were reduced for each peptide link broken.

Since a relatively small amount of degradation may increase protein solubility very markedly, the probable mechanism of hypochlorite action is a degradation of the protein resulting in increased solubility and therefore more effective removal of milk deposits.

The possibility of corrosion of equipment caused by incorporation of hypochlorite in cleaners used at high temperatures should not be overlooked. Laboratory tests and field observations are necessary to establish whether undue corrosion of pumps, pipelines and other parts of the system is likely to occur. Under any circumstances no more than the minimum concentration of hypochlorite needed for effective cleaning should be employed.

Summary

Laboratory tests have shown that incorporation of 25 to 100 ppm sodium hypochlorite in certain alkaline detergent solutions significantly aided in the removal of milk soil from metal surfaces using recirculation cleaning methods.

Analysis of milk soil deposits suggests that the chlorine exerts its effect in the detergent solution by acting on milk protein.

Acknowledgement

Acknowledgement is due R. W. Stachwick, Damascus Milk Company, Portland, Oregon, who kindly obtained data on residual chlorine in commercial recirculation cleaning units.

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NEW SCHOLARSHIP AWARDS MADE BY AMERICAN CAN CO.

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THE NATIONAL RESEARCH COUNCIL'S REPORT ON A STUDY OF MILK REGULATIONS AND SANITARY MILK CONTROL*

HAROLD S. ADAMS*
Assistant Professor of Public Health, Indiana Univresity Medical School Indianapolis, Indiana

This article reports upon research performed under the direction of the Committee on Milk Production Distribution and Quality of the National Research Council. The purpose of this research was to study the effect of milk regulations and their enforcement on the sanitary quality of milk. Eight large American city milk supplies were studied in detail. The field work included an inspection of a representative group of farms and milk plants and the examination of milk samples representative of each supply. Certain regulations governing the production and handling of milk were found to be definitely reflected in the bacteriological quality of both the raw and finished product. Several significant conclusions are drawn which should be of particular value to those engaged in milk control work.

BACKGROUND FOR THE STUDY

In March, 1953, a study was completed and published which represents the most comprehensive and detailed report on fluid milk quality ever undertaken in this country. This Report entitled, "Sanitary Milk Control and Its Relation to The Sanitary, Nutritive and Other Qualities of Milk," was the culmination of some thirty months of investigation, research, and field observation of the fluid milk supply of eight large cities in this country. The extensiveness of this research can best be appreciated when one studies the final report which contains 130 pages of printed text, 91 tables, 11 graphs, and an appendix of forms and questionnaires. Undoubtedly many of you have already seen this report and can appreciate the detail which it contains.

The entire project for this study of milk regulations in relation to milk quality was carried on under the direction of the Committee on Milk Production, Distribution and Quality of the National Research Council. This Committee was instrumental in obtaining funds for the project through the Federal Research and Marketing Act of 1946. The National Research Council was then selected as the agency to administer the work and a contractual agreement was entered into between the Council and the Dairy Branch of The Production and Marketing Administration of the U. S. Department of Agriculture. The contract prescribed certain procedures and placed a budgetary as well as a time limitation for the operation and completion of the project. The guiding committee mentioned above was composed of representatives from several interests and included dairy technologists, public health officials, and economists. Dr. W. E. Krauss, Associate Director, Ohio Agricultural Experiment Station, Wooster, Ohio, served as the Committee Chairman.

The original objectives of this Committee were set forth early in its deliberations. These objectives were stated to be:

1. A compilation and analysis of state and municipal laws and regulations concerned with the production, handling, processing, and transportation of fluid milk products.
2. A study of the effect of such statutes and regulations as measured by their administration and enforcement, as well as by actual experimental procedures, on the quality of milk.

The first phase of the project was completed in 1950, and the results were published in July of that year as Bulletin 121 of the National Research Council, under the title, *Sanitary Milk and Ice Cream Legislation in The United States.* The second phase of the project, and by far the most detailed and inclusive, was completed late in 1952 and the final report was printed and ready for distribution in April, 1953. This briefly sets forth some of the background for the work. While other organizational and administrative details could be given, it seems more desirable and pertinent to review with you at this time some of the significant findings and conclusions as a result of this research. My discussion will be confined to these as disclosed by the actual project and by the investigations conducted on the milk supplies of eight selected cities.

Since the basic objective of this research was to study the effect of statutes and regulations upon the quality of milk, it is significant at this point to examine the definition of quality as used in this study. This is the definition: "The attributes of quality in milk are considered to be freedom from disease producing bacteria and toxic substances, freedom from foreign material, low bacterial count, good flavor, satisfactory keeping quality, and high nutritive

Mr. Adams is Assistant Professor of Public Health at Indiana University School of Medicine. During 1949-50 he was on leave of absence from his former position with the Minnesota Department of Health, and was Associate Project Director for the Committee on Milk Production, Distribution and Quality of the National Research Council. His early work in public health was concerned directly with milk control, but over a twenty year period he has held positions in sanitation with county, municipal, state, and federal health departments. He is the author of the text, *Milk and Food Sanitation Practice.* He is presently Second Vice-President of the IAMFS.

*Presented at 40th Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., East Lansing, Mich., Sept. 1-3, 1953.

*This study was sponsored and supervised by the Committee on Milk Production, Distribution and Quality of the Agricultural Board and the Food and Nutrition Board of The National Research Council. Dr. A. C. Dahlberg was project director and M. E. Held and the writer were associate directors. The final report was jointly authored by those named.

value. All of the factors covered by this definition were investigated in the course of the extensive laboratory work conducted throughout the experiment, except that the milk was not examined for the actual presence of pathogenic organisms or toxic substances.

The cities which were studied were selected for definite and predetermined reasons. The first consideration was the population, since the contract called for these studies to be conducted in cities having a 1940 population of at least 100,000. Geographic location, importance of dairying in the area, possible variations in milk production methods due to climatic conditions, also were considered in making the selection. The type of milk ordinance was also considered in selecting the study cities. A study of local milk ordinances which had been previously made, placed them in three different categories: (1) those which followed closely state laws; (2) those which were basically local in character, and (3) those modeled after or following closely, the *Milk Ordinance and Code Recommended by the U.S. Public Health Service.* Cities representative of all three types were included in the study. The following are the eight cities which were chosen: Birmingham, Alabama; Boston, Massachusetts; Houston, Texas; Louisville, Kentucky; Minneapolis, Minnesota; Rochester, New York; Sacramento, California; and Washington, D.C. In the case of Minneapolis, this city milk supply was studied both in winter and summer to show the possible effects of climatic conditions on the quality of the milk supply and on the enforcement of regulations. The seasonal study in Minneapolis did disclose some differences and some of these will be brought out later on in this discussion.

The investigations were conducted strictly on the basis of original research and field study. No local records of dairy farm or milk plant conditions were used, nor were laboratory reports on the bacterial quality of the milk consulted. Original investigations of farms and plants were made on a basis of random selection. All milk samples were examined at a central laboratory, or were tested locally by a bacteriologist who was a member of the field survey team.

So much in the way of a brief introductory background, but as you will readily understand, a discussion of the plan of the investigation, laboratory arrangements, shipment of samples, selection of milk plants and dairy farms, and the gathering of other supplementary information could be given if time permitted. However, for those desiring these particulars, information can be obtained directly from the final report.

SOME RESULTS OF THE STUDY

Mastitis Control

In reporting some of the results let us first begin with the source of the milk, the dairy cow. While no attempt was made to evaluate the health of dairy animals other than by observation and by inquiry concerning tuberculosis, brucellosis, and mastitis control, it was found that the milk in one market, Rochester, New York, showed a lower leucocyte count than the milk of any of the other markets. If it is accepted that a cell count of less than one million per ml is satisfactory, the supply of Rochester was well below this standard, and averaged 262,000 per ml, while the average cell count of the milk of all cities was 680,000 per ml. One factor in reconciling the difference between the average cell count and that of the Rochester raw milk supply was a state-wide mastitis eradication program which had been active in the State of New York for a number of years. Nine veterinarians were employed full time on this problem by the College of Veterinary Medicine, Cornell University, and six mastitis diagnostic laboratories were being operated under this program. The active program carried on in New York State undoubtedly influenced the cell count of the Rochester milk, although the low leucocyte count did not influence the bacterial count of the milk and any effect was minor in relation to the importance of other factors.

Coliform Count of Raw Milk

Another fact of interest involves the coliform count of raw milk. While no city made coliform counts or had any standard for the number of coliform bacteria in raw milk, it was decided that examinations would be made for survey purposes to determine the situation. The frequency distribution data show that the raw milk delivered to plants in Louisville, Minneapolis in the summer, Rochester, and Sacramento, had some coliform counts over 100,000 per ml. The average coliform count on all raw milk samples was 5800. Raw milk of Birmingham, Alabama, had the exceptionally low count of 111. The coliform count of raw milk in the Washington, D. C. market also was low. In both of these markets much attention was given to the cleanliness of the flanks and udders of cows, and this appeared to be an important factor in these low counts. In Birmingham, udder washing was done under a stream of water prior to milking, and in the Washington, D. C. market rather rigid requirements applied to the washing and wiping of the udder of each cow with an individual towel which had been moistened in a germicidal solution; in fact, a separate towel was required for washing and for drying the udder of each cow prior to milking. While there are other factors contributory to a low coliform count, such as the cleanliness of utensils and the prompt cooling and holding of milk at a low temperature, it would appear that in the case of the two markets mentioned, attention to udder cleanliness did have a marked influence on the coliform count of the raw milk.

Cleanliness of Dairy Utensils

The physical cleanliness of dairy utensils with which milk came in contact, was scored during the course of the field investigations of representative producing farms on each milk shed. Boston and Rochester were the only two cities where milk utensils of less than half, actually 46 and 44 percent respectively, of the producers inspected were considered to be satisfactorily clean. In relation to the cleanliness of milk utensils, it is interesting to note that the milk ordinances of the cities of Boston and Rochester did not require two compartment wash vats and hot water heating facilities in the milk house, though in both markets it was found that some producers had, of their own volition, installed such equipment. As would be expected, there was a direct correlation between cleanliness of milk utensils and the bacteria count of milk. When the rating of milk utensil cleanliness at the farm was between 80 and 90 percent, the bacterial count of

the raw milk averaged between 100 and 200,000 per ml, and 1500 to 3000 per ml on the pasteurized milk. Conversely when utensil cleanliness as judged by physical inspection rated between 60 and 70 percent, the bacteria counts on raw milk were approximately 500,000 per ml, and this likewise was reflected in the higher counts on the pasteurized product.

While the argument for and against necessity for providing washing facilities in the milk house is not as heated as it was in the past, this study definitely showed that the bacterial count of raw milk produced in two cities where this was not an ordinance requirement, had a higher bacteria count than in the other cities where such facilities were mandatory. It can therefore be concluded that since the bacterial quality of milk was adversely affected, there is reason to justify ordinance requirements for proper milk house facilities for the washing and disinfecting of utensils.

A similar situation was repeated when the cleaning and bactericidal treatment of milking machines were considered. Birmingham enforced complete disassembling and washing of the milker after each milking, and rubber parts were then stored in a lye solution. Complete disassembling was also required in the Washington, D. C. market, followed by immersion in water at 180°F. Sacramento likewise required complete disassembling, but allowed the use of either heat or any suitable chemical germicide. Each of these cities received the highest rating on milking machines and utensil cleanliness. This was reflected in the bacteriological condition of the milk since these three cities had a logarithmic average bacterial count of 180,000, 151,000 and 82,000 respectively, which was considerably lower than the average count for milk of the other study cities.

Size of Farm and Bacterial Quality of Milk

Another interesting fact disclosed by this study relates to the correlation between the bacterial quality of milk and the size of the dairy farm where it is produced. We have all heard arguments that the small producer can produce milk as well as the large one, and in some instances this may be true, but under actual conditions the reverse has been shown to be the case. In this study the cities were arranged in three groups according to the average number of gallons of milk delivered from each farm daily. It should be emphasized that it was the cities that were classified according to the average number of gallons of milk sold daily from each farm, but no attempt was made to study the quality of milk of individual producers in each market. In four cities the dairy farms produced an average of 60 gallons of milk or less per day; in two cities from 61 to 100 gallons, and in three cities the average was 100 gallons or over. As the average size of the dairy farm increased, the average bacteria count of the milk decreased. Standard plate counts on the raw milk averaged 458,000 per ml for the group of cities with small dairies; 370,000 for the group of cities with medium sized dairies, and 120,000 for cities having the larger dairies. The same relationship held true for pasteurized milk as the standard plate counts averaged 8600 per ml for cities with small producers; 6200 for cities with medium size producers, and 2200 for the cities with the larger dairies. We cannot, however, say categorically that because a farmer produces a large quantity of milk, his bacterial counts will always be low for there are some other factors to be considered. Assuming equal contamination in the equipment such as the milking machine, the more milk produced per milking the less bacterial contamination per ml of milk. It is a simple problem of dilution. Also, sanitarians can inspect a few large dairies easier and more effectively than a large number of small ones. Then too, the large dairyman has such extensive investments, and his income from milk sales is so much, that he is more likely to provide more adequate facilities and pay closer attention to milk quality.

Effect of Cooling

A graphic example of the importance of properly cooling and holding milk was demonstrated in the Minneapolis market. As was mentioned earlier, the Minneapolis supply was studied both in summer and in winter. This city has an ordinance which establishes the bacterial standard for milk prior to pasteurization, at 200,000 per ml or less. The best compliance with this standard was shown by Minneapolis in the winter when 86 percent of the samples examined fell within this standard. However, on this same market, and from approximately the same producers, only 9 percent of the milk shipped to Minneapolis in the summer complied with this standard. In other markets studied, with the exception of Minneapolis, practically all of the milk was cooled by mechanical refrigeration, but in Minneapolis only 52 percent of all farms had mechanical refrigeration and the balance used running water for cooling. In the summer the cooling water on the farm was too warm so the night's milk arrived at an average temperature of 58 degrees, which was not sufficiently low to prevent rapid bacterial growth. The influence of cooling was noticeably demonstrated in the Minneapolis market when the average counts for the raw milk in winter were 112,000 per ml. Then when the warmer weather arrived and the cooling water warmed, the bacteria count soared to 647,000 on the raw milk. This increase was also reflected in the pasteurized milk when the average standard plate count for milk in the winter was 2,000 compared with an average of 13,700 per ml in the summer.

As further evidence of the importance of adequate cooling the two cities of Sacramento and Washington both had milk cooled by surface tubular coolers. Sacramento stored all cooled milk in walk-in refrigerators or insulated bulk milk storage tanks, and in Washington 18 percent of the producers had walk-in refrigerators. From these facts one would expect bacterial counts of milk in Sacramento and Washington to be low, and it was found to be true. Average counts for these two cities were 83,000 to 151,000 respectively on the raw milk, and 1100 to 4,000 on the pasteurized milk.

A similar significant correlation between cooling and total bacteria counts of raw milk can be drawn from the study of the Houston milk supply. Cooling in Houston was a close second to cooling in Minneapolis in the summer since 60 percent of Houston's milk supply arrived at milk plants above 50 degrees. This however, was not a violation of their ordinance, but was reflected in the total average bac-

teria count of milk from this market where the logarithmic average of standard plate counts showed 350,000 per ml even in face of the fact that the general sanitary conditions on dairy farms of Houston ranked high. It is obvious therefore, that even with good sanitary practices on the farm, cooling and holding milk at a low temperature is a requisite for low count milk.

Bacterial Standards

In arriving at a bacterial standard and at regulations for the production and processing of milk there is a basic thought that is often overlooked. This idea is that the consumer is entitled to and should have a milk supply produced and processed under conditions that would meet with his approval. It is not only a question of the production of a safe, wholesome milk supply. Such milk might be produced under far less sanitary conditions than now exist on the majority of dairy farms approved for city milk supplies, and this is the situation in many countries. Milk should be produced and processed under conditions which, if observed, would be satisfactory to the consumer and would encourage consumption. There is no necessity of producing milk under such excellent sanitary conditions that the producer bears expenses for special features in which the customer has no interest. Certainly, milk sanitarians ought not advance standards far beyond the appreciation of the public and the requirements for a safe, wholesome milk supply.

This study did not reveal any public health reason for the variation which existed in bacterial standards for milk. The range in maximum bacterial standards for raw milk was from 75,000 per ml in Sacramento to 400,000 per ml in Boston. In the raw milk examined in this study, bacteria within any of the legal standards did not produce chemical changes of any detectable quantity as measured by acidity of and organoleptic tests on the pasteurized milk. The number of bacteria in raw milk was an indirect measure of farm sanitation. Low bacterial numbers were generally found in milk that was handled in properly sanitized utensils and that was efficiently cooled. In some instances the condition of the udder of the cow may be a factor in affecting bacterial counts, but this study did not include obtaining data to determine the relationship of infected udders to bacterial counts.

There is no reason from the standpoint of either the producer or the consumer to enforce continually lower and lower bacterial standards without public health justification. Instead, standards should be established and adhered to even though producers become so proficient and well equipped that the standards are easily met. The best that the dairy farmer can do is to keep the milk as good as it was when it was drawn from the cow; and the best that the milk processor can do is to keep the milk as good as it was when the producer delivered it to the plant, combined with the merits in safety, reduced bacterial numbers, and improved keeping quality imparted to it by pasteurization.

This research has not established a standard for maximum bacterial numbers in raw milk of good quality for pasteurization. There is no exact figure that will divide milk into two classes on the basis of sanitary quality of public health significance. The most prevalent standard, a maximum bacterial count of 200,000 per ml for raw milk as received at the plant from the producer, is accepted as satisfactory. Experience has shown that this standard can be readily attained with reasonable facilities and good methods of production. However, as only half of the milk tested in this study complied with this standard, it could be rigidly enforced only by increased activity to insure better sanitary practices in some of the markets studied. In most instances, the buildings and equipment were adequate so the principal problem was improvement of methods on farms producing milk of high bacterial content.

Relation of Regulations To Quality of Raw Milk

This study shows that milk produced on farms under the most extensive, detailed sanitary regulations rigidly enforced possessed the best sanitary quality as judged by the usual bacterial tests. Low bacterial counts were associated with good sanitary practices and proper cooling of milk on the farm. This was true for the total numbers of bacteria and also for the numbers of coliform bacteria. The sanitation program and milk of the three cities which illustrated this situation particularly well were Birmingham, Sacramento, and Washington. However, even in these three cities, the same good quality of raw milk probably would have been obtained if most of the unusual farm requirements, mentioned in this report, were not required in the sanitation laws. Low bacterial counts generally signify that the utensils have been properly sanitized and the milk has been well cooled. It may be true that unusually detailed requirements may simplify the inspection work of the health department and make it easier to assure milk of highest quality, but the important consideration is the value of the regulations in making it convenient and probable that the dairyman will produce milk of high sanitary quality.

Surely, one could not expect research to show any relationship between the quality of milk and such regulations as the cow yard or the milk house being a specified distance from the barn, the exact dimensions of barns and milk house, the means used for the efficient cooling of milk, having the milk flow through a sanitary pipe line into the milk house, and one selected procedure for sanitizing milking machines and other utensils. The problem of sanitary laws is to include only essentials as requirements, so that they may be rigidly enforced.

It may be that there should be details of practice which health departments would recommend but not require. Too much emphasis was placed upon such items as size and kind of walkways, construction features for milk houses, method of hay and feed storage, separation of the milk house from milking barn, and similar details which have no proved significance as far as sanitary milk production is concerned. Plans for barns and milk houses are unquestionably useful for the producer who is constructing new buildings or remodeling old structures. Such plans are conducive to uniformity, approval by sanitarians, and may make the dairy operation easier and more efficient, but it is decidedly doubtful whether a producer who must build to precise specifications would produce better milk than another without them.

It seems that more emphasis

should be placed upon three groups of requirements respecting facilities and practices which are significant in the production of sanitary milk. These essential features of sanitary milk production on farms are:

1. Healthy cows and other factors reducing possibility of presence of pathogenic bacteria, such as fly control, potable water, and sanitary sewage disposal.
2. Clean utensils given proper bactericidal treatment. This condition was associated with clean cows, clean milking barns, and clean milk houses provided with hot water and two-compartment wash vats.
3. Prompt cooling of milk to 50°F or below which was always accomplished by electric refrigeration, except that milk to be pasteurized promptly after production need not be cooled.

Good production practices and essential facilities should be the goal and most particulars of structure and design should be recommendations and not requirements of the sanitary laws. Such emphasis on the important factors of milk sanitation would maintain and improve the measurable quality attributes of milk while reducing the number of requirements which tend to harass dairymen and to restrict the movement of milk between producing areas and new market areas.

Conclusion

An attempt has been made in this paper to highlight some of the findings that appear to be of most interest to milk sanitarians. There is a large volume of material which this paper has not covered. Pasteurization of milk, the condition of pasteurization plants, the chemical composition of milk, keeping quality and the flavor of milk, and its nutritive qualities were extensively investigated in this research but have not been reported here. This research represents some very significant findings and every milk sanitarian should acquaint himself with the report in its entirety. In the writer's judgment, this work has established two fundamental premises which are as follows:

1. The basis for any sanitary milk regulation is the cleanliness, healthfulness, and sanitary protection of milk, and if regulations or requirements are written without scientific proof that they will serve these purposes, then there is no valid reason for them.
2. The second premise established by this study is this. We are not doing as good a job as we should do with the knowledge and tools we presently have at hand. We have fallen short of the goal of selling the dairyman on quality milk production. We have emphasized laws and regulations that theoretically protect the product, but we have not convinced the dairyman that good sanitary practices are just as important as good animal husbandry practices. When sanitation and the production of milk are viewed as a whole and not as separate entities, the validity of this statement will be demonstrated through improved milk quality. We have reached a point in milk control programs where more than physical surroundings and low bacteria counts are the ultimate goals.

RETAIL GROCERS URGE AGGRESSIVE DAIRY MERCHANDIZING

The dairy industry can sell its way out of the surplus problem in 1954 if its products are returned to the competitive market and it does an effective job of advertising, promotion and merchandising, Mrs. Marie Kiefer, secretary-manager of the National Association of Retail Grocers, declared in an address before the 59th annual "Dairy Industry Day" at Iowa State College, Ames, Iowa, on March 23.

Pointing out that the per capita consumption of total milk solids has been decreasing, while at the same time milk production has been increasing, Mrs. Kiefer urged dairymen to go in for aggressive and effective selling. "Dairy products must be purchased by the American consumer," she said, "not exported, stored or allowed to go to waste."

According to Mrs. Kiefer butter is being produced for the subsidy, while margarine is being produced for the market. As of last month there were more than 282 million pounds of butter in Federal storage. She declared that butter is a good example of the harm rigid price supports can do to any industry.

"No one can merchandise,—no one can do a big sales job,—as long as the product is not in a competitive position," she asserted. "Butter prices do not have to be the same per pound as other spreads, but the differential must be less than now existing if it is to be successfully merchandised . . . Butter at 2½ to 3 times the price of margarine will not recapture its former market!"

Mrs. Kiefer further pointed out that the dairy industry has a ready-made distribution organization in the nation's independent retail grocers who handle 64 percent of the total food volume. However, she added, they need ample product information, effective sales material and a consistent advertising program by the dairy industry.

Commending the dairy industry on its $54 million planned promotional expenditure for 1954, Mrs. Kiefer expressed the hope that an adequate percentage would be used for attention-getting displays in food stores to encourage impulse buying.

"Many grocers have thousands of dollars invested in their dairy departments and they expect these departments to earn money for them," she declared. "Many aggressive grocers are promotion-hungry and they're eager to obtain new and unusual ideas to encourage more sales to more customers."

Housewives, she said, do not have enough knowledge of the many effective and wonderful uses to be made of non-fat dry milk solids. There is a big market for this product, she added, but the need is great for more consumer education on uses, cooking suggestions and recipes.

Mrs. Kiefer said that traditionally grocery stores were looked upon as a secondary outlet for fluid milk and ice cream, but that has changed. She predicted that in 1954 food stores will be selling in excess of 58 percent of all ice cream.

In the average store today, she pointed out, dairy sales account for a little more than 8 percent of total volume, and all that added up to slightly less than $4 billion in 1953. Mrs. Kiefer thinks they can do better than that with more promotion and advertising.

IODINE BACTERICIDES IN THE DAIRY INDUSTRY*

N. E. LAZARUS
Lazarus Laboratories, Inc., Buffalo, N.Y., Division West Disinfecting Co.

A new development in dairy sanitation resulting from the combination of elemental iodine with non-ionic surfactants. The latter as carriers provide a solubilizing medium for the elemental iodine which favorably modifies the undesirable properties of iodine. The well-known germicidal efficiency of iodine is retained.

The products, known commercially as IOSAN for dairy farm sanitation, and IOBAC for plant germicidal use, were thoroughly checked by laboratory and field tests to meet federal agencies, and state and municipality health department requirements.

Both products have received a favorable reception by health authorities and the dairy industry.

PROPERTIES OF IODINE

Iodine is a member of the halogen group which includes chlorine, fluorine, and bromine and is the forty-seventh most abundant element in the earth's crust. The most important source of iodine is the Chilean nitrate deposits. It is also present in appreciable quantities in some underground brine and to some extent in sea-water.

Iodine was discovered by a Frenchman, Bernard Courtois, around 1811, during the Napoleonic wars when they were in great need for potassium nitrate required for gun powder.

To conserve the supply of potash, Courtois developed a process of removing the major part of the impurities before conversion to the potassium salt, and in the course of this process, converted the calcium nitrate to the sodium salt by means of crude soda ash, which was obtained from the ashes of seaweed and therefore contained iodine.

Since this discovery, iodine has been an important factor in the advance of chemical science. This importance continues in both the fields of physical and synthetic organic chemistry where iodine and its compounds are finding widespread use in the development of new products and processes. The value of iodine extends even to its modern application with radioactive isotopes.

Many papers have been published concerning the use of iodine as a germicide or bactericide. This has been due mainly to the fact that it fulfills a function that many bactericides do not and cannot perform. Iodine has been used in various forms as a germicide for the skin, wounds, and mucous surface of the body; for sterilization of air and water, and as a prophylatic and therapeutic agent in disease caused by bacteria, viruses, and fungi.

The value of iodine according to voluminous research cannot be questioned wherein it pertains to its germicidal efficacy. Iodine exhibits an inhibiting as well as a lethal action against a wide variety of organisms such as viruses, rikettsia, spores, bacteria, yeasts molds, fungi, protozoa, worm-eggs, larvae, etc.

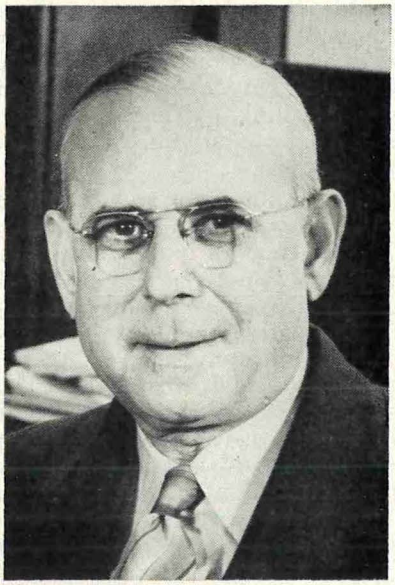
This striking effectiveness of iodine as a germicide is almost nullified by the element's toxicity and corrosive nature and the fact that it is also a strong primary irritant and sensitizer. Furthermore, many organic and inorganic agents are capable of neutralizing the efficacy of iodine.

Until very recently, iodine's defects were accepted on the basis that its virtues far outweighed its faults. But now, as a consequence of research, by Dr. Herman A. Shelanski of Philadelphia, Pa., the whole iodine picture has been changed. It was found that iodine is taken up by high molecular weight surface-active agents and water-soluble polymers and held in some sort of loose chemical combination. These agents are known as carriers and the combination of the iodine and carrier is designated as an iodophor.

The type of synthetic surface active agent that was most effective as an iodophor combination is generally referred to as "non-ionics," particularly the group whose water-solubilizing factor is a polyoxethylene ethanol chain. This represents the water-soluble or hydrophilic group of the molecule and the hydrophobic or water-insoluble group was derived from a fatty acid or a fatty alcohol. The balance of these two groups, one against the other, determines the surface-active properties, particularly the solubility behavior which is determined by the length of the polyoxyethylene chain attached to the water insoluble portion of the molecule.

This carrier provides a solubilizing medium for the iodine and favorably modifies the undesirable properties of iodine creating a "tamed iodine." The vapor pressure is reduced almost to the vanishing point, a prime factor in the stabilizing of iodine. Reactivity is slowed considerably but the reason for this slowdown is not completely clear. It may be due to intermolecular solution, formation of addition compounds, or steric hindrance from the micelles of concentrated carrier solutions. Steric hindrances affect chemical action due to the arrangement of atoms in a molecule. Micelles are units of structure built up from complex molecules in colloids.

Anhydrous solutions of iodophors are stable. In addition, non-ionic solutions containing as much as 25 percent elemental iodine render the



Quality control and sanitation consultant to the Dairy Industry from 1916 to 1947. From 1947 to date, President of the Lazarus Laboratories, Inc., now a Division of West Disinfecting Company of Long Island City.

Author of *Quality Control of Market Milk* and a number of papers on sanitation of milk and dairy products. Developed detergent-sanitizer products for the Dairy Industry.

*Presented at the 40th Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC. East Lansing, Mich., September 1-3, 1953.

halogen soluble in water. The addition of phosphoric acid brings the pH below the isometric point of casein thus preventing dissolution of milk solids and the lime and magnesium salts in hard water.

One explanation for the aqueous solubility is that the iodine dissolves in the micelles of the non-ionic, which themselves are soluble in water. On the basis of experimental evidence, solvation appears to be the mechanism underlying the dissolution of iodine in the micelles. Although this theory may be open to question, the benefits derived from the non-ionic iodophor are indisputable. It gives greater total reactivity as a germicide than equivalent solutions of iodine in alcohol or potassium iodide. It has little or no effect on the skin and does not give a stinging sensation which is the opposite of alcoholic and potassium iodide solutions.

Since the toxicity and sensitizing activities are important factors in any product used in food sanitization, acute oral toxicity test studies were made on white rats and guinea pigs. The iodophor was introduced directly into the stomachs of the animals to insure proper dosage. The acute oral toxicity values were compatible with U. S. Food and Drug requirements. See table 1.

Patch tests studies were made on 200 unselected subjects (100 males and 100 females) to determine the skin irritating effects of this iodine-nonionic halophor. The following conclusions were drawn from these tests:

1. This iodine-nonionic halophor at concentrations above 20 percent is a mild primary irritant.
2. It does not tend to be a sensitizer.

The problem of ascertaining the germicidal strength of the iodophor, regardless of temperature, hardness of water, and organic matter, is very quickly and easily determined. Any person can see at any time and under practically all conditions of use whether germicidally active iodine is present. If the characteristic iodine yellowish color is absent, the germicidal activity is used up. Iodine can also be easily detected as the free element, by the characteristic blue color it gives with starch solution. A very sensitive test for free iodine is the use of 0.1 percent alcoholic solution of alpha-naphthoflavone as the reagent for titrimetric examination and colorimetric analysis. This test readily detects 0.1 ppm.

A test procedure was developed whereby the amount of iodine in the use dilution—initial and residual—can be determined directly in the field. Those plants maintaining laboratories can easily determine the amount of iodine by titration of the solution with sodium thiosulphate or by a simple colorimetric test using chloroform or carbon tetrachloride as indicators which detects 2 to 3 ppm of available iodine.

Obviously, the iodophor presented potentialities for use in dairy farm sanitation and in plants. Shelf life and other factors such as pH and compatability were determined. In the course of our work, it was found that there was a definite synergistic action between the non-ionic carrier and the iodine which enhanced the cleaning phase and increased the germicidal value. The synthetic surface-active agents used in the formulation had the fundamental properties for cleaning, i.e. of wetting, rinsability, emulsification, deflocculation, sequestering, dissolving, and non-corrosion.

TABLE 1—ACUTE ORAL TOXICITY VALUES FOR A SOLUTION OF 10% IODINE AND 90% NONIONIC OF THE ALKYLPHENOXY POLYGLYCOL ETHER TYPE

White Rats		*Guinea Pigs*	
L.D.	0 — 4 cc/kg*	L.D.	0 — 4 cc/kg
L.D.	50 — 4.5 cc/kg	L.D.	50 — 5 cc/kg
L.D.	100 — 6.0 cc/kg	L.D.	100 — 6 cc/kg

*Kilogram per body weight of animal

FIELD TESTS

To evaluate the new product, specifications for a field and laboratory test program were set up with the concurrence of officials of the milk and food sanitation laboratory of the U. S. Environmental Health Center of the U. S. Public Health Service. This test program was conducted under the supervision of the Cleveland Health Department in March, April, and May, 1952.

TABLE 2—SUMMARY OF CLEVELAND FIELD TESTS USING IODINE SANITIZE—DETERGENT-GERMICIDE ON 28 FARMS

Raw Milk	*No. of Farms*	*%*	*Laboratory Past. Milk*	*No. of Farms*	*%*
From 10,000 to 25,000	5	17.86	Under 500	8	28.58
From 25,000 to 50,000	5	17.86	From 500 to 1,000	5	17.86
From 50,000 to 75,000	2	7.14	From 1,000 to 2,500	6	21.42
From 75,000 to 100,000	3	10.72	From 2,500 to 5,000	2	7.14
From 100,000 to 150,000	4	14.28	From 5,000 to 7,500	1	3.57
From 150,000 to 200,000	4	14.28	From 7,500 to 10,000	1	3.57
Over 200,000	5	17.86	Over 10,000	5	17.86
		100.00%			100.00%
Total general average 122,800			Total general average 4,880		

A number of farms were selected in the Cleveland milkshed, most representing the poorest quality of milk supplied, with previously bad records of bacteria counts, and with poor general sanitation records. The only change in the cleaning and sanitizing practice on these farms was the substitution of the iodophor compound for any other type of cleaner and/or sanitizer being used by these producers.

The results of the tests were compiled, tabulated, and evidenced achievement of excellent progress.

TABLE 3—SUMMARY OF FIELD TESTS USING IODINE SANITIZE—DETERGENT-GERMICIDE ON 28 FARMS

Raw Milk	*No. of Farms*	*%*	*Laboratory Past. Milk*	*No. of Farms*	*%*
From 10,000 to 25,000	9	32.15	Under 500	0	
From 25,000 to 50,000	6	21.43	From 500 to 1,000	1	3.56
From 50,000 to 75,000	6	21.43	From 1,000 to 2,500	9	32.15
From 75,000 to 100,000	3	10.71	From 2,500 to 5,000	9	32.15
From 100,000 to 150,000	4	14.28	From 5,000 to 7,500	3	10.71
From 150,000 to 200,000	0		From 7,500 to 10,000	0	
Over 200,000	0		Over 10,000	6	21.43
		100.00%			100.00%
Total general average 53,800			Total general average 7,900		

Forty-five percent of the raw milk counts were under 25,000 per ml—55 percent on laboratory pasteurized under 500 per ml—only 15 percent of the raw counts were over 200,000 per ml, and 10 percent of the laboratory pasteurized over 10,000 per ml. See tables 2 and 3.

Upon investigation by Cleveland Health Department personnel, high counts on raw milk were found to be due to poor cooling of the milk, insufficient water level in storage cooler tanks, and dependence on outdoor temperature; likewise insufficient time contact of utensils with the iodophor use solution. Excessive pasteurized counts were found to be due to poor cleaning technic—lack of brushing of inflations and air hose lines.

Hardness of water on the farms ranged from 2.6 grains to 24.3 grains per gallon as $Ca\ CO_3$. In no instance did the hardness of water affect the germicidal value of the iodophor compound.

An interesting observation was the fact that the use solution had an ample residual of available iodine at the end of the operation.

The producer reaction was unanimous that the iodophor gave excellent cleaning. They also reported no ill effects on utensils, rubbers, and udders. Only three producers reported that they were affected slightly by odor irritation and the cause was found to be due to the use of excessively hot water.

Some of the other comments by producers were to the effect that the compound healed lesions on udders, cuts on hands, left no milkstone residue, kept utensils and milking machines in better condition, was easier to use than previous procedures, and that inflations did not slip off the teats during the milking process.

A similar field test has just been completed in New York State by a large dairy organization under the supervision of the New York City Health Department. The results show 53-1/2 percent of the raw milk counts are under 50,000 per ml and only 14-1/4 percent over 150,000 per ml. Laboratory pasteurized show 79 percent under 7,500 and 21 percent over 10,000.

This test was carried out during the extremely hot weather of July, 1953. Observations by the microscope Breed procedure showed a predominance of lactic acid bacteria. The 28 dairy farms participating in the test are considered better than average producers of milk.

1. Where conditions on the farm were satisfactory both before and after the test period, the use of Iodine detergent-germicide resulted in the maintainance of cleanliness and the improvement of bacterial quality. This group included 7 producers or 25 percent.

2. Where conditions on the farm were not completely satisfactory at the beginning of the test period, and where the use of Iodine detergent-germicide resulted in the improvement of such conditions, the bacterial quality of the milk improved. This group includes 10 producers or 35.6 percent.

3. Where conditions on the farm were unsatisfactory before the test period and where such conditions were more or less found at the end of the period due to poor or improperly cleaned equipment, three of the producers or 10.8 percent showed slight improvement of bacterial quality, 4 or 14.3 percent maintained bacterial quality, and 4 or 14.3 percent became worse.

4. Of the total 28 producers, 20 or 71.4 percent improved bacterial quality and 14.3 percent maintained bacterial quality.

From observation of the equipment at both inspections, the general appearance of milker pails, milker machine parts, and other metal equipment was greatly improved. The film left on equipment that was observed in some cases when powder cleaners or quaternaries were used had disappeared. In many cases milkstone had also been dissolved. The condition of the rubber parts in most cases was improved by the use of Iodine detergent-germicide.

Of the twenty producers on the test program who were personally contacted at the end of the period, all indicated that they liked the product. Such comments were made as "cleans good or better than previous cleaners," "easy on the hands," "easy to use," "easy on the cows' udders," "kills trap odors," "saves cleaning time." Two producers indicated they had noticed an odor in using the product, but neither objected to it.

In accordance with the program of evaluation of Iodine Sanitize, laboratory tests were made by the Hill Top Laboratories, Inc. of Cincinnati, Ohio. The Iodine detergent-germicide was checked by the Weber-Black technic, diluted 1:640 and using chlorine as sodium hypochlorite of 50 ppm and 100 ppm strength. The test organism was *Escherichia coli.*

Under the conditions of this test, Iodine detergent-germicide at 1:640 dilution and chlorine as sodium hypochlorite at 50 ppm and 100 ppm are equally effective against *E. coli,* causing the death of all organisms, 100 million per ml, in 15 seconds at 25°C (78°F).

A second test was made in December 1952, to determine the rate at which various dilutions of Iodine detergent-germicide kill *S. aureus,* S209 and *E. coli* 198, using the Weber-Black test method. A typical hard water, Norwood, was used.

They reported "Iodine detergent-germicide is a potent germicide. Under the conditions of this test, an Iodine detergent-germicide solution containing 10 ppm active iodine kills the test organisms as rapidly as a solution containing 50 ppm available chlorine using 100,000,000 organisms per ml."

To meet the U. S. F. and D. regulations, acute oral toxicity studies and patch tests on humans were conducted by the Industrial Toxicology Laboratories of Philadelphia, Pa. They reported: "It appears that Iodine detergent-germicide in concentrated form may be considered relatively non-toxic. It appears to be a mild primary irritant but is not a sensitizer. Iodine detergent-germicide in use dilution may be considered non-toxic and is neither a primary irritant nor a sensitizer. It is therefore our opinion that this material may be safely used for the purpose for which it is designed."

As a result of data presented, the U. S. Public Health Service issued an office memorandum regarding the use of iodophor compounds on February 5, 1953. Information is available from U. S. Public Health Service and its regional offices.

To meet the needs of the dairy industry for a germicide for the use in plants for bactericidal treatment of equipment at a cost comparative with hypochlorites, Iodine Bactericide was formulated. Field and laboratory tests have given excellent results . At Cornell University, the effectiveness of Iodine Bactericide using three methods of application, (recirculation, flushing, and spraying) has been demonstrated. Coliform and plate counts were zero. Iodine Bactericide gave a maximum amount of wetting action with a minimum of foam. This renders the iodine doubly effective by enabling it to work on a completely wetted surface thus insuring thorough contact with surfaces to be sanitized.

Another use for Iodine Bactericide is in the treatment of wash-water to improve the keeping qualities of cottage cheese. Under the auspices of the New York State Department of Agriculture and Markets and supervised by Dr. J. C. Marquardt, tests were conducted in several cottage cheese plants.

It has been established that psychrophilic organisms cause a cottage cheese spoilage. The spoilage is characterized by a slimy surface with a resulting off-flavor and odor. The organisms are not pathogens but are common in water and soil. Their presence in milk is destroyed by proper pasteurization. When equipment is improperly sanitized, they are especially difficult to control. Their destruction is most difficult when they are lodged in milkstone.

It was recognized that their growth was retarded when the pH was reduced toward the acid side. Higher pH value induced their growth. The critical range was above and below pH 5.0. Another attack of the problem was based upon properly cleaned and sanitized equipment and the destruction of psychrophils in the wash water.

Preliminary trials were not favorable to chlorine as it had an undesirable effect upon the texture of the curd. In amounts as low as 10 ppm chlorine was detectable in the wash water, and contact with the curd did not dissipate the flavor or odor.

As compounds which release active iodine impart only a slight flavor to the wash water which is entirely dissipated by contact with curd, Iodine Bactericide was used with excellent results.

Further studies are in progress in laboratory and field evaluation of Both Iodine detergent-germicide and Iodine Bactericide. Sufficient data, however, has now been accumulated to meet the requirements of federal, state, and city regulatory authorities. This data may be summarized as follows:

1. No corrosive effect on metals, rubber, and plastics.
2. Toxicity, sensitivity, and irritation tests meet F & D requirements.
3. Since Iodine detergent-germicide and Iodine Bactericide have an acid pH, the factor of water hardness is counteracted, and has no deterrent effects.
4. The salts commonly associated with the development of milkstone are solubilized and act as a preventive of stone formation.
5. The presence of organic matter affects Iodine detergent-germicide and Iodine Bactericide to a far less degree than is the case with hypochlorites and quaternaries.
6. There is no perceptible odor, flavor, or taste in use-dilution solutions on butter, cheese and milk and cream.
7. Both products are free-rinsing and have sufficient wetting to insure contact with surfaces to be sanitized, leaving no film or deposit.
8. The germicidal action of Iodine detergent-germicide and Iodine Bactericide is effective on contact for practically all types of organisms to an extent superior to other germicides for similar use in dairy sanitation.
9. As a germicidal agent, the cost of Iodine Bactericide in use-dilution is as low or lower than hypochlorites. Iodine as a detergent-germicide is compatible in cost to quaternary detergent-sanitizers and combined cost of alkali cleaners plus chlorine.
10. There is no inhibition caused to lactic acid development.
11. Psychrophilic (low temperature) organisms are destroyed.
12. The users of these products find they are time and labor savers and easy to use.

Iodine detergent-germicide and Iodine Bactericide are not miracle products. It still is essential to use good housekeeping procedures, produce clean milk, not cleansed milk. Cattle must be free from diseases, milk must be proberly cooled, and directions properly followed to achieve quality results.

ARMY ACCEPTS CALIFORNIA INSPECTION

Colonel Russell McNellis, Headquarters, Sixth Army, Presidio of San Francisco, California, has issued a memorandum to Sixth Army Veterinarians outlining inspection procedure and standards for the quality control of manufacturing milk.

The memorandum provides for the acceptance of the quality control program as administered by the California Bureau of Dairy Service.

CHANGES IN THE TENTH EDITION OF *STANDARD METHODS FOR THE EXAMINATION OF DAIRY PRODUCTS**

LUTHER A. BLACK
Chief, Milk and Food Sanitation Laboratory, Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio.

Methods for extraneous matter and vitamin determinations have been omitted and new material added on growth innibitors, detection of psychrophilic and thermoduric bacteria, improved sampling procedures for milk in tanks or vats, and for gassed or pressurized creams. Changes in microbiological methods include milk free plating agars and use of metal 0.01 ml. transfer syringes and 3 alternative staining procedures in the direct microscopic methods. Numerous revisions or modifications made in other bacteriological and chemical procedures are reviewed.

The preface of the Tenth Edition[1] of *Standard Methods for the Examination of Dairy Products* states that the book represents a compilation of methods of analysis prepared jointly or separately by Committees of the Laboratory and the Food and Nutrition Sections of the American Public Health Association, and selected methods reproduced by permission of the Board of Editors from the Seventh Edition of *Official Methods of Analysis of the Association of Official Agricultural Chemists.*

"At annual meetings of the Association of Official Agricultural Chemists, official changes to improve the methods are authorized to become effective on the thirtieth day following each February 15. In order that analysts in public health laboratories may keep informed, a record of relevant AOAC changes will follow the summarized report of the Chairman of the Subcommittee on *Standard Methods for the Examination of Dairy Products,* as published in successive editions of the *APHA Year Book.*"

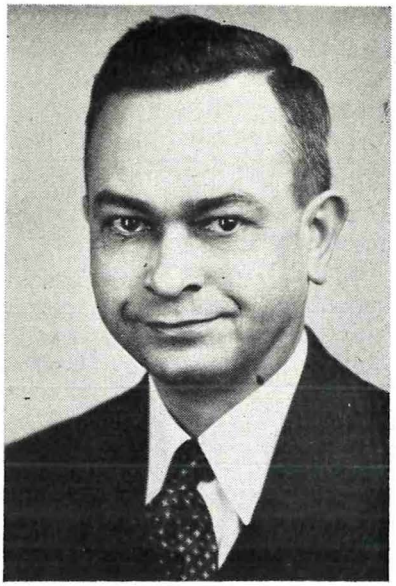
The new edition maintains uniformity of arrangement and style of presentation, uses a simple cross-reference system, and contains a more complete index. The general format is identical with that of the Ninth Edition. Certain methods have been omitted, principally directions for extraneous matter and vitamin determinations in dairy products which are rarely referred to or used in public health laboratories. Workers who need to perform vitamin bioassays are referred to official procedures published in the latest editions of *United States Pharmacopoeia,* by the Board of Trustees of United States Pharmacopoeial Convention. Those who need to determine extraneous matter in dairy products are referred to *Official Methods of Analysis of the Association of Official Agricultural Chemists.*

APPLICATIONS AND INTERPRETATIONS

In the Ninth Edition of Standard Methods, Chapter 1 was reorganized to discuss the applications and interpretations of methods as a guide to administrative officials, with the remaining chapters describing sampling and analytical procedures. This was well received; accordingly, Chapter 1 in the Tenth edition, also entitled "Selection and Interpretation of Quality Tests", briefly describes selected microbiological procedures and explains their common applications and limitations when used to examine milk and milk products.

New material in this chapter includes a discussion of potential growth inhibitors in milk and cream which may influence determination by the agar-plate method and the reduction-type methods. These include residues from chemical sanitizers applied to farm and plant milk-handling equipment; residues from "sulfa" drugs, or from antibiotics, used therapeutically; bacteriophages, or other unidentified inhibitors.

Processors of dairy products who observe unusually delayed lactic-acid development after adding starters are cautioned about erroneously attributing the cause to antibiotics or to quaternary ammonium compounds in milk. Since bacteriophage and other types of contamination in starters may be overlooked, and since current methods for positive identification and determination of trace quantities of certain inhibitors have limitations, it is inadvisable to conclude that any one inhibitor is the sole cause of delayed fermentation, of colony failures on plates, or of abnormally long reduction-time intervals, without definite proof excluding all other possibilities.



Dr. L. A. Black graduated from the University of Illinois in 1924 and took his M.S. and Ph.D. degrees in 1925 and 1928.

He was a bacteriologist with the Illinois State Health Department in 1926-27; Assistant Professor at the State College of Washington and Dairy Bacteriologist at the Washington Agricultural Experiment Station from 1928-30; Associate Professor and Professor of Bacteriology at the University of Maryland from 1930-1941, and since then with the U.S. Public Health Service.

He is the author or joint author of over fifty scientific articles in several fields of bacteriology and sanitation.

Under Optimal Incubation Temperature, the discussion points out "To minimize variations due to unavoidable fluctuations in incubation temperatures and to make counts more uniformly indicative of total bacterial contents, plates should be incubated at 32° C, as recommended preferentially in Standard Methods since 1941. Counts on milks of good quality are not greatly affected by incubation at the lower temperature, but incubation at 32° C will more nearly reflect the actual bacterial densities in poorer quality milks. The feasibility of using 32° C incubation has been shown repeatedly."[1] It may be a fact of interest that on February 16, 1953, Amendment 1 to the Federal Specification for whole fresh milk specified incubation at 32° C[2].

*Convention Proceedings, Vol. 4, Laboratory Section, Pages 58-70. The Milk Industry Foundation, Boston, Mass., October 27, 1953.

Most laboratories use 35° C incubation for standard plate counts and many other tests. The Tenth Edition specifies incubation at 35° C for coliforms and pathogens described in Chapter 3: namely pathogenic streptococci, tubercle bacilli, and Brucella species. Many leading health department laboratories are using 35° C incubation for all pathogenic microorganisms. I understand that some effort will be made by the APHA Coordinating Committee on Laboratory Methods to standardize on 35° C incubation in the next edition of their "Diagnostic Procedures and Reagents".

Because of the widespread practice of every-other-day delivery of milk and cream to consumers, the increasing use of cold-wall tanks for storage both on farms and in distributing plants, and the arrival of shipments in consuming areas after 3 and 4 days of refrigerated transportation, the importance of detecting psychrophiles in fluid milk and cream was given increased attention. The Tenth Edition briefly discusses the organisms concerned and their sources, and specifies incubation at 5° C for 7 days for their detection.

The discussions of the significance of coliform organisms have been clarified to emphasize their application as an index of recontamination of pasteurized milk and cream, and their limited applicability to raw milk and cream. More emphasis has been placed on their quantitative significance, and for liquid media it is noted that because of differences in the customary volume bases used for reporting determinations, a positive result by the tube method emphasizes recontamination at all levels more than the plate method does. Similarly, for solid media, increased emphasis should be attached to positive tests by the plate method when larger volumes are plated. It is reported that some cities in Quebec have enforced a coliform standard for pasteurized milk as delivered to consumers of not over 50/100 ml in 3 of the last 4 samples.

The discussion reports that coliform standards for raw milk to be pasteurized do not appear to be widely used, although one state requires that coliform organisms shall not exceed 100/ml in raw milk to be pasteurized. As some pathogens may grow at temperatures used in commercial preparation of cultured milks, or may not be destroyed at the low pH of certain products, it is pointed out that all cultured milks should have as low a coliform density as possible. It is noted that federal specifications for buttermilk now require that "The product, after pasteurization and until delivery, shall have a coliform count not exceeding 10 per ml in more than 1 sample out of 4 consecutive samples examined".[3]

With reference to coliform organisms in frozen dairy foods, a recent study is quoted[4] in which the authors conclude that unmelted samples are preferred, the use of undiluted samples was unsatisfactory, the accuracy of analysis is related to volume used, with 2 grams giving maximal count, and desoxycholate lactose agar gave significantly higher counts than brilliant green bile lactose broth. Nearly all of the collaborators preferred to use solid media for coliform determinations.

State pasteurization requirements for ice cream vary widely. In many states these have not been revised recently to incorporate present knowledge of the need for higher temperatures. Accordingly, results of coliform tests on pasteurized frozen dairy foods should be interpreted cautiously. These organisms are less readily killed at milk-pasteurizing temperatures when present in foods that contain sugars and added milk fat. However, higher pasteurization temperatures can be used on frozen dairy foods without injuring their quality. Higher temperatures are recommended in modern public health ordinances, and are in general use by the industry. Recent studies indicate that foam in mix pasteurizing vats is often a prolific source of coliforms.

It is mentioned that in well-operated plants the coliform density of frozen dairy foods may be expected not to exceed 10 per gram in 3 out of 4 samples[4]. In some manufacturing plants, certain fruits, chiefly banana and peach, are known to be common sources of coliform contamination when used as flavors in frozen dairy foods. It is noted that some manufacturers purchase their flavoring ingredients on a coliform-free basis and then process them so that even this possible source of contamination is controlled satisfactorily.

In general, the other interpretation and standards discussed are the same as in the Ninth edition, with revisions as necessary to bring them up to date. Chapter 1 of the Tenth Edition concludes with a bibliography of 331 references.

MICROBIOLOGICAL METHODS

Microbiological Methods for Milk and Cream are presented in Chapter 2, including equipment and procedures for sampling. Provision is made for the use of rubber liners instead of paper liners for caps of sample and dilution bottles, if made of non-toxic material. These may be affixed in plastic caps by a drop of a suitable non-toxic polyvinyl acetate adhesive. This adhesive softens in hot water, and if liners are to be replaced after each use, caps may be washed in hot water. Generally, such liners are reused and for this purpose caps with rubber liners may be washed by hand in lukewarm solutions.

The prescribed temperature for hot-air sterilization has been raised from 160° C to 170° C. Where the direct microscopic method is used and icing of samples during transit is impracticable, use of 0.08 percent formaldehyde in final concentration in the milk has been reported to be satisfactory for preserving samples intended for analysis within 36 hours after collection.

For removal of gassed or pressurized creams, whipped cream substitutes, etc., it is suggested that the charged container be exposed sufficiently to deep-freeze temperatures so that the entire contents may be transferred to sterile sample receptacle without undue contamination. The above procedure permits the testing of gassed products without determining the sanitary condition of the dispensing outlet. "For testing outlet, optionally pass a known volume of sterile water through it after aseptic removal of portions of contents, if any adhere to closure near internal opening to outlet. To determine whether the outlet has been properly sanitized, plate portions of rinse sample".[1]

Directions for sampling milk and cream have been revised to present operations in sequential order. Standard Methods permits taking subsequent samples of milk and cream from any one source from previously opened containers and

from weigh vats, after applying practical sanitizing treatments to sampling equipment between successive samples, even after a violation has been discovered, providing administrators are reasonably assured that such violation can and will be corrected without need for litigation. It is pointed out that where there is any doubt of correcting violations without litigation, all samples, until violation is corrected, shall be taken, with laboratory-sterilized equipment from previously unopened containers, promptly after delivery.

Because the time required for agitating milk and cream in large tanks and vats before the contents are homogeneous will vary according to shape and size of container, volume of milk or cream, type, location and force of agitator, and other factors, operators are directed to make tests and to have on file records to show the time required under most unfavorable conditions of mixing before a representative sample can be removed. Regulatory agencies may make additional tests to establish the reliability of the operator's results.

The technique for the agar-plate count essentially is the same as in the Ninth Edition of Standard Methods. A tentative standard for bacteria, yeasts, and molds of air in plating areas has been included of not over 15 colonies per plate during a 15-minute exposure of poured plates. Milk-free plating media, consisting either of Bacto-Plate Count Agar No. B479, by Difco Laboratories, or of BBL brand Milk Protein Hydrolysate Glucose Agar No. 298, by Baltimore Biological Laboratories, will replace the present milk containing plating media now required for the agar-plate method. Effective date for using the milk-free media will coincide essentially with publication date of the Tenth Edition.[5]

"Traces of certain wetting agents used in glassware washing compounds have been found to adhere so tenaciously that from 6-12 successive rinsings may be required in order to reduce their growth inhibiting effects on glassware used in cultural methods."[1] Residuals on laboratory glassware of several wetting agents that may be used in laboratory or plant detergent formulations have been demonstrated to have a bacteriostatic effect upon total plate counts[6]. It is the intent of Standard Methods that laboratories should make control tests of detergents of unknown composition, using adequately rinsed glassware in comparison with that washed normally. In our experience, after being washed with detergent formulations containing *suitable* non-toxic wetting agents, even inadequately rinsed glassware showed no bacteriostatic effect.

The Tenth Edition of Standard Methods also recommends, "As necessary to assure complete cleaning, optionally at weekly or biweekly intervals, soak pipettes for 24 hours in strong cleaning solution." Residuals on inadequately rinsed laboratory glassware from the bichromate-sulfuric acid cleaning solution recommended has been reported to have similar bacteriostatic effects upon Salmonella organisms[6], and this may be serious in analysis of certain milk products.

"In the interests of standardization, use of buffered distilled water for diluting test portions in the agar plate method will be mandatory".[5] "Because of microbic growth 'build-up' in filters and inevitable tendencies under routine conditions of use to fail to renew ion-exchange elements as frequently as they should be renewed, ion-exchange (permutit-, resin-, etc.) treated and other forms of so-called demineralized water are likely to be unsatisfactory substitutes for distilled water."[1]

Recent comparative studies have shown considerable differences in pH of agar reported on the same material examined by different laboratories. It appears that users of glass electrode pH meters may not realize that temperature compensators on pH meters do not permit correction of temperature difference between test solution and reference solution. Standard Methods points out that temperature compensators should be set at the temperature at which the measurement is made.

In reporting counts, provision is made for reporting unsatisfactory counts due to bacterial growth inhibitors as "GI". In order to resolve the doubt that some have had as to correct terminology where colonies on plates have been estimated, the Tenth Edition more clearly states that estimated counts made according to directions are reported as Standard Plate Counts.

In the direct microscopic method, encouragement is given to the use of micro slides, with delineated round one square centimeter areas over which 0.01-ml test portions are to be spread, in order to assure more even spreading and drying of the film. Use of such micro-slides with one surface sand-blasted, except for the several clear round square centimeter areas, is a standard practice in some jurisdictions. After cleaning, such slides are used repeatedly.

Encouragement is given to the use of a metal syringe in the direct microscopic method to transfer 0.01 ml test portions of milk and cream to square centimeter areas on micro slides. The syringe permits more rapid and more positive measurements with an accuracy of ± 5 percent than can be made with the 0.01-ml pipette on which graduations may be ± 10 percent. Measurements may be made of heavy creams even at temperatures of 40° F. Detailed directions are included for cleaning and using the 0.01-ml syringe.

Slightly more emphasis is placed in the Tenth Edition on making numerical determinations of bacterial densities, wherever possible, instead of making grade-conformance determinations only. After numerical determinations are made, results may still be reported in terms of grade conformance. Because results by the direct microscopic method are more commonly reported by both official and industrial laboratories in terms of clump counts, less emphasis has been placed on individual cell counts. The table of suggested microscopic factors lists the fields to be examined in making clump counts/ml as "actual numerical estimates".

Studies of six staining technics for the direct microscopic method revealed that essentially identical results can be obtained by each of three procedures, the use of any one of which is optional. These are the acid and water-free stain described by Levine and Black[7], the aniline oil-methylene blue stain described by North[8], and the polychrome methylene blue stain described by Anderson, Moehring and Gunderson.[9]

There has been some misinterpretation of specifications in the Ninth Edition for methylene blue thiocyanate tablets and for res-

azurin tablets. Henceforth labels for the respective tablets will bear the statement "Dye per tablet: ca 9.0 mg" and "Dye per tablet: ca 11.0 mg" instead of the actual determined dye content for each successive batch of tablets prepared.

"Revised directions for reduction type methods will prescribe that tests shall be incubated at 35.5-37.5° C and that test portions shall be brought to at least 35.5° C within 10 minutes after placing in water bath"[5]. Optional use will be authorized of Golding's modification of the reduction-type methods, which consist of preserving the dye by evaporating to dryness 1.0-ml portions of diluted reagent in the tubes or vials for use at any time thereafter by adding to each 10-ml test portions of milk. Since the "One Hour Reduction Test" by the resazurin method is essentially a screening test, directions for its use have been transferred to the chapter on Screening Tests.

DETECTION OF SPECIAL BACTERIAL GROUPS

In Chapter 3 the procedures for coliforms provide for the same liquid and solid media listed in the Ninth Edition, with the exception that desoxycholate *lactose* agar replaces desoxycholate agar. A procedure is given for the Milk Ring Test for Brucellosis, together with a brief discussion.

MICROBIOLOGICAL METHODS FOR DAIRY PRODUCTS

Microbiological methods for Butter are given in Chapter 4. Chapter 5 describes microbiological methods for Cheese, including procedures for the isolation of pathogenic Streptococci, Brucella, Salmonella, Shigella, and enterotoxigenic staphylococci.

Chapter 6 describes microbiological methods for ingredients used in frozen dairy foods. As in the former edition, this includes milk products, coloring and flavoring materials, sweetening agents, egg products, and stabilizers. Directions for preparing dilutions of powdered milk have been modified to permit adjusting dilution water blanks to about 45° C before adding the 11-gm test charge, and then allowing the dilution waters to cool (not over 15 minutes) as the powder dissolves, before making additional dilutions or plating. The 0.1 N LiOH dilution blanks should be used only for powders that are relatively insoluble in standard diluent, such as cultured (high-acid), dietetic, malted, and special blended powders, including those intended for infant feeding. For the microbiological examination of gelatins by the agar-plate method, the Tenth Edition specifies the use of 11-gm sample in 99 ml of buffered distilled water for initial dilutions.

For isolation of Salmonella from egg products "suitable enrichment media" are to be inoculated. Although not published at the time of preparation of Standard Methods, a recent article[10] reported "Marked deficiency in productivity of selenite enrichment broth for the recovery of *Salmonella* from pure culture and from egg products has been observed when the media were prepared from different types or batches of peptones. Similar deficiencies have been noted in selenite broth prepared from commercial dehydrated products. In the isolation of *Salmonella* from egg products, such deficiencies may be in part improved by the addition of the substance under examination and marked improvement is obtained by the addition of cystine in concentration of 10 micrograms ml. Similar additions of cystine are essential when examining a substance which would not contribute to the nutritional character of the medium. Greater emphasis should be placed on the need for determining the efficiency of the enrichment broth when using new batches or when the character of the inoculum is changed".

Chapter 7 discusses microbiological methods for frozen dairy foods.

SANITIZATION OF EQUIPMENT

In Chapter 8, on tests for sanitization of equipment and containers, a swab method has been substituted for the shaking method previously described for cans. The plate-contact method for determining surface contamination has been deleted. "Where chlorine and/or quaternary ammonium compounds are known *not* to be used for sanitizing utensils to be tested and that hot water alone has been used as a sanitizing rinse, the neutralizing agents, thiosulfate, Asolectin and Tween, may be omitted from rinse solutions". "Standards for sanitizing are so liberal that chance contaminations in laboratory are insignificant and controls with laboratory sterilized containers are unnecessary. However, when critical standards are applied, controls are necessary to determine extent of air or other chance contamination in laboratory."[1] A control procedure is described. In the disintegration method for paper materials, a limitation of not over 2 minutes is placed on use of disintegrators.

SEDIMENT, PHOSPHATASE, AND CHEMICAL METHODS

In Chapter 9 methods for Sediment in Fluid Milk have been revised to clarify the objectives and limitations. "Because the coarse sediment mixture, as described in the Ninth Edition, for preparing comparison discs was somewhat inapplicable to retail milk samples, a fine sediment mixture will be recognized for this purpose".[5]

In Chapter 10 on Phosphatase Methods to Determine Pasteurization, AOAC, Official, "The New York City Laboratory method and the former rapid Field Method for residual phosphatase in milk and cream will be deleted. A 1952 modification of Scharer's $CuSO_4$ Laboratory Method and a 1952 modification of his $CuSO_4$ Field Method for residual phosphatase will be included in the chapter on Screening Tests. The AOAC (Sanders-Sager) method for residual phosphatase is official for milk, cream, hard cheese, soft cheese, ice cream, butter, and chocolate milk. The New York State Department of Health (Gilcreas-Davis) Method is official for milk and cream".[5]

Chapter 10 discusses General Precautions, Application of Controls at some length, and false positive tests in frozen dairy foods, and comments briefly on application to goat's milk. Limits for phenol for the Gilcreas and Sanders-Sager phosphatase tests in this chapter of official AOAC procedures and the modified Scharer laboratory and field tests described in Chapter 12 have been placed on a uniform basis of micrograms of phenol per ml (microgram/ml). "Phenol values equal to or exceeding 94 micrograms/ml of milk by AOAC Method 1 (New York State Department of Health Method), or exceeding 4 micrograms/ml by AOAC Method II (Sanders-Sager Method), or 2.3 micrograms/ml by Scharer method, indicate inade-

quate heat treatment and/or contamination with raw milk."[1]

In this connection some may have overlooked the effect of Amendment 1, 16 February 1953 to Federal Specification for whole fresh milk. In the original specification C-M-381e 22 August 1950, Section 4.3.2 states[11]. "Efficiency of pasteurization shall be determined by means of the phosphatase test described in the latest edition of the *Standard Methods for Examination of Dairy Products*". This would allow use of any of the methods described in the Ninth Edition of Standard Methods, namely Sanders-Sager, New York State, New York City Laboratory or New York City Field Test. In the 16 February 1953 Amendment to C-M-381e, paragraph 4.3.2 is deleted and paragraph 4.3.1 is amended to read in part.[2] "Unless otherwise specified, the chemical examinations shall be made in accordance with the methods listed in the edition of *Official Methods of Analysis of the Association of the Official Agricultural Chemists* in effect on the date of invitation for bids". The results of this amendment would be that only the Sanders-Sager technique or the New York State Method could be utilized, since these are the only phosphatase methods now in the AOAC Official Methods of Analysis.

The amount of phosphatase permitted in pasteurized milk by Amendment-1, 16 February 1953, to C-M-381e appears ambiguous. This inserts on Page 2, paragraph 3.3, line 10, that "The phosphatase activity . . . . . shall be not greater than 2 phenol equivalents per 0.5 ml of milk". Phenol equivalents are not defined and may well be confusing to the reader, since properly pasteurized milk will have different phenol values, depending upon the phosphatase procedure used. In the next edition of Standard Methods an effort has been made to change the phosphatase values in all procedures to micrograms/ml. By the Sanders-Sager technique properly pasteurized milk would have not over 4 micrograms/ml, by the New York State (Gilcreas) Method this would be 94 micrograms/ml and by the Scharer Laboratory technique 2.3 micrograms/ml.

Chapter 11 contains Chemical Methods adopted and published by the Association of Official Agricultural Chemists. Certain procedures in the Ninth Edition are omitted, including lactic acid, the sour-serum method for added water, and all phenylhydrazine tests for formaldehyde, and other tests are modified or replaced. A test for available chlorine in sodium hypochlorite is modified, a new method is included for calcium hypochlorite, and the procedure for Chloramine T is modified.

SCREENING TESTS

Chapter 12 contains a number of rapid sampling and analytical procedures grouped as Screening Tests. Optional re-use of the same agitator or sampling instrument is permitted where practical sterilization is used, provided at least 1 minute is allowed for sterilization between samples.

"Where taking samples directly from individual cans of one producer, optionally omit rinsing and sterilizing step between cans and use same instruments (without undue exposure to contamination) for mixing milk in each can and transferring proportionate and representative amounts thereof immediately after delivery from each container to sterile compositing container. Submit composite so obtained or subportion thereof as sample."[1]

Cautions are given for use of a transfer loop in the direct microscopic method, and the use of the single dip Newman-Lampert stain is described.

"Procedures for the determination of thermoduric bacteria are clarified under four distinct subapplications in the chapter on Screening Tests, as follows: (1) Agar Plate Culture Method, (2) Tube Culture Method, (3) Small Plate Culture Method, and (4) Modified Small Plate Culture Method for Samples Exposed to High Temperature Short Time Pasteurization."[5]

"A Laboratory Pasteurization Count may be compared with a Standard Plate Count, made simultaneously on an unheated portion from the same sample, or with a result obtained by one of the commonly used rapid industrial methods. The rapid methods are less refined and cheaper to perform. A still simpler method consists of streaking a measured loopful from each of 4 or 5 laboratory pasteurized samples in identified areas on the surface of a poured blank plate and, after incubation at 35° C (or 32° C) for 48 hours, counting the colonies originating from each streak."[1]

"As a check on the technic or for administrative purposes, some laboratories use a control on each batch of laboratory pasteurized milk. Following such pasteurization of a known sample of raw milk, it is subjected to a phosphatase test. A positive result would indicate underpasteurization and thus afford an additional check on the adequacy of the time and temperature of laboratory pasteurization. Where different commercial pasteurization temperatures are legally prescribed and different methods are used to determine residual phosphatase, the limits for micrograms phenol/ml of milk listed . . . in the absence of published data, may serve provisionally to indicate whether samples have been overheated or underheated in the laboratory pasteurization process."[1]

In case a laboratory is unable to make gravimetric measurements of frozen dairy foods, precautions are given for volumetric measurement of test portions. To supplement official sanitization tests for containers and equipment, the "Seeing is Believing Swab Test"[12, 13] is included in the chapter on Screening Tests. It is noted that the chief value of this test is to impress lay operators and personnel with tangible evidence of insanitation.

With reference to phenol standards for the Scharer phosphatase test, it is pointed out that the concentrated stock solutions stored under refrigeration are stable for a week, but that the dilute solution and the resultant color standards are not stable and should be prepared daily.

The procedure for the Scharer modified field phosphatase test published posthumously[14] did not contain directions for preparation of the color standards for the field test. The Tenth Edition of Standard Methods suggests for this purpose the extraction of phenol standards as prepared for the laboratory test with 3 ml of butyl alcohol. After separation of the butyl alcohol, a portion of the butyl alcohol extract may be drawn off with a pipette and diluted with an equal volume of butyl alcohol. No conversion factor is necessary, as the extracted and diluted standard may be read

directly as micrograms phenol/ml of milk.[15]

A procedure is given "to detect 'admixed heated milk' in case raw milk presumably has been heated (or a portion thereof heated before mixing with the entire consignment) in order initially to reduce the bacterial count and/or to inactivate lipase. This practice may occur where transportation requires refrigeration in tanks for more than 12 hours (often 24-48 hours) prior to use either as raw or after pasteurization in consuming areas. When such milk is used raw, the health hazard is enhanced appreciably."[1]

A modified Babcock procedure for determining fat in homogenized milk has been included. The Pennsylvania modified Babcock method for determining fat in chocolate milk or flavored drink is described.

In view of the need for a method to detect and to determine trace amounts of quaternary ammonium compounds in milk and in sanitizing solutions used on dairy equipment, the Furlong and Elliker[16] method is described. Additional collaborative studies are planned in accordance with the authors suggestions to improve the accuracy of the method for detecting amounts at low concentrations (1 ppm level).

In view of the need for qualitative and quantitative tests for antibiotics in milk, a filter-paper disc method for antibiotic assays has been developed. "Working concurrently and independently, one group of investigators studied its application to milk late in 1950 and another group applied the disc method to milk in 1951. The method . . . described with some added refinements has been applied to nearly 2,000 commercial milks for determining residual antibiotics, including penicillin. With due care and use of suitable controls, reasonably reliable assays can be made. The use of previously interstandardized materials should provide more uniform conditions for testing."[1]

The chapter on Screening Test concludes with a procedure for the thiosulfate titration for available chlorine.

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KLENZADE ANNUAL TRAINING SCHOOL

One of the outstanding company activities held each year by Klenzade Products, Inc., Beloit, Wisconsin, is the Klenzade Annual Training School for Klenzade sales representatives and field personnel. The two week training course held at the Beloit Country Club, March 1st through March 13th, had a record attendance of more than 60 people.

Although the Klenzade Training School has been an annual event for many years, this year's roster of speakers and lecturers far exceeds that of previous years not only in the number of people on the various panels, but also in the depth and breadth of the subjects covered.

Featured among the various subjects were the Fundamentals of Microbiology, Sanitation Chemistry, Food and Utensil Borne Infections and Food Poisonings, Institutional Sanitation Program, Commercial Laundry Procedures, Klenzade Farm Program, Can Washing, Bottle Washing, Cleaning of Milking Machines, High Temperature Equipment Cleaning, General Plant Sanitation, Water Treatment, Poultry and Egg Sanitation, Sanitation in the Food Processing Industry.

Sessions began promptly at 8:00 A.M. each morning and continued through to 5:30 P.M. with a short intermission for luncheon. Evening sessions began at 7:00 P.M. to 9:00 P.M. Much of the material was illustrated with exhibits, slides, and film, and represents, probably, the greatest amount of sanitation educational material ever assembled for class room dissemination. Highlighting the program were such well-known national authorities as Dr. Richard S. Guthrie, DeLaval Separator Company, Chicago, Illinois, and Prof. K. G. Weckel, University of Wisconsin.

The Klenzade Training School is not only conducted for the indoctrination of new Klenzade salesmen, but also acts as a refresher course for Klenzade field personnel generally. Progress in sanitation techniques were thoroughly discussed and considerable time was also devoted to advances made in cleaning chemicals and their applications to effective cleaning routines.

COORDINATING THE DAIRY INDUSTRY AND REGULATORY AGENCIES IN A QUALITY MILK PROGRAM*

HAROLD J. BARNUM
Department of Health and Hospitals, Denver, Colorado

All persons connected with the production, processing, delivery, sale, and quality control of milk and dairy products have long since recognized the necessity of sanitation requirements and quality control. The recognition of these facts by the dairy industry, health authorities, and educators has caused this important function to become as much a part of the American way of life as any of our well-known social necessities.

Milk quality control is a science. It is a never-ending job. It is no longer a hit and miss affair. Furthermore, it is a costly function. Confusion must be cut to the minimum. To keep the costs within bounds, to keep confusion under control, and to get the job done requires the coordination of the efforts of the entire dairy industry and all control agencies.

During the past 30 years, the struggle to improve our milk and dairy supplies has caused us to go through cycles of approach. Until recently and in too many cases at present, control agencies and the industry have often been on opposite ends of the struggle. Too many control agencies felt that the dairy industry was not to be trusted —that police methods must be employed to get the job done, and that any association with the dairy industry or delegation of responsibility to that industry was unthinkable. There was no common ground to pool their efforts. Distrusts and misunderstanding developed.

Changing economic conditions and the demand for better control found it necessary to increase taxes to meet rising costs of enforcement. Production and processing methods were constantly changing, and quality control methods caused new problems. In order to provide personnel and facilities to get the job done, the control agencies supplemented dwindling treasuries in various ways, such as: increased license fees, inspection fees, hundred-weight fees, etc. Many cities found themselves collecting the entire cost of milk regulations enforcement from the dairy industry. Actually, in some instances the dairy industry found themselves subsidizing a governmental agency, which in turn enforces their activities.

It is my firm conviction that you cannot get a job done that involves so many ramifications and such constant supervision as a quality milk control program without the wholehearted support of all concerned.

COSTS

Everywhere today we hear the problem of costs. The public demands that government costs be reduced. Industries who are not mindful of costs will soon find themselves out of business. High taxes are on the minds of everyone. Therefore, it is the duty of all concerned to make it their job to see that the cost of government is kept down. How then can we get the job done with the least expenditure?

Quality control and sanitation are one and the same. You cannot divorce them. Today quality control is a must. We agree there is a job to be done—our problem is how best to do it. First we must decide two things:

1. What is the Dairy Industry's Responsibility in a Quality Milk Control Program?
2. What is the Responsibility of the Control Agency?

I. The Dairy Industry's Responsibility.

A. To see that the products they sell meet the requirements for cleanliness, safety and quality.

1. Unfortunately some members of the dairy industry feel that this is the job of the government. It seems that this shifting of responsibility indicates shortsightedness. The advocates of this philosophy argue that the government imposes regulations on their activities. Because these regulations are government inspired, therefore, it is the duty of the government to carry on the expense of the quality program.

(a.) Progressive companies have long since discarded this philosophy in favor of organized control under their own supervision.

Mr. Harold J. Barnum, born in Colorado, graduated from the local high school, farmed for two years, and graduated from the Montana State College with a B.S. in Dairy Manufacturing. He took his M.S. in Dairy Husbandry from Michigan State College. He has served as Milk Sanitarian and City Chemist in Detroit and Ann Arbor, and, after some industrial experience, is now Chief of Milk Sanitation, Denver Department of Health and Hospitals.

Mr. Barnum served as Secretary-Treasurer of the Michigan Association of Milk Sanitarians for ten years. He has served as Chairman of the Dairy Farm Methods Committee, a member of the Coordinating Committee and the Committee on Chocolate Milk, and last year as President of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS.

II. The Control Agency's Responsibility.

A. To see that the dairy industry carries out its responsibility, to carry on an honest and judicious enforcement program, and to make sure that the interests of the consumer are protected at all times.

1. It appears to many of us that the control agency should not be obligated any further.

III. The Cost of Milk Quality Control.

A. Is it the public's responsibility?

B. Is it the dairy industry's responsibility?

C. Is it the responsibility of both the industry and the public?

D. The Industry should adopt a policy on their responsibility and see that their responsibility is carried out.

*Address delivered at French Lick, Indiana.

A STUDY OF TWO OPPOSITE APPROACHES

A. The first to be considered are two cities where:

1. The Dairy Industry carries the entire financial load through license fees and hundred-weight checkoffs.

(a.) The Industry goes their way —the Health Department goes their way. There is no coordination of efforts. Many dealers take the attitude that since they are paying for the work it is the job of the Health Department to do it.

(b.) Some dairy plants in these areas find it necessary to supplement the efforts of the Health Department in order to get a satisfactory job of quality control done.

2. The question naturally arises—Can we justify duplication of efforts? Can we afford this duplication?

B. Industry and Control Agency Coordinated Activities.

1. With your permission I should like to prove my point by showing the results of the coordinated program which has been built up in Denver.

(a.) Our program came about because necessity is the mother of invention. We had a very limited amount of money. Our instructions were to get a job done. Industry readily recognized the shortcomings of the program under which they had labored for years. When it was shown that uniform interpretations within the department, within the area, and within the state were actually a fact, and that they were to have a voice in the policies under which their efforts were to be expended, the coordinated program began to make progress.

(b.) Milk Plant field men meet regularly with our sanitarians. Our first responsibility is to see eye to eye in the basic fundamentals in the production of high quality milk. Compliance with requirements and follow-up on excessive bacteria counts are the responsibility of the fieldman.

(c.) Laboratory facilities and procedure were coordinated. Five laboratories are certified and do official work for the Health Department. The dairy industry pays the entire cost of the operation of these laboratories.

2. Since 1947, progress as indicated below is shown.

(a.) A U.S.P.H.S. milk sanitation survey in 1947 gave a rating of 62%. In 1953 it was 92.5%.

(b.) No increase in the number of employees by the Health Department was made.

(c.) Per capita costs (government).

1947	*1949*	*1951*	*1952*	*1953*
8.9c	10.8c	10.6c	9.8c	9.6c

(d.) Milk production increase—110.4%. Fluid milk sales increase—61.2%.

(e.) Over-all costs—1953
City of Denver.....$63,000
Dairy industry.....$120,000

(f.) License fees $9,500
Public funds $53,500

Periodically, requests from the City Hall have come to increase license fees and make the program self-supporting. When the efforts of the industry were shown, and the amount of money spent for quality control itemized, the City "Dads" were satisfied with the arrangements. This illustrates the necessity of good records and official results to back them up.

It is well known everywhere that your good State of Indiana is the leader in the field of industry participation in a milk program. I feel out of place discussing these things with you when actually you are doing such a good job carrying out the very things I advocate here.

In Colorado we lean heavily on our Dairy Products Association. Our advice is to use your own Association whenever possible. They are organized to lend their support for better dairy products.

SUMMARY

A. The first responsibility of control agency is to:

1. Eliminate overlaping functions, and coordinate rules and regulations and ordinances with the Public Health Service, state control agencies, and adjoining territories. Set up reciprocal inspection agreements.

2. Employ qualified personnel. Pay accordingly.

3. Uniform interpretation of rules and regulations.

4. Understanding of the dairy business and its problems.

B. The first responsibility of the dairy industry:

1. Understanding of the health department and other control agencies' problems.

2. Employment of trained and competent industry fieldmen.

3. Employment of adequate laboratory control.

4. An active interest in the welfare of your control agency to see that they are properly manned, adequately paid, and that conflicts of jurisdiction and interpretations do not spoil their efficiency.

C. Responsibility of both:

1. That inspections are properly made.

2. That laboratory work is adequately and properly done.

3. That the proper follow-ups are made, and that producers and processors are given the proper information and understand the objectives.

D. The dairy industry is at the cross roads.

1. Substitute fats and solids and consumer resistance prove that quality, attractiveness, and flavor must be foremost in the minds of dairymen if their market is to be maintained.

E. Objectives, control methods, technological approaches of the control agencies and the dairy industry are the same.

1. Therefore, when we pool our resources and coordinate our efforts, confusion is reduced to a minimum and the final result more nearly the ideal.

2. The wise and progressive dairyman knows that laws and ordinances such as the U.S.P.H.S. Milk Ordinance are necessary for day after day preparation of nature's most perfect food.

(a.) He knows that a product with:

(1.) A low thermoduric and psychrophylic count has longer shelf life and will remain palatable longer.

(2.) That a product with no coliform bacteria will keep longer and remain free of undesirable flavors longer.

(b.) He knows that consumer confidence is his best sales force and a properly functioning control agency is his best developer of consumer confidence.

(c.) He knows that a quality product cannot be made from inferior ingredients.

(d.) He goes all out to promote adequate sanitary precautions.

(e.) He expects the control agency to employ well-trained personnel to employ modern methods of inspection service and laboratory control.

(f.) He expects his tax money to be administered in the most effective way.

Continued on Page 169

MILK and FOOD SANITATION

ABSTRACTS OF PAPERS PRESENTED AT THE SECOND ANNUAL DAIRY ENGINEERING CONFERENCE MICHIGAN STATE COLLEGE, EAST LANSING, MICHIGAN, MARCH 3 AND 4, 1954.*

F. W. FABIAN
Associate Editor

Engineering Design and Operation of Bulk Milk Coolers on Farms.

C. N. TURNER AND LEON F. CHARITY
Agricultural Engineering Dept., Cornell University, Ithaca, N.Y.

There has been a rapid increase of bulk milk coolers in New York State. They increased from 40 in 1952 to more than 300 at the present time. Many other states are experiencing a similar increase. There is a wide range of physical and mechanical differences in the tanks. There are differences in agitator size, shape, and location, and these will affect the rate of cooling and blending of the milk. Just how important the combination of these factors is has not been determined. The greatest factor in the rate of cooling milk is the condensing unit, and even in this common element, there are wide differences. The engineering problems are discussed, and four diagrams of different types of controls are given. (Cornell Ext. Bull. No. 899, entitled "Bulk Milk Cooling and Handling on the Farm" will soon be available.)

Which Farm-pick-up Tank and Truck is Best Suited for Your Operation.

TOM BURRESS
Sales Mgr., Tank Div., Heil Co. Milwaukee, Wis.

Thirteen important considerations are given for selecting the proper unit to do a particular job. Each of the considerations is then discussed such as tank size, how the tank should be mounted, outer jacket materials, insulation, pump type and size, how pump should be mounted, size and kind of hose, tray facilities and cooling methods, when is a two compartment tank needed, agitation, baffles and sanitary regulations.

Effect of Bulk Handling of Milk on Plant Operation.

MAX L. JACOBY
Sani-Seal Dairies, Inc. Bay City, Mich.

The effect of bulk handling of milk in a plant (Midland, Mich.) handling about 17,000 lbs of milk daily is discussed. Briefly the favorable results were: made additional floor space available, eliminated expensive receiving room equipment and its maintainance, effected a saving of approximately 50%, reduced temperature of milk to 40°F or lower as compared to an average of 52°F with cans, thereby saving on refrigeration necessary for holding vats, and greatly improved quality. The savings in handling and the improved quality of the milk has been so satisfactory that they are now converting their Bay City plant into 100% bulk pick-up.

Remarks

C. W. BROUGHTON
Commercial Mgr., Creamery Package Mfg. Co., Chicago.

"Many dairymen believe that the bulk method of handling milk on the farm has done more for the dairy industry than any one single development since pasteurization." Discussing the first subject of bulk tank coolers he said it was particularly interesting because we were still very definitely in the early and promotional stages of farm tank cooling. We are in the same stage today with farm tanks as we were 25 years ago with ice cream cabinets. Continuing, he said "Here is a method, which with proper sanitary procedure, produces milk quality beyond our fondest dreams and hopes. Let's not drown our progeny before it learns to swim. This is both a challenge and a warning to manufacturers and sanitarians alike." Speaking of section 3A in the Sanitary Code he said that it was not for the sanitarians any more than it was for the manufacturers or the dairymen; it was for the dairy farmer, the man who buys the farm tank. He believed the best way to develop the farm tank program in the manner originally intended is to all work together. Continuing, he said, "Considerable work was done by the sanitarians, milk people, and the manufacturers this past year to develop the present tenative code. Notwithstanding, there are many sanitarians who have their own original ideas. You sanitarians own the 3A copyright, but you must all be together before it will ever attain its rightful stature. In the same breath, tank manufacturers will wish to give the 3A standards complete cooperation. It is only with this oneness of purpose that the dairy farmer will receive the most for his money."

Everyday Problems of a Dairy Plant Engineer.

A. L. RIPPEN
Plant Manager, Kegle Dairy, Lansing, Mich.

It is the duty of the dairy plant engineer to have all the machinery in condition to maintain high quality production on an efficient basis. New techniques and automatic devices such as found in controlling temperature in heating and refrigeration equipment have been of great assistance. Some of the engineer's problems that were discussed were preventive maintenance, operation of equipment by plant personnel, operating costs, personnel safety, and finally trouble shooting and handling a breakdown. The dairy plant engineer plays a very significant position on the production team of the plant with consumer satisfaction the ultimate goal.

Water Treatment for Dairies.

JOSEPH O'DELL
Chem. Engr., Board of Water and Electric Light Commissioners, Lansing, Mich.

Water treatment for dairies was discussed from an operating standpoint. The four objectives in any boiler feedwater treatment are: to

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*The Second Annual Michigan Dairy Engineering Conference held at the Kellogg Center, Michigan State College, March 3 - 4, 1954, was attended by 115 representatives from 15 different states and Canada—in spite of a blizzard on the first day of the conference. The next Conference is scheduled for March 8 and 9, 1955.

prevent chemical scale deposition, corrosion, boiler water carryover, and caustic embrittlement of the boiler metal. Usually the addition of sodium nitrate to the boiler water in a concentration equivalent to 30-40% of the boiler water NaOH alkalinity eliminates it. The effects of boiler scale on a heat exchange surface was discussed especially heat flow and overheating. Removal of scale is accomplished by acid cleaning or turbining or a combination of both. The most practical solution of the corroding of iron piping in the boiler feed water and return condensate system is to install brass or copper pipe. Corrosion was discussed in detail.

Engineering a Modern Receiving Room.

V. SCHWARTZKOPF
President, Lathrop-Paulson Co., Chicago, Ill.

A receiving room is important to the profitable operation of a dairy because the milk is inspected, weighed, and sampled for butterfat testing here. The accuracy of this work affects producer relationship, makes production control practical, and simplifies accounting practices —all of which have a direct bearing on profits. The more important factors which should be given consideration in a receiving room are: the number of grades, the number of cans and pounds of milk to be received per hour, the number of producers and their average daily delivery in the period of highest production, the elevation of receiving platform in relation to the driveway, and finally the traffic lanes to and from the receiving room.

Proper Installation and Use of Conveyors.

W. S. CAMPBELL
President, M & C Conveyors, Inc. Chicago, Ill.

Conveyors should be installed not only to eliminate labor but also to keep men contented on their jobs by making the work easier and more enjoyable. In many cases there should be two automatic can stops. One should be located at the dumping position and the other placed ahead of it so that cans can be stopped for inspection, sediment tests, fat tests and the like. Many are installing conveyors which permits the weighing to be done right on the conveyor. It is possible now to install conveyors to carry the milk as it is unloaded from the cans on the truck throughout the entire plant to the filled milk bottles which end up in the refrigerator.

Engineering the Dairy Plant of the Future.

JOHN H. FORSLEW
Engineer, Carnation Los Angeles, California.

In the future, city bottling and ice cream plants will undergo many improvements in design and building construction. The nature of these improvements will be determined by the improvements in machinery and the nature of the raw and finished products. The future milk plant may be a less complicated engineered plant. For example, in the future a city bottling plant may simply be a plant where whole powdered milk is reconstituted since it will be possible and more economical to produce and condense or powder the milk in a less populous area. Again the ice cream plant will be a reconstituting plant where all the ingredients are received in concentrated form, placed in a mixing vat, reconstituted, and then made into ice cream. Milk and ice cream plants will be consolidated for economic reasons. They will also need considerably more space for parking. Therefore, we shall be speaking in terms of acres rather than square feet.

Scheduled Maintenance of Refrigerating Systems.

W. R. LAUT
Westerlin & Campbell Co., Detroit, Michigan.

Preventive maintenance is a planned program that is faithfully administered. If maintenance is scheduled on a systematic basis it will go a long way towards reducing costs with a minimum of down time. Such a program will accomplish three principal things: first, get the longest practical life of the equipment, second, it will keep operating costs to a minimum, and finally, there will be a minimum of down time. This last item is far reaching and can be so costly that the eventual result cannot be calculated. Two methods of administering preventive maintenance to a refrigerating system are discussed. The first method is to contract with a commercial company to furnish periodic inspection by a competent refrigeration specialist. The contract should call for a certain number of inspections and can cover the renewal of parts—both material and labor. The contract price is determined from actuary tables that takes into account many items such as size of plant, age of equipment, complexity of system, compressor sizes, and other such items. The second method is to build a service group within the dairy operating engineers. This method is feasible but has many contingencies such as an experienced, well-trained engineer, adequate help, and the amount of other work he is required to supervise. These and many other things can militate against a good refrigerating program. Consequently, the refrigerating system is neglected. A typical contract service form was shown on slide No. 1. Refrigeration plant inspection forms were shown on slide No's. 2 & 3.

Applying Time-motion Study to Dairy Plant Operations.

ALBERT E. GEISS
Bowman Dairy Co., Chicago, Illinois.

Since about 1881 when Taylor pioneered the science of time and motion study, it has been widely practiced throughout the world. Its value has been recognized by management and labor alike and they have gradually accepted it as an accurate technique for establishing standards of performance for men and machines. The dairy industry has been tardy in using this valuable tool. Recently some dairy companies have used the time study technique in an analysis of processing, cleanup and delivery operations. To date about 100 dairies in the East and many more on the west coast have used the method to determine product costs and to improve methods. Many questions arise in the mind of a dairy plant operator as to what the time study will accomplish. Such questions arise in the mind of a dairy plant operator as to what the time study will accomplish. Such question as: What is time study supposed to accomplish? Will such a study help in determining accurate costs? What is the reaction of the plant worker to them? Will I be able to do a better job of

running my business? Is time study for the large or small plant? The answer to these and other questions were discussed. Also specific examples of time studies in a dairy were given. What is a time study? A time study is the process of recording the detailed elements of an operation and, with the aid of a stop watch, the time required to perform each element of that operation.

Solutions to Dairy Plant Paint Problems?

IVAN NICODEMUS
Chemist, Valdura Division, American-Marrietta Co.

Completely satisfactory paint performances have not been easy to obtain in many fields of industry because of the nature of the unit processes or unit operations. Each paint application should be given careful consideration such as type of surface, proper preparation of surface, color desired, application procedure, and the conditions to which the surface will be exposed. Each of these points was discussed. High moisture causes paint failure such as peeling and flaking from moisture coming through the wall until sufficient pressure is built up, due to a differential in moisture vapor pressures, so that the paint is literally pushed off the wall. Such a condition exists for example when a high moisture content room is adjacent to one of low moisture content or when a colder room with a low moisture content is adjacent to a warm room with a high moisture content. Any cracks or joints should be fixed. Preventive measures include better ventilation and the use of impervious paints. Growth of mold on walls and ceilings need not occur since fungicides can be added to paints to control them effectively. Damp surfaces may be painted with paints containing certain resins and oils. For areas subject to normal conditions there are high gloss enamels with a base of oil-modified alkyd resins. Vinyl coatings should be used on machinery subjected to water, cleaning solutions, abraisons, and the like. A class of paints that are extremely resistant to moisture and various chemicals are chlorinated rubber finishes.

Cleaning in Place Specialized Equipment.

GORDON HOBBS
Chief Engineer, Beatrice Foods, Inc., Chicago, Illinois.

Cleaning in Place (C.I.P.) first was applied to plate type heating and cooling equipment. Later it was demonstrated that with correct cleaning materials, proper control of time and temperature, and control of the rate of flow through the passages between the plates, a plate heat exchanger could be completely cleaned by the circulating method. Sanitary piping was next cleaned successfully. Later a few plant men tried cleaning pumps, homogenizers, internal tube heat exchangers, and even ice cream freezers. There are differences of opinion about the effectiveness of the C.I.P. method of cleaning some of this equipment. However, experience shows that freezers and sanitary pipe lines in an ice cream plant can be effectively cleaned by the C.I.P. method. It has also been proven that bacteria in an ice cream plant can be controlled more effectively by C.I.P. than by hand methods of cleaning the lines and freezers. Causes of failure to use the C.I.P. effectively has been due to: incorrect cleaning materials, improper control of time and temperature, and finally insufficient velocity and flow of the cleaning solutions for the respective circuits. Examples of failure due to one or more of these causes are given. The conditions necessary for successful use of C.I.P. are: sanitary pipe secured firmly in position; all sanitary pipe connections sealed with C.I.P. gaskets, stainless steel circulating pumps of sanitary construction with sufficient velocity to completely fill lines and freezers; remove core of all in-line sanitary valves and all parts of the valve brushed clean after rinsing and before circulating the cleaning solution; completely dismantle, thoroughly check and hand clean all sanitary lines at least once every 90 days; dismantle and check freezers once each week; replace old gaskets with new gaskets every 30 days—clean and sterilize old gaskets for re-use in next period. If molded gaskets and grooved fittings are used, it is not necessary to replace the gaskets except where a leak has developed; remove pump impellers from pumps on freezers and replace the plate before the first rinsing operation; hand-wash the impellers and do not replace until the next morning before the sanitizing agent is circulated; install a recording thermometer near the end of the circuit so that supervisory personnel can constantly check the time and temperature while the circuit is being circulated; and finally leaking joints that appear during the freezing operation should be taken apart, cleaned, and the gasket replaced between the first rinse and the circulating of the cleaning compounds. One of the advantages of the C.I.P. method is that it eliminates much of the trouble caused by careless assembly of equipment.

Keeping a Floor in Your Plant.

RAYMOND B. SEYMOUR AND JOHN R. SWIFT
Atlas Mineral Products Co., Mertztown, Pa.

The requirements for modern dairy floors are: a high degree of sanitation; complete resistance to milk, milk acids, grease, detergents, and other liquids characteristic of the dairy industry; ability to withstand steam, sterilization, and damage from impact by cans, cases, and bottles; attractive appearance and freedom from odors; and finally long service life. These requirements are met by modern quarry tile floors in which both the bed and vertical joints consist of a chemically resistant resin cement. The advantages and disadvantages of the various type of floors were discussed. These types were wood, monolithic Portland cement, protective coating floors, monolithic resin cement, industrial acid-proof, Portland cement tile, tile floors pointed with furan cements, and modern furan dairy floors.

Hardening Room Longevity.

EDWIN C. WARD
District Manager, United Cork Companies, Chicago, Ill.

The question was asked, what is the life span of a hardening room? The Internal Revenue department allows 20 years for the depreciation of a freezer or hardening room. It is one thing to have a hardening room to last just 20 years but quite another thing to have it effective

(*Continued on Page 163*)

RECENT DEVELOPMENTS IN RADIATION STERILIZATION OF FOODS[1]

WILLIAM C. MILLER, JR.[2], BERNARD E. PROCTOR[3], AND SAMUEL A. GOLDBLITH[4]
Massachusetts Institute of Technology, Cambridge, Mass.

Research efforts during the past decade indicate that ionizing radiations may be used in certain industrial processes. Unique among these processes is that of cold sterilization of foods, drugs, and pharmaceuticals. Discussion of the applicability of the various types of ionizing radiations available for such purposes and a brief discussion of the theory of the mode of action of ionizing radiations are presented. Major problems involved in this method of processing are discussed. The results of some of the more pertinent research studies are summarized.

The results of research efforts in the past ten years indicate that certain industrial processes may be carried out by utilizing high-voltage X-rays or cathode rays. Unique among these processes is that of cold sterilization of foods, drugs, and pharmaceuticals. For over fifty years it has been known that ionizing radiations have bactericidal effects. In fact, research in this direction was begun shortly after the discovery of X-rays by Roentgen. However, only within the past ten years, when large sources of ionizing radiations have been developed, has intensive research in this field been carried out. The increased interest in this subject is indicated by the fact that in 1948 only two or three laboratories were engaged in research on sterilization by ionizing radiations, whereas now, in 1954, ten or twelve laboratories are actively engaged in studies of this nature.

The purpose of this paper is to describe briefly the means by which microbes are destroyed by ionizing radiations and to discuss the present-day status of these studies.

Relative Radiosensitivities of Various Forms of Life

During the past few years it has been shown that all kinds and types of microorganisms can be destroyed by ionizing radiations. Perhaps the most important single factor in the energy requirements in radiation sterilization is the radiation sensitivity of the particular species of microorganisms under consideration. The resistance of a given species of microorganism to ionizing radiations parallels, in general, its resistance to conventional heat processing.

The lethal doses of cathode rays for various microorganisms are indicated in Figure 1[8]. It will be noted that spore-forming bacteria are more resistant to ionizing radiations than non-spore-forming types and that mold spores are less resistant than bacterial spores.

Figure 2, based on examination of results reported in the literature, also presents some information on the relative radiosensitivities of various forms of life, indicating the dose levels of ionizing radiations required for various biological effects. In general, the lower the order in the plant and animal kingdom, the greater is the resistance of the organism to ionizing radiations.

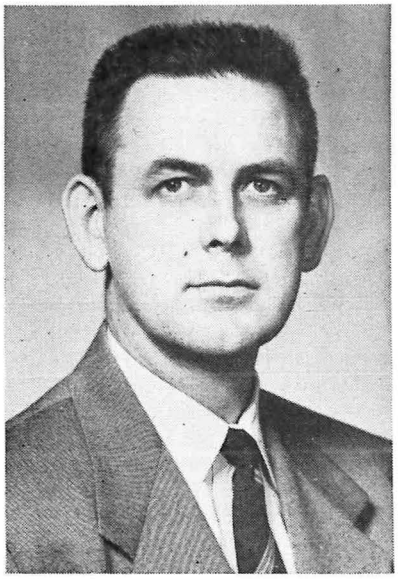
Mode of Action of Ionizing Radiations

As in the case of conventional heat processing, the destruction of microorganisms by ionizing radiations appears to be a first-order reaction. A number of investigators have shown that destruction of bacteria or of other single-celled organisms is effected by the passage of a single ionizing particle through or near the cell.[4] Such passage, which is called a "hit", causes ionization and the subsequent death of the organism.

With increase in the dose of ionizing radiations, the number of viable organisms decreases in a geometric progression. In other words, the survival curve is exponential, that is, the number of organisms that withstand a given exposure to ionizing radiations is an exponential function of dose. Accordingly, the number of organisms surviving a given dose may be calculated according to Eq. 1:

$$n = n_0 e^{-D/D_0} \qquad (1)$$

where the fraction surviving dose D is n/n_0 and where n_0 is the initial number of organisms, n is the number of organisms surviving dose D, and D_0 is the dose required to score an average of one hit per organism[4]. D_0 is conveniently defined as the mean lethal dose, the inactivation



William C. Miller, Jr. was born in Chester, South Carolina, in 1917. He is a graduate of Erskine College, Due West, South Carolina, having majored in science and mathematics. He did postgraduate work in public health at the University of North Carolina.

From 1940 to 1943, Mr. Miller engaged in county health work in Columbus County, North Carolina. In 1943, he was commissioned into the United States Public Health Service and assigned to milk sanitation activities in Tennessee. In 1944-1946 he was with UNRRA and saw duty in Egypt and Greece. After serving as Milk and Food Consultant in the Chicago Regional Office of the Public Health Service from 1946 to 1949, he was assigned to the Interstate Carrier Branch, Division of Sanitation, Public Health Service, Washington, D.C., to participate in the development of the series of handbooks relating to sanitation on interstate carriers. In 1951, he became a member of the staff of the Milk and Food Branch, Public Health Service.

Currently, Mr. Miller is assigned to the Department of Food Technology, Massachusetts Institute of Technology, for study and research in food technology and in applications of ionizing radiations to foods.

Contribution No. 183, Department of Food Technology Massachusetts Institute of Technology, Cambridge, Mass.

[1]Presented at the Fortieth Annual Meeting of the International Association of Milk and Food Sanitarians, Inc., Sept. 3, 1953, at Lansing, Michigan.

[2]Sanitarian (R), U. S. Public Health Service; assigned for research and study, Dept. Food Tech., Massachusetts Institute of Technology.

[3]Professor of Food Technology and Head of the Department of Food Technology, Massachusetts Institute of Technology.

[4]Assistant Professor of Food Technology, M.I.T.

dose, or the 37 percent dose ($e^{-1} = 0.368$).

This theory regarding the mode of action of ionizing radiations in the destruction of bacteria is known as the "direct hit" or target theory. This direct mechanism of destruction is recognized by the following criteria:

(a) the survival curve is exponential;

(b) destruction is independent of dose rate, that is, the effect of a given dose is the same whether the dose is administered rapidly or over a longer period of time;

(c) destruction is independent of temperature; and

(d) the concentration of organisms does not affect the percentage survival.

FREE RADICALS

Although the "direct hit" or target theory is thought to account for most bacterial destruction, some lethal action may be attributed to chemical effects caused by free radicals produced in the solvents that may be present[10]. For example, the reaction of high energy radiation in water may be illustrated as follows.

When water is bombarded by ionizing radiations, a positive water ion is formed and an electron is liberated.

$$H_2O \rightarrow H_2O^+ + e^- \quad (2)$$

The electron reacts with another water molecule and produces a negative water ion.

$$e^- + H_2O \rightarrow H_2O^- \quad (3)$$

The positive water ion dissociates into a hydrogen ion and a free hydroxyl radical.

$$H_2O^+ \rightarrow H^+ + OH^\circ \quad (4)$$

The negative water ion dissociates into a hydroxyl ion and a hydrogen atom.

$$H_2O^- \rightarrow OH^- + H \quad (5)$$

The hydroxyl radical is a strong oxidizing agent and will oxidize any oxidizable solute. The hydrogen atom is a strong reducing agent and will reduce any reducible solute. If no oxidizable or reducible solute is present, these free radicals may recombine to form water again.

$$H + OH^\circ \rightarrow H_2O \quad (6)$$

Knowledge of these reactions is of principal importance in an understanding of the side-effects that may be produced on the sterilized product.

TYPES OF IONIZING RADIATION

A number of different types of ionizing radiation and radiations that cause excitation are available for consideration. All types have destructive effects on microorganisms, but each has its own characteristics and limitations.

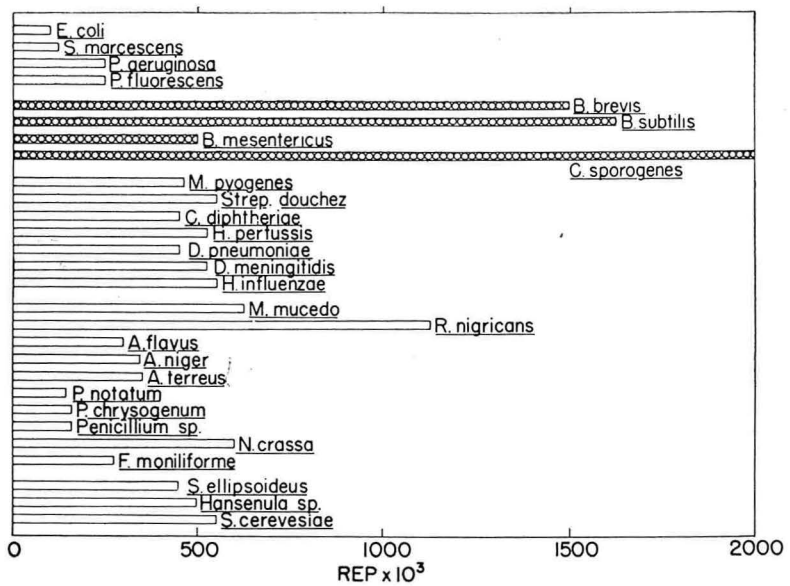


Fig. 1. Doses of cathode rays lethal to bacteria, molds, and yeasts. (Proctor and Goldblith, 8; reprinted by permission of *Food Technology*.)

Beta rays, which are streams of electrons emitted from a radioactive material, and cathode rays, which are streams of artificially accelerated electrons, have a somewhat limited power of penetration. However, the efficiency of cathode ray production is relatively high, for approximately 75 percent of the energy of the electron beam can be utilized, thereby effecting sterilization in a matter of seconds or fractions thereof.* Although cathode rays penetrate matter less deeply than X-rays of corresponding voltage, their range of penetration is of sufficient magnitude to warrant giving consideration to this type of radiation. The penetration of cathode rays into matter of unit density is approximately 0.5 cm per 1 m.e.v. of energy. Figure 3 indicates the ranges of penetration of cathode rays of different accelerating voltages into matter of unit density[15].

Gamma rays and X-rays, on the other hand, have a relatively great power of penetration into matter. X-rays are produced by the bombardment of a heavy metal target with cathode rays. However, only 3 to 5 percent of the electron energy is used in the production of X-rays. The remainder of the electron energy produces heat in the target. As a result, the sterilization of a No. 2 can of food, for example, would require from 10 to 20 minutes, even with a beam of high current. Hence it becomes questionable whether, with the present types of available equipment, the use of X-rays as a means of sterilizing foods is practicable.

The biological and chemical effects of X-rays are similar to those of cathode rays, and in neither case is any induced radioactivity produced except at voltages in excess of 15 million volts.[5]

Alpha particles are heavy particles consisting of helium nuclei. They produce dense ionization along their paths in matter and readily kill bacteria. However, alpha particles have little power of penetration into matter. In fact, they may be stopped by the thick-

*For greater efficiency in the use of cathode rays, solid food products may be treated by "cross firing", that is, by exposing the product to beams of electrons coming from opposite directions through two ports. This can be accomplished by splitting the electron beam and bending it electromagnetically or by using two accelerators located opposite one another. By "cross firing" with present-day machines, samples approximately one inch thick can be sterilized effectively.

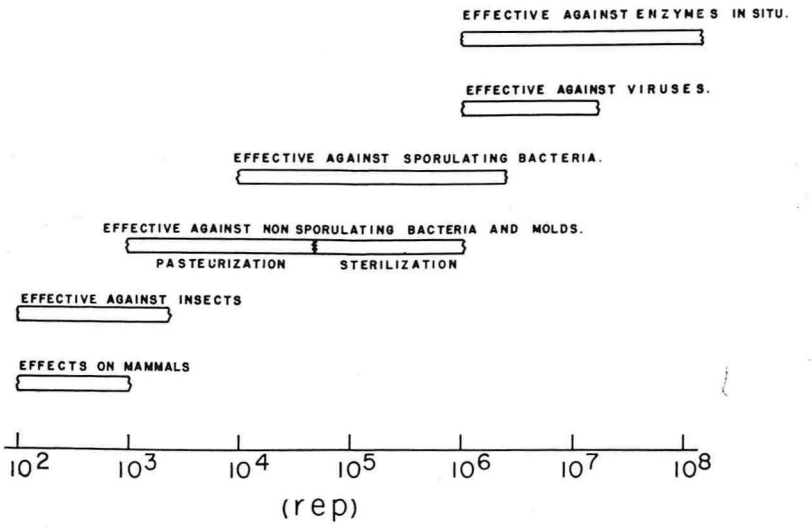


Fig. 2. Dose levels of ionizing radiation required for various biological effects. (Nickerson *et al.*, 7; Reprinted by permission of *Am. J. Pub. Health.*)

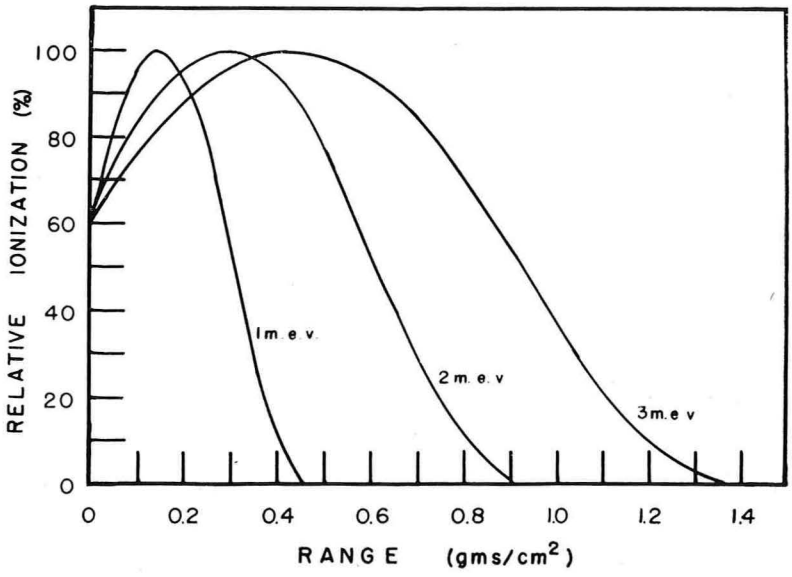


Fig. 3. Ranges of penetration of cathode rays of various voltages into matter of unit density. (Trump, Wright, and Clarke, 15; courtesy of Prof. J. G. Trump and *J. Appl. Physics.*)

ness of a sheet of paper and, therefore, should not be considered for the sterilization of foods.

Neutrons are unchanged subatomic particles. They have a relatively great power of penetration into matter. Because neutron production is extremely inefficient and because neutrons create induced radioactivity, this type of radiation does not appear feasible for food sterilization.

The inability of ultraviolet light to penetrate matter to any appreciable depth makes this type of radiation unsuitable for food sterilization under present-day considerations.

On the basis of the above considerations as well as on the basis of the present availability of sources of ionizing energy in the quantities required for sterilization, it appears that cathode rays are the only type of ionizing radiation possessing the three characteristics of efficiency, safety, and practicability. Gamma rays may hold promise for use in sterilization at some later date, dependent on the availability of adequate quantities of radioactive fission products.

Sources of Ionizing Radiations

The sources of ionizing radiations include both machines and radioactive isotopes. Among the cathode ray generators are the Van de Graaff Electrostatic Accelerator[14], the Capacitron[2], and the Resonant Transformer[3]. Generators with accelerating voltages of 3 m.e.v. are available today, which make possible the sterilization of solid food packs 1 inch in thickness. Generators of 4 or 5 m.e.v. may be available in the near future.

Other potential sources of ionizing radiations are the by-products of atomic fission that emit gamma rays. These fission products or isotopes retain a portion of the energy of fission and release this energy by radioactive decay. Until adequate technology for processing can be developed, these fission products have been stored in underground tanks as a part of the war-born expediency.

Problems To Be Solved

Present-day problems in the use of ionizing radiations for food processing are concerned both with the source of such radiations and with the effects of these radiations on the food product. All these problems are being subjected to intensive investigation. In any consideration of the industrial utilization of particle accelerators for sterilization, the reliability of the equipment as it relates to power output must be given considerable attention. Furthermore, accelerating voltages of the order of magnitude required to handle reliably conventional containers of foods have not as yet been achieved. In the case of isotopic sources of energy, there are problems to be solved in the preparation of these materials in megacurie quantities, in the obtaining of such materials in the appropriate condition of decay (or age) required for sterilization, and in the packaging of these materials so as to facilitate their safe use.

When sterility in food products is effected by ionizing radiations, undesirable flavor changes occur in many instances. The theory has been postulated that the flavor molecules in food are true chemical compounds. As indicated previ-

ously, when foods are subjected to ionizing radiations of high energy, hydroxyl radicals and free hydrogen atoms are produced. If a flavor molecule in a food is oxidizable, it can react with the hydroxyl radical present and produce an oxidized off-flavor. If, however, a compound is introduced into the food and such a compound shows a greater affinity for the particular radical involved than do the compounds already present in the food, the development of off-flavor may be obviated to a great extent.[10, 11] This is illustrated by the following formula, in which FRA means free-radical acceptor:

$$\text{Flavor molecule} + OH^{\circ} + \text{FRA (reduced)} \rightarrow \quad (7)$$
$$\text{Flavor molecule} + \text{FRA (oxidized)} + OH^{-}$$

Research has been instituted in which so-called free-radical acceptors have been used as a means of obviating flavor changes. Some of the results obtained have been encouraging. It has been found, for example, that ascorbic acid or vitamin C and its analogues will, in many cases, act as free-radical acceptors and prevent flavor changes in foods during and after irradiation.[11] Ascorbic acid is an illustration of one type of compound that, when added to food, would in itself have no toxic effect.

Studies are also being conducted on other methods of minimizing undesirable changes in irradiated products. These studies include observations on the effects of irradiation of foods in the frozen state and at low oxygen tension.[9] Studies have also been made on the use of extremely short pulses of cathode rays as a possible means of overcoming these changes.

Figure 4 shows the protective effect of D-iso-ascorbic acid in low concentration when the amino acid histidine is irradiated with cathode rays in the presence of this free-radical acceptor. Figure 5 shows the protective effect of sodium D-iso-ascorbate when an enzyme, crystalline pepsin, in acetate buffer is irradiated in its presence. Both pepsin and histidine are biochemical substances typical in foods.

A number of other factors must be studied before ionizing radiations may be used commercially for food processing. Toxicological studies must be made, preferably in collaboration with the various

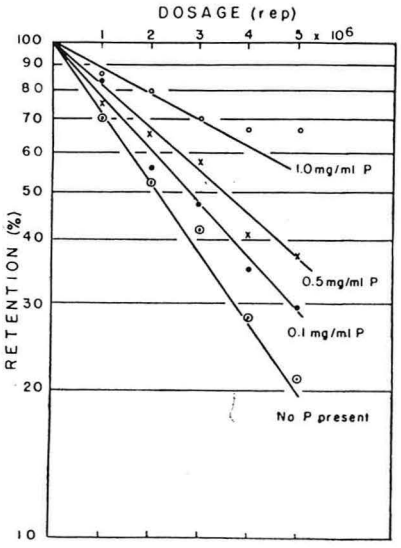


Fig. 4. Effects of cathode rays on aqueous solutions of histidine HCl (1.0 mg/ml) in the presence of varying concentrations of D-isoascorbic acid. (P is protector) (Proctor *et al.*, 11; Reprinted by permission of *Food Technology.*)

government regulatory agencies that would be concerned with the particular application. Studies must also be made to determine whether irradiation causes losses of the nutrient elements of foods and the effect that various storage temperatures have on the keeping qualities of irradiated foods.

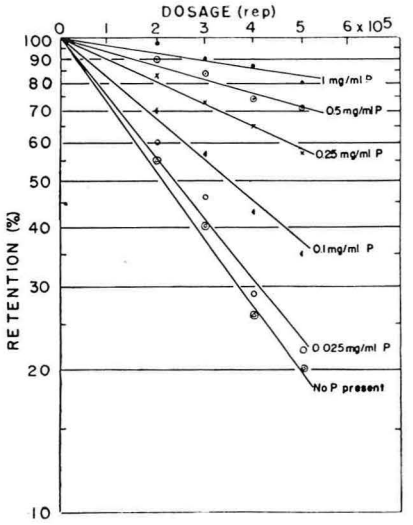


Figure 5. Effects of cathode rays on pepsin (1.0 mg/ml) in acetate buffer (pH 4.3) in the presence of different amounts of sodium D-isoascorbate. (P is protector) (Proctor *et al.*, 10; reprinted from *Nucleonics* April 1952; copyright McGraw Hill Publishing Co., 1952).

Although some studies on these factors have been made and are being made, the results obtained thus far do not offer conclusive answers to the problems mentioned in respect to all types of foods.

SOME DEVELOPMENTS IN RADIATION STERILIZATION

Investigations carried out at the Massachusetts Institute of Technology and elsewhere have shown that ionizing radiations are capable of killing any kind of microorganism in any medium or menstruum, and in any type of container, provided the physical dimensions of container and contents are within the practical limits of penetration of the particular type of radiation used.[7]

Successful sterilization of meat, fish products, vegetables, and spices[12] has been effected with ionizing radiations.[9] As mentioned earlier, however, a number of problems associated with the sterilization of these foods by ionizing radiations are still to be solved.

Liquefied whole eggs inoculated with three species of *Salmonella* have been successfully sterilized with ionizing radiations at a dose level of 300,000 rep.* No organoleptic preference was found between liquid eggs irradiated at this level and then spray-dried, and untreated liquid eggs that had been spray-dried.[13]

A number of investigators have shown that milk can be pasteurized by comparatively low doses of high-energy cathode rays.[9] However, milk and milk products appear to be extremely sensitive to ionizing radiations, and irradiation of these products is frequently accompanied by undesirable changes in flavor.

Insects are relatively sensitive to ionizing radiations. They can be killed by doses of less than 100,000 rep, and their reproduction is prevented with even lower doses.[7] The elimination of insect infestation in grain by application of ionizing radiations may prove economically feasible.

Trichinae in pork can be destroyed with low doses of high-voltage cathode rays.[1]

In addition to these applications related to foods, investigations indicate that ionizing radiations may find service in the cold

sterilization of heat-labile drugs and biologicals, in the sterilization of blood, and in the sterilization of human organs for subsequent transplant. The Department of Food Technology at the Massachusetts Institute of Technology has been cooperating with surgeons at the Harvard Medical School with respect to this latter application.[6] Aortae sterilized in this manner have now been successfully transplanted into human beings. Today approximately twenty persons have had sections of their aortae replaced with tissues that were removed from fresh cadavers and sterilized with ionizing radiations.

If the present-day knowledge of radiation sterilization of foods is compared with what was known five years ago, it is apparent that considerable progress has been made. Much research is yet to be done, however, before food processing with ionizing radiations becomes an industrial reality. Studies on the fundamental mechanism of the action of ionizing radiations on foods and food components are being continued, in an effort to determine the cause of undesirable side effects and the means of preventing them.

*This expression "rep" is the density of energy, equivalent to 93 ergs absorbed by 1 gram of ordinary tissue.

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ABSTRACTS OF PAPERS

Continued from Page 158

and efficient for the 20-year period. To get this type of service from a hardening room it must be constructed correctly from the very beginning. Detail description of the building of a hardening room to last not only 20 years but longer was given. First described was the construction of the outer walls—the thickness, type of materials to use, and how to build them. Similar details followed for the floor and other parts of the hardening room. The heaving of floors in hardening rooms was discussed and also the three different types of construction that may be used to avoid heaving. After the details of constructing the shell were given, the best type of insulation for the floors, walls, and ceiling were given and finally a discussion of the different types of doors available and the ones that give the most satisfactory service.

A bound book containing mimeographed copies of the original papers reported in these abstracts may be obtained by sending a check, money order, or draft for $1.50 to Dr. Carl W. Hall, Dept. of Agricultural Engineering. Michigan State College, East Lansing, Michigan.

MARKET MILK CONFERENCE PURDUE UNIVERSITY

Lafayette, Ind., April 13. About 95 percent of all fluid milk sold in Indiana today is Grade A pasteurized milk, John Taylor, dairy division director of the Indiana State Board of Health, said Tuesday at Purdue University.

He told more than 85 dairy plant operators and dairy products manufacturers at a Market Milk Conference that this top quality milk is being inspected and supervised by cities operating under Grade A milk ordinances.

Taylor went on to say that current proposals in Indiana call for dairy farm and dairy plant sanitarians to be licensed so they can offer relief to dairies outside the jurisdiction of cities having Grade A milk ordinances. They would help dairies to qualify their supplies and label their products Grade A. He also thought the time was drawing near when other products such as ice cream may be made from inspected products and qualified for labeling as Grade A.

G. P. Gundlach, president of G. P. Gundlach and Company, Cincinnati, Ohio, said that dairy products offer one of the greatest food bargains today for the 41 million housewives who are trying to buy food for their families at the lowest possible price.

Speaking on the preparation of cultured buttermilk, Dr. C. E. Parmelee, of Purdue's dairy department, told dairy plant operators that the incubation temperature for this product should be maintained at 70 to 72 degrees F. to keep the culture organisms in balance and to produce a fine flavor.

Other speakers on the Tuesday program were Dewey Shaw, of Kraft Foods Company, Chicago; C. E. French, Purdue agricultural economist; and members of the Purdue dairy department staff.

The milk conference was held in cooperation with the Indiana Dairy Products Association.

A SYMPOSIUM ON EXTRANEOUS MATTER IN FOODS

FORWARD

An informal meeting of food technologists was held by the Department of Plant Sciences of Syracuse University at Syracuse, New York, on January 11, 1952. The meeting was organized by J. D. Wildman. It was held to discuss problems of extraneous matter in foods. While considerable time has elapsed since the meeting, it was felt that a brief presentation of the papers would be of interest to other workers in the field. The papers which follow reflect, but do not necessarily follow exactly, the talks given at the meeting.

AIDS TO INSTRUCTION IN MICROANALYTICAL METHODS

HOWARD R. SMITH
Research Laboratories, National Canners Association, Washington, D. C.

This article describes three procedures: (1) a method for preparing permanent mold count slides; (2) a method for preparing permanent insect fragment slides; and (3) a method for preparing test fragments to study extraction procedures.

(1) *Permanent Mold Count Slides.*

In 1953[1], the writer described a procedure for the preparation of permanent aqueous microscopic mounts, including those for mold count instruction. The procedure described has been improved by a slight modification of technique. If glycerine is added to the sample used in making the mount, there is a marked reduction in the tendency for the sample to dry out, and the sample on the mount is more firm and less liable to damage. Directions for making the mounts now are as follows:

> The pattern slide is made as previously directed. A small amount of U.S.P. Glycerine jelly is warmed on a steam bath and mixed with an equal volume of a tomato products sample, such as tomato puree or catsup. This mixing should be done carefully so as to avoid the incorporation of air bubbles. A large drop of this mixture, while still warm, is put on the pattern slide. If air bubbles are present they should be pushed to the edge of the sample with a needle. Finally, with the sample drop somewhat mounded at the center, a microscopic cover slip is put in place carefully and pushed down gently so as to leave the sample at the desired thickness. The sample mixture is still fluid at this stage and the slide must be left in a horizontal position for at least 24 hours. The excess sample around the edges of the cover glass can, then, be removed with a damp cloth. A seal of colorless nail polish is placed around the edges of the cover glass. The slide can then be washed with soap and water and polished with a dry cloth. Such slides have been used for three years and are still in good condition. They can be shipped through the mail and handled with ordinary care without danger of distortion. The examination of the sample and the special report sheet to be used are as described in the previous article[1].

(2) *Insect Fragment Slides.*

The pattern slide used as described above may also be used to indicate the positions of each of 25 individual fragments to be identified on a single slide. Microscopic fragments of known source are selected for study. Greatest benefit is obtained if fragments are selected because of their difficulty of identification. It is well to put on the same slide fragments both of animal and of vegetable origin, making a careful note of the identity of each fragment on each slide. The fragments are mounted on the pattern slide as follows:

> Place a very thin film of Canada balsam over the top of the pattern slide. Allow this to dry somewhat until it is distinctly tacky. Place the test fragments, one at a time, in the designated circles. After some further drying, add a small drop of Canada balsam over the entire mass and press out under a second cover slip carefully so as to avoid moving the fragments. Allow the slide to dry thoroughly before handling so that the fragments will not be moved. Prepare a report sheet to record the results of particularly designated fragments. Such slides have been found to be permanent and have been used over and over by analysts in different parts of the country. Some analysts have found difficulty in identifying the fragments because they have not been able to touch them and turn them over in their examination. However, this slide may be turned over and examined from the bottom as well as the top. Analysts quickly become impressed with the degree of care which must be used in the identification of questionable fragments, and after examining a few such slides have no further difficulty.

(3) *Test Fragments for Use in Studying the Extraction Procedures for Insect Fragments in Comminuted Products.*

The A.O.A.C. method for testing of products for the detection of insect fragments calls for mixing the sample with some gasoline or oil, trapping off the oil or gasoline layer, and after filtering on a filter paper, counting the number of fragments on the paper. Such fragments as are found unquestionably come from the product, but there has often been doubt as to what proportion of the fragments present are recovered by such a procedure. Experienced analysts in different sections of the Country have appeared to get different degrees of recovery. These differences persisted to the point that it appeared certain that there were differences in technique which resulted in different degrees of recovery. Finally the method itself was studied in our laboratory by adding to the test sample known numbers of test fragments. The test fragments were added directly to the sub-division used for analysis, variations due to sampling thus being eliminated.

Difficulty was experienced in finding suitable test fragments. Pieces of chitin, or wings, or other appendages, were fragile and broke easily so that the absolute number could not be assured. Finally it was found that the outer skin of the corn ear worm was a osurce of suitable test fragments. This very thin, outer skin is tough like a thin piece of leather and yet extremely small fragments exhibit characteristic structures which permit positive identification. The skin was cut with a microtome, into strips about 0.2 mm wide, and these strips were further cut crosswise into small parallelograms. This last cutting was done by hand with a sharp scapel, under a Greenough microscope. The number of such fragments was counted at the time they were cut off and these were added directly to the subdivision to be examined. The size of these pieces was such that they were discovered on the paper with reasonable ease by an experienced analyst and still were small enough to be of the order of magnitude of the fragments found in comminuted food products.

A definite measure of the efficiency of the extraction procedures

was obtained by the use of such test fragments. Certain analysts using a particular technique within the A.O.A.C. general procedure were able to get practically all of the fragments back. Other analysts using different technique got a very much smaller proportion of the fragments from each sample. There was, clearly, a real difference in the efficiency of extraction of different analysts using the same general procedure. Finally, a conference of analysts resulted in identification of the features of technique essential for efficient recoveries, and, when experienced analysts were trained to use the technique agreed upon, all were able to get satisfactory recovery of test fragments.

Using such test fragments, it is now possible to try out any desired variation in technique or analytical procedure.

A few precautions are necessary regarding the preparation of the test fragments. The very thin worm skin must not be mounted in paraffin because such mounting destroys the wettability of the fragments, and thus destroys their usefulness. The whole skins or the strips may be separated and kept in water until needed for use. It is very difficult to handle them when they become dry. In cutting the strips into the final fragments, a single strip is put on a microscope slide with a drop or two of water and the fragments are kept in water at all times.

[1]Smith, H. R., Permanent Aqueous Microscopic Mounts. *Ind. Eng. Chem. Analytical Ed.* 7, 286, (1935).

(Note—A more detailed account of making this determination will appear in a paper entitled "Instruction in Microanalytical Methods" which will be published in an earl issue of the *Journal of the Association of Official Agricultural Chemists.*

THE APPLICATION OF AN EXISTING AOAC* METHOD TO COMMERCIAL CONDITIONS

M. L. KUBOVCIAK
Foods Laboratory,
Beech-Nut Packing Company,
Canajoharie, N. Y.

In a food processing plant such as ours, with large tonnages handled each day, it has been necessary to standardize on a working outline in order to secure an adequate sampling and control program. The control of the sanitary condition of spinach is described below as an example of this procedure. In the microanalytical examination of spinach the official method of the Association of Official Agricultural Chemists is followed. Certain modifications of the AOAC method will be mentioned later.

We begin our testing by assigning each incoming load of raw material a number. This number is used on the particular load in question from the time of arrival straight through to the finished product. Thus, we are able to make positive identification of each load through all stages of processing. Our spinach procedure may be broken down into 3 major steps.

Step 1. From each incoming load of raw spinach, we prepare a 100-gram sample for actual trap flask recoveries. This sample is obtained by collecting individual handfuls of spinach throughout the load, mixing them together, and then taking 100 grams from this composite. In the cane of raw spinach, we cut the leafy material with scissors and place it in the Erlenmeyer flask along with 100 ml of hot lead acetate solution, (AOAC) 10 ml acetic acid, and 200 ml of hot water.

The flask is then placed on an electric hot plate and allowed to boil for approximately 10 minutes. We use the so-called "California-type" stirrer in our recovery procedure. While boiling, this stirrer is suspended within the neck of the flask by a clamp. After boiling, we add a mixture of 70% light white mineral oil and 30% white gasoline and stir for approximately 2 minutes employing a gentle swirling motion. We then fill the flask with deaerated water and allow it to stand for 30 minutes, stirring and "scraping" the sides of the flask at 10-minute intervals. The general theory regarding this phase of the procedure is that the insect fragments will become coated with this oil-gas mixture. This oil-gas phase is then trapped off, filtered, and the filter paper examined under a Greenough-type 'scope at 20-30 diameters magnification.

Counts obtained from each raw sample are recorded on a special sheet provided for that purpose. We sub-divide our total counts into whole insects and fragment parts.

Step 2. As soon as material from a raw load has been through our washing process, we obtain a 100-gram sample of the washed material and test it immediately as a control on the efficiency of washing.

Step 3. Finally, a third series of extractions are performed in our laboratory on the finished product to further insure and corroborate our Step 2 finding.

Using the standard AOAC method, Step 1 is performed at least once on each incoming load, at which time the original load number is assigned. If time permits, additional composite samples are collected and examined. Step 2 is performed at half hour intervals, so that frequently we are able to check the effectiveness of the washing procedure several times per load. Step 3 is performed every 15 minutes, thus furnishing us a more than adequate check on the finished product.

In addition to performing the standard AOAC procedure on all three steps of our operation, we have developed several new techniques. To date, results obtained from these latter methods appear very encouraging.

One of the new variations has been to induce a vacuum in the flask before filling it with water in order to remove as much of the air as possible prior to the addition of the oil-gasoline mixture. In some instances, this has been of considerable value where the present AOAC method proved unsatisfactory. By using the vacuum principle, we have been able to eliminate the lead acetate boiling portion of the present method. We have also experimented with the use of detergents which seem to aid in obtaining a clear filter paper. We have also tried out both anionic and cationic wetting agents, but for the most part, these did not appear to be very effective.

The above schedule requires the services of several full time technicians plus many assists from other personnel along the entire processing line. That is the one main reason why we have felt that some new techniques should be developed in order to shorten the actual working time. With a more practical method, the gain in time over the existing procedure could be applied to making recoveries more frequently thus assuring the packer of a better, higher quality pack.

*Association of Official Agricultural Chemists.

THE NEED FOR SIMPLIFIED EXTRACTION PROCEDURES IN CONTROL WORK

LEROY V. STRASBURGER
Strasburger and Siegel,
Baltimore, Maryland

It is expedient at this time to consider just what is meant by simplified procedures and by control work. Simplifying a procedure means to make it easy, or to render it free from complication. This should infer an increase in the rapidity of completion of the operation and a subsequent reduction in man hours expended. Control, according to the dictionary means to

exercise a directing, restraining or governing influence over, to verify or to rectify. In this instance the reference is to control the quality.

We are prone to speak rather loosely of quality control. Is it a cover up for production, a succession of useless motions and exertions, a series of reports that are quickly buried in the files, or does it imply uniformity of product with line shutdowns for correction and improvement when necessary? It may mean either. The choice lies with management.

Any worthwhile control of quality must govern all influencing factors. It must keep the finished product within acceptable tolerances, rectifying the influence of ingredient variation. This can only be done during the actual course of manufacture and not after processing and packaging. So-called control examinations made at this level are only spot checks to determine conformity with manufacturing, trade or government specifications.

Production facilities in the food industry are reaching higher levels each year. Packaging equipment is not yet operating at supersonic speeds but it is not abnormal for a single can-closing machine to double seam in excess of four hundred cans per minute. The increasing dollar value of product handled per minute or per day is a mandate to food technologists to keep actual control measures apace of production.

The methods currently in use for determining the presence of extraneous matter in foods were formulated largely by the microanalysts and chemists of the Food and Drug Administration. It is the responsibility of this organization to police the food industry and where necessary to take violators of the law into Federal Court. They must show that the food which was detained may have been contaminated. The analyses incident to prosecution must be carefully made. All possible insect eggs, insect feces, insect parts, whole insects, rodent hairs, and rodent pellets must be recovered, identified, and recorded. Accuracy, and not time, is of the essence.

A rapid glance through the 1950 edition of the A.O.A.C.* will give some indication of the time that is involved in various recovery steps. Instructions call for digestions ranging in length from one hour to over-night, heating for 30 minutes and upward, boiling for 20 minutes, stirring for 15 minutes, settling for 15 minutes, standing for 30 minutes to one hour, trapping, retrapping and then trapping again. The time consumed in many of these operations bar them from being used for actual quality control.

It is incumbent then for all interested parties in industry, in educational institutions, in enforcement and in regulatory work to direct their thoughts toward means of simplification. This involves a possible reduction in the number of preparation steps, the substitution of other tools or equipment for those now prescribed, and a possible mechanization of some steps now carried out manually.

The availability of trained personnel is a problem that is currently causing industry many headaches. In our own operation we have been able to train technicians to carry on the preparation and recovery procedures, leaving the actual reading of plates to skilled microanalysts. At times, necessity has caused our operation to reach production line proportions, so our interest in simplified procedures is more selfish than casual. Accuracy must be coupled with all possible speed. Many clients who submit samples for analysis today expect the results yesterday. With industry, speed is of the essence.

For actual control of batch operations, the time required for making a determination of extraneous matter should be less than that consumed in preparing and packaging that batch. In most instances this is an ideal which is not currently attainable. Where such determinations fall behind production and become periodic checks of a lot of cans, jars, or packages a question often arises with management concerning the disposition of questionable or borderline lots.

For a number of years I have visualized the feeding of aqueous suspensions of food products into a continuous operating centrifugal and obtaining an immediate separation of light and heavy filth. In the summer of 1951 we devised a rotating funnel for use in recovering the eggs and larvae of the fruit fly from tomato products. Although the eggs settled rapidly, so did the tomato fibers. The method was discarded but the information obtained from its use led to a new procedure which is more rapid than the standard A.O.A.C. method and less expensive to use.

I am still naive enough to believe that most of the preparation steps in the recovery of extraneous matter can be speeded up and in some cases mechanized. To those of you in the educational field I suggest that you bring this requisite of industry to the attention of your students. Many of our worthwhile inventions and discoveries have been made by men in their twenties who are completely uninhibited by the bounderies of thought that are so often acquired in maturity. Meanwhile those of us actively engaged in the field will continue our quest for simplicity.

*Methods of Analysis of the Association of Official Agricultural Chemists.

EXTRANEOUS MATTER PROBLEMS FROM THE MANUFACTURER'S VIEWPOINT

EUGENE N. BILENKER*
Quaker Maid Co., Inc., New York, N. Y.

SUMMARY

Extraneous matter in foods is a very serious problem affecting every branch of the food industry. It is expensive with regard to the damage to raw materials in storage, in manufacturing operations, and in the packaged product. The occurrence of infestation in a grocery item has the double-pronged effect of possible liability to government prosecution and loss of consumer confidence. These are reasons enough for each food manufacturer to be deeply concerned with all factors relating to extraneous matter.

Tolerances for extraneous matter in foods are not provided for in the Food, Drug, and Cosmetic Act. In such items as spices, for example, it is difficult for the food manufacturer to determine what the government considers maximal extraneous matter. The situation is complicated further by AOAC methods which yield variable results.

Further standardization of certain AOAC methods is necessary.

*Present address, Dept. of Food Technology, Massachusetts Institute of Technology.

The impetus for achieving this should originate with those whose daily concern it is to control the purity of foods. The sensitivity of the subject militates against individual initiative, and this implies the need for a representative body to articulate problems as they arise.

This Syracuse Conference has demonstrated its potential and it should develop into a full-fledged organization which represents all those concerned with extraneous matter in foods. It should be a clearinghouse for all information on the subject, and should be the intermediary between government and industry in seeking out improved analytical methods which would be incorporated in clearly defined tolerances.

ESTABLISHMENT OF RELIABLE METHODS FOR ADOPTION BY AOAC AND APHA ORGANIZATIONS

A. H. ROBERTSON

Department of Agriculture and Markets, Albany 1, New York

SUMMARY

Before analytical procedures are recognized by the Association of Official Agricultural Chemists or by the American Public Health Association, it is essential that chemists, bacteriologists, and other analysts using different pieces of equipment in other laboratories be able to obtain practically identical determinations on subdivisions of the same food and other materials. Recognized test procedures begin with a newly conceived or an improved idea for an analysis. No attempt is made to retain any procedure when the worthiness of an improved procedure can be demonstrated.

The sponsor of an improved method demonstrates to his own satisfaction that his method is reasonably reliable and also, if possible, that by adding a known quantity of a test substance to certain foods, he can recover at least 90 to 95 percent of the material added, and interferences will not cause the recovery to exceed 100 percent by more than 5 percent. The next step is to determine whether other analysts can interpret the sponsor's directions and can succeed equally well in recovering quantitatively the added ingredient in several test samples, which are usually prepared by a referee before submitting subdivisions of each to collaborators without pre-informing them of the amounts added.

The above routine for establishing the worthiness of analytical procedures has been followed by the AOAC for many years. The value of such systematic testing is recognized also by bacteriologists who are required to establish the reliability of bacterial density and other determinations in dairy and other food products.

The establishment of reliable methods for quantitatively recovering extraneous matter in foods involves a different approach because of the insoluble character of separate pieces of matter and the consequential difficulty of distributing the foreign material uniformly in the food. This distribution is distinctively different from that where soluble chemicals can be incorporated uniformly throughout mixtures. Despite the insoluble character of finely distributed extraneous matter in foods, collaborative work has demonstrated that quantitative recoveries of foreign matter can be made with a high degree of success by careful and well trained analysts. In addition to emphasizing this application of quantitative methods to extraneous matter in foods, attention was directed to the responsibility of the analyst to be certain of his determinations because he may be required to defend them in case the owner of the food elects litigation.

Methods of analysis which have passed the censor of the AOAC and of the APHA and are recognized in their respective official publications are commended for their reliability.

THE EXTRANEOUS MATTER FIELD AS A SCIENCE

J. D. WILDMAN

Department of Plant Sciences, Syracuse University, Syracuse, N. Y.

The actual papers and the discussions which took place at the conference showed plainly the position of the person who is called upon to deal with extraneous matter problems. Certain difficulties must be met. The worker must apply several sciences to his work. He must be in part a chemist, bacteriologist, entomologist, mycologist, and botanist. The Civil Service Commission may classify such a person as a microanalyst but there are objections to this name. Ideally, this person must be more than a proficient microscopist for basically he must understand the problem of the source of undesirable materials in foods. He must be a field man and a sanitarian and then a microscopist.

Many, if not most, of the recovery procedures employed by the "fieldman-sanitarian-microscopist" are empirical in nature. Because of this, several factors may influence his results. In variability of results, he finds himself between the chemist who has materials in solution and the bacteriologist who works with large numbers of organisms. As a matter of fact, Dr. Robertson in his talk would seem to have left a niche for this worker. It would fall somewhere between the bacteriologist, represented by the "APHA", and the chemist represented by the "AOAC".

To the difficulties mentioned above we must add the very great difficulty of finding proper expression for the results of research work in the field. The logical end for research is, of course, adoption in practice, but publication of results is needed as a basis for progress. If we consider the science in question to be the broad one of the relation of field and factory conditions to the results of the microscopical tests, we find that much work done by commercial concerns and government laboratories is never published.

In fact, published results of investigations, in which the visible and obvious condition of the prepared raw material is related to the results of extraneous matter tests made on the finished product, are not numerous. Such studies are very valuable especially when they are concerned with the possibility and practicality of controlling or eliminating the field or factory condition which has introduced extraneous matter into the food.

Another difficulty encountered by the "fieldman-sanitarian-microscopist" is that when he has achieved proficiency in his work he is still without a set of standards. There are no official "tolerances for filth". What can the food industry microscopist do? The answer to this important problem is that it is the job of industry to set its own standards through the efforts of the "fieldman-sanitarian-microscopist".

In spite of the difficulties

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SYMPOSIUM ON EXTRANIOUS MATTER

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mentioned, the writer ventures the opinion that the field is a "science", that it should be the whole field of the control of cleanliness as aided by the extraneous matter tests, and that the tests should be in such order that correlational results will be helpful to industry and government and finally that such correlational results should be published.

COORDINATING THE DAIRY INDUSTRY

Continued from Page 155

3. The consumer expects and has every right to expect the same results.

4. How else can we get the job done than by coordinating our efforts, pooling our resources, and speaking the same language.

95% OF ALL MILK USED IN FAMOUS NESTLÉ'S PRODUCTS is filtered through *Perfection* DUBL-CHEM-FACED MILK FILTER DISCS

... *says* GEORGE L. MOSS, *Nestlé's District Field Supervisor*

... regarding our use of DUBL-CHEM-FACED milk filter discs:

We have used this disc for our patrons since they came on the market a number of years ago and we have had good results in all cases.

The disc itself is strong and does not "wash" as some other makes of discs do. The plastic faces on both sides of the disc not only filter but also reinforce the disc just as gauze on both sides does, yet gauze does not filter milk...only holds the cotton together.

Ninety-five percent of all the milk we buy is filtered through Perfection DUBL-CHEM-FACED Milk Filter Discs.

Another redeeming feature of this disc is the cost. It is much cheaper than the gauze-type disc. Since we advocate filtering not more than 10 gallons of milk through one disc, no matter what the make, we could show the dairy farmer that he really gets more for his money by using this improved disc after we decided to supply our patrons with Perfection DUBL-CHEM-FACED discs.

Yours very truly

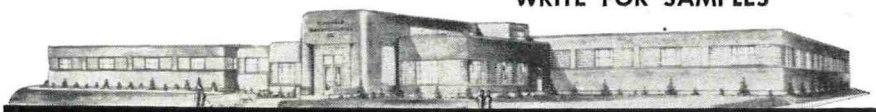
George L. Moss, District Field Supervisor
The Nestlé Company Inc., Marysville, Ohio.

3 filters* IN ONE *at less cost!*

***1 - The TOP face FILTERS...**
2 - The CENTER area FILTERS...
3 - The BOTTOM face FILTERS...

TO PROTECT MILK QUALITY see that your producers use *Perfection* DUBL - CHEM - FACED MILK FILTER DISCS always!

WRITE FOR SAMPLES



SCHWARTZ Manufacturing Company • *"Perfection in Filters"* • TWO RIVERS, WISCONSIN

HYAMINE makes odorless, non-irritating, chemically stable sanitizers

In meat packing plants the preferred way to clean meat cutting tables is to remove greasy residues first with an alkaline cleaner containing TRITON X-100, a Rohm & Haas non-ionic detergent. Then apply a HYAMINE sanitizer which reaches germ breeding places; maintains activity against organism growth.

The use of HYAMINE in commercial, hospital and public automatic laundries has grown steadily. HYAMINE is not irritating to the skin. It is absorbed and held by textile fibers, and provides residual antiseptic activity, helping to prevent ammonia dermatitis (diaper rash). The HYAMINE held by the fibers acts as a barrier against contamination—a safety factor *not* provided by chlorine or live steam alone.

HYAMINE and HYAMINE-TRITON cleaning compounds are preferred *for janitorial work* in hospitals, schools, and buildings of all types. Cleaning personnel like the quick-acting, dirt-removing action of TRITON detergent. They appreciate the odorless, non-irritating qualities of HYAMINE solutions. Institution and building managers profit from the versatility and fast, germ-killing cleaning activity of HYAMINE-TRITON sanitizers.

Good sanitation procedures and healthy cows are *both* necessary to produce good milk. Cleaning is easy and fast when detergent-sanitizers containing HYAMINE and TRITON are used. These compositions have consistently helped farmers produce low bacteria-count milk. Reports on field trials and on the wide-spread use of HYAMINE-TRITON detergent-sanitizers on dairy farms will be sent at your request.

Soda fountains, restaurants, bars and cafes find HYAMINE-formulated compounds effective and low-cost sanitation aids. Glassware, dishes and silver are protected against bacteria when sanitizers containing HYAMINE are added to the rinse water. Workers like sanitizing solutions based on HYAMINE because they are odorless and do not irritate the skin. HYAMINE germicides are effective bacteria killers over a wide range of water temperatures. They withstand long exposure to high temperatures without decomposing or volatilizing.

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

You'll Be Years Ahead with the New FACTORY-SEALED MILKEEPER

BULK FARM COOLING TANK

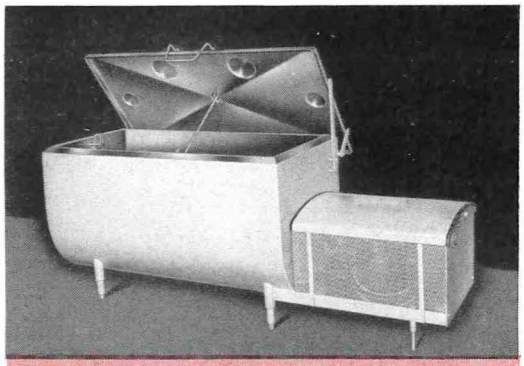
It's as Trouble-Free and Fully Automatic as the Most Modern Home Refrigerator!

For the first time, here is a direct expansion bulk farm cooling tank with a refrigeration system that normally requires no maintenance and no attention! Just like your home refrigerator, the entire refrigeration system, including the compressor, is hermetically sealed and then tested at the factory. There's no special installation needed—hook it into any suitable power source and the unit is ready to go.

For your patrons the new CP Factory-Sealed Milkeeper means continuously care-free cooling and holding with maximum safeguards for their milk.

For you it means automatic protection for the quality of your milk at the source.

Ask your CP Representative or write for Bulletin No. B-1020.



CP Factory-Sealed MilKeepers are available in 150, 200 and 250-gallon sizes. 200 and 250-gallon sizes have side opening covers; 150-gallon size has end opening cover.

LARGER MILKEEPERS—FROM 300 TO 1000 GALLONS—ARE AVAILABLE FOR USE WITH SEPARATE CONDENSING UNITS

Gives You All These Famous CP MILKEEPER Features

- Ample refrigeration surfaces for fast cooling and safe holding
- Slow speed agitator for thorough, gentle agitation
- Minimum compressor running time and power consumption
- Stainless steel interior designed for easiest cleaning and highest sanitation
- Durability for years of economical service

Many Uses In Processors' Plants, Too

CP MilKeepers can be used to hold incoming raw milk; as balance tanks ahead of bottle fillers; for cooling and holding buttermilk, chocolate milk, water ices, sherbets and mix.

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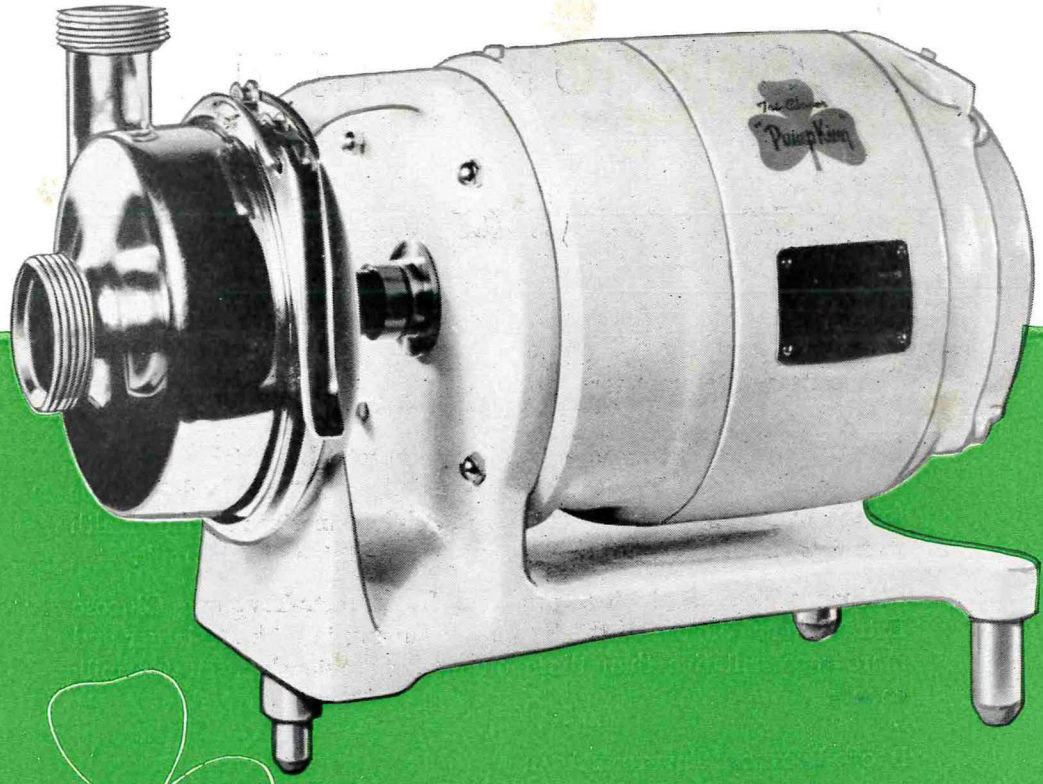

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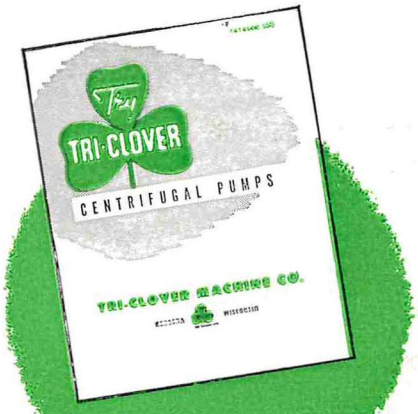
. . . and here are some of the reasons why: (1) *Wide choice of seal types, tested and proved for specific applications;* (2) *Design and manufacture that actually exceeds 3A sanitary standards;* (3) *Streamline heads—faster assembly and disassembly—easy to clean;* (4) *Patented impeller—higher efficiency—minimizes foaming action;* (5) *Pump heads can be turned full 360 degrees—simplifies installation.*

These are just a few of the advantages you get when you specify TRI-CLOVER Centrifugal Pumps. These modern, high efficiency units are backed by years of specialized experience, and are available in a full line of sanitary and industrial types to meet practically every corrosion-resistant pump requirement.

Let our experienced engineering staff help in solving your pumping problems.



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CULTURE MEDIA

for Examination of Milk

BACTO-PLATE COUNT AGAR
(Tryptone Glucose Yeast Agar)

is recommended for use in determining the total bacterial plate count of milk in accordance with the new-procedure of "Standard Methods for the Examination of Dairy Products" of the American Public Health Association. This medium does not require addition of skim milk.

Upon plates of medium prepared from Bacto-Tryptone Glucose Extract Agar colonies of the bacteria occurring in milk are larger and more representative than those on media previously used for milk counts.

BACTO-PROTEOSE TRYPTONE AGAR

is recommended for use in determining the bacterial plate count of Certified Milk. The formula for this medium corresponds with that suggested in "Methods and Standards of Certified Milk" of the American Association of Medical Milk Commissions.

BACTO-VIOLET RED BILE AGAR

is widely used for direct plate counts of coliform bacteria. Upon plates of this medium accurate counts of these organisms are readily obtained.

BACTO-BRILLIANT GREEN BILE 2%

BACTO-FORMATE RICINOLEATE BROTH

are very useful liquid media for detection of coliform bacteria in milk. Use of these media is approved in "Standard Methods."

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