JOURNAL
of
MILK TECHNOLOGY

Volume 2 | May, 1939 | Number 3

Editorials

The opinions and ideas expressed in papers and editorials are those of the respective authors. The expressions of the Association are completely recorded in its transactions.

An Institute to Appraise Equipment Performance

Many papers and committee reports have been presented at meetings of milk dealers, ice cream manufacturers, milk sanitarians, public health engineers, and health officers, describing the application of new control procedures or the performance of new dairy plant equipment. A survey of any milk equipment exposition reveals the great differences of opinion as to the kinds of equipment that are believed to be the best for handling certain operations. Manufacturers of dairy machinery, concerns furnishing laboratory apparatus and materials, and producers of various supplies make strong claims as to the excellence of their products in the fields of their respective applications. However, the determination of compliance is left to the individual judgment of each purchaser, interested milk sanitarian, or control official.

The Committee on Sanitary Procedure of the International Association of Milk Sanitarians, in collaboration with the trade associations, is expected to reduce much of the confusion (1, 2, 3). However, its work as now projected lies in the field of only designating the *principles* that should be incorporated in design. It calls attention to needed developments. It "accepts" designs of construction. However, it does not attempt to specify details. It is unable to determine performance and degrees of compliance with claims of manufacturers. The judgment of experts is highly desirable to point out existing needs, to indicate where new developments are necessary, and to generalize on design. Their work would be greatly facilitated, however, and their findings far more authoritative if physical means were provided for determining whether particular equipment and supplies actually do comply with the claims of their producers.

Such a service should not in any way conflict with the work of laboratories engaged in research on dairy equipment, as for example, the engineering laboratory for dairy equipment research in the National Institute of Health. These latter serve as valuable sources of information for the above committee. When these laboratories are governmental, they usually are not authorized nor are they interested in undertaking performance studies on all pieces of equipment that are offered, and in issuing certificates showing the degree of compliance with published standards. The same principle which now is used in certifying colors for use in foodstuffs should be more widely applicable in certification of bacteriological culture media, incubators, and other laboratory supplies. The service would show whether any product does or does not meet accepted standards. The claim of a manufacturer that his model of pasteurizer does embrace the accepted *performance* specifications should be subjected to proof in an engineering laboratory. Such an institution should be sponsored by the International Association of Milk Sanitarians, and its operations directed by the Committee on Sanitary Procedure.

England has its National Institute for Research in Dairying, at Shinfield, Reading. Scotland has its Hannah Dairy Research Institute at Kirkhill, Ayr. Germany has its Dairy Research Institute at Kiel. Here, all kinds of dairy equipment are subjected to thorough test, and official reports are published, somewhat in parallel to those of our National Bureau of Standards. In Germany, every new design of equipment must be subjected to test, and may not be sold until its behavior and durability are approved.

Regimentation and restriction of developments are not desired by us. But experience does indicate that we need the organization of an institution for testing any equipment or supply (such as pasteurizer, can or bottle washer, filter, detergent, bottle cap, laboratory incubator, culture medium, glassware, hood, etc.) which is voluntarily presented by any manufacturer who wants to secure the unbiased technical judgment of the group. The data would be publicized by the manufacturer (within certain limits), or not, according to previous agreement. The results would be available for acquainting prospective buyers, milk sanitarians, health officers, or other interested persons with the facts concerning the effectiveness, durability, and degree of compliance of the articles with fundamental standards, and also with the claims of the manufacturers. Such reports would be the last word for milk control officers who must approve new installations and supervise operations.

When participants in the formulation of committee reports or responsible officials have before them the plans of equipment to be installed in a plant, we urge that they make a mental comparison of the ultimate effect upon the industry, upon their own profession, and upon the general public of rival and competing claims, as compared with the effect of similar claims when supported by a recognized institute of research. They should unite in sponsoring the organization of such an undertaking.

This is not the time to offer suggestions as to details. They can develop later. At present, the concept is what we must consider. Let the establishment of such an institute be an objective of the International Association of Milk Sanitarians.

1. Report of the Committee on Milk Plant Equipment and Committee on Sanitary Procedure by W. D. Tiedeman, *Chairman, J. Milk Tech.* 1 (7), 4 (1938).
2. Order out of Chaos. Editorial. *Ibid.* 2, 55 (1939).
3. Three Associations Standards, by W. D. Tiedeman, *Chairman. Ibid* 2, 91 (1939).

C. A. A.

Inter-

The word "International" as applied to the name of the International Association of Milk Sanitarians indicates that its membership is open to and is comprised of persons of various nations, commonly interested and employed. International as applied to the scope of the Association more definitely defines at least one phase of the organization, i. e., the international interchange of information concerning the fundamentals of milk sanitation and milk technology. This is also true of the interstate and inter-provincial relationships of the Association. The Association is international in fact, having members from Mexico, Cuba, the British Isles, Canada, and the United States. Since its organization in 1911, the Association has held a position of prestige. Within the past year the membership has almost doubled.

Inter-relationship is established and developed between the official and commercial milk sanitarians and technologists through active and associate membership in the Association. Both groups are mutually interested and interdependent in those matters with which the Association is concerned.

Inter-association relationship is greatly fostered through the medium of the Journal of Milk Technology, the official publication of the International Association of Milk Sanitarians. As of present record, eight state and area associations of milk sanitarians and technologists have designated the Journal as their official publication. Thus official and commercial inter-relationship is advanced and made more universal. The Journal is an intermediate factor in fostering and interlinking this inter-relationship even beyond the individuals and groups in the several associations, for now the paid circulation includes seventeen countries. This has been accomplished within the interim of its first year of existence. Intermingling of milk sanitarians and technologists and the interchange of knowledge and experience is afforded through the meetings of the International Association of Milk Sanitarians. The interesting and instructive formal programs introduce the newer knowledge, and discussions of the topics permit opportunity for interpellation, interview, and interpretation. This knowledge is also inter-communicated through the Journal of Milk Technology.

The International Association of Milk Sanitarians together with its official publication, Journal of Milk Technology, is the intermediary which makes possible intercourse for the advancement of milk sanitation and milk technology, and for the awakening of ambition and ideals in the minds of men in similar fields of endeavor. May its usefulness become ever more valuable and its service interminable.

W. B. P.

West Virginia Association of Milk Sanitarians

When men, engaged in the daily round of milk inspection and supervision, seek to be associated with others occupied in similar and allied fields both at home and abroad, they evince their broad vision, a constructive interest in communal welfare, and a healthy ambition to avoid the dulling effects of provincialism. Their communities benefit from potent factors for improving the public health and for raising the level of dairy technology. The West Virginia Association of Milk Sanitarians, an active organization in a state where milk inspection and dairy technology have been on the march for several years, is the eighth state and area association to name the Journal of Milk Technology as its official publication. This addition to the fellowship of progressive milk sanitarians and technologists is heartily welcomed with the confidence that mutual benefit will be derived, and public health and milk technology advanced.

J. H. S.

Milk Section of Texas Public Health Association

Experience teaches that sometimes we can be so close to a problem that we lose perspective. In milk inspection, distortion of our sense of proportion may cause us to over-emphasize non-essentials or to neglect new factors. Avoidance of such difficulties is facilitated by associating ourselves with new groups who may not be hide-bound nor committed to out-moded practices. Accordingly, we are glad that the Milk Section of the Texas Public Health Association has designated the Journal of Milk Technology as their official organ. The aggressiveness, enthusiasm, and splendid quality of their personnel is personified in our President Ehlers, of Austin, Texas. We cordially greet these new friends from the great open spaces, and hope that their influence and example may inspire the inspectors of other states in the great Southland and the Southwest to associate themselves with their fellow milk inspectors in a broad-gauged program of milk quality improvement.

J. H. S.

Report of the Committee on Communicable Diseases Affecting Man *

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The report of this committee is composed of the statistics on milk-borne epidemics which have been reported through public health authorities to the sanitation section of the United States Public Health Service (1). Canadian data were obtained from a report by Defries (2) entitled, "Survey of Certain Milk-borne Diseases in Canada." Both of these reports contain much information relative to milk-borne disease which cannot be presented in this report, and it is suggested that those interested in this subject should consult the above references.

This Committee report, also, is composed of contributions by the various members of the committee on subjects which they think are pertinent and which may need clarification.

In Table 1 are recorded the epidemics of the different diseases which were observed during 1937. As is usually the case, typhoid fever holds first place with 15 epidemics. This disease caused all deaths, 11, which were reported from the United States. Streptococcal infection runs typhoid a close race in the number of epidemics, if scarlet fever and septic sore throat are combined. In this disease, we note the greatest number of cases, 986, as opposed to 161 cases of typhoid fever. There were 14 epidemics of gastroenteritis, assuming that food poisoning, gastroenteritis and diarrhea, may be grouped under that term. It seems that there is no uniform term which may be used in reporting these three diseases. All three are covered by the term, gastroenteritis. The etiologic agent, however, is the important item in milk-borne epidemics of this type. Is the disease caused by staphylococcus toxin, *Salmonella enteritidis* infection, or is it paratyphoid fever? The sources of the infection in each instance are apt to be different. None of the three terms used in Table 1 give any indication as to the etiologic agent; in fact, any one of the three may be represented in any one or all of the conditions. Unfortunately, the causal agent is often undetermined, hence the use of a term which the health authority favors. Canada was the victim of rather severe typhoid epidemics during 1937, and this disease again is to be noted as the cause of a majority of the deaths.

* Presented at the 27th Annual Meeting of the International Association of Milk Sanitarians, Cleveland, Ohio, Oct. 19-21, 1938.

TABLE 1.

Milk-Borne Epidemics (1937)

Diseases	Number of Epidemics	Cases in Community	Cases using Suspected Supply	Deaths
UNITED STATES				
Typhoid fever	15	208	161	11
Scarlet fever	11	389	324	0
Septic sore throat and scarlet fever	1	645	312	0
Septic sore throat	2	350	350	0
Food poisoning	10	435	435	0
Gastroenteritis	2	88	88	0
Diarrhea	2	35	35	0
Total	43	2150	1705	11
CANADA				
Typhoid fever	3	......	79	13
Paratyphoid B	3	......	35	4
Undulant fever	7	......	182	0
Total	13		296	17
Grand total	56		2001	28

TABLE 2.

Origin of Milk-Borne Epidemics in United States

	Typhoid fever	Scarlet fever	S S throat and Sc. fever	Septic sore throat	Food poisoning	Gastroenteritis	Diarrhea	Total
Cases	1	4		1*				6
Carrier	14	2*		1	1			18
Cow		4*	1	1*	1	1		8
Water								
Undetermined		2			8	1	2	13

* More than one source involved.

In Table 2 the origins of the epidemics which occurred in the United States are recorded. It is obvious that in milk-borne disease, the carrier presents the gravest problem. In some instances the carriers were human and bovine. This was particularly the case in scarlet fever. The origins of 13 of the epidemics were undetermined, which represents a real handicap for control officials. The role of the cow as a carrier in milk-borne disease is usually confined to the streptococcal and staphylococcal infections. The typhoid fever epidemic which occurred in England and which received so much attention last year was found to be of bovine origin. The cows involved had waded through a stream into which raw sewage was allowed to flow. The role of the cow as a carrier of Salmonella organisms was revealed in the report by Conybeare and Thornton (3) of an epidemic of food poisoning which occurred in Wiltshire, England, in 1936 involving over 100 persons, chiefly school children. Investigation showed that the causal organism was a Dublin type Salmonella. Human carriers were sought in vain. The cows of the milk producing herd were tested serologically for agglutinins for the organism. Three of them gave significant reactions. The feces of the three cows were examined. From one of the cows an identical strain of the organism was recovered. The milk supply was undoubtedly infected through contamination with feces by the faulty operation of the mechanical milking plant.

The type of milk or milk product most often involved (see Table 3) again was proven to be sweet milk which was consumed in its raw state. In the few instances where pasteurized milk was involved, investigation revealed that the process was faulty or contamination occurred subsequently to pasteurization. Milk products are so rarely the cause of epidemics that it may be of interest to relate the conditions under which they were

TABLE 3.

Type of Milk or Milk-Product Involved

Disease	Sweet milk	Cream	Home made Ice Cream	Cheese	Choc. milk	Raw	Past.
		Number of Epidemics					
Typhoid	14*	1*			1	14	1
Scarlet fever	11					11*	2*
Scarlet fever & S. sore throat	1	1*				1	
Septic S throat	2					2	1*
Food poisoning	5		3	2		3	6
Gastroenteritis	1		1			2	
Diarrhea				2		?	?

* Indicates more than one type involved.

TABLE 4.

Distribution of Milk-Borne Epidemics by States—1937

	Typh. fever	Scar. fever	S S Th. Scar. fever	Septic sore throat	Food poisoning	Gastro-enteritis	Diarrhea	Total epidemics	Total cases
California				1(250)	6 (63)			7	313
New York	2(15)	3(38)				1(75)		6	128
Oklahoma		2(70)		1(100)	1 (29)			4	199
Michigan	1 (3)	2(86)						3	89
Illinois		1(41)					2(35)	3	76
Missouri	2(12)	1(15)						3	27
Texas	2(15)	1 (9)						3	24
Iowa			1(312)		1(300)			2	612
Minnesota	1 (2)				1 (37)			2	39
N. Carolina	1 (3)					1(13)		2	16
W. Virginia	2 (8)							2	8
Ohio	1(79)							1	79
Vermont		1(65)						1	65
Maine	1(22)							1	22
Washington					1 (6)			1	6
Maryland	1 (1)							1	1
Pennsylvania	1 (1)							1	1

Figures in parenthesis represent total cases.

involved. It is significant that all the epidemics produced by milk products were gastrointestinal in nature. Four were caused by home made ice cream and four by cheese.

Two epidemics of diarrhea in Chicago were traced to cheese imported from Italy. These were so unusual that the brief description of them as given in the U. S. Public Health Service report (1) may be quoted. Number one: "On the fifth and sixth of February, 1937, eleven people reported illness after having consumed Romano (imported) cheese. The symptoms were nausea, cramps, vomiting, diarrhea, and chills. The onset was four hours after eating, and the duration forty-eight hours. This cheese was imported from Italy and shipped to a wholesaler in Chicago, and by that company sold to local delicatessens, who in turn sold it to consumers. The cheese was alleged to have been bought in December, 1936. Samples of this cheese, collected by the local office of the Federal Food and Drug Administration and sent to the main office at Washington, D. C., were examined by the laboratory there. C.H.D." Number two: "On April 16 and 17, twenty-four people became ill, the symptoms being nausea, vomiting, chills, stomach-ache and diarrhea, the onset being three and one-half to four and one-half hours. The common food consumed was Pecorino cheese, imported from Italy to a Chicago dealer and by him sold to a local delicatessen. C.H.D."

One would be inclined to think that these epidemics were due to staphylococcus toxin, judging from the period of onset of symptoms following consumption of the cheese.

The states in which milk-borne epidemics occurred in 1937 are shown in Table 4. It is observed that last year, as the year before, California and New York led in the number of epidemics. We call attention again to the fact that this is not because those two states are lax in milk control efforts, but quite the contrary, which may explain why more epidemics were reported.

The need of milk sanitation in small communities appears to be substantiated by Table 5 which shows the population groups affected. Twenty-eight of the forty-three epidemics which occurred in the United States were observed in cities under 10,000 population. The number of cases in these cities was 1308 of the total number 1705. This would seem to add some support to the data in the 1936 report (4) of the Committee of this Association on Methods of Improving

TABLE 5.

Population Groups Affected by Milk-Borne Epidemics

	1 – 10,000	10,000 – 20,000	20,000 – 50,000	50,000 – over
Typhoid	10 (63)	2 (2)	2(82)	1(14)
Scarlet fever	7(178)	1 (25)	2(80)	1(41)
S S throat and scarlet fever	1(312)	....	....	....
Septic S throat	1(250)	1(100)	....	....
Food poisoning	7(417)	2 (13)	....	1 (5)
Gastroenteritis	2 (88)	....	....	....
Diarrhea	....	....	....	2(35)
Total	28(1308)	6(140)	4(162)	5(95)

Figures in parenthesis represent total cases.

Milk Supplies in Small Communities, which revealed that a large percentage of the cities of this size do not have adequate milk sanitation organizations.

A few years ago a report of this Committee presented a tabulation of the total epidemics of milk-borne nature which had occurred in the United States since the origin of this committee. Similar data are presented in Table 6 covering the period 1923-1937. The totals of 653 epidemics, 25,291 cases and 767 deaths, represent a great deal of human suffering.

STREPTOCOCCAL MILK-BORNE INFECTION

Milk-borne epidemics due to streptococci during 1937 further substantiated the 1937 report (5) of this committee that just as many persons affected show rash as those who do not. Cases showing rash are called scarlet fever, and those not showing rash are called septic sore throat, both groups having sore throat and other symptoms in common. It appears likely that the separation of these diseases, as is done in this report, is unnecessary, and that this disease should be referred to as "streptococcal infection" or some other suitable term.

One of the characteristics of this infection is the greater number of cases which are found in the mature age group. Commenting on the question, "Why do not more children get milk-borne infections?", the July 18, 1938 issue of Health News of the New York State Health Department offers the following explanation:

"Studies of large numbers of epidemics, in this and other states, have revealed that a preponderance of victims with ages over fifteen years is one of the characteristics of milk-borne outbreaks of scarlet fever and septic sore throat. Apparently the age distribution of patients in these outbreaks ordinarily fol-

TABLE 6.

Milk-Borne Epidemics in United States — 1923—1937

Year	Typhoid	Septic sore throat	Scarlet fever	Gastro-enteritis	Other diseases	Total epidemics	Total cases	Total deaths
1923	15	1	6	0	1	23	834	36
1924	35	1	5	2	1	44	1552	67
1925	33	6	4	0	1	44	1739	56
1926	51	6	5	4	2	68	3364	94
1927	26	0	4	1	5	36	954	91
1928	26	3	8	3	7	47	2196	120
1929	31	8	10	1	1	51	2332	53
1930	30	9	2	5	2	48	1968	56
1931	22	8	1	2	1	34	1398	24
1932	23	3	6	1	0	33	642	28
1933	25	7	4	6	6	48	1426	40
1934	26	8	3	7	1	45	1787	42
1935	16	9	2	16	0	43	1829	21
1936	15	6	16	5	4	46	1565	28
1937	15	3	11	14	0	43	1705	11
Total	389	78	87	67	32	653	25,291	767

lows quite closely that of the population in the community where the outbreak occurs. For example, the 1930 census showed that the proportion of individuals over fifteen years of age in the state was 75 percent, and the same average proportion prevailed in the epidemics studied. It also appears from our studies of milk-borne epidemics that, contrary to the impression most of us have had in the past, there is very little difference between persons of different ages so far as consumption of milk is concerned. We know, of course, that almost the entire diet of young infants is milk, yet it is comparatively rare for them to contract scarlet fever or septic sore throat with milk-borne outbreaks. This probably is explained by the fact that cow's milk fed to young infants, if not pasteurized, usually is heated before the feeding.

In what we call "contact" outbreaks of scarlet fever—where the disease is spread simply by contact between individuals, it is quite different. Here the age distribution is practically reversed, as compared with milk-borne outbreaks. This apparently is due to the fact that contacts among children, generally speaking, are more numerous, closer, and less restrained than among adults.

It should, perhaps, be added that the responsibility for the outbreak which raised this question was fixed not only on the milk supply but on one particular cow contributor thereto. There was no guess-work involved. The cow's udder was infected with the human type of streptococci."

The need of a definite identification of the streptococcus which is found in a milk-borne epidemic is imperative, and the identification of the streptococcus found in the udder of the suspected cow is equally so. Two committees of the American Public Health Association, the Committee on Standard Methods for the Examination of Milk and Dairy Products and the Committee on Diagnostic Procedures and Reagents, have sought to formulate methods which will make identification of streptococci an undoubted procedure. It is certainly hoped that this will be accomplished, for the cow should not be accused unjustly merely because she harbors hemolytic streptococci which may be only a family affair and of no concern to the health of humans.

The complexity of streptococcal milk-borne infection and the difficulty of ferreting out the source of infection, is illustrated by the following epidemic (6):

"On May 2, 1938 a small outbreak of septic sore throat was reported from a village in upstate New York.

Investigation revealed that the illness was clinically typical streptococcal pharyngitis (septic sore throat). Four of five cultures submitted by patients were positive for hemolytic streptococci. Thirty-one persons were attacked: twelve on April 29, twelve on April 30, four on May 1, and three on May 2. Fourteen of the patients were among the twenty-one persons employed at a milk collecting station, and the remaining seventeen among members of their families. Epidemiological inquiry showed that the one factor common to all patients was the use of raw milk from the milk collecting plant.

Milk received at the plant was secured from 199 different farms which had a total bovine population of about 3600. As received at the plant, it was inspected, weighed, cooled, and shipped raw to New York City where it was pasteurized before distribution. On being received at the plant, it was pumped through a cooler into a tank car. Whenever the capacity of the cooler was exceeded, milk was pumped directly into a storage tank, whence it was subsequently piped through the cooler into a tank truck. Milk for the employees was always drawn from the cooler, being usually secured about 8:00 A. M., just after the last of the farmers had delivered their milk. Thus, although all milk was pooled, it was possible that occasionally the milk drawn for the employees might consist chiefly of milk from a single farm.

The high attack rate among persons using the milk raw, the evidence of a single massive dose of infection, and a complete inability to demonstrate any likely source of infection within the plant itself, led to the conclusion that the source of the outbreak was a cow with mastitis.

Attempting to locate the responsible cow among 3600 cows on 199 farms appeared to be a task of considerable magnitude. It was manifestly not feasible to examine and take specimens from each cow on all 199 farms. Therefore, as a screening procedure, it was determined to perform a direct microscopic examination of a stained smear (Breed smear) of a sample of pooled milk secured from each dairy farm. These specimens were taken at the plant on the morning of May 3. On examination, the smear of the milk from one dairy farm stood out from all others in its profusion of leucocytes and clumps of chained cocci. This farm was investigated first, and a cow with a suspicious type of mastitis was discovered. From the suspected quarter of this cow's udder, hemolytic streptococci of Group A of Lancefield's classification were isolated. Smears from forty other farms showed varying degrees of evidence of gargety milk. None of the samples from cows on these farms yielded hemolytic streptococci of human origin.

The implicated producer sold daily about 1600 pounds of milk to the cooling plant. It was his wont to deliver milk every morning shortly before eight o'clock, just before the time that milk for the employees was usually secured from the cooler.

The infected cow had been purchased by the producer between two and nine days before the beginning of the outbreak. None of the milk from this cow had been used by the family of the producer, and there had been no suspicious illness on the dairy farm.

The farm from which the cow had come originally had sold its milk to a pasteurizing plant, milk being used raw only by the caretaker and his mother. These two persons each gave a history of a moderately severe sore throat late in December 1937. The cow is believed to have freshened in February 1938, and is reported to have then developed a "caked" udder, which necessitated considerable care. It is believed that the caretaker must have served as the original source of infection, since he was the only person looking after the cow. Although he gave no history of sore throat subsequent to December, his throat culture was positive for hemolytic streptococci on May 11th."

RABIES

This subject appears rather out-of-place in a report of this nature but the question of transmission of the virus through the milk of an infected cow is often asked. Rabies control is an important problem of Veterinary Medicine. A special Committee on Rabies was asked for at the last meeting of the American Veterinary Medical Association in New York City. Unfortunately the literature concerning the transmission of the virus through milk is extremely meager. Graham (7) answers the question as follows:

"Altho milk from rabid animals may contain rabies virus in infective amounts, and some writers believe that rabies may be transmitted thru this medium, there is little convincing evidence on the point. Furthermore it is recognized that the virus will not pass thru the unbroken skin or the unbroken mucous membrane. - - In observations at the Illinois Agricultural Experiment Station young rabbits nursed a rabid doe up to the time of the doe's death without themselves acquiring the disease."

UNWARRANTED INCRIMINATION

Milk is accused of being the vehicle for the transmission of so many disease-causing microorganisms that we should question thoroughly any unfounded reports which may arise. Undoubted milk-borne epidemics present problems enough for control officials and the dairy industry without having to combat all sorts of imaginary diseases. A milk supply should never be incriminated unless there is absolute proof that it is involved. Even then, undue publicity may do more harm by causing a decrease in milk consumption than one or two cases of disease of a mild nature. There appears to be little justification for involving the milk supply of an entire city and that of neighboring cities in unwarranted publicity.

EDUCATION OF MILK HANDLERS

In order to protect their business and the people whom they serve, milk handlers must be informed of the methods which have been proven effective. An appropriate pamphlet which may be distributed to dairymen is distributed by the Connecticut State Department of Health. A copy of this pamphlet is made a part of this report.

DISEASES SPREAD BY MILK

INFORMATION FOR MILK HANDLERS

Germs of diphtheria, scarlet fever, septic sore throat, tuberculosis, typhoid fever, and paratyphoid fever are sometimes carried in milk. An outbreak of disease on a milk route may destroy in a day a business built up by years of effort. Dairymen can insure against such a disaster by keeping disease germs out of milk.

Disease germs reach milk from a sick cow or an infected milk handler. Every milk producer can take a few simple measures that will go far toward preventing such an occurrence. These are as follows:

1—Have all cows tuberculin tested.

2—Sell no milk from cows with garget.

3—Keep all persons with sore throat away from cows and milk.

4—Keep all sick persons away from cows and milk.

5—Require all handlers to wash hands before milking.

Dairymen who wish to take further precautions can provide frequent veterinary examination of cows and medical examination of handlers. The doctor can send specimens to the laboratory to discover disease germ "carriers" among the handlers. Milk producers should protect themselves and their customers by keeping disease germs out of milk. For further information ask the milk inspector.

THE WHY AND HOW OF IT

Dairymen want to understand the things they are advised to do. They want to know why they should do them and how doing them will help prevent disease. Here are the reasons:

1. Have all cows tuberculin tested. Cows have tuberculosis which is caused by a kind of germ. The germs are given off with the milk and cause tuberculosis in children who drink the milk. That is one reason. Another is that tuberculous cows are not profitable. So much of the food they eat must be used to combat the disease that milk production is cut down. This may not be noticed unless accurate record is kept, but it is true. Cows with advanced tuberculosis eat up the profit on the healthy cows. The dairyman cannot afford to keep tuberculous cows. It is not good business. Even one tuberculous cow may spread the disease to the entire herd. Thus, keeping one diseased cow now may cause loss of the herd later. Tuberculin testing protects milk consumers from bovine tuberculosis only. Milk from tuberculin tested cows may carry germs of other milk-borne diseases.

2. Sell no milk from cows with garget. Inflammation of the udder, also called mastitis, mammitis, caked udder or garget, is caused by germs. Any one of several kinds of germs may cause the disease. Some germs that cause garget in cows may not cause disease in man. The germs of at least two diseases in man may cause garget in cows. These diseases are septic sore throat and scarlet fever. A cow with garget due to one of these germs gives off many millions of them in the milk. The result is an outbreak of disease among the human consumers.

When a cow has garget, it is not possible to say off-hand that the germ causing it will cause disease in man. Nor is it possible to be sure that the germ will not cause disease in man. In view of this uncertainty, the milk should not be used. Besides, all gargety milk contains pus. Nobody wants to drink pus. Gargety milk should not be used even though it were certain that the germs would not cause disease among the consumers. In fact, a cow with garget should be removed from the herd to protect other cows from infection.

3. Keep all persons with sore throat away from cows and milk. Sore throat is caused by germs. Three common germs that cause it are the germs of septic sore throat, scarlet fever, and diphtheria. Any one of these germs may also infect a cow. For the protection of the cow, all persons with sore throat should be kept away. Besides, a person with sore throat may get germs into the milk he handles. For example, coughing over a milk pail may cough germs into the milk. Germs may also be sneezed into the milk. The hand, after covering a cough or sneeze, may convey germs to the cow or the milk. By all means, then, persons with sore throat should be kept away from cows and milk to prevent an outbreak of disease among the milk consumers.

4. Keep all sick persons away from cows and milk. A sick person may have a disease that can be carried by milk. An attack of typhoid fever or paratyphoid fever comes on so gradually that the patient may be ill several days before he finally gives up and goes to bed. Such a patient may easily cause a milk-borne outbreak of typhoid fever by handling milk while ill. Germs from an infected finger or hand may be of a kind that will infect a cow or a human consumer of her milk. In that case disease may be spread from an ulcer or boil on the hand of a milk handler. In order to take no chances, all sick persons should be kept away from cows and milk. In short, all milk should come from healthy cows and be handled by healthy handlers.

5. Require all handlers to wash their hands before milking. The milk handler may be a disease germ "carrier" and not know it. A "carrier" is a person who harbors disease germs in his body but is not ill. The hand is often the vehicle for conveying disease germs to milk. This is especially true in the case of typhoid fever and paratyphoid fever. The germs of typhoid in either a beginning case or carrier are in the discharges from the bowels. The hand soiled with these discharges carries the germs to the milk. Washing the hands with soap and water and a good brush will wash off the germs and keep them out of the milk. At least it will wash off the germs that are easily removed and are most likely to get into the milk. This will include most of the disease germs that may be on the hands. Thus, carefully and thoroughly washing the hands before milking or handling milk will greatly lessen the chances of passing disease germs from the hands to the milk. "Dry-milking" will also help prevent germs reaching milk from the hands.

MILK-BORNE OUTBREAKS OF DISEASES

An average of about one milk-borne outbreak of disease per week is reported in this country. A total of 104 such outbreaks were reported for the years 1926 and 1927. In Connecticut 15 milk-borne outbreaks were reported during the 7 year period from 1923 to 1929. These outbreaks included 4 of septic sore throat, 6 of typhoid fever, 3 of scarlet fever and 2 of paratyphoid fever. In addition to these there have been many cases of tuberculosis among infants and children who drank milk from tuberculous cows.

While investigating these outbreaks it was learned that in the case of septic sore throat and scarlet fever some one with sore throat had milked the cows or handled the milk before the outbreak had occurred. Whether germs passed directly from handler to milk or from milker to cow and thence to the milk was not ascertained in all cases. In the typhoid and partayphoid outbreaks a disease "carrier" had handled the milk without washing his hands. Thus the simple preventive measures herein recommended are based upon facts ascertained by investigating milk-borne outbreaks.

PASTEURIZATION KILLS GERMS

Another fact brought out by investigating these outbreaks is that pasteurized milk was not responsible for the spread of disease in any of the outbreaks. It is well known that pasteurization kills the disease germs in milk, provided the process is properly carried out. The milk must be heated hot enough and kept hot long enough to kill the germs. In Connecticut the law requires heating to 145 degrees Fahrenheit and holding within three degrees of that temperature for thirty minutes. Pasteurization will continue to be our main safeguard against milk-borne outbreaks of disease. In fact, for large supplies drawn from many sources, pasteurization is a necessity. For small supplies where pasteurization is not practicable, the simple measures herein recommended will help safeguard consumers from milk-borne disease.

SICK PERSONS NOT TO HANDLE MILK

The handling of milk or milk utensils by a person ill with a communicable disease, or who cares for a person ill with such disease, is prohibited by state law. Each dairyman must report promptly to the local health officer any case or suspected case of communicable disease on a milk farm.

Any one with sore throat is a suspected case of communicable disease. By promptly reporting such a case the dairyman can obtain expert advice in regard to handling the situation. Regulation 17 of the Sanitary Code requires the local health officer to transmit such report immediately to the State Department of Health. Representatives of the State Department of Health and of the State Dairy and Food Commissioner are always available for investigation and advice upon request of the local health officer.

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SYMPOSIUM ON FROZEN DESSERTS,—F. W. Fabian, *Editor*

(Continued from March Issue)

Sanitation of Products Added to Frozen Desserts *

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Pasteurization of the mix from which commercial ice cream is manufactured has come to be a standard practice. Further precautions to protect the sanitary quality of ice cream by using proper methods of washing and sterilizing the plant equipment are routine procedures in all modern ice cream plants. Under such conditions of operation there should be little question about the sanitary qualities of commercial ice cream. However, the possibility of contaminating ice cream with the materials ordinarily added at the freezer, such as flavoring and coloring, has not been fully appreciated. The various kinds of fruits, nut meats, and candies that make up our daily diet are generally accepted by the consumer without question as to their sanitary qualities. The possibility of the transient laborer who harvested the box of berries we serve for dinner having septic sore throat or being a carrier for typhoid fever does not excite us. We, as consumers, give little thought to the history of the nut meats we buy for the dinner party, even though they may have been touched by the hands of an infected worker. The ice cream industry has accepted these materials in much the same way, assuming that they are not dangerous to health.

For the purpose of getting first-hand information as to how some of these products, whose history is unknown to the user, are actually prepared for market, visits were made to some of the places putting up pecan nut meats. Because of the difficulty of removing the meats, pecans are usually purchased by the ice cream manufacturer in shelled form. The nut dealers, in order to remove the kernels without badly shattering them, soak the nuts in water before cracking. They are then permitted to dry until the shells are brittle but the kernels are still moist enough to be removed without breaking. The cracking may be done either by hand or by machinery. In one plant visited, the workers were Italian men, women, and girls. In another plant, colored women and girls were employed. The operator of one plant required the workers to wash their hands and sterilize them by dipping in a weak chlorine solution each time they came into the room. As far as could be learned, the workers are not subjected to periodic health examinations. In some of the southern states where shelled nut meats are prepared for marketing, much of the cracking is done in the homes of workers where the entire family of adults and children may take part. The nut meats are usually stored at a low temperature (32° — 36° F.) until shipped.

One of the most popular flavors of ice cream is strawberry. Many manufacturers use what are called frozen pack berries which are preserved by low temperature storage. The fresh berries are washed with cold water, hulled, mixed with sugar (2-3 parts berries to 1 part of sugar) and stored at freezing temperatures until used. Most of our strawberries are picked by transient labor. These workers often live under very insanitary conditions and nothing is known of their pathological condition. To be true, as far as is known, no case of disease has ever been traced to frozen pack berries or pecans, yet we must recognize the existence of any potential sources of infection.

How to safeguard the consumer of these ingredients is not a simple problem. One possible avenue of approach would be to bring all of the premises where these products are handled under rigid supervision of state and city health officials and to establish proper sanitary regulations. Suitable health examination might also be given all food handlers. However, to bring about such control would likely increase the cost of the food products concerned, and appreciably increase the cost of the public health service.

In the study to be reported here the problem was approached from the angle of the ice cream plant in an endeavor to determine to what extent methods of preparing nut meats, fruits, flavor, and color materials could be developed that would bring about better sanitary qualities in commercial ice cream.

PECAN NUT MEATS

In a survey conducted at the Illinois Experiment Station (1) it was found that 65 percent of the nut meats collected from ice cream plants supported bacterial growth, 75 percent were contaminated with molds and 50 percent of the samples gave a positive test for *Escherichia coli*. It was evident from the data secured that some form of treatment to reduce the possible contamination from nut meats was desirable. Various methods of treating the meats were tried, such as washing with cold water, hot (180° F.) water, boiling water, boiling salt solution, alcohol (95 and 70 percent), dry heat, hot (180° F.) and boiling sucrose solutions of 25-50-75 percent concentrations, and hot (208° F.) and boiling 240° F.) butter. Of these methods, the sucrose and salt solutions, and butter and dry heat treatments were found to be the most promising, as far as the flavor of the pecans was concerned. Nut meats were inoculated with a fast-growing organism of the colon group. They were then treated by the methods found to be most promising, and with the exception of the dry heat treatment (250° C. for 2 and 3 minutes), they all reduced the count on the nut meats from 3,000,000 to less than 60 per gram.

The rancid flavor that develops in nut meats was diminished appreciably by treating the meats for 15 seconds in a 50 percent sucrose solution followed by drying for 2.5 minutes at 250° C. When stored for one week in ice cream, the sucrose-sugar treated meats retained their crispness and flavor. The butter-treated meats resembled the control in both flavor and texture. The meats receiving the dry-heat treatment were crisp but they had a roasted flavor which was more evident after being added to the ice cream. The samples treated in the boiling 20 percent salt solution were crisp and had the best flavor of all the samples; however, in the ice cream the kernels were sufficiently salty to be objectionable. By adding 1 percent of salt to the sucrose-sugar solution in which the meats were dipped, a slightly better flavor was produced in the ice cream. This treatment was considered the most desirable.

Since treated pecan meats must be stored until used, a study was made of the practicability of various storage methods using pecans that had been treated with hot and boiling sucrose solutions to which 1 percent of salt had been added. Samples of the treated meats were then stored at 36° F. (humidity 80 percent) and 80° F. (humidity 42 percent) in open and stoppered (rubber) bottles. At the end of three weeks storage the samples, kept in an open bottle at room temperature, had a good flavor and were crisp, while those stored at 34° F. in an open bottle were tough and lacked fine flavor. Those stored in a closed bottle at 34° and 80° F. were fairly crisp, but the flavor was not good in every case.

Storage of the treated meats at room temperature in the presence of air having produced the best results from the standpoint of flavor and texture, a series of experiments were performed in which the meats treated with the boiling 50 percent sucrose solution containing 1 percent of salt were placed in various types of containers and stored at room temperature. Glassine bags, a tinned can with a cheesecloth covering, paper sacks, paper containers, and perforated tin cans were used. At intervals the meats were tested bacteriologically, and examined for mois-

* Presented at the Annual Meeting of the American Public Health Association at Kansas City, Missouri, October 25-28, 1938.

** This report is based on a thesis prepared under the author's supervision and submitted to the Graduate School of the University of Illinois by W. H. Brown in partial fulfillment of the requirements for the degree of Master of Science.

ture, flavor, and texture. From a bacteriological point of view, all the containers used were satisfactory, even after seven weeks of storage. During the storage period, the moisture content of the nut meats decreased with each test. The humidity in the room during the test period of seven weeks averaged 40.5. The flavor, texture, and color of those meats stored in the glassine sacks were superior to those of the others, though the meats stored in a tin can with a cheesecloth covering were a close second. The meats stored in the paper bag and paper container became discolored.

METHODS OF PREPARING COLORING MATERIAL IN THE MANUFACTURE OF SANITARY ICE CREAM

In order to correlate the sense of flavor and color, it is necessary to add coloring material to several types of commercial ice cream. The colors used are usually in liquid form. Several investigators have found these coloring solutions to be heavily seeded with bacteria. Fabian (2) found the counts to vary from 0 to 15,000,000 bacteria, and 35 percent contained organisms of the *Escherichia-Aerobacter* group. Smallfield (3) found coloring material that would add as much as 100,000 bacteria per gram in ice cream in which it was used. At the Illinois Experiment Station (1) it was found that the bacterial counts of of 111 samples of colors secured from commercial ice cream plants ranged from 0 to 14,000,000 and 12.6 percent of the samples gave a positive test for *Escherichia coli* organisms.

There is a tendency for ice cream manufacturers to be careless in handling their color materials. Often the containers in which the colors are stored are left uncovered. The measuring graduates are sometimes used day after day without rinsing with scalding water. An excess of coloring solution may be returned to the stock solution, thus possibly seeding the entire lot.

To study their bacterial quality under different storage conditions, 2 percent solutions of eleven different colors were prepared, using distilled water. The solutions were heated to 180° F. and held 30 minutes. A few spore formers (10-20 per ml. of color solution) survived the heat treatment in the case of five of the samples. Fifty ml. lots of each solution were placed in dark glass bottles for experimental study.

To one set of samples, 0.05 ml. of a sterile 10 percent solution of sodium benzoate was added. To another set, 95 percent alcohol was added before the heat treatment at the rate of 10, 15, 20, and 25 percent by volume.

The samples used in these experiments were contaminated once every week by pouring 20 ml. of each coloring material into a 100 ml. graduate, and immediately returning it to the storage bottle. No attempt was made to protect the graduates from air contamination. Three days later, the contaminated samples were plated. The experiments covered a period of ten weeks. The storage temperatures used were 40°, 80°, and 100° F. The results are given in Tables 1, 2, and 3 (the data on sample No. 3 is representative of that on all the others):

The bacterial counts of the samples stored at room temperature increased rapidly. While the growth in the 40° F. samples was slow at first, in most cases at the end of ten weeks there was little difference between the growth of these samples and those stored at room temperature. The rate of growth at 100° F. was much slower, indicating this temperature was too high for most of the organisms. Mold growth was particularly bad in the 80° and 100° F. samples. The addition of 0.1 of 1 percent of sodium benzoate did not prevent the multiplication of microorganisms, although the growth was somewhat less, particularly during the early part of the ten-week storage period. In general, the addition of 10-25 percent of alcohol prevented the growth of bacteria. Only one of the 68 experimental samples fermented brilliant green bile. Air contamination is not an important source of bacteria of the colon group.

In another series of experiments using water solutions of the eleven dyes noted

TABLE 1
Relation of Air Contamination and Temperature of Storage to the Number of Microorganisms Present in the Colors

Number of Microorganisms per ml after:

Color No.	1 week Bacteria	1 week Mold	2 weeks Bacteria	2 weeks Mold	4 weeks Bacteria	4 weeks Mold	6 weeks Bacteria	6 weeks Mold	8 weeks Bacteria	8 weeks Mold	10 weeks Bacteria	10 weeks Mold
					Colors stored at 40° F.							
1	10	0	5,600	0	420,000	0	247,000	0	1,250,000	*	2,800,000	*
2	30	0	870	0	150,000	0	1,000,000	0	2,120,000	*	4,400,000	*
3	0	0	0	0	30,000	0	78,000	0	5,000	*	313,000	*
4	0	0	30	0	30	0	60	0	40	*	680	*
5	0	0	10	0	14,600	0	100,000	0	770,000	*	480,000	*
6	0	0	10	0	0	0	120	0	1,570	*	7,900	*
7	0	0	0	0	0	0	20	0	10	*	40	*
8	1,980	0	30,000	0	2,250,000	0	40,000	0	5,000	*	228,000	*
9	0	0	0	0	30	0	1,330	0	2,210	*	5,600,000	*
10	6,900	0	250,000	0	240,000	0	190,000	0	127,000	*	130,000	*
11	0	0	0	0	930	0	140,000	0	3,000	*	117,000	*
					Colors stored at 80° F.							
1***	1,650,000	0	10,500,000	0	10,700,000	*	10,300,000	*	3,170,000	*	11,100,000	*
2	130,000	0	96,000	0	41,000	*	63,000	**	161,000	6,000	7,600	3,600
3	70	0	1,000,000	0	1,610,000	*	1,370,000	**	1,380,000	*	1,300,000	*
4	130,000	0	1,670,000	0	630,000	*	1,170,000	*	130,000	320,000	110,000	24,000
5	504,000	0	1,000,000	0	2,760,000	*	2,800,000	*	1,480,000	*	2,160,000	*
6	0	0	0	50	600	Plate	130,000	3,000	2,500,000	14,000	3,200,000	57,000
7	20	0	0	0	0	covered	1,810	*	30	760	2,600	780
8	250,000	0	236,000	0	250,000	34,000	15,000	60,000	2,000	44,000	1,002	
9	3,200	0	3,500,000	0	7,900,000	*	2,070,000	*	340,000	*	45,000	*
10	83,000	0	74,000	5,300	530,000	4,900	1,110,000	3,000	570,000	*	1,320,000	*
11	183,000	0	7,000,000	0	5,600,000	*	390,000	*	6,500,000	*	1,150,000	*
					Colors stored at 100° F.							
1	0	0	100	0	230,000	*	7,600	*	6,300	*	4,500	120
2	0	0	0	0	10	*	0	*	0	20	0	50
3	540	0	15,000	0	32,800	*	3,800	100	10,000	*	25,900	*
4	10	0	11,700	0	4,400	*	0	9,400	0	8,000	0	6,800
5	0	0	0	340	10	70	0	100	0	90	0	100
6	10	0	0	0	0	*	0	10	0	*	0	*
7	0	0	0	0	0	*	0	*	0	*	10	*
8	0	0	0	0	0	*	0	*	10	*	10	2,600
9	0	0	0	0	0	*	0	*	20	*	90	*
10	82,000	0	4,000	0	100,000	*	68,000	*	148,000	*	294,000	*
11	0	0	0	0	150,000	5,400	400,000	*	540,000	*	600,000	*

* Indicates sub-surface mold growth. ** Gas formers present.

TABLE 2

Relation of Air Contamination and Storage Temperature to the Number of Microorganisms in the Colors with 0.1 of 1 Percent Sodium Benzoate Added as a Preservative.

Number of Microorganisms per ml. after:

Color No.	1 week Bacteria	1 week Mold	2 weeks Bacteria	2 weeks Mold	4 weeks Bacteria	4 weeks Mold	6 weeks Bacteria	6 weeks Mold	8 weeks Bacteria	8 weeks Mold	10 weeks Bacteria	10 weeks Mold
					Colors stored at 40° F.							
1	40	0	20	0	60	0	43,000	0	312,000	*	280,000	*
2	20	0	30	0	170	0	0	0	80	*	160	*
3	10	0	0	10	230	0	10	0	100	*	50	*
4	0	0	30	0	30	0	30	0	160	*	50	*
5	0	0	0	0	8,900	0	2,000,000	0	8,400,000	*	5,300,000	*
6	0	0	0	0	0	0	410	0	10,600	*	113,000	*
7	0	0	0	0	0	0	10	0	0	*	20	*
8	0	0	410	0	15,100	0	30,000	0	85,000	*	1,000	*
9	0	0	430	0	370,000	0	2,930,000	0	12,600,000	*	7,000,000	*
10	1,200	0	90,000	0	55,000	0	290,000	0	3,000	*	130,000	*
					Colors stored at 80° F.							
1	316,000	0	5,170,000	0	7,400,000	*	4,800,000	*	2,670,000	*	3,900,000	*
2	49,300	0	6,000	0	1,400,000	*	60,000	*	50,000	12,000	700	5,400
3	560,000	0	600,000	0	890,000	*	920,00	*	1,370,000	*	820,000	*
4	0	0	0	0	2,930,000	*	1,840,000	*	100,000	*	260,000	*
5	298,000	0	920,000	0	1,270,000	*	131,000	*	1,490,000	*	840,000	*
6	0	0	0	0	20	*	650	230	100	57,000	100	28,000
7	0	0	0	160	0	230	0	390	0	1,400	0	46,000
8	449,000	0	510,000	0	680,000	*	340,000	*	1,480,000	*	3,900,000	17,000
9	0	0	5,400,000	350	1,410,000	8,700	18,200,000	*	9,400,000	*	6,500,000	*
10	10,600	0	500,000	0	830,000	*	770,000	*	460,000	*	490,000	*
					Colors stored at 100° F.							
1	0	0	0	6,800	20	11,800	0	9,300	0	12,200	0	12,200
2	0	0	0	*	70	*	0	*	10	*	20	*
3	0	Moldy	0	1,100	10	Moldy	1,000	1,200	3,100	1,400	4,300	Moldy
4	10	0	10	*	10	*	0	*	0	*	30	170
5	20	0	10	*	10	60	10	40	50	*	200	*
6	0	0	0	*	0	*	10	*	20	*	20	*
7	0	0	10	*	0	*	0	*	10	*	40	*
8	0	0	10	*	20	*	10	*	10	*	10	*
9	0	100	0	5,800	0	2,000	0	100	10	*	40	*
10	7,500	0	20	*	30	*	0	*	18,000	*	130,000	*

* Indicates sub-surface mold growth.

TABLE 3

Relation of Air Contamination and Temperature of Storage to the Microorganisms Present in Colors to Which Various Amounts of Alcohol Were Added

Number of microorganisms per ml. after:

Percent alcohol added	1 week Bacteria	1 week Mold	2 weeks Bacteria	2 weeks Mold	4 weeks Bacteria	4 weeks Mold	6 weeks Bacteria	6 weeks Mold	8 weeks Bacteria	8 weeks Mold	10 weeks Bacteria	10 weeks Mold
					Color No. 3							
					Stored at 40° F.							
10%	30	0	390	0	10	0	50	0	40	0	40	0
15%	20	0	30	0	30	0	20	0	50	0	50	0
20%	10	10	40	0	20	0	40	0	40	0	30	0
25%	20	0	50	0	20	0	0	0	10	0	20	0
					Stored at 80° F.							
10%	20	0	70	0	10	0	50	10	20	0	30	0
15%	10	0	30	0	50	20	20	30	40	0	60	0
20%	0	0	40	0	90	0	10	0	50	0	30	0
25%	0	0	140	0	20	0	20	0	10	0	10	0
					Stored at 100° F.							
10%	0	0	0	0	30	0	20	20	10	0	100	0
15%	10	0	10	0	120	0	70	0	60	0	20	0
20%	0	0	70	0	30	0	10	0	40	0	10	0
25%	10	0	60	0	30	0	10	0	10	0	0	0
					Color No. 6							
					Stored at 40° F.							
10%	10	0	40	0	110	0	90	0	60	0	100	0
15%	0	40	40	40	20	0	30	0	10	0	10	0
20%	0	0	0	0	0	0	0	0	0	0	10	0
25%	10	50	20	240	50	340	40	90	30	70	30	100

above and three shades of colors in water solution with 0.1 of 1 percent of sodium benzoate, 20 ml. of each solution were poured into a sterile graduate and then poured back into the bottle again once each week. No attempt was made to protect the pouring lip of the bottle against air contamination. The growth of bacteria and mold, in general, was found to be noticeably less than in those experiments in which the graduates were not sterilized before using.

In a third series of experiments, the samples were not disturbed except when the weekly bacteriological samples were taken. While there was some growth of mold and bacteria, the numbers were much less than in either of the two previous experiments.

In all the experiments, 0.1 of 1 percent of benzoate of soda failed to inhibit bacterial growth to any great extent. In further studies, bacterial growth was found even with as much as 2 percent of the benzoate.

Three different shades of coloring materials were inoculated with *Eberthella typhosa* and *Staphylococcus aureus*, and incubated at 37° C. Although the number of these organisms was found to decrease rapidly, at the end of two weeks some of the organisms were still living.

During the storage of the color solutions, weekly checks were made on the color intensity, using a Bausch and Lomb colorimeter. Five of the eleven colors were found to deteriorate during storage. The greatest change occurred in the samples stored at 100° F., and the least change occurred at 40° F. The rate of change was independent of the number of organisms present, the effect apparently being one related to time and temperature of storage.

Thinking that it might be desirable to pasteurize color solutions periodically before the last in the bottle was used, an experiment was performed in which five color solutions were each heated at 145°, 160°, and 180° for 30 minutes, five different times. Between each heating the solutions were cooled to 50° F. and sampled. Single heating at any of the three temperatures did not affect the quality of the color. In only one case did the second heating at 145° F. injure the colors. But the intensity of the color of the materials heated to 160° and 180° F. was changed at the second and subsequent heatings.

METHODS OF PREPARING FRUITS AND FLAVORING MATERIALS FOR ICE CREAM

Ordinarily little consideration is given to flavoring materials such as fruits and extracts as a possible source of bacterial contamination of ice cream. However, since much of the fruit used is fresh or frozen packed, the possibility of contamination from this source should not be overlooked. Frozen pack strawberries secured from commercial ice cream manufacturers varied from 10 to 67,000 bacteria per gram. Eight samples of fresh berries picked up on the Urbana market gave counts ranging from 300 to 839,000, and two of the samples fermented brilliant green bile.

It is commonly recognized that fruit preserved by heat does not impart as desirable flavor to ice cream as fresh fruit. However, it was thought that it might be possible to apply a limited amount of heat to the fresh or frozen pack fruit and certain other flavors, and make them safe from a sanitary point of view without serious injury to their quality.

A series of experiments were performed in which the heat treatments employed were in most cases effective in reducing the bacterial content of the fruits (see Table 4). The injury to the flavor of the strawberries and raspberries (red, black, and purple) caused by heating to 145° F. for 30 minutes was not noticeable after the berries were added to ice cream. Likewise, heating to 160° F. for 15 minutes gave satisfactory results, but a cooked flavor resulted when the berries were heated to 180° F. for 5 minutes or to 212° F. momentarily.

Fruits, such as peaches that need to be peeled just before using should not present much of a sanitary problem. For experimental purposes, the standard meth-

TABLE 4

Destruction of Bacteria in Fresh Strawberries by Heat Treatment (Initial Count 78,000)

Treatment	Bacteria after treatment
2:1 Pack	
145° F. — 30 min.	540
160° F. — 15 min.	350
180° F. — 5 min.	250
212° F. —	80
3:1 Pack	
145° F. — 30 min.	80
160° F. — 15 min.	40
180° F. — 5 min.	30
212° F. —	30
4:1 Pack	
145° F. — 30 min.	80
160° F. — 15 min.	50
180° F. — 5 min.	30
212° F. —	30

od of dipping the peaches in boiling water for 1 minute and cooling with cold water in order to remove the skins, was used. The pits were then removed, and the fruit sliced and mixed with sugar at the rate of 4 parts of fruit to 1 part of sugar. The fruit-sugar mixture was boiled for 3 minutes. This procedure not only destroyed most of the organisms present but also produced a product with a good flavor.

Counts under 100 per gram were obtained on bananas that were prepared by mixing the sliced fruit with sugar (4 parts fruit and 1 part of sugar), taking care that the operator's hands were thoroughly cleaned and that all the equipment used was thoroughly washed and disinfected before using.

When preparing oranges, the juice extracting machine must, of course, be as carefully washed and disinfected as any dairy utensil. Dipping the fruit in boiling water prior to extracting the juice resulted in a change in both the color and flavor. Dipping the oranges in a solution of 75-100 parts per million of chlorine followed by a rinse with cold water, had no detrimental effect upon flavor. This should be done just before extracting the juice.

The data in Table 5 show that it may be possible to heat flavoring extracts in case there is any doubt as to their sanitary qualities, without materially decreasing their usefulness in ice cream. To be true, these data are not all-inclusive because of the existence of a large number of different types and kinds of flavoring materials, some of which may be more seriously affected by heat than those included in Table 5. Ordinarily, however, the flavoring extracts contain sufficient alcohol to protect them from serious bacterial growth.

CONCLUSIONS

An attempt has been made to show that it is possible for dairy plant operators to improve the sanitary qualities of ice cream by paying more careful attention to the way in which they prepare and care for the flavoring and coloring material used in their ice cream. The following procedures have been found helpful in this respect:

1. Nut meats should be dipped in boiling sugar solution (approximately 50 percent), to which has been added 1 percent of salt, for 15 seconds, and then dried in a 250° C. oven for 2.5 minutes. Prepared nut meats are best stored in glassine bags or tinned cans at room temperature.

2. Color solutions should be made using 180° F. water, and should be placed in clean sterile bottles. These bottles should be kept covered and should be stored at 40° F. while not in use. The measuring graduates should be washed and rinsed with hot (180° F.) water each day before using. Unused portions should not be returned to the stock solution. Stock solutions should be prepared fresh weekly. Old solutions should not be used without first heating to 145° F. for 30 minutes.

3. Operators handling fresh fruits should have clean hands and clothing. All equipment used in handling fruit should be cleaned and disinfected before use. Fruits with delicate flavors such as fresh strawberries and raspberries can be satisfactorily pasteurized by being mixed with sugar and heating to 145° F. for 30 minutes. If necessary, certain flavor extracts can be heated to 145° F. for 30 minutes without serious injury to the flavor.

TABLE 5

Relation to the Heat Treatment of 145° F. for 30 Minutes to the Intensity of the Flavor of the Flavoring Materials

Sample No.	Description	Criticisms of Flavors Heated: In the Mix	Alone
1	Black walnut imitation	No change	No change
2	Maple syrup concentrate	No change	No change
3	Isolate cherry	No change	No change
4	Imitation apricot	No change	No change
5	Isolate vanilla	No change	No change
6	Nutmeg	No change	No change
7	Imitation raspberry	Less flavor than control	No change
8	Extract of peach	No change	No change
9	Isolate pineapple	Slightly less flavor	Changed (less flavor)
10	Isolate strawberry	No change	Faded or less flavor
11	Imitation banana	Softer flavor than control but faded	Softer flavor than control but faded
12	Isolate distilled lime	Flavor changed	Flavor changed
13	Lemon extract	Flavor slightly faded but smoother than control	Flavor slightly faded
14	Almond	Flavor slightly faded	Flavor very slightly faded

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Public Health Aspects of Fruits, Nuts, Colors, and Extracts Used in Frozen Desserts *

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Most of the ice cream today is made from pasteurized mix, considered by milk sanitarians as a necessary practice to insure the safety of the ice cream. The mix consists of the various products such as whole milk, skim milk, cream, butter, evaporated milk, powdered milk, sugar, and gelatin or some other stabilizer.

There are in the finished product, the ice cream, other ingredients besides those present in the pasteurized mix. Such ingredients as flavoring extracts, fresh fruits, preserved fruits, berries, candies, syrups, nut meats, and others are a necessary part of ice cream. These ingredients cannot be added before pasteurization. They are added to the mix at the time of freezing and, therefore, do not receive the protection of pasteurization.

The sanitary quality of these ingredients has frequently been questioned by dairy sanitarians. Newman in 1930 (1), Fabian in 1930 (2), and Smallfield in 1933 (3) have examined many of these ingredients to determine their bacteriological condition. They found that these ingredients may harbor a large bacterial population and thus contaminate the pasteurized ice cream mix.

The study reported in this paper is of similar nature as the studies referred to above. Its purpose was to accumulate further evidence and to suggest remedies where needed.

The samples of these ingredients were taken in the regular ice cream plants mostly from the opened containers in which they were kept while in use. Some of the ingredients were fresh while others were old, being used occasionally and meanwhile kept in store room or refrigerator. The samples, therefore, were representative of the ingredients as these were being used.

The bacteriological examination consisted of agar plant counts, yeast and mold counts, and the determination of the presence of coliform organisms. For the bacterial plate counts, regular standard agar with 1 percent lactose was used. For yeast and mold counts, regular standard agar containing 2 percent dextrose was used. The agar was acidified with tartaric acid to pH 4.5. For the determination of the coliform organisms, brilliant green bile broth in fermentation tubes was used. The development of gas in the closed arm was recorded as positive. No attempt was made to hunt for pathogenic microorganisms.

In addition to the taking of samples and examining them bacteriologically, the ice cream plants were inspected, especially with regard to the care and storage facilities for keeping these ingredients. Visits were also made to several establishments, in which these ingredients are prepared, to investigate the sanitary practices and the environment under which some of these ingredients are being prepared.

A summary of the results of the bacteriological examinations of a part of the samples is presented in Table 1. Of the 207 samples reported, 164 harbored bacteria, 24 had an abundance of coliform organisms, and 107 had yeast and molds.

The various flavoring extracts which were dissolved in alcohol were for the most part free from bacteria. Vanilla samples were of interest because they invariably contained some bacteria, mostly spore producers.

* Presented at the Annual Meeting of the American Public Health Association at Kansas City, Missouri, October 25-28, 1938.

TABLE 1

Microbial Condition of Certain Ice Cream Ingredients

	Product	No. samples analyzed	Percent showing E. coli	Percent showing molds	Range of mold count	Percent showing bacteria	Range of bacteria count (per ml. or per gram)
1.	Candy	51	5.8	37.2	0 – 260	70.6	0 – 1,000,000
2.	Maraschino cherries	9	11.1	44.4	0 – 110	77.7	0 – 1,780,000
3.	Nutmeats	20	20	65	0 – 470	70.0	0 – 1,000,000
4.	Frozen pack strawberries	13	0	84.6	0 – 19,000	100.	10 – 67,000
5.	Caramel color solution	13	0	46.1	0 – 1,800	61.5	0 – 5,800,000
6.	Blue color solution	14	7.1	50	0 – 1,700	85.7	0 – 560,000
7.	Green color solution	20	20	65	0 – 2,800	75.	0 – 14,000,000
8.	New York color solution	17	17.6	41.2	0 – 160	64.7	0 – 10,000,000+
9.	Yellow color solution	12	25	25	0 – 16,900	58.3	0 – 8,000,000
10.	Red color solution	26	7.6	61.5	0 – 11,700	92.3	0 – 1,000,000+
11.	Orange color solution	13	23.1	53.8	0 – 2,200	69.1	0 – 12,000,000
12.	Vanilla extracts	13	0	7.7	0 – 20	100.	30 – 60,000
13.	Miscellaneous (Plant 1)*	21	9.5	0	0	57.5	0 – 220,000
14.	Miscellaneous (Plant 2)**	30	56.6	56.6	0 – 700	100.	900 – 1,000,000+

* Different ingredients from a plant where they were properly cared for.
** Different ingredients from a plant where they were neglected.

Fresh fruits and berries always contain some bacteria. As a rule, the coliform organisms were absent, but yeasts and molds were always present, occasionally in large numbers.

Of the various ingredients, the coloring solutions may contain the largest number of organisms, molds, and at times fairly large numbers of bacteria.

While some of these ingredients may harbor quite a large number of bacteria, the increase in bacterial counts of ice cream due to them will, as a rule, be small. The real interest and concern of sanitarians lies in the fact that these ingredients, at least some of them, do not receive protection through pasteurization. After all, it is not the number alone but the kind of bacteria there we are concerned about.

As seen from the table, there were quite a number of samples harboring coliform organisms. Where these came from was not determined but probably in most cases they were of human origin. If this group of organisms can be transferred from the hands of the operators to the food products, the same thing might happen in case of such bacteria as typhoid bacteria, pathogenic streptococci, tuberculosis bacteria, etc. Unfortunately, the results of this study give no information as to the presence of such organisms in these ingredients.

The visits of the writer to a number of establishments where some of these ingredients were handled and prepared convinced him that the possibilities of contaminating the ingredients with pathogenic organisms were very great.

These ingredients cannot be put into the ice cream mix prior to pasteurization, therefore, some other method or treatment must be employed to make them safe.

Three different suggestions might be offered. First, some inspection and regulation should be made of the establishment where these ingredients are prepared. This is a responsibility not only of dairy inspectors but of health officers in general. Some of these ingredients are used in other foods besides ice cream and some of them such as nut meats are consumed directly.

Second, the dairy inspector should see that the various ingredients are kept in an acceptable storeroom or in a refrigerator in ice cream plants. The importance of this is well illustrated by the data in Table 1. The ingredients in Plant 1, No. 13, came from an ice cream plant where the ingredients were properly kept. In Plant 2, No. 14, the ingredients came from an ice cream plant where they were kept on shelves, unprotected from dust and at room temperatures.

Third, some of the ingredients should receive a bactericidal treatment before they are used. For example, nut meats may be so treated (4) that they will be practically free from bacteria.

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Quality Improvement of Cream for Butter

The Cream Quality Committee of the American Butter Institute has issued in Service Bulletin 608 the following recommendations for improvement in quality of cream for buttermaking:

1) That the purchase of all cream be made strictly on the basis of grade.

2) That purchases of cream on the basis of grade be made in accordance with the prevailing laws or regulations governing cream grading in the various states.

3) That there be appointed in each state a committee for the study of the relative market values of the various grades or qualities of cream, including obnoxious-weedy. That the report of each such committee be placed in the hands of its state cream quality committee.

4) That special attention and study be given to the transportation of cream from the contract buyer to the plant where it is to be churned. That shipments of cream move daily, in no case remaining in the station longer than 24 hours from date of purchase; and that all cream reach the churning plant within 48 hours.

5) That no cream be purchased from an unsanitary station or from any other source which does not meet sanitary requirements.

6) That the message of better quality be carried to cream producers by every practicable means, using existing educational facilities to the greatest possible extent. (In this connection particular attention is directed to the manual prepared by the Illinois State Cream Quality Committee for use in the Smith-Hughes schools. Arrangements for the use of this manual in the various states can be made on a nominal basis provided a sufficient quantity is ordered.)

7) That the cooling of cream by the best means available be urged upon all concerned with cream handling, as a necessity in the maintenance of quality. (It is recognized, of course, that cooling facilities are not equally good in all producing areas, but the importance of full use of the best methods available in a given area cannot be overestimated.)

8) That every butter-producing state now without a functioning cream quality committee take prompt steps to appoint such a committee, whose best efforts shall be devoted to the promotion of a sound cream quality program for the state.

9) That greater use be made of meetings with producers and cream buyers, as a means of placing in the hands of both the information essential to the production and care of quality cream. The practical value of such meetings has been repeatedly demonstrated.

10) That special emphasis be placed upon the continued use of the sediment test as an important adjunct to quality improvement work. It should be kept in mind that the sediment test represents one of the most effective means at hand for producer education.

Milk Supplies and Their Control in American Urban Communities of over 1,000 Population in 1936—A. W. Fuchs and L. C. Frank. *Public Health Bul.* No. 245 (1939).

This bulletin contains the statistical data and comments of the authors on the results from a questionnaire survey covering the more important features of the milk supplies and their sanitary control in 2,654 municipalities, representing 41 percent of the total number and 63 percent of the combined population of all municipalities of over 1,000 population in the United States.

The daily per capita consumption was 0.66 pint of fluid market milk, 0.035 pint of cream, and 0.031 pint of buttermilk, making a total of 0.73 pint. About half the cities graded their milk, the proportion increasing with the size of the city. Of the market milk volume sold, 74.7 percent was pasteurized, 99.4 percent was from tuberculin-tested herds, 35.2 per cent was from abortion-tested herds, and 20.3 percent was protected by all three measures.

About 36 percent of the municipalities had a milk ordinance, one-fourth of which was the Public Health Service ordinance. Raw milk showed an average plate count of 39,000 organisms per cc., pasteurized averaged 22,000, and pre-pasteurization raw had 87,000. The per capita expenditure was 7 cents per year, or ¼c per gallon, or $14 per farm or plant per year.

Copies of this excellent bulletin on the statistical aspects of milk control in the United States can be purchased from the Superintendent of Documents, Washington, D. C., at 10c each.

J. H. SHRADER.

Condensed and Evaporated Milk with Reference to Ice Cream *

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In the commercial manufacture of ice cream, the addition of milk solids not fat has long been an established practice. The standardization of the mix so that it contains the amount of butterfat required by law is of course necessary. The addition of sugar and flavor to suit the demands of the consumer as well as the addition of milk solids not fat to produce a smoother body are of great interest to the manufacturer.

The adjustment of the ratio between water and total milk solids in the mix is an important factor in the manufacture of a good-bodied ice cream. This adjustment usually requires the addition of from 2 to 3 percent of milk solids not fat. The source of such solids in the ice cream mix may come from condensed milk products such as evaporated, sweetened condensed, or plain condensed. These may be made either from whole milk or skimmed milk as the situation demands. From the standpoint of sanitation, we shall consider the manufacture of the condensed products in the order named. It is of interest to consider their method of manufacture and their possible importance as a source of contamination that might be reflected in the bacteria counts.

EVAPORATED MILK

According to Federal standards: "*Evaporated milk* is the product resulting from the evaporation of a considerable portion of the water from milk, or from milk with adjustment, if necessary, of the ratio of fat to not-fat-solids by the addition or by abstraction of cream. It contains not less than 7.8 percent of milk fat; not less than 25.5 percent of total milk solids; provided, however, that the sum of the percentages of milk fat and total milk solids be not less than 33.7."

"*Evaporated skimmed milk* is the product resulting from the evaporation of a considerable portion of the water from skimmed milk, and contains not less than 20 percent of milk solids."

In the manufacture of the products just defined, the process is very similar for both whole milk and skimmed milk. The milk is handled in the plant in the usual sanitary manner, placed in a hot well or heater, heated to near the boiling point and held for at least 10 to 15 minutes. It is then drawn into the vacuum pan where it boils rapidly and is concentrated. A vacuum of from 23 to 27 inches of mercury is maintained in the pan, thus giving a boiling point of 120 to 145° F. This process usually continues for from 2 to 4 hours, depending upon the size of the batch. When the desired amount of water has been removed, the vacuum is broken and the product passed through a homogenizer to break up the fat globules so that the cream will not separate upon standing. It is then canned in tin cans, sealed, and sterilized at approximately 245° F. for 15 minutes. This product, if used as soon as the cans are opened, would be a very insignificant source of contamination when used in the ice cream mix.

SWEETENED CONDENSED MILK

The Federal standards for this product are as follows: "*Sweetened condensed milk* is the product resulting from the evaporation of a considerable portion of the water from milk to which sugar (sucrose or sucrose and dextrose) has been added. It contains not less than 28 percent of total milk solids, and not less than 8 percent of milk fat."

"*Sweetened condensed skimmed milk* is the product resulting from the evaporation of a considerable portion of the water from skimmed milk to which sugar (sucrose or sucrose and dextrose) has been added. It contains not less than 24 percent of milk solids."

In the manufacture of these products, the process consists of heating the milk either whole or skimmed, in the hot well or heater to 200° to 210° F. During the heating process, sucrose is added in sufficient amounts to give a sucrose content in the finished product of from 43 to 45 percent. The sugar and milk mixture is drawn into the vacuum pan and boiled until the desired concentration of milk solids is obtained. The vacuum is maintained as in the case of evaporated milk and the boiling temperature varies from 120° to 145° F. for the duration of the process. When the desired concentration has been obtained, the product is drawn from the pan, cooled, and stored until packaged. The whole-milk product is usually packed in tin cans, hermetically sealed, and placed on the market. In the case of skimmed milk product, it is usually packed in kegs or barrels. This product, having a total solids content of 72 to 74 percent, contains sufficient sucrose in the water left in the product to make a saturated solution. This condition prohibits the growth of most microorganisms even when held at room temperature for long periods of time.

Modifications of this method are often used when it is to be used for ice cream purposes. Usually it is handled in barrels or large cans, and in some cases combinations of sucrose and dextrose are used. If the product has been properly made, barrels furnish a satisfactory container and the product should reach the plant in good condition. However, when the manufacturer prepares a skimmed milk product without the proper care, the quality of the product in the barrel after it reaches the plant may deteriorate before it is used in the mix. This deterioration may be due to insufficient sugar or improper methods of manufacture, especially that of improper heating in the hot well. The system of holding such a product under refrigeration temperature until used will remedy this situation to some extent.

Any modification from the standard procedure may give a product which will not have the necessary preservation factor furnished by the high concentration of sugar. Some manufacturers have found it desirable to prepare condensed skimmed milk containing 30 percent milk solids with only 30 percent sugar. One can readily see that this type of product does not contain sufficient sugar to give the protection that would be found in the standard product. Such a product would necessarily have to be kept under refrigeration until used if deterioration were to be eliminated. The method of handling such a product varies all the way from storing at 32° F. to freezing solid in a zero degree room and thawing as needed. From a sanitary standpoint, the later method of storing such a product is very satisfactory when properly handled in the plant. However, the problem of thawing a frozen product in such a way as to eliminate bacterial growth is a problem that many plants have not yet solved. Because of this fact, not only the question of the method of manufacture but also the method of handling the product in the plant where the mix is prepared should be given consideration.

PLAIN CONDENSED MILK

The manufacture of plain condensed milk, either in the whole or skimmed condition, consists of heating the milk in the hot well to a temperature of 150° to 200° F. at which temperature it is drawn into the vacuum pan and condensed 3 or 4 to 1. This concentrated product, with a total solids content of from 30 to 35 percent, is stored in ten-gallon milk cans and used very extensively in the ice cream mix. This product is in no way different from whole milk from the standpoint of spoilage. It sours readily and must be held under refrigeration. During periods of storage, it is either held at 32° F. or slightly lower, or frozen as in the case of the sweetened condensed milk. On

* Presented at the Annual Meeting of the American Public Health Association at Kansas City, Missouri, October 25-28, 1938.

account of its perishability, one should expect to find the same sort of conditions as in the case of cream or milk in an ice cream plant. Great care must be taken to keep the bacteria from increasing while it is in storage and while it is being handled prior to the manufacture of the mix. Here again the question of melting the frozen product should receive consideration.

In some plants, a product known as super-heated skim milk condensed is used. This product is nothing more nor less than plain condensed, just described, which is heated under vacuum by the use of live steam to a temperature sufficiently high to coagulate partially the casein, thus making a thick viscous product. The characteristics of this product are very similar to those of plain condensed, and should be handled in the same manner.

HANDLING OF MIX

With the manufacturing methods of these products in mind, one might theorize as to the condition of the mix when prepared in a plant using the various products. The quality as expressed by the bacterial content shown by the plate method of the ice cream mix before pasteurization would depend entirely upon the quality of the products used in the mix. The effect of the condensed or evaporated milk used in the mix would depend upon the method of manufacture, method of storage, as well as the method of handling the product in the ice cream plant. The only way to determine this condition is to examine the mix before it is pasteurized.

If the process of pasteurization is carried out with suitable equipment and under standard conditions, one would expect to find an ice cream mix with a bacterial count well within the standard suggested by health authorities.

One finds many variations in the method of preparing ice cream mix. One of the interesting points that comes to mind when considering the problem is that of multiple pasteurization. It is generally understood in public health circles that fluid milk is to be pasteurized but once. However, in the products used for the furnishing of milk solids not fat in ice cream mix, especially that of condensed skimmed milk, it is possible for the product to be pasteurized at least three times before the ice cream mix is finally frozen. In other words, milk is received at the plant, pasteurized, separated, the skimmed milk going to the vacuum pan where it is again pre-heated to temperatures well above pasteurizing conditions, held for varying lengths of time, evaporated in the vacuum pan at a temperature approaching that used for pasteurization and for longer periods, and finally packed as a finished product, having had at least two heat treatments at pasteurization temperatures. After this product is placed in the mix, it again receives a heat treatment. It really has been pasteurized or has received a heat treatment equivalent to that of pasteurization at least three times. In many cases, this brings up the question of thermophilic organisms, and may result under certain conditions in a high-count product. In other words, bacterial counts of products such as these may not always give a true picture of their actual condition, as far as the question of sanitation is concerned.

The problem of handling frozen products in the plant during the process of thawing preparatory to using in the mix is of great importance, and should be given much consideration if the bacterial count of the ice cream mix before pasteurization is to be kept at a minimum.

Sanitary Control of Dried Milk *

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Since approximately 3,000,000,000 pounds of fluid milk are converted into dried milk in this country annually, nearly all of which is consumed as food, sanitary control of milk in this form has a place in the public health officials' food control program. Unlike fluid milk, dry milk is used mostly as an ingredient in other foods, is seldom retailed, and is in powder form. These conditions have helped it to escape the sanitary control given the fluid form.

Public health officials are accustomed to apply various bacteriological procedures in controlling the sanitary quality of fluid milk. However, additional factors are involved when these procedures are applied for a similar control of dry milk. These may seem to make such control more difficult.

This is due largely to the physical properties of dry milk. A brief review of dry milk manufacture and handling will be helpful at this point. There are several methods of manufacture but the two most common are the use of the atmospheric roller or drum dryer, and the spray dryer. In the former, a thin film of milk is spread over a revolving, steam-heated drum or roller. As the drum rotates, its heat evaporates the water, and the film of dried milk solids is scraped off by a knife. The whole process takes place at atmospheric pressure and at high temperature. In the spray drying process, a descending spray or mist of milk meets a rising current of hot, dry air. The moisture in the tiny droplets of milk is evaporated almost immediately, and the dried milk falls to the bottom of the spray dryer. This almost instantaneous evaporation cools the milk solids so rapidly that not even the lactalbumin is coagulated. It is seen that the latter method gives a more soluble product, because the milk solids are not subjected to as severe a heat treatment as in the former method.

Dried milk is usually packed in barrels. The conditions of storage of these barrels of dry milk may affect its sanitary quality. The development of rancidity in dry milk is not likely to be of major importance since most dry milk is made of surplus skim milk, and dry skim milk usually contains not over 1 percent fat. But an off odor, described as "stale" or "tallowy", will develop during improper storage. This "off" odor will carry over into frozen desserts or other food products in which the tainted milk powder is used. Dry skim milk is subject to weevil infestation. It should be protected from all types of contamination during storage, and held in a dry, cool place. Uneven storage temperatures are detrimental as they cause sweating with consequent lumping and mold growth. High humidity in the storage room is bad for the same reasons.

Since dry milk is frequently made from surplus skim milk, the sanitary quality of the original, fluid milk frequently leaves much to be desired. The plate count of the dried product may or may not reveal the original sanitary quality, depending on the process of drying employed and the age of the dry milk. In this connection a statement by the American Dry Milk Institute (15), referring to the plate count, is important: "It is generally agreed that the bacterial count of dry milk solids is not necessarily an indication of the quality of raw milk from which the dry product is made. The process of manufacture has a direct

* Presented at the Annual Meeting of the American Public Health Association at Kansas City, Missouri, October 25-28, 1938.

bearing upon the extent to which the bacteria are destroyed."

However, use of the microscopic technic that shows the dead as well as the living bacteria and likewise the types will tell much concerning the previous history of the product under examination. The importance of knowing the past history of the product was demonstrated in an outstanding piece of work by Shrader and his co-workers (12) at Baltimore. Figure 1, which is Chart 1 in Dr. Shrader's paper, summarizes their findings.

The procedure described by Breed and Brew (3) is the most satisfactory method of using the microscopic technic with the powdered milks that dissolve easily. The 1:10 dilution of the powder in distilled water is used for making the smear, and is done by the procedure described in "Standard Methods" for fluid milk.

With samples that are difficultly soluble, it is almost impossible to secure a uniform, finely dispersed suspension in the distilled water blank. As a result, a very uneven film of milk solids is obtained on the slide. Such films not only

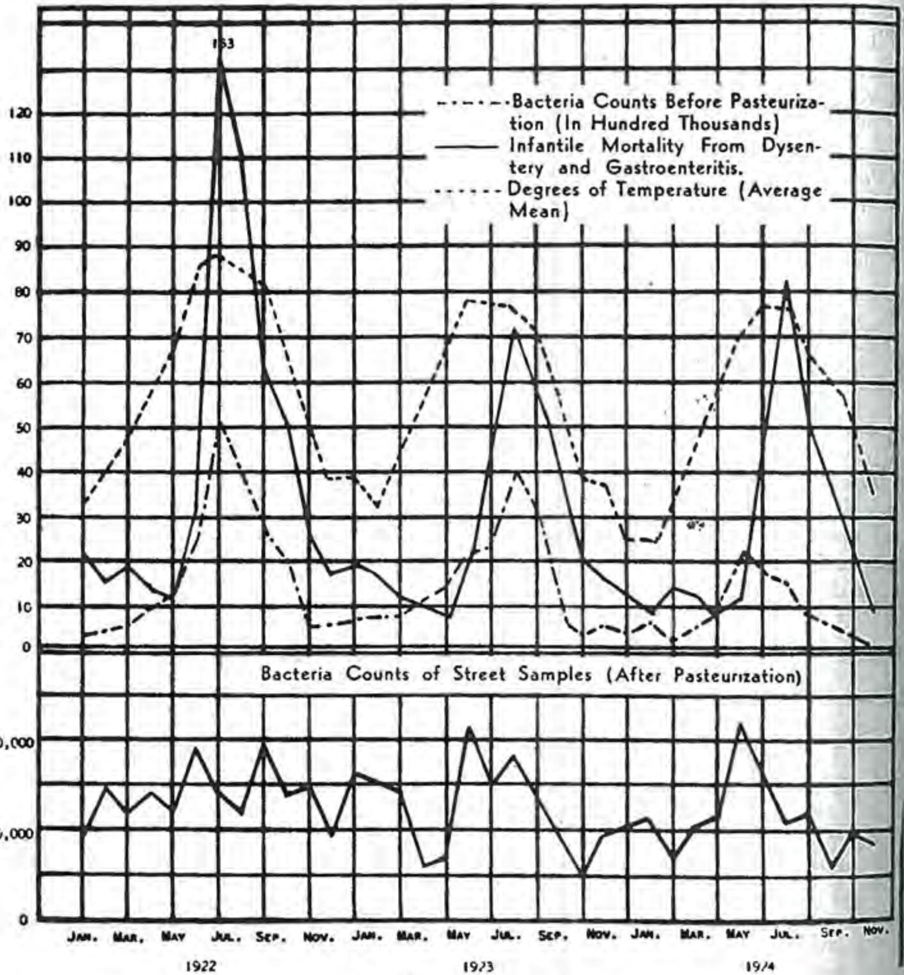


FIGURE 1.

Chart indicating some relation between pre-pasteurized bacteria counts and infantile gastroenteritis.

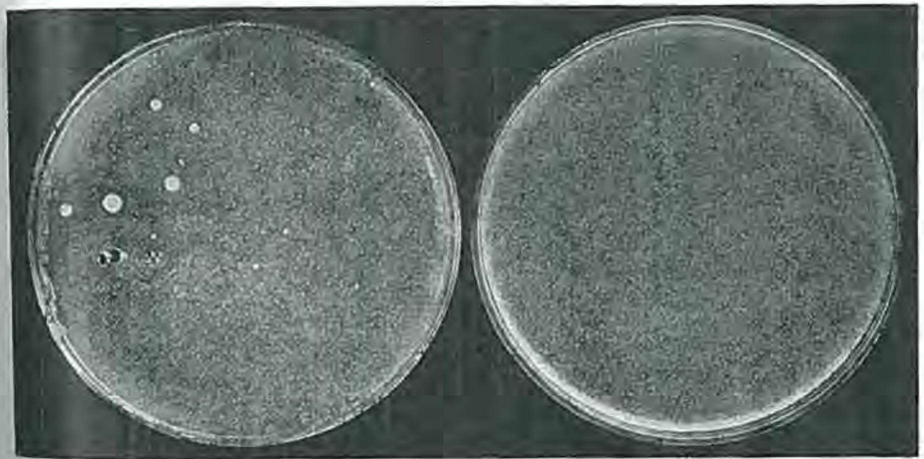
are frequently washed off during staining, but also clumps of casein often so obscure the bacteria that it is impossible to make a satisfactory examination of the smear. Such samples may be examined satisfactorily by microscopic technic when 1:10 dilutions in LiOH are used, as described by Prickett and Miller (2). Another method of staining, employing a different fixative and an aniline oil-methylene blue stain, but using the 1:10 dilution in LiOH, has been reported by Schneiter and North (16) to be satisfactory for difficultly soluble milk powders.

Although, as indicated previously, both dehydration and storage tend to reduce the numbers of viable bacteria present in the original, fluid milk, as shown by Supplee and Ashbaugh (17), Macy (1), and others, nevertheless the plate count is an important bacteriological procedure in the sanitary control of dry milk. Not only does it give some idea as to the original flora of the fluid milk, but it also reflects the contamination to which the milk was subjected following drying. For the latter, it is specially important, according to Supplee and Ashbaugh (17), in the case of atmospheric drum-dried milk.

The chief difficulty encountered in the plating procedure is the preparation of satisfactory dilutions of difficultly-soluble powdered milks. It is important to prepare the dilutions so that: (a) the milk fat, if appreciable amounts are present, will not be churned out of suspension, and (b) the poured plates will be as free as possible from undissolved particles of dried milk that may be confused with "pin-point" colonies when the plates are examined after incubation, illustrated in Figure 2.

Spray-dried milk is sufficiently soluble to dissolve with little difficulty in the distilled water dilution blank. However, the less soluble drum-dried powders will dissolve with difficulty in such dilution blanks. If careful warming of the dilution water to 43 - 49° C. (110 - 120° F.), before the weighed powder of sample is added, does not put the sample into solution, then the use of an alkaline dilution blank is recommended.

Prickett and Miller (2) reported that their best results in using alkaline dilution blanks to eliminate the particles of milk solids (Fig. 3) by the solvent action of alkali were obtained with LiOH solutions. Although they found the pH values of dilutions of milk powders are slightly increased when LiOH blanks are

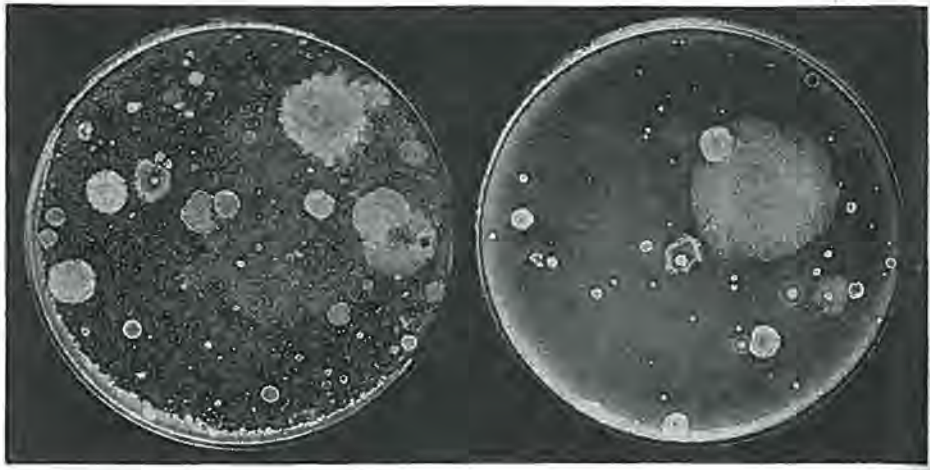


Pin Point colonies on pasteurized milk plate.

Particles on sterile plate from acid milk powder

FIGURE 2.

Appearance of plates with pin-point colonies and insoluble milk particles.



Dist. Water *N/5 LiOH*

1:10 Plates Prepared from Drum Dried Skim Milk Using Distilled Water and N/5 LiOH Dilution Blanks:

FIGURE 3.

Appearance of plates using distilled water and LiOH dilution blanks.

used, the pH values of the inoculum-medium mixtures seeded from LiOH blanks can be largely controlled by adjusting the reaction of the medium. (They recommend using nutrient agar whose reaction is pH 6.2 to 6.6 if LiOH dilution blanks are employed.) They also showed that further control of the pH is obtained by using LiOH in only the 1:10 dilution, and then employing sterile distilled water blanks for the higher serial dilutions. These authors were unable to demonstrate any germicidal action by the LiOH dilution blanks when used with powdered milk, as shown in Table 1.

From this table it is seen that a concentration as high as N/5 LiOH is not germicidal. Since only very insoluble milk powders require this concentration, it is obvious, as has been reported, that no killing effect will be encountered by using weaker concentrations which are satisfactory for most dry milks. Sorensen (13) has confirmed the value of using alkaline dilution blanks in detecting thermophilic contamination in skim milk powders, although he employed weaker concentrations.

Another difficulty in securing satisfactory plate counts of dried milk is that frequently many of the viable bacteria in this product tend to form "spreader" colonies. This tendency toward "spreader" colony formation is markedly reduced, according to Prickett (18), by the use of Bacto Tryptone Glucose Extract Agar as the plating medium.

Another bacteriological procedure frequently used by public health officials in controlling the sanitary quality of fluid milk is the test for organisms of the coliform (*Escherichia-Aerobacter*) group. Organisms of this group have been reported by Allen (4) and others to be present in powdered milks. In addition to the sanitary significance that may be attached to results of this test, it also helps to determine the efficacy of the heat treatment that powdered milk undergoes in a manner analogous to use of this test in pasteurization control, as recommended by McCrady and Langevin (6).

TABLE 1

Comparative Plate and Microscopic Counts of Milk Powders

Milk Powder Examined	Diluent Used	Plate Counts per gram 37°C.	55°C.	Direct Microscopic Counts on 1:10 dilution
Whole Milk, Drum-dried	Distilled Water	1,500	250	**
	N/5 LiOH	2,300*	350*	650,000
Skim Milk Drum-dried	Distilled Water	2,700	650	**
	N/5 LiOH	5,100*	550*	110,000,000

* - Combination of N/5 LiOH and distilled water blanks used.

** - Impossible to make satisfactory count due to undissolved particles of milk powder.

In powdered milk, more satisfactory results have been obtained when Difco Brilliant Green Bile Broth (2%) has been used as the enrichment medium in the presumptive test. "Standard Methods" should be followed for confirming presumptive tests and reporting results. It has been reported by Miller and Prickett (5) that in samples of powdered milk fairly heavily contaminated with organisms of this group, Bacto Violet Red Bile Agar can be used for their detection as well as to enumerate the numbers present. McAuliffe and Farrell (14) showed that higher dye concentration in culture media employed for the determination of *Escherichia-Aerobacter* numbers in milk gives more efficient and satisfactory results.

Due to the increasing prevalence of food-poisoning outbreaks caused by hemolytic staphylococci and streptococci, as reported by Tanner (7), Jordan (8), Denison (9), and others (10, 11), it would seem desirable, to say the least, to exclude from frozen desserts products contaminated with these organisms.

In this report some of the more important bacteriological procedures applicable to the sanitary control of dry milks have been briefly discussed. Additional procedures are available, but sufficient evidence has been produced to demonstrate that public health officials have adequate methods at their command to control the sanitary quality of powdered milks. The volume of dry milk annually consumed, amounting to approximately 300,000,000 pounds, warrants such control. Since dry milk is an excellent source of milk solids not only in frozen desserts but also in other foods, it should be used extensively, but this product should be subject to the sanitary control applied to other dairy products.

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Report of Committee on Dairy Farm Methods - 1938 *

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Another year has gone by and it is very evident that all our problems relating to dairy farm methods have not been solved. The proper methods of cleaning and storing of milking machines and dairy utensils is still a debatable question.

Cold Water One point which we believe we can all agree upon is that milking utensils should be thoroughly rinsed *immediately* after use with cold or luke warm water. In order to do this efficiently and remove all the milk, it is absolutely essential that a good, stiff brush be used with the cold or luke warm water. This practice will also help to reduce to a minimum the formation of so-called milk stone on dairy utensils.

Alkali Solutions Soap or soapy solutions should not be allowed in the cleaning of dairy utensils. Warm alkali solutions should be used whenever necessary.

Hot Water An abundant supply of hot water is essential for washing and sterilizing dairy utensils. In many sections of the country this one feature is being sadly neglected. Your Committee has arrived at the conclusion that hot water on the dairy farm is of equal importance to proper refrigeration of milk. A number of the larger electrical manufacturing companies are becoming interested in the development of proper equipment to be used on dairy farms for this purpose. Insulated, automatic electric heaters of different capacities are now quite common in some localities. An automatic heater insures to a dairyman a sufficient quantity of hot water at all times. In many instances these heaters are located in the cow stables. In the colder climates this is quite important as it helps to prevent water pipes from freezing.

There are two types of automatic electric heaters on the market, the pressure and non-pressure type. For most purposes the non-pressure type will be found most practical, and can be purchased with a capacity up to thirty gallons. As many dairy farms are not equipped with running water, a supply tank can be arranged to feed the heater. With these non-pressure type heaters, hot water cannot be drawn off unless the valve is opened, thereby permitting the entrance of cold water. Irrespective of whether the pressure or non-pressure type heater is used, they should all be so regulated that the water coming from the heater is not less than 180° F. at any time.

In some sections, dairymen provide other means of heating water, and in such cases fire insurance rates may be affected. Regardless of the method provided for furnishing hot water, it is essential to have a sufficient quantity at a temperature not less than 180° F. at the time of use. After dairy utensils have been properly cleaned and sterilized, they should be stored in a clean, dry atmosphere.

Milking machines In spite of the fact that very simple adequate methods have been developed for the care of milking machines, many milk ordinances still insist upon dairymen following more complicated, expensive and time-consuming methods. Your Committee believes that a service can be rendered to the members of the Association by bringing their attention to the advantages of these simplified methods, thereby enabling milking-machine users to produce a better quality product with less trouble and expense.

At one time it was thought necessary to entirely disassemble a milking machine after each use and wash the separate parts in an alkali solution. In some cases where bonuses are paid for milk on a bacterial basis, the bacteria content immediately increases when this method is substituted for either of the following methods: It has been satisfactorily demonstrated that a good quality, clean, low count milk can be produced with either the suction type or lye method of cleaning milking machines. However, when practicing either of these methods, it is absolutely essential that the milking machine be free from all foreign matter at the beginning. In other words, a milking machine should never be allowed to become dirty. Recent research convinces us that if a milking machine is equipped with satisfactory rubber, the machine can be kept in a clean condition if the following procedures are employed:

Suction type method (cold & hot water)—Immediately after use and before the engine is shut off, at least four gallons of cold or luke warm water should be sucked through each unit. During this operation, the teat cups should be raised and lowered at frequent intervals. At least one gallon of hot water, not less than 180° F. in temperature, should then be sucked through each unit, the teat cups remaining in the hot water until the entire amount of water has disappeared into the unit. After this operation, the units and milking tubes should be hung in such a position that the water will drain out thereby remaining dry until the next use. Some dairymen prefer the wet method of storing, such as, cold water, brine, chlorine solution, etc.

Lye method (cold water & lye solution)—Extensive experiments have resulted in the development of a method which has given complete satisfaction without the use of hot water for washing or sterilizing the rubber parts. The following is a description of the method: Immediately following the milking of the last cow, a pailful of clean cold or luke warm water is sucked through the teat cups and tubes of each unit. The teat cups are raised and lowered so that air and water alternately surge through the tubes. This causes greater expansion and contraction and removes more of the milk residue. (This suction method is equally as effective as brushing the tubes.) Next, the long milk tube is disconnected from the pail head, and the teat cups and tubes hung up on a solution rack. The teat cups and milk tubes are then completely filled with a weak solution of common lye. The solution is left in the tubes until the next milking, then drained out thoroughly and used to scrub down the milk house floor. The milk pails and pail heads are washed and sterilized along with the other metal utensils as previously described. In order to prevent the rubber tubing from sticking to the metal parts, the milk tube system should be taken apart once a week. Check valves, vacuum lines, etc., should be cleaned regularly.

The fact that no hot water is required for washing and sterilizing the rubber parts makes it well suited to average farm conditions, where only a limited quantity of hot water is available. The lye solution has the following advantages:

1. It prevents the growth of bacteria and kills many of those remaining after the suction rinsing.
2. It removes traces of fat and other milk solids, leaving the rubber parts sweeter and cleaner and lengthening their life.

**3. Lye can be bought at any grocery or general store, the solution is easily prepared, and costs less than 1¼ cents per gallon.

4. Lye solution unlike hypochlorite does not lose its strength when in contact with milk residue or rubber.

As against the advantages mentioned, there are two disadvantages: (1) Lye like other alkalies corrodes aluminum. This method should not be used on machines having aluminum parts in the milk tube system. Aluminum pails are not affected as the solution does not come in contact with them. (2) If the suction rinsing is not done thoroughly, small

* Presented at the 27th Annual Meeting of the International Association of Milk Sanitarians, Cleveland, Ohio, Oct. 19-21, 1938.

amounts of milk residue may remain. The lye solution will then throw down a precipitate of calcium phosphate, and a granular deposit will slowly build up on the inner walls of the inflations. This will rarely be found except under very careless conditions.

The first disadvantage may be met by using sodium metasilicate, which does not corrode aluminum, in place of lye. The second can be avoided by using larger quantities of water to rinse the tubes, and particularly by rinsing immediately before the milk has a chance to dry onto the rubber. If it should appear, the deposit can easily be removed by soaking in vinegar or other weak acid.

*** Preparation of Lye Solution*

(a) Stock Solution—Dissolve 3 tins of good grade lye in 5 quarts of cold water. On account of the intense heat which develops, it is best to use an enamel pail. This is the "Stock Solution" and should be kept in a tightly-stoppered glass or earthenware jar.

(b) Soak solution for Filling Milk Tube System—Take 4 oz. stock solution and dilute with clean cold water to 5 quarts. This should give a solution containing slightly less than one-half of 1 percent of lye, having a distinctly slippery feel.

The solution rack method is strongly recommended in place of the older method where the tubes were placed in a large crock. Less solution is required, and a fresh quantity of clean solution at full strength is used at each milking. It also avoids trouble due to air pockets in the tubes in the crock method, whereby portions of the tube escape contact with the solution. Less space is also required in the milk house.

A number of milking machines are equipped with large cone-shaped aluminum pails. It has been found that after sterilization these pails are inverted on a rack in the milk house, and very often are found to be moist on the inside during the entire period between milkings. If these pails are inverted for a short time so that most of the water will drain off and then placed on the side, the inner surfaces will soon become thoroughly dry.

Your Committee wishes to again emphasize the importance of immediately scrubbing with a stiff brush, using cold or luke warm water, all surfaces of dairy utensils that come in direct contact with the milk. If the utensils are scalded with boiling water, or water not less than 180° F., immediately after the cold or luke warm water brushing, it may not be necessary to wash them with an alkali solution as often recommended. In such cases where utensils are allowed to remain for any length of time after the cold water brushing, it is advisable to wash them with an alkali solution before the hot water rinse.

Another subject which we would like to stress and which was also mentioned in the Committee's report for 1937 is the question of sediment in milk. The two most important factors in the prevention of sediment in milk are: First, hair on udders and flanks of milking cows should be kept short at all times; second, cow beds should be kept clean and free from dust and fine material. When these precautions are conscientiously followed, sediment in milk is greatly reduced.

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Latest Developments in Cooling Milk on the Dairy Farm *

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To many dairymen the problem at this moment appears to be the sudden realization that the daily production of milk must be cooled to some safe low temperature very soon after it is drawn. They do not understand that this, apparently a new requirement, has long been in existence, but it may not have been rigorously observed or enforced. Today it is generally conceded that cooling the milk at the farm, immediately after it is produced, is a necessary factor in the quality program.

The ordinances and codes issued by municipal and state health authorities stipulate that milk should be cooled. However, there is neither entire agreement as to the limit of temperature nor complete knowledge touching details of the methods used to accomplish this end and the codes are rarely definite concerning cooling practice.

We lack uniformity in our requirements. Should the morning as well as the evening milk be cooled? Receiving stations continue to accept the morning milk without any precooling, as long as it arrives within two or three hours after it has been drawn.

It has been shown experimentally that the so-called bactericidal action is no substitute for prompt cooling. Milk processed within several hours after production has its keeping quality reduced if it has not been promptly cooled to a safe keeping temperature, preferably 40° F. At that temperature multiplication of bacteria practically ceases.

METHODS USED IN COOLING THE MILK

The two general methods of cooling milk on the farm are aeration and direct immersion. Aeration is practiced by the producer who retails milk directly; or, in certain areas, by a group of producers because the local municipal ordinances stipulate that requirement. Aeration is the cooling of milk by allowing it to flow by gravity over the surface cooler through which either cold water or brine is pumped to reduce the temperature. In direct immersion, milk is cooled by immersing the containers in cold water.

MODERN MILK COOLERS

The modern milk cooler is designed to meet the requirements of the individual dairyman. Nearly all milk coolers are electrically operated and automatic in their performance.

Figures 1 and 2 show four types of modern milk coolers which are designed to meet the requirements of the dairymen in solving their milk cooling problem. The automatic operation is thermostatically controlled. The agitators are independent units conveniently located which will stir the water for any desired length of time. The agitators are regulated by clocks mounted on the motor frames.

IMPROVEMENTS IN DESIGN

The modern electric milk cooler is designed to be a willing servant and requires very little attention from the dairyman. Figure 3 shows the capacitor motor with the condenser mounted on top, thus eliminating the brushes. The condenser serves their purpose when the motor starts.

In order to eliminate the necessity of having to take up the wear of the belt which runs the compressor, the motor is

* Authorized for publication September 12, 1938, as paper No. 851 in the Journal Series of the Pennsylvania Agricultural Experiment Station. Presented at the Twelfth Annual Meeting of the New York State Association of Dairy and Milk Inspectors, Rochester, N. Y., September 14-16, 1938.

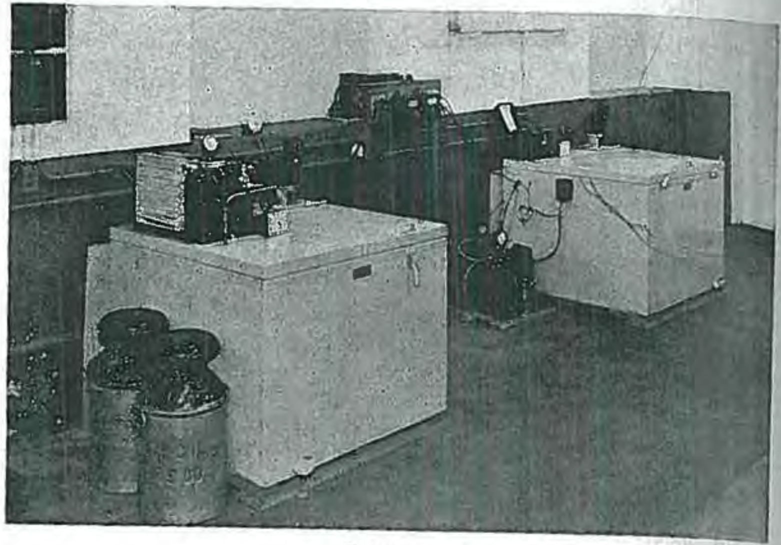

FIGURE 1

Two electrically operated milk coolers. The condensing unit of one is located at the side of the cabinet, of the other it is mountd on top left of the cabinet. Both milk coolers are provided with agitators which stir the bath water when milk is cooled.

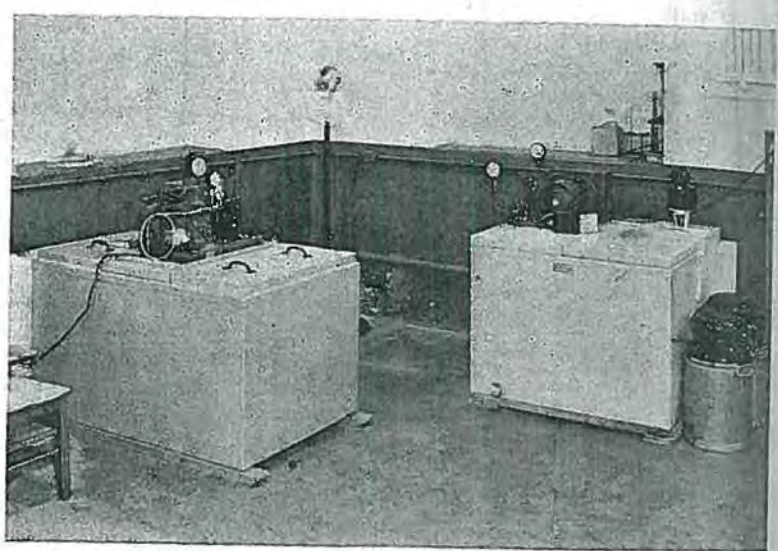

FIGURE 2

The condensing unit of the milk cooler on the left is centrally located. The condensing unit of the other is on the far left top. This unit is hermetically sealed.

so suspended that the possible wear is taken up automatically, the motor being pivoted eccentrically as is shown in Figures 3 and 4.

The complete condensing unit is simply arranged and all parts or coil connections are easily accessible, shown assembled in Figure 4.

FIGURE 3

Capacitor motor, an improvement in design for farm electric milk coolers.

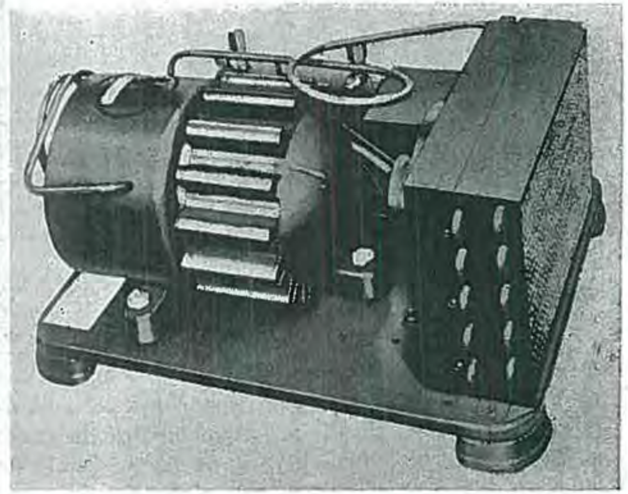

FIGURE 4

The complete condensing unit showing simplicity of arrangement and ease of accessibility to all parts or connections.

COIL ARRANGEMENT, AGITATION AND WATER SPRAYING

In direct immersion milk cooling practice, the cans of milk are placed in a cold water bath which is maintained at a low temperature by the evaporating or cooling coil. The coils may be arranged in many different ways. Figure 5 shows the evaporating coils "bunched" concentrically and housed within a thin walled cylinder suspended below the fly wheel of the compressor. When mounted on the milk cooler, it fits into a corner as shown in Figure 6. The agitation of the bath water

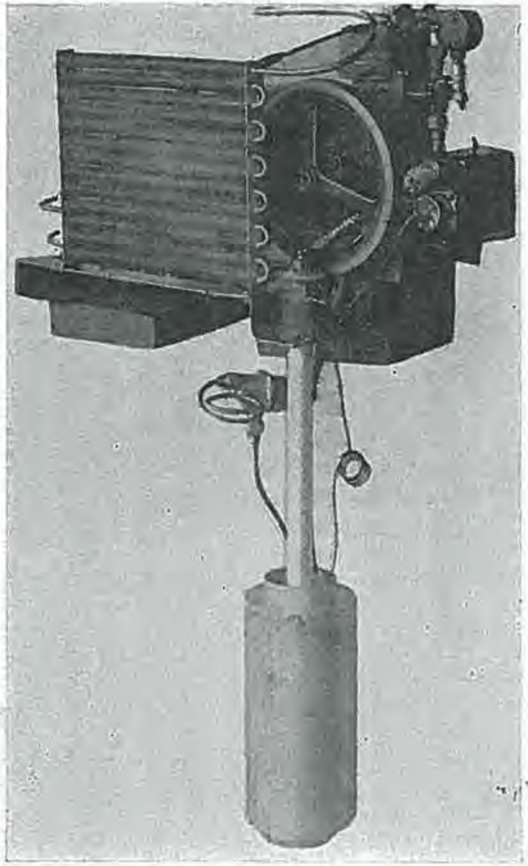

FIGURE 5

The cooling coil is "bunched" within the thin walled cylinder. The water is forced through the coil, from bottom to top, by a propeller blade which receives motion through a long shaft and its friction pulley which rides on the face of the fly wheel.

is obtained by forcing it through the coil, from bottom to the top, and then distributing it through two pipes along the inside of the cabinet so that the cold water sprays around the neck of the cans. This serves two main purposes, it provides agitation and the milk cans need not be submerged "up to their necks" for rapid cooling of the top portion of the milk.

HOW DOES MILK COOL IN A CAN?

When a ten gallon can of milk is submerged in the cold bath, it will cool rapidly and more uniformly if there is sufficient available refrigeration initially and also if the bath water is in motion. It is also important that the can be fully submerged, unless the bath water is sprayed around the neck of the can as described above, all other factors being equal.

Figure 7 shows rate of cooling of ten gallons of fresh milk. The average initial temperature of the milk was 90° F. The curves show the temperature of the milk at ten different points, two inches apart, right through the center of the can, measured for twelve hours. The can was fully submerged in water bath which was initially 36.5° F. and agitated for one and one-quarter hours. At the end

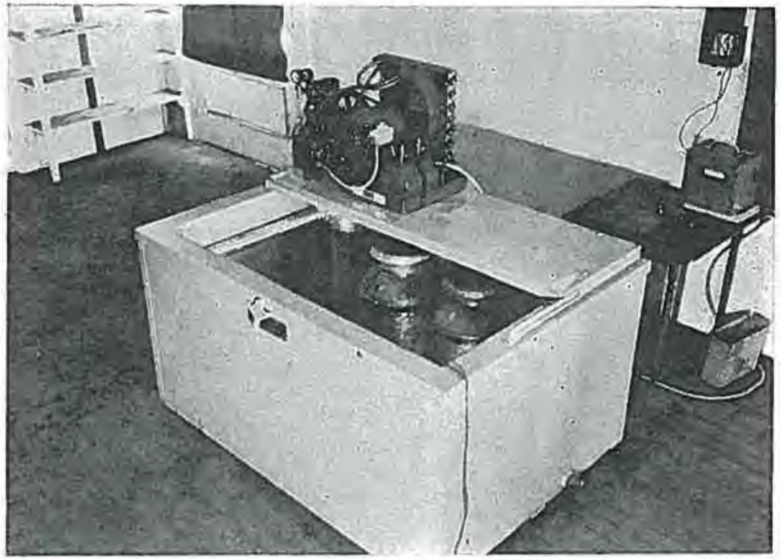

FIGURE 6

The spray type of milk cooler; the cooling coil located in one corner. The bath water is forced through the coil and is then distributed through pipes along two walls, delivering the cold water around the neck of the cans.

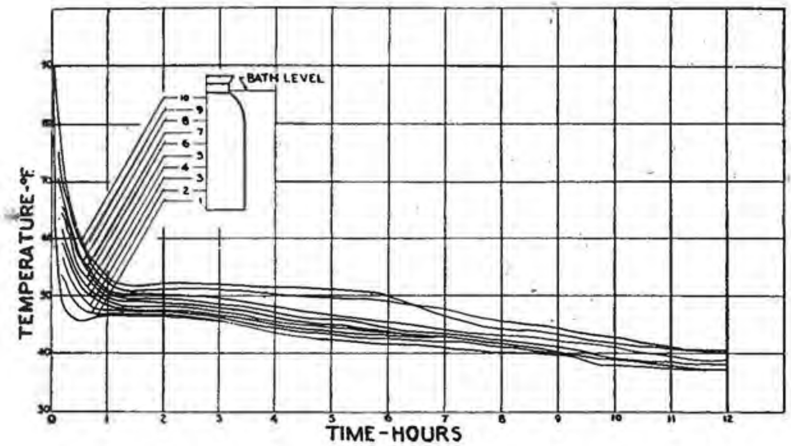

FIGURE 7

Rate of cooling of ten gallons of fresh milk, initially 90° F. showing ten different points, two inches apart through the center in the same can.

of the first hour of cooling the top of the milk was approximately 53° F. and the bottom 46.5° F. More heat was removed during the first hour than during the succeeding eleven hours.

THE WATER TEMPERATURE

The function of the cold water bath in a milk cooler is to absorb the heat of the milk. When the heat transfer takes place the bath necessarily will warm up. The degree to which it will warm up depends on the quantity of heat transferred from the milk, the quantity of water in the bath and its initial temperature.

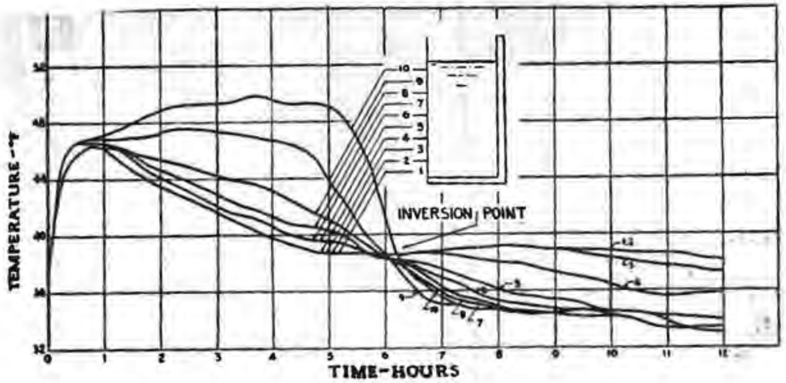

FIGURE 8

The temperature of the water bath which was initially at 36.5° F. During milk cooling there were 3.5 gallons of water for every gallon of milk cooled. The water was agitated for one and one-quarter hours.

Figure 8 shows the rise in temperature of a water bath, which was initially 36.5° F. There were 3.5 gallons of water for every gallon of milk cooled. The milk cooled as shown in Figure 7. The water temperature at the end of one and one-quarter hours, when agitation stopped, was approximately 46.5° F. or ten degrees warmer than it was initially. As the cooling continued, the water bath "spread out" or stratified in different layers, at different temperatures, while the condensing unit continued to operate. After six and one-quarter hours the water reached nearly uniform temperature and then the position of the warm and cold layers was reversed, that is "inversion point" was reached, with the coldest water on top, a very desirable condition for further cooling of the top warm milk in the can as shown in Figure 7.

The latest developments in modern milk coolers have been designed to meet the present milk cooling requirements for the dairymen.

A Study of Pasteurized Milk in Rochester, N. Y., Employing the Phosphatase Test *

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A study of pasteurizing plants supplying milk to Rochester, New York, was made by the Health Bureau to evaluate the phosphatase test for the detection of raw or improperly pasteurized milk. The results of the phosphatase tests were correlated with the data concerning the operation of the plants, as recorded by the inspectors. A comparison of the disappearance of phosphatase with the reduction in numbers of coliform bacteria during the process of pasteurization was also made to determine the relationship of the two tests.

PROCEDURE

Milk inspectors scored each pasteurizing plant, obtained specimens of milk from the holding vats at different stages of pasteurization and submitted them to the laboratory. A sample of milk was taken from each of the following sources: (1) cans of individual producers; (2) holding vats before heating; (3) when the temperature of the milk reached 143° F.; (4) after holding for fifteen minutes; (5) and after holding for thirty minutes at this temperature; (6) the first and last bottles from the bottling machine; (7) bottles of milk and cream pasteurized on the previous day.

In the laboratory, all samples of milk and cream were examined for the presence of coliform bacteria by inoculating Dunham tubes of formate-ricinoleate broth, as described by Stark (1), with 10 cc., 1.0 cc., and 0.1 cc. of each sample. After incubation at 37° C. for forty-eight hours, gas production in any tube was considered to constitute a positive test for coliform bacteria. A modification of the Kay and Graham phosphatase test (2), (3) was made on each sample, as follows: 1.0 cc. of milk was added to 10 cc. of Kay and Graham's disodiumphenylphosphate-sodium veronal buffer solution; a drop of chloroform was added and the mixture incubated at 37° C. for eighteen hours; 0.2 cc. of a 0.4 percent solution of 2,6-dibromoquinonechloroimide in 95 percent ethyl alcohol was then employed to determine if phenol was present. In the case of properly pasteurized milk, only a light grey color appears, while the presence of 0.2 percent or more of raw milk in the sample, underheating by 1° or 2° F., or decreasing the holding period by five or ten minutes leads to the formation of a blue color, the intensity of which varies with the amount of phosphatase in the sample.

Controls for reading the test were prepared by adding known amounts of phenol to pasteurized milk. Only three standards, containing 0.01 mg., 0.05 mg., and 0.10 mg. of phenol, are required to interpret the test. Milk producing 0.01 mg. or less of phenol was interpreted as "properly pasteurized"; between 0.01 and 0.05 mg., as "slightly improperly pasteurized"; and from 0.05 to 0.10 mg., as "improperly pasteurized." Samples that formed greater quantities of phenol were considered definitely unpasteurized or to contain raw milk. Pasteurized milk, to which 0.2 per cent of raw milk has been added, produces between 0.02 and 0.03 mg. of phenol with the above procedure. Furthermore, it gives results comparable to the more complicated and costly test recommended by Kay and Graham.

* This survey was conducted with the cooperation of Mr. George A. West, Supervisor of Food and Sanitation, Rochester Health Bureau.
Presented at the Twelfth Annual Meeting of the New York State Association of Dairy and Milk Inspectors, Rochester, N. Y., September 14-16, 1938.

RESULTS

The tests herein described were made on 1563 samples of milk and cream collected from 157 holding vats in 104 pasteurizing plants. The results were then correlated with the information recorded on the inspectors' score sheets.

A comparison of the results (Figure 1) of the phosphatase and coliform tests showed that the colon bacilli in the milk were destroyed more rapidly than the phosphatase during the preheating and holding periods of pasteurization. While the phosphatase was unaffected by preheating, 84 percent of the coliform bacteria were destroyed. After being held for fifteen minutes at 143° F., the coliform bacteria were reduced by 97 percent, but the phosphatase activity was destroyed in only 20 percent of the samples. After the thirty minute holding period, however, coliform bacteria and the enzyme were destroyed in all but 1.3 and 4.5 percent of the samples, respectively. Improper operations at the plants accounted for these exceptions. Entirely different results were obtained on samples of milk from the first bottle after pasteurization. Of these samples, 41.8 percent showed the presence of coliform bacteria in 10 cc. amounts, but only 3.4 percent gave a positive phosphatase reaction. Apparently, therefore, the presence of coliform bacteria in 38.4 percent of the samples was due to contamination with unsterile equipment, and not to recontamination with raw milk. Results obtained from the examination of samples taken from the last bottle of the run were similar to those taken from the first Table 1.

Of the 129 samples of milk pasteurized on the day previous to inspection, 23.2 percent were positive. This indicates that 18.7 percent of the plants which produced properly pasteurized milk on the day of inspection were operated improperly on the day before inspection. Only 10 percent of the 2816 "street" samples collected for routine examination and tested were found to be improperly pasteurized.

Correlation of the results of the phosphatase test with the data from the inspectors' score sheets showed that all but three samples of raw milk from the 481 individual cans were positive. Further investigation by the inspectors disclosed that the three negative samples were from "returned" cans of pasteurized milk, mis-

FIGURE I

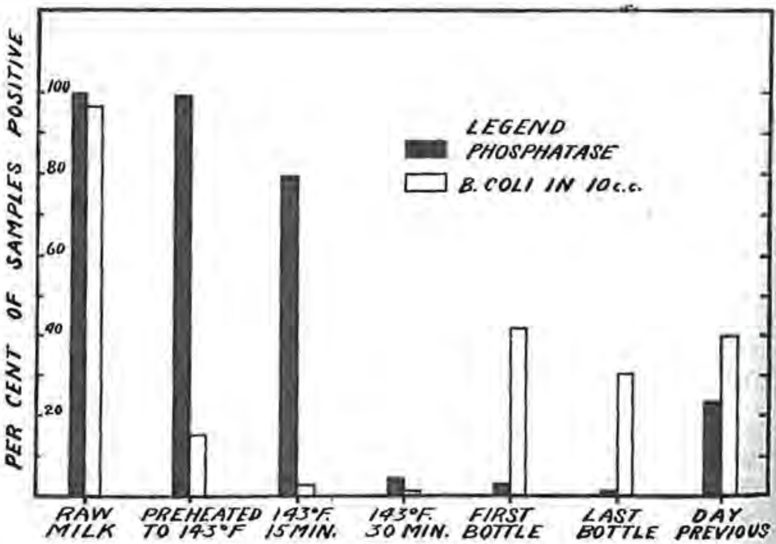

TABLE 1

Summary of Phosphatase Tests on 1563 Samples of Milk from 104 Pasteurizing Plants in Rochester, New York

Source of Samples	No. Samples Examined	Phosphatase Test No. Positive	No. Negative
Individual producers' milk cans	481	478	3
Composite raw in vat	146	146	0
Total Raw Milk Samples	657	624	3
Preheated to 143° F.	152	151	1
Heated at 143° F.—15 minutes	151	120	31
Total Incompletely Pasteurized Samples	303	271	32
Heated at 143° F.—30 minutes	157	7	150
First bottle from machine	117	4	113
Last bottle from machine	142	2	140
Milk from previous day	129	30	99
Cream from previous day	88	20	68
Total Pasteurized Samples	633	63	570

taken for raw milk. One hundred forty-six samples of mixed raw milk from the various pasteurizing vats likewise showed phosphatase activity. The 152 samples of preheated milk showed phosphatase with the exception of one sample which had been exposed to a preheating temperature of 160° F. for fifteen minutes and did not show the presence of the enzyme. The inspectors observed, however, that twenty-seven of the samples had been heated at 144° F. or 145° F. which accounts for the high percentage of negative tests. The other four samples were heated to 143° F., but they may have been mixed with "returned" pasteurized milk, or they may have contained less than the average amount of phosphatase.

Milk was properly pasteurized in all but nine, or 4.5 percent, of the 157 vats examined. In each of the nine exceptions, gross errors in pasteurization were detected by the inspectors. Phosphatase was present in the thirty-minute pasteurized samples from five holding vats, but absent in the first and last bottles from the bottling machines. Pasteurizing temperatures of from 1° to 2° F. lower than 143° F. explain the phosphatase activity of the thirty-minute samples. The first and last bottles, as well as the thirty-minute samples from two other plants, were positive. Improper pasteurization at low temperatures, leaks, and moderate foam, explain the positive findings. Finally, in two plants, the thirty-minute samples and first bottles were positive, while the last bottles were negative. In one of these, the pipe line from an overhead pump containing raw milk was left connected during the holding period. In the other, the recording chart registered 1° F. above standard, and the cooler, over which the raw milk was pumped, was not subsequently sterilized before cooling the pasteurized milk.

Tests made on 129 samples of milk and cream pasteurized on the day previous to inspection disclosed that thirty, or 23 percent, were improperly pasteurized. Routine examinations of samples from each of the thirty plants had previously been positive. Apparently, twenty-one plants which produced pasteurized milk free from phosphatase on the day of inspection, did not pasteurize properly at all times. In fifteen of these, evidence of faulty operation was found. In the other six, it is suspected that the outlet lines were connected to the bottling machine before the end of the holding period.

DISCUSSION

The results of this study make it possible to classify the pasteurizing plants in Rochester as follows:

Group 1 Nine plants in which multiple faults of operation were found on the day of inspection and which at other times gave positive tests for phosphatase on routine examination.

Group 2 Twenty-four plants in which pasteurization was conducted properly on the day of inspection. Routine samples from these plants were positive, however, and there was evidence of faulty operation.

Group 3 Twenty-one plants which pasteurized properly on the day of inspection and showed only occasional positive routine tests.

Group 4 Fifty plants which have never shown a positive phosphatase test or any evidence of improper operation.

The positive phosphatase tests obtained on the routine samples from plants in Groups 1 and 2 were readily explained by the findings of the inspectors, but those obtained on the samples from plants in Group 3 can not be so easily accounted for. Some of them have had only a single positive test during a year of intensive routine examination, and it is our opinion that the improper pasteurization in this group was due to occasional errors in operation. Relief or part-time operators, unfamiliar with the equipment, may have been partly responsible. Improper operation occurs more frequently in cases where two grades of milk are handled because of the complicated piping system and multiple operations required. While thirty-four, or 63 percent, of the fifty-four plants in Groups 1, 2 and 3 produced both "Rochester Standard Pasteurized" and "Rochester Guernsey Pasteurized" milk, only eleven, or 22 percent, of the fifty plants in Group 4 pasteurized both grades.

Several faulty conditions were found during this survey which deserve special attention (Table 2). The recording chart in one plant was so mounted on the pasteurizer that the stirrer caused the recording pen to vibrate excessively. The inked line was so broad the temperature could not be read within 3 or 4° F. In another plant, equipped to work "automatically", the operator frequently adjusted the mechanisms by hand, because the "automatic" devices failed. The drippings from leaking valves and pipe lines in a third dairy were caught in any available utensil and returned to the pasteurizer after completion of the thirty-minute holding period. In a fourth plant, the operator flushed out the equipment with raw skim milk after the cream was pasteurized. Only two cases of hand-regulated charts were discovered. The faults most frequently encountered were inaccuracies of the thermometer, and the connection of outlet lines to the vats before completion of the holding period. It is also probable that milk was drawn off before the completion of the thirty-minute holding period, although this practice was not actually observed. The bulbs of the thermometers were near the bottom of these vats. Hence, it would be possible for the plant operator to withdraw the milk after twenty or twenty-five minutes of holding at 143° F. and still obtain a perfect temperature record without advancing the chart by hand.

TABLE 2

Correlation of Plan Operations with Phosphatase Test

Data from Score Sheets	Phosphatase Test: Positive, Group 1	Positive, Group 2	Negative, Group 3	Negative, Group 4
Total number of plants in groups	9	24	21	50
Process samples positive	9	0	0	0
Samples from previous day positive	9	15	6	0
Street samples positive	9	24	21	0
Outlet line connected	5	7	13	1
Recorder error greater than 1° F.	4	8	0	1
Low temperature and short holding	8	3	0	0
Moderate foam	2	4	0	0
Excessive foam	1	0	0	0
Short holding at 143° F.	0	5	0	0
Hand regulated charts	0	2	0	0
Overhead pump connected	1	0	0	0
Pumped raw milk through pipe lines	1	0	0	0
Drippings returned to pasteurizer	1	0	0	0
Excessive vibration of recorder	0	1	0	0
"Automatic control" adjusted by hand	0	1	0	0
Plants having more than one vat	6	15	13	11

SUMMARY

During a survey of 104 pasteurizing plants in the city of Rochester, New York, a total of 1563 samples of milk, taken at different stages of the process, were collected from 157 vats, and 2816 samples of milk from distributors. All samples were examined for improper pasteurization by a modified phosphatase test and for the presence of coliform bacteria employing a formate-ricinoleate medium. In the course of a year's study, fifty plants were observed which gave no evidence of improper pasteurization. On the day of inspection, gross defects in pasteurizing methods were disclosed in nine plants, routine samples from which were positive. The pasteurization in twenty-four plants was satisfactory on the day of inspection. Routine samples from these plants, however, were positive and there was evidence of faulty plant operation. With the exception of occasional minor imperfections, the pasteurization in twenty-one other plants was reliable, and routine phosphatase tests were rarely positive.

In conclusion, it may be said that the phosphatase test is invaluable for the detection of improper operation in pasteurizing plants. It should be emphasized, also, that the test for coliform bacteria is equally valuable for the detection of recontamination by contact with unsterilized equipment at the plant. When both tests are employed simultaneously, they are of more value to the milk industry and public health officials than any other combination of tests yet devised for milk control. It is suggested that the conventional bacterial count be discarded in their favor.

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Abstracts of Technical Papers Presented at Thirtieth Annual Meeting of the American Butter Institute

(Continued from March Issue)

Application of the Phosphatase Test to Creamery Butter

G. W. Shadwick, Jr. and M. E. Parker

Experiments upon sour cream adjusted to conventional churning acidities and "flashed" at different temperatures have indicated that 185° F. or higher will give negative phosphatase reactions upon samples treated by a modification of the Scharer short method as well as by the Kay and Graham 24 hour incubation method.

"Flashing" cream at 180° F., however, gave negative results by the modified Scharer short method as well as by the 2½ hour and 8 hour incubation methods of Kay and Graham, although doubtful results were obtained by using the 24 hour incubation period.

Cream "flashed" at 175° F. gave doubtful results by the modified Scharer short method and positive results with the Kay and Graham methods whereas "flashing" below 175° F. gave positive results with all methods.

Butter freshly made from sour cream of adjusted acidity which had been "flashed" at 185° F. or higher gave negative phosphatase tests when using the modified Scharer short method and the Kay and Graham 24 hour technic.

In using the short method of Scharer, it was found that the modification which gave better end points by which to determine more accurately a positive or a negative result was obtained by increasing the incubation time from 10 minutes at 100° F. to 15 minutes at 105° F. This added temperature and time in subsequent trials appears to be critical, and has been found to give better agreement when compared with the longer methods of Kay and Graham.

Some indications of possible phenol production by bacterial activity in butter samples subjected to the keeping quality test of holding at 70° F. for eight days (100 percent humidity) have been observed.

Due to factors which may stimulate phenol production in butter subjected to normal changes in temperatures and environment during the interim between its manufacture and consumption, caution should be exercised in interpreting a positive phosphatase test as indicative of the inadequate pasteurization of the cream used in its manufacture.

Futher work should be done to establish the amount of sample of butter serum to be used to interpret its relation to the original cream from which the butter was made.

The Effect of Temperature upon Score Value and Physical Structure of Butter

W. H. E. Reid and W. B. Arbuckle

The temperature at which butter is scored appears to have a definite influence upon its score value and consumer acceptance. Butter ordinarily graded with a high commercial score (i. e., 90 points or higher) will usually give a higher score value at 70° F. than at 40° F.; whereas, butter usually given a medium or low score will generally have a higher score at 40° F. and at 70° F.

The explanation for these phenomena appears to be that all flavors are less distinct at 40° F. whereas at 70° F. all flavors are full and enhanced except when the salt content is sufficient to submerge the true characteristic butter flavor.

The score value of butter manufactured from cream of good quality is enhanced as the serving temperature is increased; whereas, the score value of butter manufactured from cream of fair or inferior quality diminishes under similar conditions. According to preliminary trials with butter samples submitted by Missouri manufacturers, the spreading properties appear to be most desirable at 60° F.

Cream Improvement

J. O. Clarke

Mr. J. O. Clarke, Chief, Central Division of the U. S. Food and Drug Administration, urged that more attention be given to sanitation on the farm, at the buying station, and at plants. He indicated that an acidity standard of 1.5 percent might be set down as one of the measuring sticks for quality. Again he brought out that consideration is being given to the mycelia or mold filament count as a means of determining condition of the product, under the new Federal Food, Drugs, and Cosmetic Act, which will take effect in June, when such standards can be adopted.

Significance of Mold Mycelia in Butter

E. H. Parfitt

Mold mycelia in butter were originally studied for the purpose of evaluating their possible relation to the quality of the cream used in the manufacture of butter. It was found that the growth of mold in cream was directly proportional to the surface exposed to air. Other favorable influences involve the factors of time and temperature. Varying amounts of mold mycelia consequently will be found in butter made from cream subjected to a variety of such conditions during the different seasons with the result that no definite correlation between the mold mycelia content and score value of butter has been established or can be indicated. While no definite correlation could be established between the amount of mold mycelia in butter and its score value, in the summer there is a tendency for all butter irrespective of score to have a greater mold mycelia content than during other seasons of the year. Conventional practices used in buttermaking appear to have no influence upon the control of the presence of mold mycelia in butter.

Holding Butter Customers

M. G. Bush

Speaking only of salted butter, the butter industry is doing itself no good in producing butter resembling lard in color rather than at least a straw color which has an appetite appeal and at the same time classifies butter automatically in its true, natural, and distinctive condition.

The general level of butter quality has shown improvement during the last ten years. Some geographical territories, perhaps more favored than others, have shown greater improvement.

(To be concluded in July issue)

JOURNAL OF MILK TECHNOLOGY

Official Publication of the

International Association of Milk Sanitarians

(Association Organized 1911)

THE JOURNAL OF MILK TECHNOLOGY is issued bimonthly beginning with the January number. Each volume comprises six numbers. It is published by the International Association of Milk Sanitarians, and is printed by The Chronicle Press, Inc., Orange, N. J., U. S. A.

Subscriptions: The subscription rate is $3.00 per volume. Single copy, 60 cents.

Advertising: All correspondence concerning advertising, reprints, subscriptions, and all other business matters should be addressed to the Managing Editor, W. B. Palmer, 29 North Day Street, Orange, N. J.

Manuscripts: All correspondence regarding manuscripts, editorials, news items, announcements, and other reading material should be addressed to the Editor, J. H. Shrader, 339 Springdale Avenue, East Orange, N. J.

Membership and Dues: Active and Associate Memberships in the Association are $5.00 per year. This includes all issues of the Journal. All correspondence concerning membership in the INTERNATIONAL ASSOCIATION OF MILK SANITARIANS, including applications for membership, remittances for dues, failure to receive copies of the JOURNAL OF MILK TECHNOLOGY, and other such matters should be addressed to the Secretary of the Association, C. Sidney Leete, State Department of Health, Albany, N. Y.

Association News

West Virginia Association of Milk Sanitarians

The tentative date for the Annual meeting of the West Virginia Association of Milk Sanitarians is set for October 20, 1939 at Fairmont, West Virginia.

An interesting and successful program of Dairy Schools for the farmer has been introduced under the guidance of the Association and the Dairy School of West Virginia University. Mr. M. K. Argenbright and Mr. J. R. Erwin inaugurated the program at Weston on April 6, 1939. Representatives of West Virginia University, State Health Department and local inspectors met with the Dairymen of the locality for an all day session.

The program included the following subjects:

Equipment on the dairy farm.

Grooming and caring of the cow.

Sanitary Milking Procedures.

Cooling and storing the milk.

The bactericidal treatment of equipment.

Open forum.

H. E. EAGAN, *Secretary.*

Connecticut Association of Dairy and Milk Inspectors

The next meeting of the Connecticut Association of Dairy and Milk Inspectors will be held at the Hotel Barnum, Bridgeport, Conn., June 6. The tentative program will deal with the following subjects:

1. Short hold, high temperature pasteurizing survey under the direction of Dr. L. F. Rettger and associates.
2. Connecticut import cream survey, directed by Prof. E. O. Anderson.
3. Composite milk samples and their testing.
4. How the Milk Regulation Board looks upon chocolate milk.
5. New legislation: its cause and effect.

H. CLIFFORD GOSLEE, *Secretary.*

Michigan Association of Dairy and Milk Inspectors

The 11th annual meeting held in Detroit, March 7 and 8, was a great success. Attendance at all sessions were greater than at any previous time. The active interest exhibited at the business meeting showed that the membership is solidly back of the long range program of the Association.

The success of the meeting last fall at the Michigan State College has encouraged the Association to plan for a summer meeting this year. Arrangements will be worked out by the Standing Committee, Grey Turney, *Chairman*, and the Sports Committee, Clarence Wright, *Chairman*.

The Association is steadily growing, as shown by the following figures:

1936	54 members
1937	64 "
1938	77 "
1939 (to date)	72 members

New York State Association of Dairy and Milk Inspectors

The Annual Meeting of the Association is scheduled for September 27, 28, and 29, 1939, at Syracuse, N. Y. The headquarters will be the Hotel Syracuse.

W. D. TIEDEMAN,
Secretary-Treasurer.

Association of Food and Drug Officials

The 43rd Annual Conference of the Association of Food and Drug Officials of the United States will meet at Hartford, Connecticut, September 26 to 29, 1939.

New Creamery Butter Standards

The new official U. S. standards for quality of creamery butter, as promulgated by the Secretary of Agriculture on November 3, 1938, became effective on April 1. These standards were discussed in the JOURNAL OF MILK TECHNOLOGY, May, 1938, p. 19. As pointed out (*Ibid.* p. 2) we regret that the revised method of scoring does not recognize such important factors of quality as sanitation in production methods, particularly, the proper pasteurization of the cream for buttermaking.

J. H. SHRADER.

The Jacksonville Meeting

In accordance with traditional Southern hospitality and generosity, our friends in Jacksonville, Florida, are planning to make the Twenty-eighth Annual Meeting of the International Association of Milk Sanitarians an outstanding event. The convention will be held at the Hotel Mayflower, October 25 - 27, 1939.

The personnel of the Florida Committee is as follows:

H. N. Parker, *Chairman,*
R. B. Becker
J. F. Harper
A. E. Johnson
V. C. Johnson
B. S. Johnston
J. M. Scott
G. E. Stengle
L. M. Thurston
A. H. Williamson
C. H. Willoughby

HORATIO N. PARKER,
Chairman, Local Committee

Horatio N. Parker, the local chairman, has indicated that we are being welcomed by the Governor, the Mayor, the Commissioner of Health, and other representative citizens. The roads are excellent, so we expect that many will drive down and bring their wives. Golfing on palm-treed links! Bathing from such a beach! Trips through that delightful country! Well, we just cannot miss that meeting. We are going.

Write now to the Hotel Mayflower and make your reservations.

One of the World's Finest Beaches, 600 feet wide.
Jacksonville, Florida