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Vol. 22

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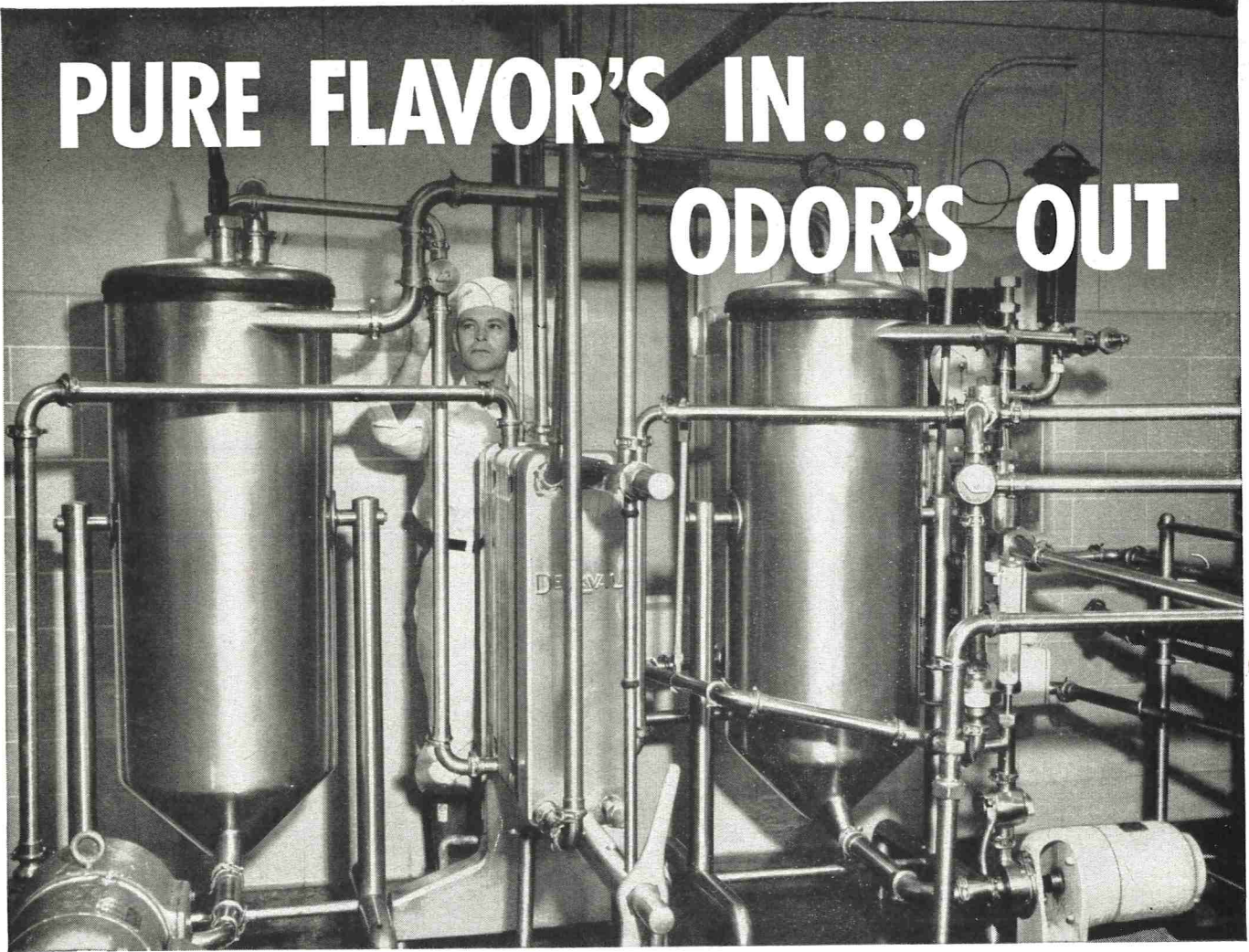
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The Journal of Milk and Food Technology (including Milk and Food Sanitation) is issued monthly beginning with the January number. Each volume comprises 12 numbers. Published by the International Association of Milk and Food Sanitarians, Inc., with executive offices of the Association, Blue Ridge Rd., P. O. Box 437, Shelbyville, Ind.

Entered as second class matter at the Post Office at Shelbyville, Ind., March 1952, under the Act of March 3, 1879.

EDITORIAL OFFICES: J. C. Olson, Jr., Associate Editor, Dept. Dairy Husbandry, University of Minn., St. Paul, Minn.; H. L. Thomasson, Managing Editor, P. O. Box 437, Shelbyville, Ind.

Manuscripts: Correspondence regarding manuscripts and other reading material should be addressed to J. C. Olson, Jr., Associate Editor, Dept. Dairy Husbandry, University of Minn., St. Paul, Minn.

"Instruction to Contributors" can be obtained from the Editor for the use of contributors of papers.

Journal of

MILK and FOOD TECHNOLOGY

INCLUDING MILK AND FOOD SANITATION
AND MILK TECHNOLOGY

Official Publication

International Association of Milk and Food Sanitarians, Inc.

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Subscription Rates: One volume per year
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Public and Educational
Libraries, 1 yr. \$6.00
Single Copies \$1.00

Orders for Reprints: All orders for reprints should be sent to the executive office

of the Association, P. O. Box 437, Shelbyville, Ind.

Membership Dues: Membership in the International Association of Milk and Food Sanitarians, Inc., is \$7.00 per year, which includes annual subscription to the *Journal of Milk and Food Technology*, (including *Milk and Food Sanitation*). All correspondence regarding membership, remittances for dues, failure to receive copies of the *Journal*, changes of address, and other such matters should be addressed to the Executive Secretary of the Association, H. L. Thomasson, Box 437, Shelbyville, Indiana.

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(1) Standard Methods for the Examination of Dairy Products, ed. 10, New York, American Public Health Association, 1953. (2) Committee Report, Am. J. Pub. Health 42:1131 (Sept.) 1952. (3) Microbiological Methods, report at 66th Ann. Meet. Assn. Official Agricultural Chemists, Sept. 29, 1952: J. Assn. Official Agr. Chem. 36:91 (Feb.) 1953. (4) Standard Methods for Examination of Water, Sewage and Industrial Wastes, ed. 10, New York, American Public Health Association, 1955.

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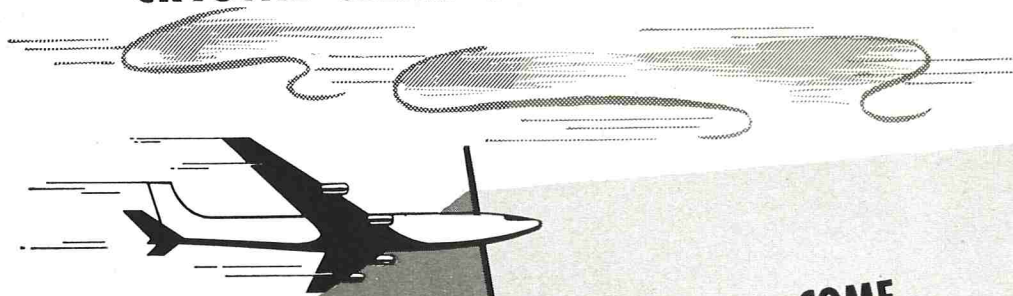


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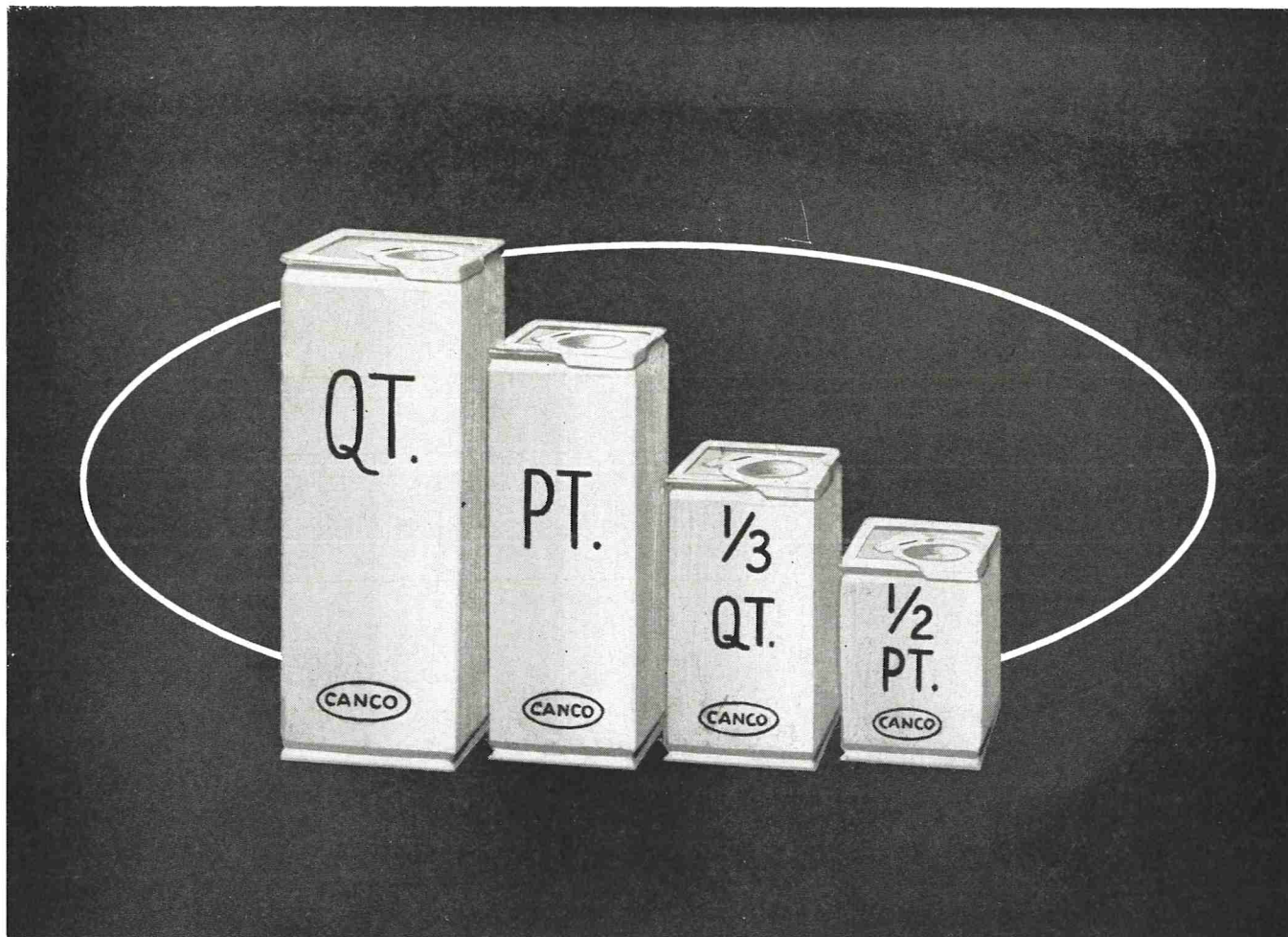
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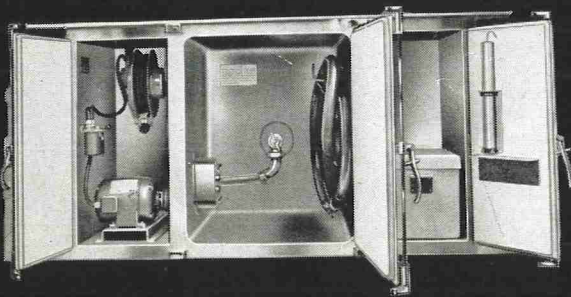
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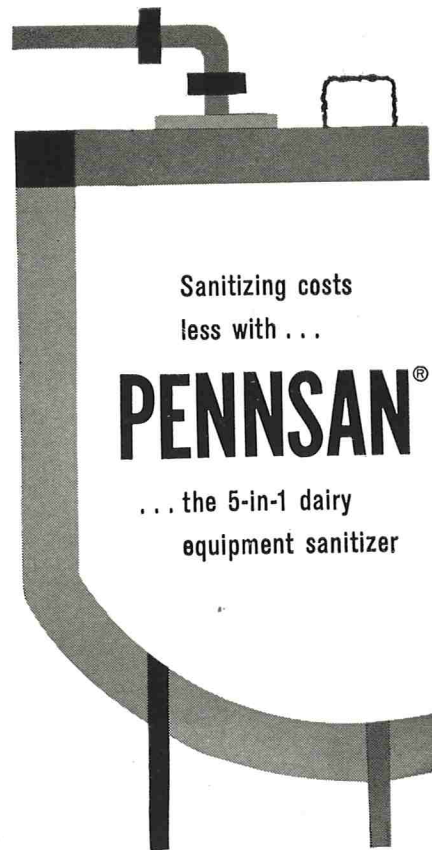


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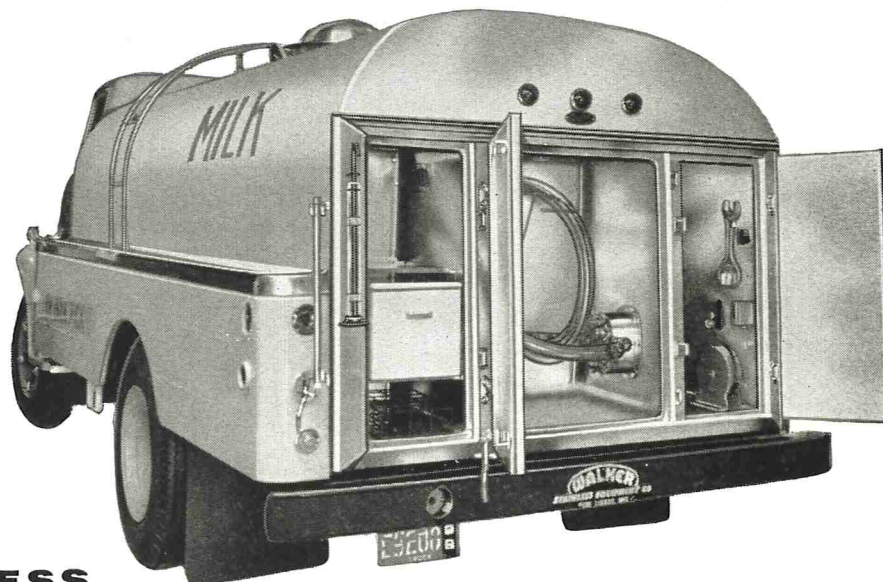
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RESAZURIN REDUCTION TEST AS AN INDEX OF THE BACTERIOLOGICAL QUALITY OF FROZEN FOODS

KARL KERELUK AND M. F. GUNDERSON

*Bacteriological Research Department
Campbell Soup Company, Camden, N. J.*

In the expanding field of the manufacturing of pre-cooked frozen foods, it is recognized that there is the need for strict control of bacterial contamination. Bacterial contamination is most often determined by the enumeration of bacterial populations by a standard plate count method. However, the determinations require 2 to 3 days to complete; whereas, the use of a dye reduction test which has been introduced by several investigators offers the possibility of shortening the time to five to eight hours.

Proctor and Greenlie (5) were able to show a rough estimation of the number of bacteria present by the dye reduction test. Using resazurin they demonstrated that foods having a high bacterial plate count, i.e., over a million organisms per gram, had a reduction rate which produced a color change in the dye within 3 to 5 hours' incubation.

When resazurin and methylene blue tests were used on egg powder, Johns (2) reported difficulty in determining the end points of long reduction times. However, Scott and Gillespie (6) obtained a good correlation between the standard plate count and resazurin reduction times with egg pulp.

Straka and Stokes (7), using principally the same methods as Proctor and Greenlie, reintroduced a resazurin reduction test which permits the estimation of the number of bacteria in precooked frozen foods (poultry and meat pies) within 3 to 8 hours. They made a comparative study of approximately 77 poultry and meat pies in which both the dye reduction time and a plate count for each pie were determined. On the basis of their data, it was possible to subdivide the pies into several groups which covered a range from less than 35,000 bacteria per gram to more than 9,000,000 bacteria per gram.

Work by Ferguson, Yates, and Jones (1) showed that the rate of reduction of resazurin dye was not necessarily proportional to the number of aerobic, mesophilic bacteria present in frozen vegetables. The dormant bacteria present in the frozen vegetables influenced the rate of reduction of the dye. The number of bacteria in frozen vegetables cannot be estimated with any reasonable degree of accuracy by the resazurin reduction test.

Mallman, *et al.* (4) introduced an indicator reduction test using a Phytone-Nacconal medium which

could be used for detecting insanitary plant operations as well as a possible means of predicting shelf-life of dressed poultry.

There is a need for a rapid test for determining the bacteriological quality of precooked frozen foods by the processors' quality control laboratories as well as other interested agencies. Since there has been some disagreement as to the usefulness of the resazurin reduction test in the estimation of bacterial populations for frozen foods, this investigation was undertaken in order to provide additional data.

MATERIALS AND METHODS

The resazurin reduction test and total bacterial counts were made on samples of frozen foods obtained from retail outlets in the city of Omaha, Nebraska.

A total of 123 samples of frozen foods which included meat pies, corn, beans, peas, peaches, blueberries, and cherries were examined for the total number of bacteria by a plate count and a resazurin reduction test.

A series of laboratory prepared unfrozen chicken meat pies were artificially inoculated with *Staphylococcus aureus* (*Micrococcus pyogenes* var. *aureus*) in order to have high population levels of the organism. This bacterium was previously isolated from a routine bacteriological examination of chicken meat pies. The pies were then frozen. It has been our past experience that frozen meat pies under proper storage conditions, purchased at retail outlets have low total counts (3).

Samples were prepared for plating and resazurin reduction by adding four parts of sterile 0.1 per cent peptone water to one part of sample (8) in a sterile Waring blender and blending for three minutes. Fifty gram samples were used for testing the frozen vegetables. The frozen meat pies were sampled by removing the top crust aseptically and one-half of the internal contents of the pie plus the bottom crust placed into the Waring blender.

A 1:10 dilution for plating of one sample was made by diluting 50 ml of the 1:5 dilution of sample with 50 ml of sterile 0.1 per cent peptone water. Subsequent 10 fold dilutions were made by mixing 10 ml of the previous dilution with 90 ml of sterile 0.1 per cent peptone water. Tryptone glucose extract agar and

trypticase soy agar were used as the plating media. Plates were incubated for 48 hours at 37°C.

The dye reduction method used in this investigation was according to the procedure of Straka and Stokes (7).

Five ml of the 1:5 dilution of the blended sample were pipetted into a test tube containing five milliliters of trypticase soy broth and one-half milliliter of the standard resazurin solution. The contents were mixed slowly by inversion to avoid incorporation of air. The tubes were incubated in a 37°C water bath in the dark and read every half hour. When the contents of the tube had turned pink, readings were made at 15 minute intervals until the pink color disappeared and the lower four-fifths of the tube was colorless. This was considered to be the end point and the time of the final reading was recorded as the reduction time.

TABLE 1—THE RESAZURIN REDUCTION TIME IN HOURS AND BACTERIA PER GRAM FOR FROZEN VEGETABLES

Sample Number	Type of Sample	Plate Count Bacteria per Gram*		Resazurin Reduction Time in Hours	
		Tryptone Glucose Extract Agar	Trypticase Soy Agar		
1	Beans	740,000	770,000	7	
2	"	140	90	8	NC
3	"	420,000	460,000	7-1/2	
4	"	2,800	2,600	7-1/2	
5	"	36,000	37,000	8-1/2	
6	"	750,000	840,000	7	
1	Corn	1,300,000	1,400,000	4-1/2	
2	"	91,000	97,000	6-1/4	
3	"	80,000	86,000	6-1/4	
4	"	6,600	7,700	7-1/4	
5	"	73,000	64,000	7-1/4	
6	"	32,000	33,000	6-3/4	
7	"	26,000	28,000	7-3/4	
8	"	23,000	19,000	7-1/4	
9	"	47,000	65,000	6-3/4	
10	"	13,000	14,000	7-3/4	
11	"	49,000	67,000	7-1/4	
12	"	48,000	38,000	7-1/4	
1	Peas	41,000	46,000	7	
2	"	5,100	6,200	7-1/2	NC
3	"	6,300	6,900	7-1/2	
4	"	4,600	5,900	7-1/2	NC
5	"	77,000	100,000	7-3/4	
6	"	6,600	8,700	7-1/2	
7	"	1,500	1,500	8-3/4	
8	"	640	890	8-3/4	
9	"	1,500	1,400	8	
10	"	440	570	8-1/4	
11	"	650	660	8-1/4	
12	"	430	470	8-3/4	

NC = No Change

*Average of three determinations

TABLE 2—THE RESAZURIN REDUCTION TIME IN HOURS AND BACTERIA PER GRAM FOR FROZEN FRUIT PIES

Sample Number	Type of Sample	Plate Count Bacteria per Gram*		Resazurin Reduction Time in Hours	
		Tryptone Glucose Extract Agar	Trypticase Soy Agar		
1	Peach	320	340	8	NC
2	"	640	420	8	NC
3	"	350	610	8	NC
4	"	210	220	8	NC
1	Blueberry	250	400	7	NC
2	"	360	170	7	NC
3	"	310	300	7	NC
4	"	170	110	7	NC
5	"	220	150	7	NC
6	"	290	220	7	NC
1	Cherry	240	120	7-1/4	NC
2	"	600	160	7-1/4	NC
3	"	110	170	7-1/4	NC
4	"	240	270	7-1/4	NC
5	"	300	510	7-1/4	NC
6	"	390	520	7-1/4	NC

*Average of three determinations

NC = No Change

RESULTS AND DISCUSSION

The use of trypticase soy agar and tryptone glucose extract agar in determinations of total numbers of bacteria in the frozen vegetables, fruit pies, and in the inoculated chicken meat pies, has demonstrated little or no difference between these media. Both media can be used interchangeably and the use of tryptone glucose extract agar in the survey of frozen meat pies was a matter of the investigator's choice.

The resazurin reduction time in hours and bacteria per gram for frozen vegetables are recorded in Table 1. The examination of the results indicate that the highest plate count obtained on the samples examined was over one million bacteria per gram for corn. The resazurin reduction time for the corn sample was 4½ hours. Bean sample numbers 1, 3, and 6 had plate counts over 100,000 bacteria per gram and the resazurin reduction times were exceptionally long for such high total bacterial counts. The reduction times were seven hours or longer. This may have been due to a color interference caused by the blending of the bean samples.

Results of the examination of frozen fruit pies are tabulated in Table 2. These results indicate that the fruit pies contained a low total bacterial count; the resazurin reduction times were 7¼ hours or longer. Even after eight hours of incubation, no reduction of the resazurin had taken place in the peach pies.

The results of the survey of the retail frozen meat pies are tabulated in Table 3. The examination of the results shows the overall excellence of the bacteriological qualities of the frozen meat pies examined. There were no pies examined which had a total bacterial plate count over 100,000 bacteria per gram. All but one of the counts were under 60,000 bacteria per gram and the resazurin reduction times were five hours or longer. The exception, number 11 of the turkey pies, had a total count of 82,000 bacteria per

TABLE 3—THE RESAZURIN REDUCTION TIME IN HOURS AND BACTERIA PER GRAM FOR FROZEN MEAT PIES

Number	Producer	Type of Frozen Meat Pie	Plate Count Bacteria per Gram*		Resazurin Reduction Time in Hours
			Tryptone	Glucose Extract Agar	
1	A	Turkey	9,800		7-½
2	"	"	7,400		7-½
3	"	"	6,100		7-¼
4	B	Turkey	6,000		7-¾
5	"	"	6,700		8 NC
6	"	"	1,700		7-¼
7	C	Turkey	4,400		8 NC
8	"	"	2,400		8 NC
9	"	"	940		8 NC
10	D	Turkey	16,000		6
11	"	"	7,700		5-¾
12	"	"	16,000		6-¾
13	E	Turkey	49,000		7-½
14	"	"	13,000		8 NC
15	"	"	5,400		8 NC
16	F	Turkey	11,000		8 NC
17	"	"	17,000		7-¾
18	"	"	18,000		8
19	G	Turkey	6,300		6
20	"	"	20,000		7-¼
21	"	"	82,000		5-¼
22	H	Turkey	350		8 NC
23	"	"	1,300		8 NC
24	"	"	1,100		8 NC
1	D	Tuna	130		8 NC
2	"	"	90		8 NC
3	"	"	70		8 NC
4	E	Tuna	1,000		8 NC
5	"	"	870		8 NC
6	"	"	5,700		8 NC
7	I	Tuna	50		8 NC
8	"	"	70		8 NC
9	"	"	180		8 NC
10	C	Tuna	70		8 NC
11	"	"	40		8 NC
12	"	"	60		8 NC
13	J	Tuna	530		8 NC
14	"	"	390		8 NC
15	"	"	990		8 NC

TABLE 3—CONTINUED

1	H	Beef	22,000		7-¼
2	"	"	3,800		7
3	"	"	2,800		7-½
4	G	Beef	10,000		7-¼
5	"	"	6,900		7
6	"	"	3,700		7-¼
1	B	Chicken	11,000		5-¾
2	"	"	24,000		6
3	"	"	16,000		6-¾
4	A	Chicken	7,900		6-¼
5	"	"	10,000		6-¼
6	"	"	9,600		6-¼
7	C	Chicken	9,100		6 NC
8	"	"	19,000		6 NC
9	"	"	56,000		6 NC
10	D	Chicken	33,000		6 NC
11	"	"	16,000		6 NC
12	"	"	7,500		6 NC
13	F	Chicken	16,000		7-¼
14	"	"	34,000		7-¼ NC
15	"	"	31,000		7-¼ NC
16	H	Chicken	28,000		7-¼
17	"	"	20,000		7-¼
18	"	"	19,000		7-¼

* Average of Three Determinations

NC=No Change

gram and the resazurin reduction time was 5¼ hours. The limited survey of frozen meat pies did not show any sample with high bacteria counts. Therefore, in order to have frozen meat pies of high bacterial populations, a series of chicken meat pies were artificially produced with high counts of coagulase positive *Staphylococcus aureus*.

The results of this experiment are recorded in Table 4. The total bacterial counts varied from 640 million *S. aureus* per gram to 15 million organisms per gram and gave resazurin reduction times of 1-1/2 hours to 2-3/4 hours. This experiment demonstrated the effect of high populations of *S. aureus* in chicken meat pies on the resazurin reduction times.

The overall study demonstrated a correlation between the plate count and the resazurin reduction times in hours. However, it was noted that there was considerable overlapping of the number of organisms needed to reduce the resazurin in a given time. These variations are due to a great number of causes. One of the causes may be due to plant production where varieties of microorganisms are inadvertently introduced into the manufactured product. Each group or species of bacteria reacts differently according to its metabolic requirements and since not all bacteria respire at the same rate, varied resazurin reduction times are produced.

The color interference does give difficulty in deter-

TABLE 4—THE RESAZURIN REDUCTION TIME IN HOURS AND BACTERIA PER GRAM OF CHICKEN PIES INOCULATED WITH COAGULASE POSITIVE STAPHYLOCOCCUS AUREUS

Sample Number	Plate Count Bacteria per Gram		Resazurin Reduction Time in Hours
	Tryptose Glucose Extract Agar	Trypticase Soy Agar	
1	640,000,000	610,000,000	1-½
2	560,000,000	490,000,000	1-½
3	630,000,000	650,000,000	1-½
4	270,000,000	290,000,000	1-½
5	27,000,000	25,000,000	2-½
6	22,000,000	21,000,000	2-¾
7	27,000,000	32,000,000	2-¾
8	15,000,000	17,000,000	2-¾

mining the end point of the resazurin reduction time. Observations from this study have indicated that samples of peas, beans, and beef pies have shown a color interference with the reduction test. This interference gives a longer resazurin reduction time than did other samples such as poultry and tuna pies.

The variations encountered in this study do not completely limit the usefulness of the resazurin reduction time test. Since the time needed for reduction of the resazurin generally decreases progressively with increased bacterial populations, its limitations in sensitivity should be recognized. The test can be used only in a broad classification of screening procedures in determining the number of bacteria per gram.

Straka and Stokes (7) recommended the use of three broad classes of numbers of bacteria present in a product as determined by the resazurin reduction time. Class one constituted a range of 0 to 100,000 bacteria per gram with a range of resazurin reduction

time of five hours or longer. Class two constituted a range of 100,000 to 1,000,000 bacteria per gram with a range in reduction time of three to five hours. Class three included anything over 1,000,000 bacteria per gram with a reduction of resazurin in less than three hours. Our investigations showed similar results; however, we have used four classification groups rather than three. The results of both studies can be noted in Table 5.

Our past experience has demonstrated the need to have a rapid determination of total bacterial counts under 100,000 per gram. We were, therefore, interested in determining resazurin reduction times of bacterial numbers under 100,000 per gram.

The three classes of numbers of bacteria as recommended by Straka and Stokes (7) were found to be satisfactory for general bacteriological screening of some frozen foods.

SUMMARY

A total of 123 frozen food samples were examined bacteriologically by a resazurin reduction test as described by Stokes and Straka and for total numbers by using a plate count method. Examination of the results indicate that the total bacterial populations could be classified by total counts and resazurin reduction times into several broad groups. The method and classification as recommended by Stokes and Straka in their investigations were found to be satisfactory and can be used with success for general bacteriological screening of some frozen foods. However, the results of our investigation could recognize four distinct classes. Class one which contained 0 to 10,000 bacteria per gram had a resazurin reduction time of eight hours or longer. Class two contained 10,000 to 100,000 bacteria per gram and showed a reduction time of six to eight hours. Class 3 which had 100,000 to 1,000,000 organisms per gram had a resazurin re-

TABLE 5—GROUP CLASSIFICATION OF BACTERIA PER GRAM AS DETERMINED BY THE RESAZURIN REDUCTION TIME

Straka & Stokes Recommendations*			Results of this Investigation		
Class	Reduction Time	Bacteria per gram	Class	Reduction Time	Bacteria per gram
1	5 hours or longer	Less than 100,000	1	8 hours or longer	0 - 10000
2	3 to 5 hours	100,000 to 1,000,000	2	6 to 8 hours	10,000 to 100,000
3	Less than 3 hours	More than 1,000,000	3	3 to 6 hours	100,000 to 1,000,000
			4	Less than 3 hours	1,000,000 to 500,000,000

* Robert P. Straka and J. L. Stokes (See Reference No. 7) Western Utilization Research and Development Division Agricultural Research Service United States Department of Agriculture Albany 10, California

duction time of three to six hours. Class 4 which contained over 1,000,000 to 500,000,000 or more bacteria per gram, exhibited a resazurin reduction time of three hours or less.

ACKNOWLEDGMENT

The authors are grateful to Barbara Merritt, formerly research technician, Bacteriological Research Department of this Company for her technical assistance with various phases of the study.

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PROPER USE OF "IN-CAN" MECHANICAL COOLERS FOR MANUFACTURING TYPE MILK

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In 1918 Ayers (1) stressed the importance of cooling as one means of aiding in the control of high counts in milk. The importance of cooling is appreciated by all field, quality and health personnel, and has been repeatedly stressed to the dairy industry in meetings throughout our nation. The large milk producer can afford elaborate equipment and has little difficulty in meeting cooling standards. However, the smaller producer must limit his purchase to simpler equipment, and thus must depend upon immersion, spray, or combination immersion-spray type in-can coolers. These units can be successfully used in cooling milk, but if improperly used, unsatisfactory results will be obtained.

The small or diversified farmer with herds of about ten cows or less produces a large percentage of the volume of milk used in manufacturing processes. It is important that these producers not only appreciate the importance of cooling, but that they also receive instruction in proper cooler operation. Information illustrating the advantages of using proper cooling methods should be of considerable importance to personnel advising those producers forced to rely on in-can coolers.

In this work, an attempt was made to collect data which will indicate the advantages and disadvantages of certain types of mechanical coolers and cooling methods used for "in-can" cooling of milk. Experimental data is presented which may help to answer the following questions:

1. Is it necessary to cool morning's milk before it is delivered to the plant?
2. If the hauler arrives within 30 to 40 minutes after the morning's milking, is it better to (A) ship this milk uncooled, (B) place it in the cooler for 30 or 40 minutes and have the hauler pick it up when he arrives, or (C) place it in the cooler until the next morning?
3. Presuming that hauling costs could be reduced by every other day pick-up, what would be the effect on milk quality if the milk were picked up every other day?
4. How cold must the milk be on the farm to assure a temperature of 50°F. or lower at the plant?
5. How important is it to maintain the proper water level in the cooler?
6. What is the cooling rate of milk in cans placed in properly operated mechanical coolers?

To attempt to answer questions 1-4, three evaporated milk plants and one powdered milk plant in four different geographical areas participated in each test. Each plant selected five patrons having immersion type mechanical coolers to participate in each test.

It must be stressed that this study was designed to study coolers and cooler practices as carried out on the small farms producing typical manufacturing type milk. For this reason, no effort was made to segregate producers using poor or borderline sanitation practices from those using good sanitation practices.

Marquardt and Dahlberg (3) demonstrated that when cooler water temperatures were maintained at 35-40°F., stirring the milk was of no advantage. Thus agitation of the milk was omitted in the above work.

The data given in Tables 1-5 represent the average of 15-20 tests at each plant location, and thus should give valid analytical results.

EFFECT OF

PROMPT COOLING AND SHORT HAULING PERIOD

In order to demonstrate the effects of prompt cooling and prompt delivery to the plant, the following procedure was carried out.

For four consecutive days, each patron placed his morning's milk in the mechanical cooler immediately after milking. The milk was cooled to 55°F. or less, after which it was transported to the plant in enclosed, insulated milk hauling trucks. Standard plate counts were run on the milk immediately after milking and again when the milk reached the plant. Temperatures were recorded at time of pick-up and after delivery to the plant. The outside air temperature at 11:00 A.M. of the day the milk was hauled was also recorded. At each plant location, the logarithmic averages of all standard plate counts were determined, and these averages were used in determining any loss of quality during the experiment. Results of this portion of the experiment are shown on Table 1.

Examination of Table 1 shows that 1) prompt cooling to temperatures below 50°F. will control the growth of micro-organisms through a hauling period of at least 2½ hours, 2) where cooling is limited to 52-55°F. some growth may take place during a short hauling period, and, 3) in general prompt cooling and prompt delivery would minimize, or, if below 50°F. would control the growth of micro-organisms.

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TABLE 1—IMMEDIATE COOLING AND SHORT HAULING PERIOD

	Plant Location			
	Southeast	South Central	Central	North Central
Average Time Milk in Cooler	3 hrs.	1-3/4 hrs.	2-1/4 hrs.	2-3/4 hrs.
Ave. Milk Temp. at pick-up	48°	55°	52°	48°
Log. Ave. SPC* when milked	230,000	1,100,000	110,000	33,000
Ave. Time in transit	1-1/4 hrs.	2-1/2 hrs.	2-1/4 hrs.	2-1/2 hrs.
Ave. Milk Temp. at Plant	53°	59°	53°	51°
Log. Ave. SPC* at Plant	230,000	1,800,000	190,000	32,000
Ave. Outside Temp. at 11:00 A.M.	79°	91°	82°	76°
Percentage increase in count	0	64	73	0

*SPC - Standard Plate Count

TABLE 2—NO COOLING AND SHORT HAULING PERIOD

	Plant Location			
	Southeast	South Central	Central	North Central
Average Milk Temp. at pick-up	91°	93°	90°	89°
Log. Ave. SPC after milking	170,000	760,000	190,000	64,000
Ave. Time between milking and delivery	3-1/2 hrs.	4 hrs.	5 hrs.	6 hrs.
Ave. Milk Temp. at Plant	85°	88°	79°	81°
Log. Ave. SPC at Plant	770,000	12,000,000	3,800,000	320,000
Ave. Outside Air Temp. at 11:00 A.M.	82°	93°	78°	74°
Percentage increase in count	353	1479	1710	400

EFFECT OF
NO COOLING AND SHORT HAULING PERIOD

The second series of tests involved the same patrons. In these tests the morning's milk was not cooled, was picked up by the hauler at the normal time, and transported to the plant. The results of this portion of the experiment are shown on Table 2.

Although the actual time in transit is comparable in Experiments 1 and 2, Table 2 shows rather extended holding periods. A rather significant time lapse existed between the time of milking and time the hauler arrived.

It is readily apparent from the data in Table 2 that failure to cool morning's milk will cause a very significant growth of bacteria, even though the transportation time from the farm to the plant is of relatively short duration. There is an indication that initial count may also effect percentage increase. This data closely correlates that of Macy (2).

EFFECT OF
PARTIAL COOLING AND PROMPT DELIVERY COMPARED
TO 24-HOUR COOLING AND PROMPT DELIVERY

The third series of tests were designed to compare the effect on bacteria counts of 30 minute cooling against 24 hour cooling. The milk cooled for a 30 minute period was transported to the plants on the same day it was milked, while the milk cooled 24 hours was delivered the following day. Results are shown on Tables 3 and 4.

Comparison of Tables 3 and 4 show that generally the percentage increase in count was similar. However, it must be stressed that the time in transit was short and that longer hauling periods or delays in transit would probably show the value of longer cooling periods with lower milk temperatures.

The rather marked increase noted at the plant in the Southeast when 24 hour cooling was used is difficult to explain. It is possible that failure to maintain the proper ice bank in the cooler may have resulted in an increase in cooler and milk temperature, and a subsequent increase in count. If this were the case, the cooling rate would be very slow, but after 24 hours in the cooler, the milk temperature would be quite low.

TABLE 3—PARTIAL COOLING AND PROMPT DELIVERY

	Plant Location			
	Southeast	South Central	Central	North Central
Ave. Milk Temp. when picked-up	65°	66°	59°	58°
Log. Ave. SPC when milked	215,000	250,000	450,000	21,000
Ave. Time in transit	3 hrs.	3-3/4 hrs.	3-1/4 hrs.	4-3/4 hrs.
Ave. Milk Temp. at Plant	67°	68°	65°	61°
Log. Ave. SPC at plant	360,000	450,000	500,000	45,000
Ave. outside air temp. at 11:00 A.M.	78°	86°	84°	80°
Percentage increase in count	67	80	11	114

TABLE 4—TWENTY-FOUR HOUR COOLING AND PROMPT DELIVERY

	Plant Location			
	Southeast	South Central	Central	North Central
Log. Ave. SPC when milked	140,000	450,000	370,000	21,000
Ave. Milk Temp. After 24 hrs. in cooler	41°	40°	40°	40°
Log. Ave. SPC After 24 hrs. in cooler	400,000	590,000	390,000	26,000
Average Time in Transit to Plant	1-1/2 hrs.	2 hrs.	1-1/2 hrs.	3-1/4 hrs.
Ave. Milk Temp. at plant	49°	53°	49°	45°
Log. Ave. SPC at plant	500,000	750,000	390,000	44,000
Ave. Outside Air Temp. at 11:00 A.M.	80°	93°	83°	79°
Percentage increase from milking to delivery	304	67	5	110

EFFECT OF FORTY-EIGHT HOUR COOLING AND PROMPT DELIVERY

In order to obtain results on the effect of holding milk in mechanical coolers for an extended time period, the morning's milk was placed in the cooler immediately after milking and was allowed to remain in the cooler for 48 hours before being hauled to the plant. Results of this experiment are shown on Table 5.

The same trend is apparent in this as in the previous experiment in which the milk was held for 24 hours. Although the percentage increases are greater in all cases, the relationship between the four plants is the same in that the plant in the Southeast again shows a significantly higher increase than the remaining plants. Again, improper cooler operation may be the reason for this difference.

When considering the data from the plants other than the one in the Southeast, it would appear that every other day pick-up of milk properly cooled in mechanical coolers would be acceptable on a year around basis. Some bacterial increase can be expected, but if cooling methods are carefully controlled and additional emphasis is placed on farm sanitation, this increase would not be serious.

TEMPERATURE RISE IN MECHANICALLY COOLED MILK WHILE IN TRANSIT TO PLANT

In order to determine the temperature rise of cooled milk shipped in mixed loads of cooled and uncooled milk in closed, insulated trucks, temperatures of the milk were taken when it was loaded at the farm and again when it reached the plant. Results are shown on Table 6. The data in the table represents an average of five readings for each patron.

The data in Table 6 is not as clear cut as that given in previous tables. If one averages the temperature rise in the cooled milk which is surrounded by warm milk, the average is 9°F. and the extreme rise is 18°F. If the cooled milk is surrounded by cans of cold milk, the average temperature rise is about 9.3°F. and the extreme rise is 15°F. There is an indication that atmospheric temperature is important, since at an outside temperature of 93°F., the average rise in milk temperature is 13°F., as against an average rise of 7.8°F. where the atmospheric temperature ranged from 80-83°F. Length of time in transit also appears to be important. Where the hauling time is less than 2 hours, the average temperature rise is 6.25°F., whereas, if the hauling time is 2 hours or more the average rise is 11.1°F.

TABLE 5—FORTY-EIGHT HOUR COOLING AND PROMPT DELIVERY

	Plant Location			
	Southeast	South Central	Central	North Central
Log. Ave. SPC when milked	280,000	250,000	690,000	24,000
Ave. Milk Temp. after 24 hours in cooler	41°	40°	41°	39°
Log. Ave. SPC after 24 hours in cooler	610,000	480,000	850,000	22,000
Ave. Milk Temp. after 48 hours in cooler	41°	40°	41°	39°
Log. Ave. SPC after 48 hours in cooler	1,000,000	440,000	850,000	33,000
Average Time in transit to plant	1-1/2 hrs.	2-1/4 hrs.	1-3/4 hrs.	2-1/4 hrs.
Ave. Milk Temp. at Plant	50°	52°	52°	45°
Log. Ave. SPC at Plant	2,000,000	570,000	1,000,000	63,000
Ave. outside air temp. 11:00 A.M.	82°	91°	90°	81°
Percentage overall increase	614	128	45	162

TABLE 6—TEMPERATURE RISE IN MECHANICALLY COOLED MILK WHILE IN TRANSIT TO PLANT

Patron No.	Initial Temp.	Temp. at Plant	Temp. Rise	Time in Transit (Hrs.)	Surrounding Milk	Outside Temp. °F.
1	44	52	8°	1-1/4	Cold	80
2	43	51	8	1-1/2	Warm	80
3	43	51	8	1-1/2	Warm	80
4	35	47	12	2	Cold	80
5	42	46	4	1-1/4	Warm	80
6	41	56	15	2	Warm	83
7	42	52	10	2	Cold & Warm	83
8	38	46	8	1-1/2	Cold & Warm	83
9	38	43	5	1-1/4	Warm	83
10	44	49	5	2-3/4	Warm	83
11	38	53	15	2-1/2	Cold	93
12	42	54	12	2-1/4	Cold	93
13	38	56	18	2	Warm	93
14	42	50	8	1	Cold	93
15	42	55	13	2-1/2	Cold	93
16	35	47	12	2-1/2	Cold	81
17	42	49	7	2-1/4	Cold	81
18	40	50	10	5	Cold	81
19	41	45	4	2-1/4	Cold	81
20	37	38	1	1	Cold	81

PROPER USE OF "IN-CAN" MECHANICAL COOLERS

TABLE 7—EFFECT OF WATER LEVEL IN IMMERSION COOLERS ON MILK TEMPERATURE AND BACTERIA COUNT

Time (Hours)	Water Level Half Way Up On Can Temperature			Bacteria Count	Water Level At Shoulder of Can Temperature			Bacteria Count
	Bottom of Can	Middle of Can	Top of Can		Bottom of Can	Middle of Can	Top of Can	
0	87	87	87	132,000	85	85	85	212,000
1	47	64	83	---	44	56	61	---
2	43	57	80	---	43	52	56	---
3	42	49	72	---	41	48	52	---
4	41	46	68	---	41	43	47	---
5	41	44	65	---	40	42	45	---
6	40	42	62	---	---	---	---	---
7	39	41	59	---	37	37	39	---
24	39	41	43	4,500,000	35	35	36	200,000

EFFECT OF WATER LEVEL IN IMMERSION COOLERS ON MILK TEMPERATURE AND BACTERIA COUNTS

This experiment was carried out under controlled conditions with technical personnel following all phases of the work. In the first portion of the experiment, immediately after milking a can of milk was placed in an immersion cooler and the water level adjusted to reach half way up on the can. Another can was placed in another cooler, and in this cooler the water level reached the neck of the can and completely covered the milk level. Thermocouple leads were placed in each can at points one-fourth, one half, and three-fourths the distance from the top of the milk level to the bottom of the can. Readings were taken every hour for 7 hours and again after 24 hours. At the beginning and end of the test, the milk was thoroughly agitated and samples were

removed for bacteria counts. The cooler water temperature ranged from 35° to 36.5°F. during the 24-hour period. The data on Table 7 represents the averages of five duplicate experiments.

It is readily apparent from the data presented in table 7 that to obtain satisfactory cooling results it is necessary to maintain the cooler water level above the level of milk in the can. Generally the water level is adjusted by the milk producer so that it will reach the shoulder of the can only when the maximum number of cans are placed in the cooler. Thus proper cooling can be expected only on the milk in the last cans placed in the cooler before the milk hauler arrives. This is a major fault of immersion type coolers and constitutes a serious quality problem.

The thermocouple data clearly substantiates the bacteria counts, and shows the temperature stratification within the partially submerged can.

TABLE 8—MILK COOLING RATE IN "IN-CAN" MECHANICAL COOLERS

Time (Hours)	Temperature °F.			Temperature °F. Two Cans				
	Immersion	Single Can	Spray	Can No. 1	Immersion Can No. 2	Can No. 1	Spray	Can No. 2
0	100		100	100	100	100		100
1/2	65		67	63	64	68		72
1	55		55	54	54	59		64
1-1/2	50		49	49	49	53		57
2	48		45	47	47	49		53
2-1/2	44		42	46	46	46		50
3				45	45	44		47
3-1/2				45	45	42		45

MILK COOLING RATE IN "IN-CAN"
MECHANICAL COOLERS

To determine the rate at which milk is cooled in cans when placed in properly operated mechanical coolers of the type typically used on small farms, a four can spray cooler and a four can immersion cooler in excellent operating condition were tested. The immersion cooler did not have an agitator for agitating the water. Tests were run using one can and two cans in each cooler representing 25% and 50% of cooler capacity. Thermocouple leads placed in the center of each can were used to determine the temperatures. The test was continued until the milk reached a temperature of 45°F. The recommended ice bank was built up on each cooler prior to running each test. Results are shown in Table 8.

This data indicates that the greatest percentage of cooling takes place within the first hour in the cooler. The milk temperature is reduced below a favorable growth temperature very rapidly. After this the cooling rate slows considerably as the milk temperature approaches the temperature of the cooling medium.

There appears to be little difference in cooling rate between the spray and immersion coolers. Both coolers have their advantages and disadvantages. The big disadvantage of the immersion cooler was demonstrated in the previous experiment. Although the spray cooler overcomes this water level problem, the possibility of the operator forgetting to turn on the spray pump constitutes a definite problem. Also the amount of spray running over each can effects the cooling rate, as indicated in the experiment where two cans were placed in the spray cooler. In the cooler used for this experiment, the can in the number two position in the cooler did not have as much water hitting the sides as the can in the number one position, which accounts for the difference in cooling rate between the two cans. On both types of coolers it is necessary to have the cooler maintained in good mechanical condition, and to have it operating at all times so as to maintain the recommended ice bank.

SUMMARY

1. Prompt cooling of milk in "in-can" immersion coolers followed by a short hauling period effectively controls the growth of micro-organisms.
2. Shipping morning's milk uncooled, even with a short hauling period, will cause a serious increase in bacteria count.
3. Cooling morning's milk for 30 minutes, or to temperatures of 58-66°F., followed by a short hauling period, gives results comparable to holding in the cooler for 24 hours, followed by a short hauling period. However, it is doubtful if this would hold true for extended hauling periods.
4. Holding milk in the cooler for a 48 hour period followed by a short hauling period would not cause a serious increase in bacteria count, provided good sanitary practices were carried out on the farm.
5. It would be difficult to predict the temperature rise in mechanically cooled milk shipped in insulated trucks with both cooled and uncooled milk. Such factors as outside temperature, temperature of surrounding milk and length of hauling period would influence the amount of temperature rise.
6. It is extremely important to have the water level in immersion type coolers above the level of milk in the can in order to control the growth of micro-organisms.
7. Both immersion and spray type "in-can" coolers will effectively cool milk if these coolers are properly operated.

ACKNOWLEDGMENT

The authors wish to acknowledge the assistance given by the fieldmen at the plants involved in this experiment.

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A BACTERIAL SURVEY OF COMMERCIAL FROZEN BREADED SHRIMP¹

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In recent years much interest has been focused on possible bacteriological standards for frozen foods. Fitzgerald (2) in an early report concerning a bacteriological standard, recommended an upper limit of 100,000 colonies per gram of frozen foods although he felt that higher counts might be permitted. Weiser (7) has discussed this problem and has mentioned the standard of 100,000 viable bacteria per gram of frozen precooked foods suggested by the Quartermaster Food and Container Institute. Litsky, Fagerson and Fellers (3) in a national study of commercially frozen beef, poultry and tuna pies, independently confirmed the suggestion of 100,000 per gram as a realistic and workable standard.

The problems of frozen food sanitation are discussed in detail in the Report of the Committee on Frozen Food Sanitation of the International Association of Milk and Food Sanitarians (5) and presently will not be treated at any great detail. It was the recommendation of the Committee "that additional study be made of the sanitary quality of the type of product."

In an attempt to provide further information a survey of 144 samples of commercially packed shrimp representing 24 brands was made. The samples were obtained from retail stores in 30 cities throughout continental United States: Albuquerque, New Mexico; Atlanta, Georgia; Boston, Massachusetts; Chicago, Illinois; Dayton, Ohio; Denver, Colorado; Flint, Michigan; Flushing, New York; Fort Smith, Arkansas; Fresno, California; Great Falls, Montana; Hagerstown, Maryland; Hammond, Indiana; Kokomo, Indiana; Manchester, New Hampshire; Milwaukee, Wisconsin; Minneapolis, Minnesota; New Rochelle, New York; New York City, New York; Oklahoma City, Oklahoma; Omaha, Nebraska; Plainville, Connecticut; Portland, Oregon; Salt Lake City, Utah; San Antonio, Texas; Seattle, Washington; St. Louis, Missouri; Valley Stream, New York; White Plains, New York; and Yonkers, New York. The samples of frozen breaded shrimp were subjected to a comparative study on total bacteria count together with coliform and enterococci counts. The presence of dominant groups of bacteria were also established in these samples.

PREPARATION OF SAMPLES

The samples were received packed in dry ice in insulated containers. Because these samples were also used for chemical analysis during another phase of this study, the packages were opened aseptically, and from each package a sample was chosen at random, and was placed in a one-half pint sterile jar. The jars were stored at -21.7° C (0°F) for future analysis.

PROCEDURE

The unit sample from the one-half pint jar was removed from storage. To each jar, chilled sterile water was added aseptically so as to make a 1:10 dilution. The sample was thoroughly comminuted in a sterile mechanical blender for 2 - 3 minutes. The blended sample was allowed to stand 2 - 3 minutes, or until the foam subsided. From this blended sample subsequent dilutions were made.

For the determination of the total number of bacteria, nutrient agar 1.5 per cent was selected after a comparative study of various media. Plates were made in duplicate and were incubated at 25° C for three days. The results are expressed in number of bacteria per gram of frozen breaded shrimp.

Violet Red Bile Agar was used for the enumeration of the coliform group because it was found to be faster (18 - 24 hrs.) and was equally as satisfactory as the *Most Probable Number* method in estimating this group.

The presence of enterococci was ascertained by the use of Azide Dextrose and Ethyl Violet Broth as recommended by Litsky, Mallmann and Fifield (4). During the estimation of enterococci, random isolates were taken from Ethyl Violet Broth cultures, and were confirmed according to Sherman, Mauer, and Stark (6). In every instance the results indicated that the isolations were in the fecal streptococci group.

BACTERIA DETERMINATION PROCEDURE

To identify the dominant groups of bacteria, subcultures were made from the dominant colonies on the pour plates. The subcultures were then identified by routine bacteriological procedures.

DISCUSSION OF RESULTS

The results of the bacteriological survey of the commercial sample are shown in Table 1. The data is presented as the range and geometric mean of six samples of each commercial brand under investigation. Each brand was represented by samples ob-

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TABLE I — RANGES AND GEOMETRIC MEANS OF BACTERIAL COUNTS FROM FROZEN BREADED SHRIMP

Brand	Total Count/Gm.		Coliform Count/Gm.		Enterococci MPN/Gm.	
	Range	Geometric Mean	Range	Geometric Mean	Range	Geometric Mean
A	21,500 - 1,660,000	75,900	10 - 700	50	3 - 2,750	52
B	39,000 - 560,000	162,000	0 - 199	56	5 - 910	41
C	1,860,000 - 3,160,000	2,630,000	0 - 10	6	91 - 640	269
D	234,000 - 870,000	380,000	0 - 100	17	35 - 218	102
E	51,000 - 9,700,000	1,620,000	0 - 19	6	32 - 210	126
F	51,000 - 1,990,000	448,000	0 - 19	2	2 - 216	14
G	1,040,000 - 19,000,000	6,910,000	0 - 0	0	23 - 162	83
H	251,000 - 2,290,000	870,000	0 - 15	3	41 - 1,120	257
I	1,290,000 - 54,000,000	3,550,000	0 - 10	2	11 - 1,090	166
J	138,000 - 540,000	263,000	12 - 480	31	12 - 170	72
K	890,000 - 54,000,000	3,980,000	0 - 0	0	174 - 724	346
L	104,000 - 910,000	363,000	0 - 31	4	4 - 269	32
M	36,300 - 1,910,000	603,000	0 - 27	2	10 - 83	18
N	98,000 - 288,000	166,000	0 - 36	7	17 - 1,090	79
O	72,000 - 3,020,000	602,000	0 - 45	6	2 - 54	6
P	420,000 - 1,440,000	891,000	7 - 371	50	109 - 13,500	2,230
Q	109,000 - 1,410,000	426,000	0 - 12	6	323 - 2,190	660
R	218,000 - 3,380,000	912,000	0 - 21	7	8 - 590	107
S	204,000 - 5,800,000	933,000	4 - 24	10	109 - 1,450	407
T	810,000 - 3,090,000	1,470,000	0 - 78	9	42 - 199	78
U	191,000 - 780,000	560,000	0 - 112	15	62 - 1,290	363
V	346,000 - 1,910,000	933,000	0 - 59	20	91 - 251	112
W	1,040,000 - 1,550,000	1,280,000	0 - 42	13	174 - 1,450	309
X	330,000 - 2,630,000	851,000	0 - 112	7	4 - 219	34

tained from retail stores in three to six different cities. The distribution of bacteria varied from a minimum of 21,500 bacteria per gram of shrimp to a maximum of 54 million per gram. The analysis of the data indicated that seven per cent contained less than 100,000 bacteria per gram. Thirty-six per cent contained less than 500,000 bacteria per gram. Out of the total samples, 61 per cent had a bacterial content of less than one million.

This wide variation definitely reflects on the process of catching, icing, packing, and subsequent manipulation of frozen breaded shrimp. Furthermore, the results indicated that the public health aspect of the problem makes it necessary to have a uniform and feasible sanitary standard for frozen breaded shrimp.

The numbers of coliform bacteria varied from a minimum of zero to a maximum of 700 bacteria per

gram of shrimp. Out of 144 samples, 98 (68 per cent) contained coliform bacteria. Ninety of these samples (92 per cent) contained 100 coliform or less per gram.

In contrast to coliform bacteria, enterococci were present in all survey samples. Their number varied from very few bacteria per gram to 13,500 per gram. Forty per cent of the samples contained less than 100 enterococci per gram of frozen breaded shrimp, and, in general, the number of enterococci exceeded the number of coliform bacteria in the same sample. A closer relationship existed between the total number of bacteria and enterococci.

Regarding the relation of coliform bacteria and enterococci in the survey samples, the calculation of the correlation coefficient showed $r = 0.21$. Although this value was significant, the relationship of the two groups is so small that it should be discarded.

The estimation of the dominant groups of bacteria showed that, in general, the genera *Micrococcus*, *Achromobacter* and *Aerobacter* were present. Of these, only five per cent were indole producers and only one per cent of all the bacteria studied were pigment forming bacteria. In some instances members of the genus *Bacillus* were isolated.

An over-all analysis of the data signifies that the public health aspect of shrimp quality is very important and sanitary standards should be established. It is the observations of the authors, that in evaluating the sanitary quality of frozen breaded shrimp, the standard plate count should be used as the primary test procedure. The data herein presented, indicated that enterococci may be considered due to their relatively low fluctuation under storage conditions at freezing temperatures. However, it should be emphasized that more work must be done to confirm and substantiate the use of this group of organisms in this type of study. This should not be taken to mean that the enterococci are not to be used in this line of testing, but more tests must be made using the enterococci before a valid estimation of this group can be made.

It is the authors' opinion that the data obtained were far beyond the expected counts and that the food industry, employing modern refrigeration and sanitary processes, should and could produce a product of better bacteriological quality. In order to do this each and every operation, from the fishing boats to the local market, must be thoroughly considered in terms of product contamination and bacterial growth. Until this is done, there can be no progress in the

constant struggle of producing an acceptable and better foodstuff.

SUMMARY

The survey of 144 samples (24 Brands) of frozen breaded shrimp obtained from retail stores indicated that there was a large variation in the number of bacteria in samples. This reflects on the sanitary quality of market shrimp. The total number of bacteria varied from a minimum of 22,500 bacteria per gram to a maximum of 54 million bacteria per gram. Out of 144 samples, 61 per cent had a bacterial content of less than one million. Ninety-eight (68 per cent) samples contained less than 100 coliform bacteria per gram. The fecal streptococci were present in all the samples. Their numbers varied from very few bacteria per gram to 13,500 per gram.

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STAPHYLOCOCCAL FOOD INTOXICATION DUE TO CHEDDAR CHEESE.¹

I. EPIDEMIOLOGY.²

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INTRODUCTION

Staphylococcal food intoxication is recognized as the most common type of food poisoning in the United States (3) (14) (8) (21). Even though food poisoning in general is poorly reported many different types of foods have been incriminated in staphylococcal food intoxications (3) (14) (21). In recent years, with improved supervision in sanitary production and processing of milk and dairy products and increased use of pasteurized milk, the number of reported cases attributable to milk and dairy products has been low (Table 1). Of the cases or outbreaks

TABLE 1—REPORTED OUTBREAKS OF STAPHYLOCOCCAL FOOD POISONING

Year	All Foods		Milk and Milk Products	
	Outbreaks	Cases	Outbreaks	Cases
1953	81	4045	1	?
1954	100	4868	4	114+
1955	102	4130	2	24
1956	111	4313	26	700+
1957	58*	1660*	0	0

SOURCE: Reference 4 and 5.

*Laboratory confirmed cases only. In prior years data included cases based on clinical diagnosis.

due to dairy products, those reported as being due to cheese are uncommon. This paper reports an outbreak of 200 cases due to cheddar cheese. Because of the infrequency of outbreaks of this nature, the literature on staphylococcal food intoxication due to cheese will be reviewed briefly.

LITERATURE REVIEW

Vaughn (20) in 1884 stated "It is well known that cases of severe illness follow eating of some cheese." He observed that they were of frequent

occurrence in the North German countries and the United States, while in France where much cheese was used there was no record of such cases. In 1884 he studied "poisonous or sick cheese" following a report of 300 cases of cheese poisoning in Michigan in a six month period. All the cheese involved came from one factory and the description of the manufacturing process indicates that it was cheddar type cheese. While staphylococcal food poisoning was not recognized at that time, he concluded that the causative agent was a chemical poison and not a bacterial one; however, he further concluded that "this chemical poison might be generated by the agency of bacteria."

According to Dack, (3) Dr. Sternberg, a United States Army Surgeon stationed at Johns Hopkins University in 1884 recovered micrococci from cheese produced in Michigan that had caused illness. He concluded, "It seems not improbable that the poisonous principle is a ptomaine developed in the cheese as a result of the vital activity of the above mentioned micrococcus or of some other micro-organisms which had preceded it and had perhaps been killed by its own poisonous products."

Jordan (9) in 1917 stated that cases of cheese poisoning were relatively numerous. He merely commented on "cheese poisoning" without elaborating, so this may or may not have been staphylococcal food poisoning. It should be remembered, however, that staphylococcal food poisoning was not generally recognized at the time of this report even though Barber (2) had demonstrated three years earlier that attacks of gastro-enteritis were caused by a toxin produced by staphylococci.

Levin (11) in 1917 examined some American cheese that had caused illness and isolated a toxigenic bacillus. Mention is made of this report because the term "cheese poisoning" was used and because a toxigenic organism was isolated even though it was a bacillus rather than a coccus. Stone (18) in a review mentions "Jack cheese" as being involved in a staphylococcal food poisoning outbreak.

MacDonald (12) described four severe cases of staphylococcal food poisoning in Great Britain from home made goat's milk cheese. *Staphylococcus aureus* was recovered from the cheese and from freshly drawn milk from one of the goats. The staphylococcal count on the fresh milk was 200 per ml, and there was no clinical evidence of mastitis.

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¹Presented in part at the Annual Convention of the International Association of Milk and Food Sanitarians, Glenwood Springs, Colorado, August 26-27, 1959.

²Under the same title, in another issue, part II, Laboratory Evaluation, will be published.

Tanner (19) lists 21 cases in eight families in Germany as being due to staphylococcal enterotoxin in cheese based on symptoms and epidemiological evidence. Mandry (13) reported on three outbreaks involving 18 persons in Puerto Rico in 1930 in which cheese was involved. Staphylococci were recovered from the cheese in each outbreak. Filtrates of organisms isolated from two of the outbreaks were given to human volunteers and produced symptoms similar to those of the original cases. Jordan's (10) report included results of studies on the organism isolated from one of these outbreaks. In reporting 183 food poisoning outbreaks of the "toxin" type that occurred in Great Britain during a 10 year period, Scott (17) stated three were due to cheese.

The U. S. Public Health Service (6) has recorded several outbreaks during the period 1944-1952. In 1944, 71 cases occurred in Virginia due to cheese from which *Staphylococcus aureus* was recovered. In 1945 there were three outbreaks with one occurring in Kentucky involving 5 cases after eating "Asiago cheese" made in Wisconsin. Epidemiological evidence incriminated the cheese. Examination of cheese submitted by one of the families involved showed hemolytic coagulase-negative staphylococci. A specimen of cheese from the same factory and same lot revealed beta hemolytic coagulase-positive staphylococci. Seventeen cases in Puerto Rico resulted from eating a native type cheese made by a farmer in his home from milk from one of his cows. All persons who ate the cheese became ill including a family who purchased 3 ounces and distributed this among seven children, each child eating 10 to 12 grams. One child aged 4 died. Laboratory examination of the cheese showed contamination with hemolytic *Staphylococcus aureus* and *Escherichia coli*. Nine cases in two families in widely separated areas were reported from Indiana. Cheese manufactured by one company and distributed in both areas had been consumed by those who became ill. Samples analyzed from one area revealed the presence of staphylococci but organisms isolated from samples from the other area could not be positively identified. The cheese was ordered removed from the market and destroyed. There were no further outbreaks. In 1946 *Staphylococcus aureus* was recovered from "native type" cheese that caused three cases in Puerto Rico. In 1947 cheese made at a monastery was responsible for sixteen cases in four outbreaks in Kentucky in which *Staphylococcus aureus* was isolated. In 1948 three cases in Oregon were attributed to "cheddar type cream cheese" that had been held in an unrefrigerated show case for three months and from which hemolytic staphylococci were recovered. In

addition, Dauer and Sylvester (5) recorded one outbreak from homemade cheese in 1953; nine cases from food containing cream cheese, and one family outbreak from cheese in 1954; nine cases due to cheddar cheese from which staphylococci were isolated from the center of unopened samples in 1955; and one outbreak with eighty cases from cheese sauce in 1956. In 1958, 60 cases were reported (15) from Indiana and Michigan due to ingestion of cheddar cheese produced in Wisconsin.

Allison (1) bacteriophage typed strains of staphylococci from 47 outbreaks of enterotoxin food poisoning of which five were isolated from cheese. Four of these were from the United States. One was from Egypt and he indicated that cheese seemed to be a common vehicle of staphylococcal food poisoning in that country.

In reviewing the above reports, it is apparent that in some outbreaks complete studies were done even to the point of using human volunteers for confirmation. In some of the reports, the diagnosis was based on less conclusive, but reasonably substantial data. In other instances there was no indication of the basis for diagnosis.

A very obvious point observed in reviewing these reports is the inadequacy of explanatory data on the type of cheese involved. The vehicle was specified as "cheddar" cheese in only three instances. In another the description of the process used to manufacture the cheese indicated it was of the cheddar type. From the literature the impression is gained that staphylococcal food intoxication due to commercially manufactured cheese is rare but does occur.

Perhaps some of the outbreaks noted above should not be included in a summary of staphylococcal intoxications due to cheese. The outbreak due to "cheese sauce" is an example. It appears that cheese may have been involved as a vehicle only by chance and that a sauce of other foods not containing cheese may have served equally as the vehicle. It is listed here, however, since it was a cheese mixture and since it was staphylococcal food poisoning.

IOWA OUTBREAK

Two hundred persons suddenly became ill Sunday evening, August 24, 1958, at a state institution with a population of about 1100 adults almost all of whom were apparently healthy before this outbreak. Most of the cases developed during a two hour period about 3 to 5 hours after the evening meal. The illnesses were characterized by sudden onset, nausea, repeated vomiting, severe diarrhea, abdominal cramps and exhaustion. Three or four patients had a

slight trace of blood in the vomitus or stool. In most cases the vomiting and diarrhea lasted 2 to 3 hours. On Monday morning almost all were sufficiently recovered to resume usual activity. One remained in bed until Tuesday because of exhaustion. Another who previously had been having trouble with a duodenal ulcer had an acute exacerbation of ulcer symptoms and was hospitalized for about four weeks.

Because of the symptoms, the explosive nature of the outbreak, and the fact that it occurred 3 to 5 hours after the evening meal, staphylococcal food poisoning was suspected. The meal consisted of natural American cheddar cheese, rye bread, boiled

TABLE 2—GROUPS OF PERSONS WHO ATE EVENING MEAL AND ATTACK RATES

Group No.	Classification	Meal Time	Total Persons	Cases	A/R
I	Kitchen Help	3:00	50	2+	4%
II	Main Group	4:15	650	180	38%
III	Additional Group	5:15	100	18	18%
IV	Hospital	4:15	100	0	0
TOTAL			900	200	

beans with bacon, luncheon meat, coffee and sugar cookies.

The institution personnel were fed in four groups as shown in Table 2. The menu was the same for all groups except some persons in the hospital group who were on special diets. Approximately 200 did not eat this particular meal.

Supervisory personnel at the institution stated that all persons who became sick had eaten cheese; some ate only cheese and bread; however, not all persons who ate cheese became sick. Unfortunately it was not feasible to obtain detailed information needed to establish attack rates (16) among persons who ate each food item and those who did not.

A few case histories will serve as examples of the illnesses that occurred.

Case 1. A resident ate a cheese and rye bread sandwich and coffee at 5:15, became sick with nausea and abdominal pains about 9:15, and in the next two hours vomited 8 or 9 times and had 6 or 7 bowel movements. About 11:00 p.m. he was exhausted, went to sleep and had no more trouble.

Case 2. A resident ate only a cheese sandwich at 5:15 and became sick with nausea, diarrhea, vomiting and abdominal cramps about 9:00 p.m.

Case 3. A clerk in the steward's office, went to the kitchen cooler and cut a slice of cheese from a

partially used wheel. He made a sandwich of cheese, luncheon meat and rye bread and took it back to the steward's office where he ate it at 5:30. He had no other food but drank a cup of coffee. About 8:30 he was nauseated, had abdominal cramps and later had diarrhea and vomited several times. He had about four liquid bowel movements per day for the following two days.

Case 4. Another clerk in the steward's office, made a sandwich in the same manner and with the same foods as Case 3. He ate at 5:30 p.m., drank water in place of coffee, became sick with nausea, vomiting and diarrhea about 8:30 p.m. and was exhausted to the extent that he remained in bed the following day.

Case 5. A staff member ate a slice of cheese about 3"x3"x $\frac{1}{8}$ to $\frac{1}{4}$ inch thick as it was being sliced about 11:00 a.m. Later he went off duty and returned home. He became ill about 3:30 p.m. with nausea, abdominal pain and chills. Between 4:00 p.m. and 8:30 p.m. he vomited 8 to 10 times and had an equal number of bowel movements. The following day he was exhausted but had no other complaints.

Case 6. On the following day institution officials were collecting several cheese samples for laboratory examination. A helper boastfully said "There is nothing wrong with this cheese. I ate some yesterday. Nothing makes me sick anyway." He proceeded to eat a slice of the cheese being sampled. Four and a half hours later he complained of nausea and abdominal cramps, vomited, and developed diarrhea.

The foods on the menu for this meal were prepared and handled in the following manner:

1. The beans were boiled in a steam kettle starting about noon. Locally cured bacon was added after the beans were partially cooked.

2. The luncheon meat was a commercially prepared USDA inspected product and had been refrigerated prior to slicing and after slicing prior to serving. Portions of the same lot were served subsequent to August 24, without unfavorable results.

3. The rye bread was made at the institution.

4. The cheese served was from a shipment of about 1900 lbs. (61 wheels or flats representing 13 lots) received August 21 from the cheese factory* at another state institution. It was made during the period January 1-April 28, 1958. It had been shipped from the cheese factory to its destination, a distance of about 125 miles, in an uncovered truck and placed in the kitchen refrigerator at 40°F upon arrival about 3:00 p.m. The shipment was held in the cooler until seven wheels were removed for slicing at 11:00 a.m.

*Cheese from this factory was not distributed through commercial channels.

August 24. After removal of the rind, the cheese was cut into large rectangular pieces and then sliced on a mechanical slicing machine. The slices were placed on a tray with paper, from a roll of kraft paper, between each layer and returned to the cooler. It was not possible to determine identity of the wheels that were served, since identifying marks were destroyed in the cutting process. Thus the seven wheels may have come from any of the 13 lots that were represented in the shipment. Two men sliced the cheese and were said to be free of boils, cuts and other skin defects. They had not complained of any respiratory infections.

During the evening of the outbreak, institution officials suspected that the disease was food borne and collected samples of remaining foods. Specimens of cheese, rye bread, and luncheon meat were sent to the State Hygienic Laboratory. In addition, a sample of ice cream that had been served at the noon meal was submitted to the laboratory. Subsequently, additional samples were collected from remaining cheese at the institution. Samples also were taken at the cheese factory from remaining cheese of the same lots from which the institution shipment was made. Coagulase-positive beta hemolytic *Staphylococcus aureus* was recovered from 75 of 84 cheese specimens. All other foods were negative for staphylococci. Complete laboratory procedure and results are presented in the second paper of this series.

Since the laboratory findings indicated that the cheese was contaminated prior to being shipped from the cheese factory, a sanitary inspection of the cheese factory was made. The plant proper was of satisfactory construction but there was lack of room separation. The equipment (cheese vat, curd knives, rakes, agitator, whoops, etc.) that was used in the manufacturing process was in good repair and clean. The surge vat, separator, strainer buckets, and pipes were in a poor state of repair. The milk used for cheese manufacturing was obtained from an institution herd and 7 commercial dairy herds. Cans of raw milk were dumped directly into the cheese vat. Subsequent operations were essentially those generally used in the manufacture of cheddar cheese. The highest temperature of the milk during the cheese making process was about 100°F. The result was cheddar cheese made from unpasteurized milk. This fact was confirmed by phosphatase tests on the cheese.

Samples of the milk from herds supplying the cheese factory were obtained. Coagulase-positive beta hemolytic *Staphylococcus aureus* organisms were isolated from milk from two of the eight herds. The bovine bacteriophage patterns of these isolates were similar to those obtained from the cheese.

Tests on one strain isolated from one lot of the cheese using kittens indicated the strain was enterotoxigenic.

Nose and throat swab specimens were taken from all persons (six) working in the cheese factory at the time of inspection. One person was found to be a nose and throat carrier of coagulase-positive beta hemolytic *Staphylococcus aureus*; however, he was not working in the cheese factory during the January-April period when the cheese in question was made. Cultures from the five other employees were negative. Four persons who had worked at the plant during at least part of the January-April period were not available for tests.

DISCUSSION

The clinical manifestations of the illness, incubation period, epidemiological findings and laboratory results including kitten tests, indicate without doubt that the outbreak was due to staphylococcal food intoxication from natural American cheddar cheese. Since the cheese served at the meal was from 7 wheels taken at random from the shipment of 61 wheels representing 13 lots it is likely that cheese from more than one lot was used. Cheese from some of these lots had been consumed previously without unfavorable results being reported. Thus it appears some lots were safe and some were not. This may be one reason for the relatively low attack rate among the entire population that ate the meal. It was believed that everyone who ate the meal ate the cheese. The problem of determining which, if any, lots were safe and which contained enterotoxin arose. Since all lots yielded coagulase positive beta hemolytic staphylococci, it was concluded that all lots were potentially capable of causing gastro-enteritis. It was not feasible to do kitten tests on strains from all lots and there were no human volunteers. Finding staphylococci in the raw milk supply that were similar in bovine phage type to those found in the cheese manufactured earlier in the year from the same milk supply along with the fact that the milk had not been pasteurized indicated that contamination of the milk occurred prior to delivery to the cheese plant. The period during which the enterotoxin was produced is not known. It has been reported that staphylococci will multiply at 50-108°F but grow best at 98°F. (7). With proper cooling of milk on the farm, bacterial growth with resultant enterotoxin formation would be at a minimum; however, the temperatures of 86 to 100°F maintained for several hours during the cheese manufacturing process would promote rapid bacterial growth. In addition, the cheese was held at room temperature for 24 to 48 hours before it was placed in the curing room at

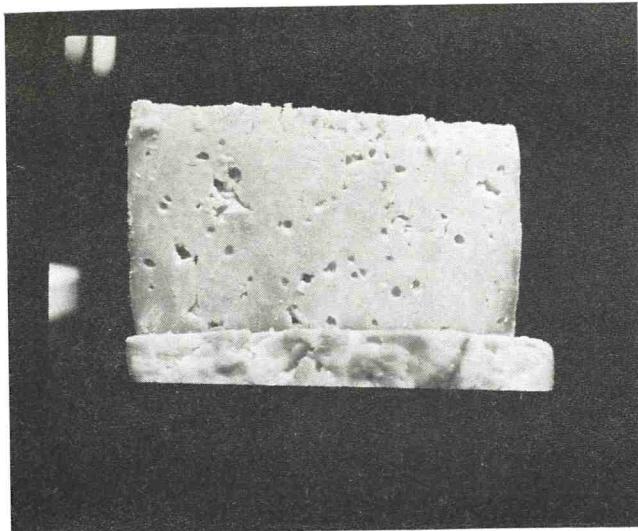


FIGURE 1

Droplets of fluid noted on freshly cut surface of this lot of cheese.

a temperature of about 36°F. In the process of obtaining samples of cheese, small droplets of fluid were observed on the freshly cut surface of cheese from one lot (Fig. 1) and on the slicing knife. This is of interest since Vaughn (20) also noted drops of a slightly opalescent watery fluid on the freshly cut surface of poisonous cheese.

SUMMARY

Two hundred cases of staphylococcal food intoxication resulted from eating natural American cheddar cheese that was 4 to 8 months old. The cheese was made from raw milk. Coagulase-positive beta hemolytic *Staphylococcus aureus* of similar phage type was isolated from the cheese and from the milk of two of eight herds supplying milk to the cheese factory.

ACKNOWLEDGEMENT

The helpful suggestions and comments of Dr. E. G. Zimmerer, Dr. R. H. Heeren and Dr. I. H. Borts during this study are gratefully acknowledged.

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NEWS AND EVENTS

QUESTIONS AND ANSWERS

QUESTION: What off flavor is most common in milk?

ANSWER: The most common off flavor is one which has resulted from the growth of the so-called psychrophilic bacteria in milk. A substantial quantity of milk is returned to plants because of this unpleasant flavor. The flavor is difficult to describe. Some call it a putrid flavor which is quite a good description. By others it may be called a sour flavor, although it will not have a clean sour taste.

QUESTION: What causes this off flavor?

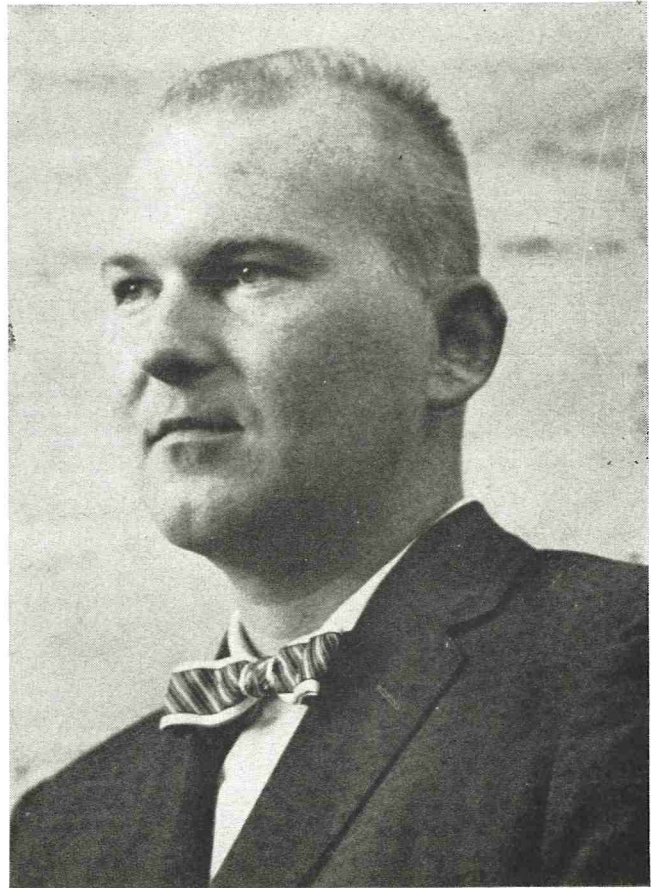
ANSWER: As pointed out above psychrophilic organisms give rise to this flavor. There are several that may be classified as psychrophilic. Each organism or a combination of them can give a different flavor. The two factors, flavor and cause are best considered at the same time. The organisms that produce the flavor are like the coliform group in that they are destroyed by pasteurization. In fact, some of the coliform group, at times, may be psychrophilic.

QUESTION: What are some remedial measures that can be taken.

ANSWER: Some remedial measures are as follows:

- a. Thorough cleaning (the complete removing of all soil from all equipment in contact with the product.)
- b. Thorough sanitizing of all product contact surfaces just before using the equipment.
- c. Temperature control of the product in question. While many psychrophiles will grow at 40°F or below, they will grow more rapidly at 50 or 60°F, or higher.
- d. Critical inspection by sanitarians and quality control people for thoroughness of cleaning and thoroughness of sanitizing.
- e. A realization by management and control officials that adverse conditions exist but that they can be controlled. Often quality control people argue that their equipment has been thoroughly cleaned and sanitized even though good sanitary control is absent. Some plant managers will argue that their plant sanitation is perfect and will cite as proof that the local or state sanitarian gave them a very high score. Bacteriological analysis of the product indicates, in many cases, that the visual inspection was not adequate. If the above conditions exist, the principal remedy is *thorough cleaning and sanitizing*. Management, technicians, and inspection officials must (1) recognize this problem, (2) be able to recognize the presence of soil and (3) insist that a thorough job be done every single day.

Note: Questions of technical nature may be submitted to the Editorial Office of the Journal. A question in your mind may be in the minds of many others. Send your questions in and we will attempt to answer them.



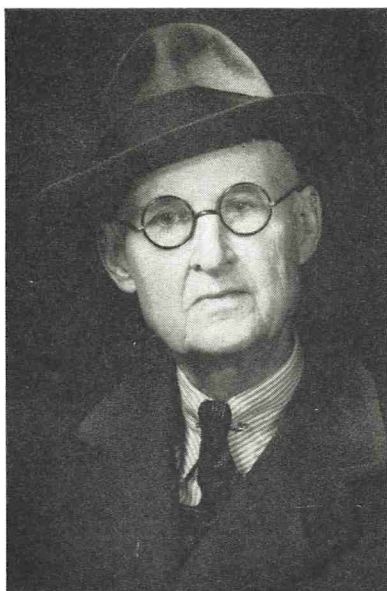
**WILLIAM B. PALMER SCHOLARSHIP
AWARDED TO INDIANA STUDENT**

The William B. Palmer scholarship in the amount of three hundred dollars, given annually to a student majoring in public health and sanitary science was awarded to Gene A. Uhrick, a senior student in the Department of Public Health, at the Indiana University School of Medicine. Announcement of the award recipient was made at the 46th annual meeting of the Association at Glenwood Springs by W. Howard Brown, Chairman, Committee on Education and Professional Development.

Mr. Uhrick is 27 years of age and is a graduate of South Side High School, Fort Wayne, Indiana. He served in the U. S. Air Force from 1951 to 1955. After separation from the Air Force he took a position in sanitation with the Allen County Health Department, Fort Wayne and while so employed attended Indiana University Extension Center. He completed sixty hours of academic work through the Extension Center, by attending night classes. His junior year of academic work was completed at Indiana University, Bloomington, in June 1959. He is now in his senior

year at Indiana University School of Medicine. He has maintained a creditable scholastic standing during his three years at the University.

The scholarship recipient is married and has twin daughters. He plans after graduation to take employment in the field of food control or in industrial sanitation.



WILLIAM H. PRICE HONORED

Dr. William H. Price of Detroit, was honored at the 46th annual Association meeting by being elected to Honorary Life Membership. Dr. Price was one of the charter members of this Association when it was founded in 1911. He was active in milk control work for many years with the Detroit City Health Department. He has maintained an active interest in International over the years. It was for the high esteem of our officers and members that this Honorary Life Membership was conferred and in recognition of his pioneering work in the field of milk sanitation.

SOUTH CAROLINIA ASSOCIATION HAS SUCCESSFUL MEETING

The South Carolina Association, recently held its annual meeting in conjunction with the State Public Health Association. Attendance was excellent with nearly all of the 147 members present, according to E. M. Causey, Jr., Secretary-Treasurer. Keynote speaker was Julian A. Johnson, Assistant Attorney General of South Carolina. He spoke on the sub-

ject, *The Interpretation of Procedure for Enforcing Public Health Laws*, and ended his remarks by saying, "When you follow instructions, the policy and the rules and regulations handed to you by your superiors, regardless of the field in which you operate, then you should have no fear of consequences. Let me say to you that in the performance of your duties, you should think wisely, act justly and walk with your God."

At the Association business meeting, James H. Fowles of Columbia was elected president. He graduated from the University of South Carolina in 1933 with a degree in civil engineering. After three years with the State Planning Board, and except for military duty in China during world-war II, he has been sanitary engineer with the Richland County Health Department, the position he currently holds. Vice President elected at the meeting was John C. Brown of the State Board of Health.

SOFT ICE CREAM SHORT COURSE

The third annual Soft Ice Cream Short Course of The Pennsylvania State University will be presented December 7 to 11, 1959.

This one week course is designed exclusively for individuals employed or who expect to be employed in the soft-serve frozen dessert business. The instruction will cover items such as:

- Composition and properties of milk
- Composition and properties of frozen desserts
- Ingredients used
- Processing the mix
- Problems of the mix manufacturer
- Equipment used
- Principles of refrigeration
- Flavoring and freezing soft and hard frozen desserts
- Cleaning and sterilizing equipment
- Sanitary regulations
- Problems of the soft-serve operator

The registration fee is \$12.25; for non-Pennsylvanians the fee is \$17.25.

An application blank and a free bulletin describing this and other courses in Dairy Manufacturing may be secured from the Director of Short Courses, College of Agriculture, The Pennsylvania State University, University Park, Pennsylvania.



Dr. C. K. Johns and Dr. Franklin Barber as seen during the recent meeting of the FOA/WHO Expert Committee meeting on Milk Hygiene, held at Geneva Switzerland. Both Dr. Johns and Dr. Barber are past presidents of International and very active in Association affairs. In the picture, Dr. Johns is on the left with Dr. Barber next to him then Dr. M. Kaplan, Secretary, WHO.

BARBER AND JOHNS HAVE PROMINENT ROLES AT SECOND MEETING OF JOINT FAO/WHO EXPERT COMMITTEE ON MILK HYGIENE

In June 1956, the Food and Agriculture Organization and the World Health Organization of the United Nations jointly convened a meeting of experts from various countries to consider milk hygiene problems, with particular reference to the under-developed countries. The report of this meeting (Joint FAO/WHO Expert Committee on Milk Hygiene, WHO Technical Report No. 124 (FAO Agricultural Studies No. 40) published in 1957, is a very useful reference, and reflects a lot of hard work.

A second meeting of this Expert Committee was held in Geneva July 13-18, 1959. Dr. F. W. Barber (U. S.) was elected chairman, with Dr. P. Kaestlim (Switzerland), vice-chairman and Dr. C. K. Johns (Canada) as rapporteur. Other committee members came from Russia, India, Britain, France, Italy

and the Netherlands, while FAO, WHO and UNICEF were again represented.

In bringing the first report up to date, attention was given to such topics as, antibiotics and insecticides in milk, improvements in collection, transport, and distribution of milk, quality control tests for fluid milk, pasteurization, sterilization and drying. Attention was given to the special problems of dairying in warm weather countries, and to the hygienic control of the production and handling of various dairy products. Under the capable guidance of Dr. Barber, the committee reached agreement in regard to its recommendation despite the marked diversity of background and opinions of the members.

In retrospect, it was a most valuable experience for those in attendance. The second report, which should be published early next year, should be of great value to administrators looking for authoritative statements regarding the hygienic aspects of milk and its products. The two agencies of the

United Nations - FAO and WHO - are to be commended for their initiative in bringing about these meetings. By means of the exchange of views and experiences which is thus made possible, each country's representative contributes to the common fund of information and at the same time broadens his own knowledge of milk hygiene. In these days of rapid transportation, no country is far away any more; anything which helps to promote a better understanding of other countries and their methods is surely helping to make this world a safer and pleasanter place in which to live.

NOTE TO MEMBERS

The annual meeting pictures reproduced on these pages are a few of the many taken by Mel Wilkey of the Rocky Mountain Association. If you would like copies of these or of others available, write to Mr. Wilkey, at 857 Revere St., Denver Colorado. Prints 5 x 7 in size are ten cents each. Prints 8 x 10 are seventy five cents each.

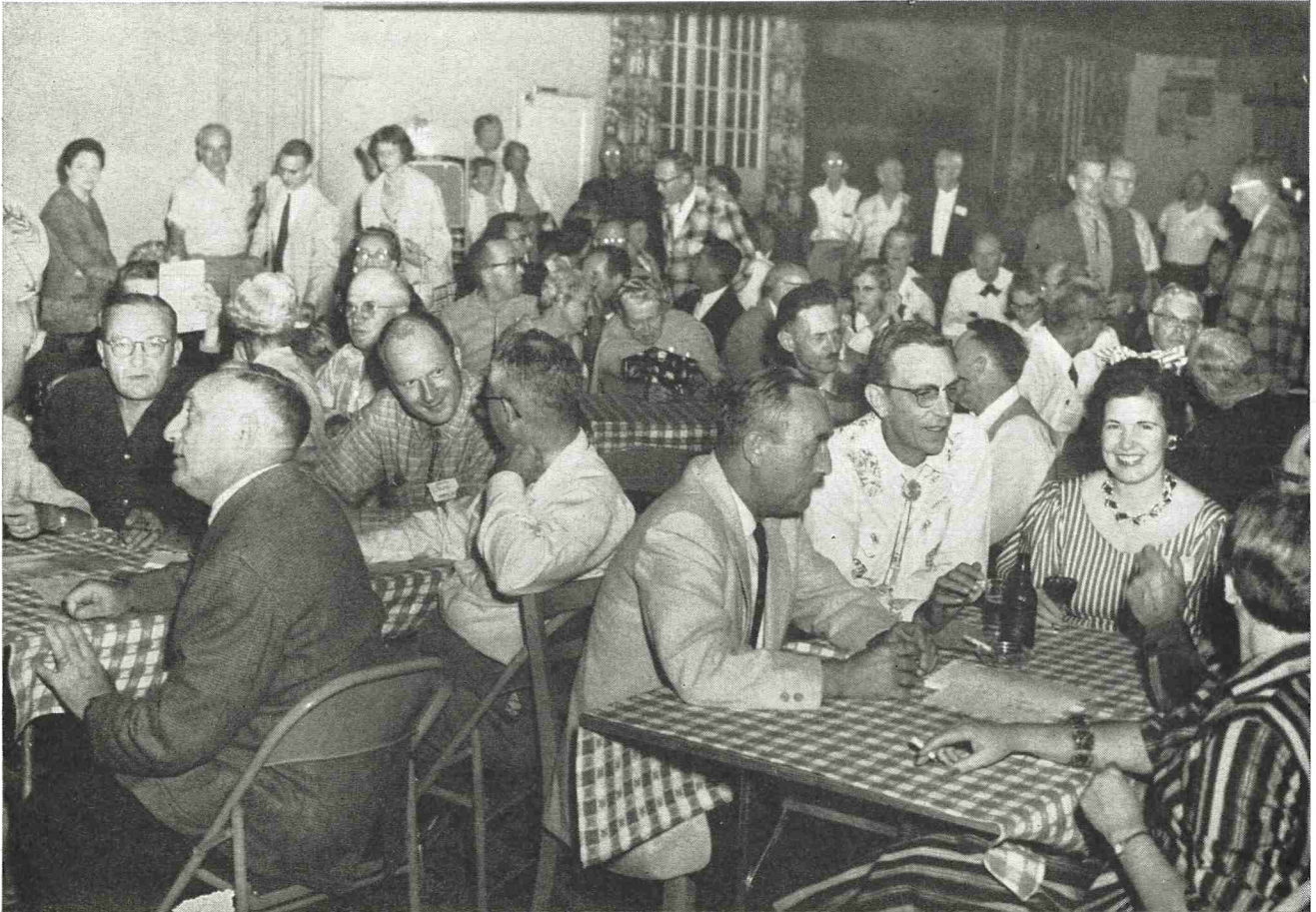
RECENT TRAVELS AND DOINGS OF YOUR SECRETARY

Tuesday, September 15th left on 8:40 A.M. flight from Indianapolis to Hartford, Conn. Arrived 3 P.M. Curt Chaffee met me at the airport and we drove to the Old Newgate Coon Club, Norfolk, Conn., a beautiful drive through the Berkshires for about forty miles. Don't know why Curt needs four wheels on his car, except that he never knows which two he will have on the road. The Coon Club really is old, set in picturesque and beautiful surroundings, with good facilities and excellent food, an ideal place for a small meeting.

Steve Mizak, Pres. of the Conn. Association, and Dick Parry, Secretary had invited the President and Secretary of neighboring affiliate associations, Bill Hickey and me for a "confab" with no organized agenda. Present were: Alden Chase, Sidney Shepard, Rhode Island; Dick March, Don Race, N. Y.; Herb Ewell, Mass; Willard Tompkins, Cliff Goslee, Curt Chaffee, Sam Morse, Dick Parry and Steve Mizak, Conn. Before and after dinner three main topics were discussed as follows: increase in dues,



Informal get together at Glenwood Springs the evening before the 46th annual meeting opened. Greeting old friends and meeting new ones is always one of the meeting high lights.



Ready for the start of the old fashioned melodrama. The Rocky Mountain Association wanted the members and families to see a real tear jerker—and they did. Maiden, villain and hero were all there and the crowd of nearly 600 loved it.

possibility of securing more affiliates in the north-east, and affairs of International. A very profitable discussion with the idea being developed that similar meetings could be held in various sections of the country, with very good results.

After a good breakfast, drove down to Restland Farms, Northford, Conn. for the Conn. Association's annual outing. What an outing! Over 500 present. All kinds of recreation such as: horseshoes, volley ball, whiffle golf, casting and softball. Dick Parry, Cliff Goslee and I umpired twelve innings of softball. Tried our best to get an old fashioned rubarb going, but I guess they were on to us. Anyway we weren't successful. Too bad Bill Hickey had to catch a 3:30 plane to Detroit. He sure missed a good banquet, good food, lots of prizes, and no speakers. A swell crowd, a fine outing, congratulations to the committee on arrangements.

Rode to Hartford with Curt, met Cliff and Dick, had a cup of coffee and to bed at Hotel Bond. Conference with Dick, Curt, Sam Morse and two or three of Dick's boys in the Agriculture Dept. the next morning. To the airport with Curt; left 11:45

A.M. arrived Indianapolis 3:20 P.M. — home 4:30 P.M. Three days correspondence on my desk to be answered and Journal dummy for Sept. to be finished for printers. Next trip - Sept. 30, Nashville, Tenn.

"Red"

NEW YORK CITY RODENT CONTROL STEPPED UP

More than 100 especially trained Health Department inspectors began a rat control program in a 200 block area of Harlem in mid September. About 125,000 families live in the area.

The 115 inspectors will be divided into 12 squads with a supervisor and eight men. Each squad of nine men will be assigned to one block. Twelve squads will go into 12 blocks in the 200 block area where every building in each block will be inspected. When a squad completes the inspection of all buildings in a block, it will be assigned to a new block.

In buildings where rats are found, or where evidence is found that there are rats, the landlords, janitors and tenants will be notified that under the

new Health Code which became effective October 1, 1959, the premises must be cleaned up, the rats exterminated and the rat holes closed. The present Sanitary Code (which is the City's basic body of health laws) forbids the maintenance of conditions which constitute a nuisance or possible health hazard. This general nuisance section includes rat control.

The new Health Code, which was enacted by the Board of Health in March 1959 and became effective October 1, 1959 specifically requires that all buildings, lots and premises shall be kept free of rats and free of any conditions which encourages rat infestation. The Health Code provides that: "The person in control (of a building) shall not allow the accumulation of water, garbage and other waste in any part of the building" and "all garbage shall be deposited in tightly covered, water tight metal cans." When rats are present the landlord, according to new Health Code, is required to apply continuous eradication measures. Landlords will be given copies of the anti-rat section of the new Health Code.

Immediately after October 1, 1959, buildings which are found rat infested will be reinspected. If reinspection shows that nothing was done to control the rats, summonses will be served charging violation of the anti-rat section of the new Health Code. Violation of the Health Code is a misdemeanor, punishable upon conviction by a fine not exceeding \$500, imprisonment for a period not exceeding one year, or both.

Later the Health Department's rat control program will be extended to other sections of the City. The initial effort in Harlem will last two months during which time it is hoped that the 200 block target area will be cleaned up.

This particular area was chosen, because a large number of rat bites have occurred there. In the whole City 450 persons were bitten by rats in the period from January 1, 1959 to August 15, 1959. As a result of these rat bites 1,041 inspections were made and in the great majority of cases, conditions were corrected. However, as a result of those inspections 29 summonses were served.



One glance will tell you the ladies who attended the 46th annual meeting at Glenwood Springs really enjoyed themselves. Here you see the group about to leave for an interesting trip followed by a tasty luncheon at one of the many interesting and colorful places in the Colorado Rockies.

INSPECTION AND BULK TANKS

One of the best ways we have of getting an overall picture of dairying in any area is to travel with a milk hauler or an artificial breeding technician. We do this quite often so that we can better judge the type of articles which will be of greatest interest and perhaps which will satisfy the greatest need of all dairymen.

On two occasions recently we have traveled with bulk milk haulers and the contrast in observations is interesting and revealing.

On one route we found from one-fourth to one-third of all bulk tanks to be in an unsatisfactory sanitary condition. Milkstone accumulations were all too common. As some tanks were emptied the sediment remaining in the bottom proved there was careless milking and handling of the milk. On this route, we gained the impression that inspection was not particularly strict but perhaps representative of that which prevails in many sections of the country.

On another route in a neighboring state we saw a marked contrast. Every bulk tank was sparkling clean. We saw no accumulations of milkstone anywhere. We failed to note any sediment remaining in any tank on the entire route. Here, however, we heard a few growls about stiff inspection and the "hardnosed" inspector. But the results proved where the best milk was being produced.

Sanitation and discipline are unfortunately inseparable. Discipline is seldom pleasant but sanitation is essential in our production of this most perishable and flavorful product.

Reprinted from *Hoard's Dairyman*, Sept. 1959.

U. S. SLOWS CALORY INTAKE, REPORT INDICATES

The U. S. experienced a 5% reduction last year in per capita food consumption below the average for 1947-1949. In pounds, according to a report for the Nutrition Foundation compiled by Oris V. Wells, Administrator, Agricultural Marketing Service,



One of the sessions in full swing. The technical reports and papers at the 46th annual meeting were outstanding. New techniques, improved methods and latest developments in the food and milk field were discussed by many outstanding speakers.

U. S. Department of Agriculture, average yearly consumption dropped to 1,491 pounds in 1958 from the 1947-1949 average of 1,569 pounds.

More important, calorie consumption decreased too. Average daily intake for 1958 stood at 3,150 as opposed to 3,270 for the 1947-1949 period and the still higher 3,310 average in the 1935-1939 period. But daily calory intake still towers above the "recommended dietary allowance" of the National Research Council, 2,400 calories a day.

While total food consumption slipped through the 1950's, Mr. Wells attributed much of the loss in the U. S. public's slackening appetite for potatoes, average per capita consumption of which dropped 19 pounds between 1949 and 1958. Another factor figuring in the over-all drop was the lessening popularity of bread and cereal products, which in terms of average per capita consumption stood at 148 pounds in 1958, as opposed to 171 pounds for the 1947-1949 period. In the 1930's, the Agriculture Department's report indicates, consumption was 204 pounds a year.

But with growing U. S. prosperity, as well as increasing knowledge of sound nutrition practices, meat, fish and poultry consumption was up, last year reaching 169 pounds a year per person, over a mark of 156 pounds for 1947-1949 and an average of only 132 pounds for 1935-1939.

An appraisal of major nutritional factors included in the average daily diet showed that the 1958 intake exceeded "recommended dietary allowances" in every category for which norms have been established. In the case of protein, average daily consumption was 95 grams, as opposed to the norm of 64 grams. Iron consumption was 5.2 milligrams above the norm; ascorbic acid more than 50% above the recommended dietary allowance. Consumption exceeding norms was also scored in calcium; vitamin A; the vitamin B components thiamine, riboflavin, niacin and folacin; and for fats and carbohydrates. But Mr. Wells cautioned that the intake figures are not "discounted for loss of nutrients in the homes, whether due to preparation or plate waste." Neither do they indicate how many individuals, through carelessness or ignorance in the midst of plenty, consumed less than optimum intake.

The nutrition report also measured food consumption within economic strata. According to Mr. Wells the "surprising thing about the -- data is the relatively uniform supply of -- nutrients available to families in different income classes." Thus, the report's tables indicated that per capita calorie consumption for members of families with an income of \$10,000 or over was 3,290, while persons in families with an income of less than \$2,000 consumed a daily



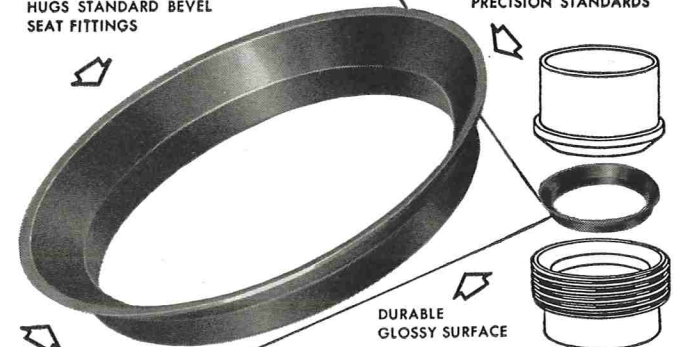
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average of 3,190 calories. In terms of the all-important protein factor, the per person intake in the wealthiest group averaged 115 grams a day, while the poorest group averaged 93 grams a day. The median figure for protein consumption was 105.5 grams a day per person.

Reviewing the economic index for food consumption, Mr. Wells concludes that, "much of the malnutrition which exists in the U. S. today is a matter of food choice or preference rather than an income problem."

HOME USE OF NONFAT DRY MILK INCREASING

Nonfat dry milk is making a place for itself in the household milk market. In so doing, it apparently is increasing the outlet for milk and boosting total milk consumption.

Growth of the nonfat dry milk product market has been phenomenal. Ten years ago, only 2 million pounds of nonfat dry milk were being packaged for household use in this country. By 1958, this had risen to 170 million pounds.

According to a recent Agricultural Marketing Service study, which included nearly 500 families in the metropolitan Chicago area, there was little change in fluid milk purchases by families either using or not using nonfat dry milk between July 1954 and June 1957. Families who bought nonfat dry milk actually increased their total milk consumption.

Forty-six percent of the families purchased nonfat dry milk in 1 or more of the 6 semiannual periods under study. Ten percent of these were frequent purchasers. That is, they bought the product at least once in each of the 6 periods.

Despite the rather general acceptance of nonfat dry milk, this product seems to have trouble getting additional users. As the survey period progressed, fewer and fewer new customers purchased nonfat dry milk.

Generally, purchases were inversely related to family income. Low-income families bought more than higher income households.

Purchase rates for fresh milk, on the other hand, were greater for middle-and high-income families than for low-income families. Middle-and high-income households purchased about the same amount of fresh milk.

AMS researchers also analysed purchase patterns for evaporated and filled milk. (Filled milk is a product similar to evaporated milk, but with a vegetable fat rather than a milkfat base. It can be legally sold in only a few States.) Again, there didn't seem to be any substitution of nonfat dry milk for either of these two products.

Practically all of the families in the sample pur-



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chased fresh fluid milk during each 6-month period and almost 1 out of 6 made purchases of nonfat dry milk. One out of 2 families bought evaporated milk, and 1 in 3 purchased filled milk.

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DRI-VAC CULTURES

These new Dri-Vac Cultures are the result of over two years research and proving in actual plant operations on various types of cheese and cultured dairy products.



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DR. WALDECK APPOINTED DIRECTOR OF RESEARCH

Dr. W. F. Waldeck has joined Klenzade Products, Inc., as Director of Research and Laboratories. Dr. Waldeck is well known throughout the chemical industries for his important technical contributions to the advancement of detergent science. He is a graduate of New York University with a B.S. degree in chemical engineering and a Ph.D. in inorganic and physical chemistry. He is a member of the American Chemical Society, Institute of Chemical Engineers, Sigma Xi, Tau Beta Pi, with a distinguished alumnus citation from New York University in 1954.

Dr. Waldeck is the inventor of a number of patented products and processes now widely used in various industries and has won outstanding recognition in detergent chemistry as technical director of several of America's foremost chemical companies.

For over seventeen years he was Research Chemist and Director of Laboratories for a prominent detergent chemical corporation where his important technical work substantially contributed to the growth of the company. In his new position with Klenzade, Dr. Waldeck will be in charge of expanded Klenzade research programs devoted to product improvement and the utilization of newer scientific advances in detergent chemistry.

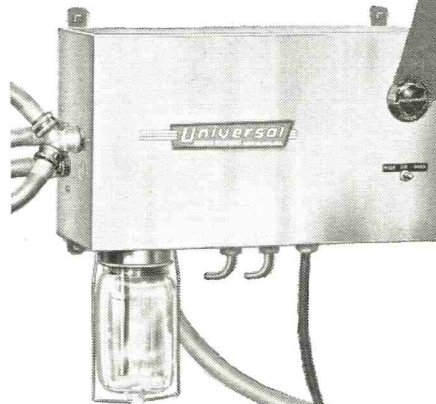
OREGON TWENTIETH STATE TO BECOME BRUCELLOSIS CERTIFIED

The Oregon State Department of Agriculture announced, the latter part of July, 1959, that it had received word from the USDA that it had become the twentieth state to be declared a modified-certified area. This means that not more than 1 percent of the cattle nor more than 5 per cent of the herds are infected with the disease.

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IT'S AUTOMATIC**

Universal's new automatic washing system pre-rinses, washes, and gives final rinse to the pipeline milking system. Before milking, the dial is set for sanitizing.

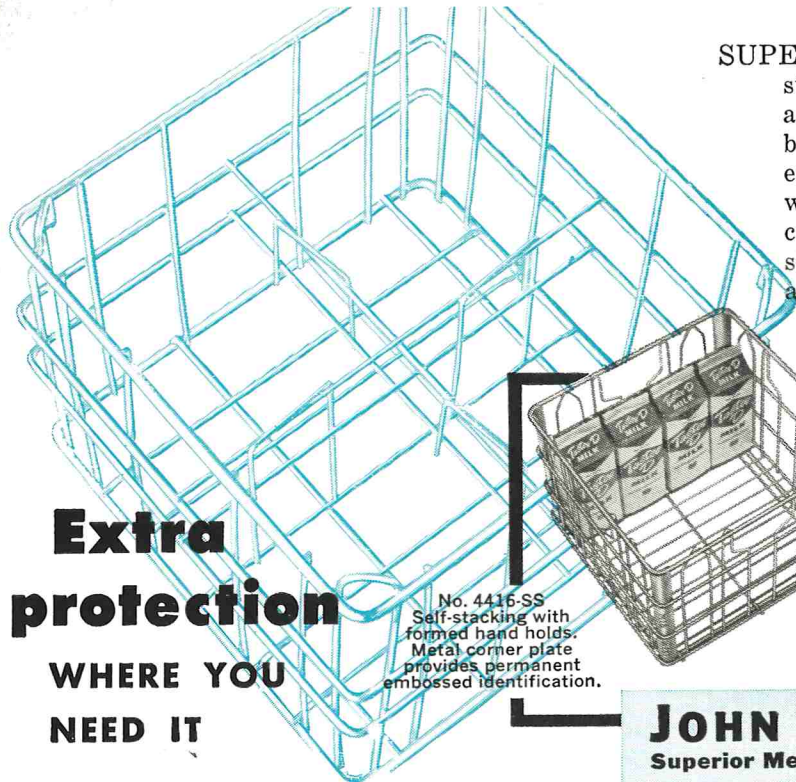
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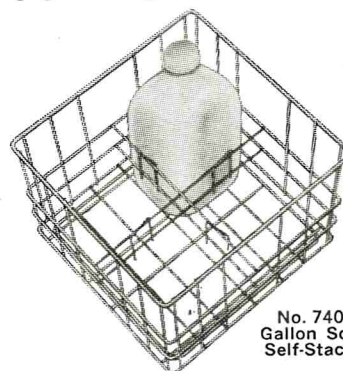
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SANITARY METHOD OF APPLYING
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TO DAIRY & FOOD
PROCESSING EQUIPMENT

*Haynes
Spray*

U. S. P. LIQUID PETROLATUM SPRAY
U. S. P. UNITED STATES PHARMACEUTICAL STANDARDS

CONTAINS NO ANIMAL OR VEGETABLE FATS. ABSOLUTELY NEUTRAL. WILL NOT TURN RANCID—CONTAMINATE OR TAINT WHEN IN CONTACT WITH FOOD PRODUCTS.

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The Haynes-Spray eliminates the danger of contamination which is possible by old fashioned lubricating methods. Spreading lubricants by the use of the finger method may entirely destroy previous bactericidal treatment of equipment.

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HAYNES-SPRAY
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AND OTHER APPROVED INGREDIENTS
(Laboratory Controlled)

**SANITARY • NON-TOXIC
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PHARMACEUTICALLY ACCEPTABLE

CONTAINS NO ANIMAL OR VEGETABLE FATS.
ABSOLUTELY NEUTRAL. WILL NOT TURN RANCID
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- ▶ Valves, Pistons & Slides of Ice Cream, Cottage Cheese, Sour Cream and Paper Bottle Fillers, Stainless Steel Threads and Mating S. S. Surfaces
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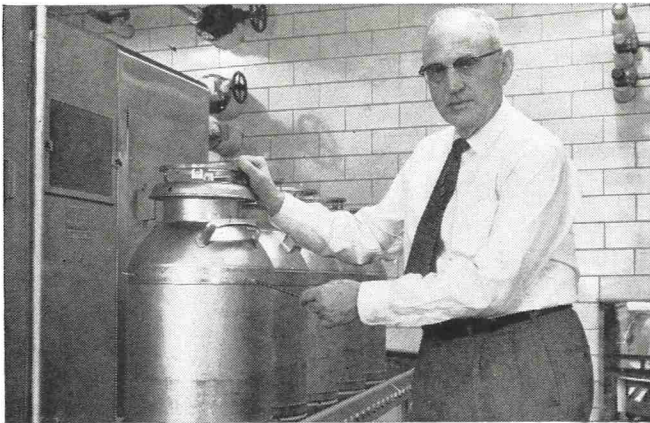
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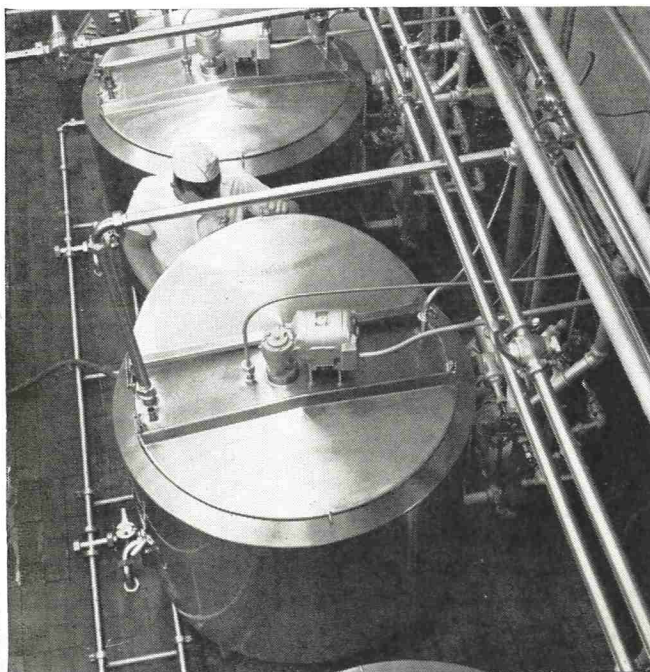
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Dairy sells more milk at lower cost

"We figure we're saving over \$750 a year in retinning costs alone by using Stainless Steel milk dispensing cans," says Mr. Darrell M. Hendrickson, Sales Manager of the Michigan State University Dairy Plant in East Lansing, Michigan. "Stainless Steel cans do not require retinning. We save time by not having to inspect the cans for corroded spots; there's never any danger of corrosion with Stainless Steel."



"Stainless Steel can't be beat for cleanliness and sanitation . . . so important in every dairy. Our entire plant is equipped with Stainless Steel."



"Another Stainless Steel product that we highly approve of for greater profits and customer satisfaction is the bulk milk dispenser. By buying milk in bulk, our customers are saving as much as $1\frac{1}{4}\%$ on every portion they sell. They like the cleanliness and convenience of Stainless Steel bulk dispensers; and the milk is always cold and fresh. There's no problem of handling and storing numerous containers. We both sell more milk at a higher profit."



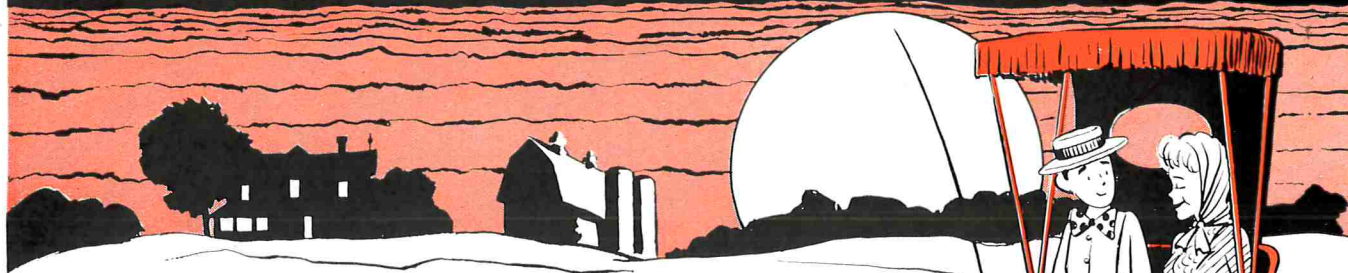
If you would like to have more information about dispenser cans or bulk dispensers, write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania. *USS is a registered trademark*

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United States Steel

SUNDAY NIGHT MILKING



Where I was working 50 odd years ago everybody in the neighborhood knew exactly what you meant when you used the expression "Sunday night milking" . . . and here is why.

He might be no beauty but the horse was curried and combed so that he was as pretty as he could be made; the buggy might need some paint but it had been run down to the creek and given a good scrubbing; the dust was beaten out of the cushions and the tassels on the fly net were all untangled. Everything was all ready and organized. All that you had to do was slip the halter, put on the bridle, hook up the check rein, and there you were all dolled up to gather up some girl and take her to church or home from church or just out for a buggy ride.

The nickelodeon was not allowed to run on Sunday but the drug store could sell ice cream if you happened to have a dime for each of you, and the moon was allowed to shine and in that country and at that time it was much brighter than the pale and faded moons that we have now.



Everything was just about all right . . . except . . . the cows still had to be milked and they could not be milked until it was milking time and that complicated things; a tight schedule had to be met.

So it is finally time to grab the pails and head for the barn and some heifer suddenly forgets that she has ever been milked before in all her life and she doesn't care for the idea . . . that slows things up. A usually placid and dignified matron becomes a cantankerous old hellion and holds up her milk. Things go rapidly from bad to worse and it takes a lot of sweating and fumbling and bellowing by man and beast simply because it is Sunday night and you are in a hurry.

Of course, all the old grey beards knew exactly what the trouble was all about and repeated what their fathers

had told them . . . "Never hurry a cow if you want her to hurry for you" . . . the young men had to learn that fact the hard way and by the time they got it learned they were not so young any more.

Habits and manners and customs change but cows have not changed very much. What happened more than half a century ago can't be of much interest now . . . except . . . that it seems to me that I have seen more Sunday night milking in the past couple of years than in the previous 20 . . . and . . . it wasn't happening because it was Sunday night.

The same bellowing and cussing, the same push and shove, the same tense anxiety on the part of both cows and men. In my sunburned youth "Sunday night milking" happened only once a week . . . now . . . I can take you to places where it happens twice a day every day.

That's a little bad, I think.

The above article was written by George Courtland Mather, and originally appeared in "Hoard's Dairyman" magazine.

If, in the interest of improving cow milking in your area, some extra copies of these words in booklet form could be of help . . . they are FREE for the asking.

Just write to Sales Promotion Dept., Babson Bros. Co., 2843 W. 19th St., Chicago 23, Ill.

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