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Journal of

MILK and FOOD TECHNOLOGY

Official Publication

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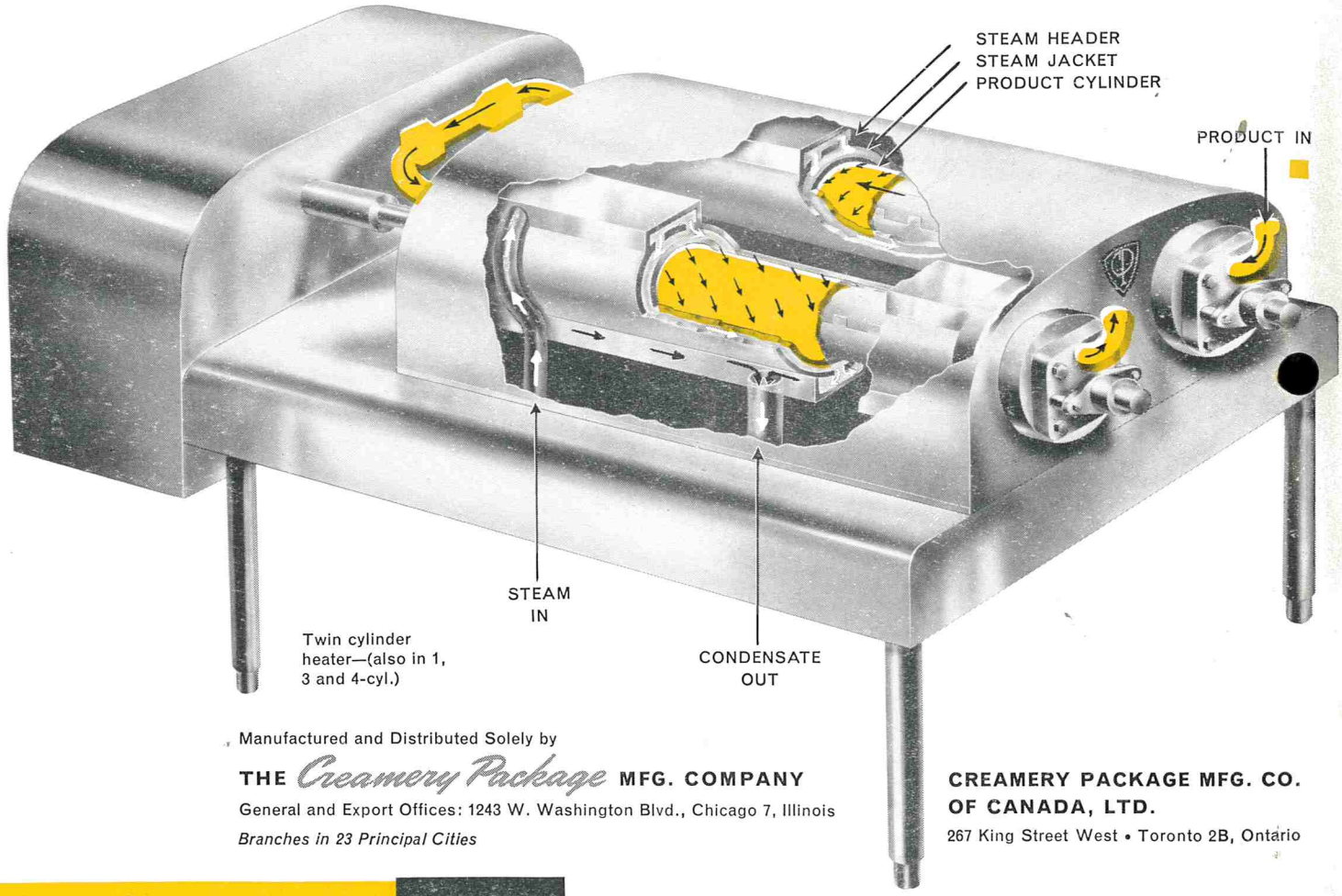

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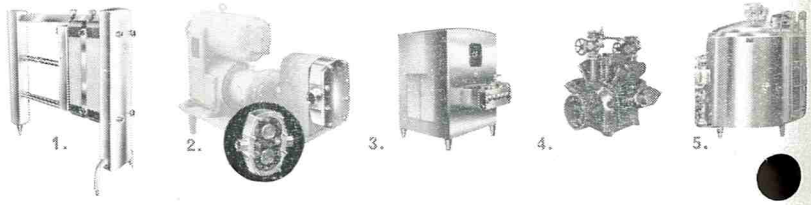

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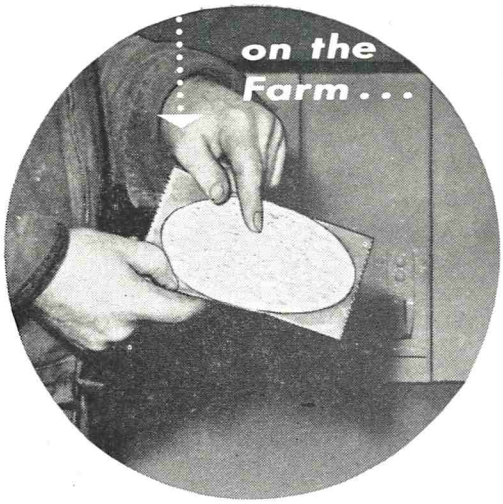

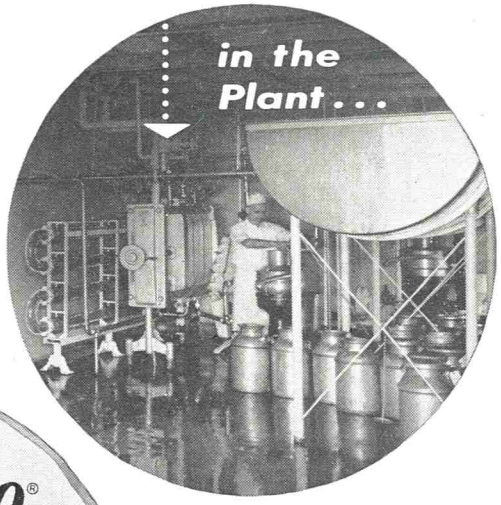

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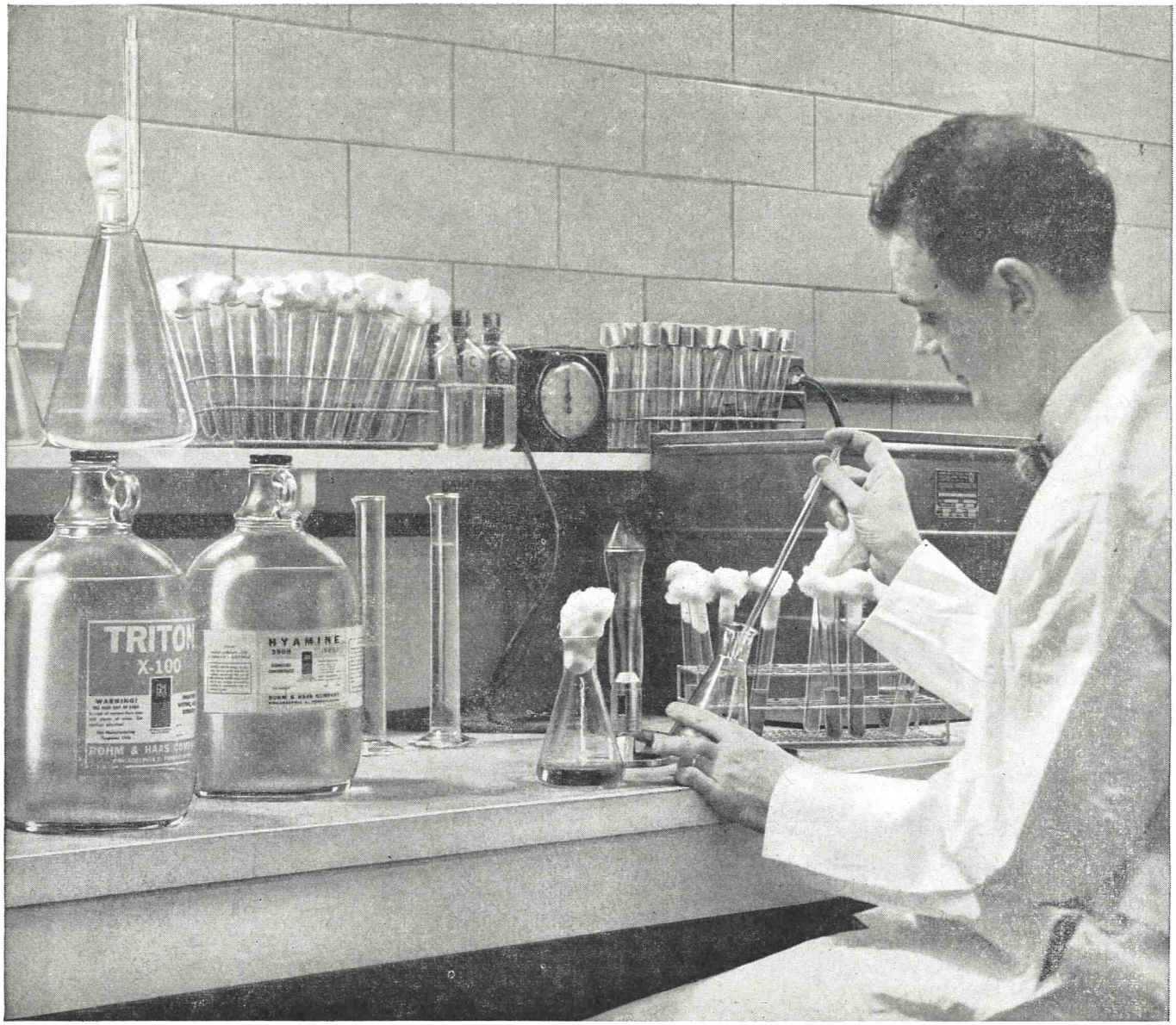

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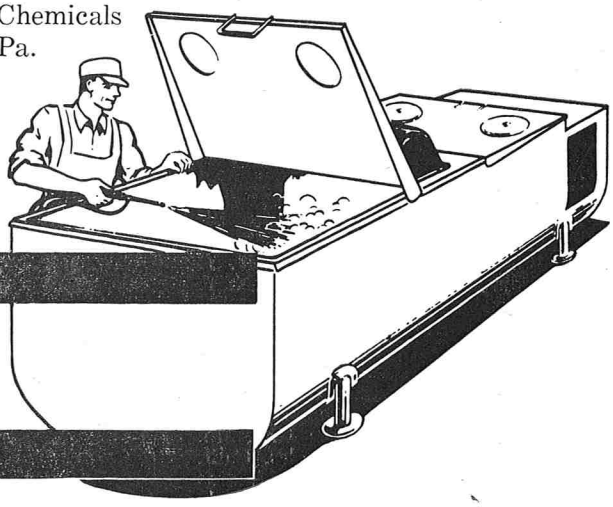

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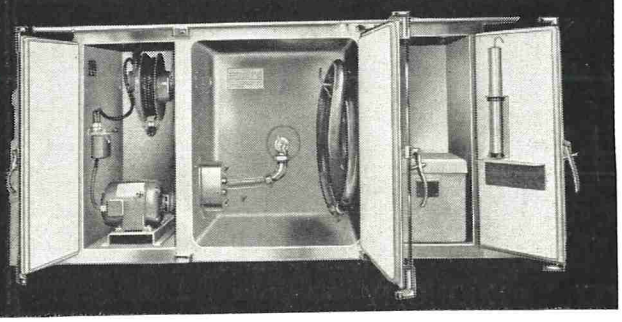

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PESTICIDE RESIDUES IN MILK[1]

ARNOLD N. MORTON
Seattle District, Food and Drug Administration,
Department of Health, Education, and Welfare

The Federal Food, Drug, and Cosmetic Act enforced by the Food and Drug Administration is the legal instrument which guards and protects the safety of all our foods, drugs, and cosmetics. Under this law a food may not contain any amount of added poisonous substance unless a safety level called a "tolerance" has been established for that substance. A recent amendment to the law, called the Miller Amendment, provides specifically for tolerances for pesticide chemicals added to raw agricultural products. If a tolerance has been established, the amount of the substance present must not exceed the tolerance. Such tolerances have been established for many pesticide chemicals on a large variety of raw agricultural commodities. You may ask if tolerances have been established or considered for milk. They have been considered but no tolerance yet has been established for any such substance in milk. The Food and Drug Administration takes a serious view of any proposal to add foreign substances to milk and milk products. Let us examine the problem in its several ramifications.

Soon after the Food and Drug Act of 1906 became law, the Bureau of Chemistry of the Department of Agriculture, which then enforced the law, adopted the policy that milk should not contain added poisonous chemicals such as formaldehyde. This policy was reaffirmed shortly after World War II, when DDT became available for civilian use. It was discovered that use of DDT for fly control in dairy barns results in DDT in the milk as it comes from the cow. With this discovery the Food and Drug Administration restated the policy that milk should not bear added poisonous substances. The Department of Agriculture, in registering labels for DDT, required warnings against use of the chemicals around dairy animals and against treated forage of dairy animals. These warnings, if followed, should keep the pesticide out of milk.

Today, the policy of the Food and Drug Administration that there shall be no residues in milk is being subjected to searching scrutiny. Agricultural authorities, pesticide manufacturers, and others are asking whether it is necessary. We in the Food and Drug Administration are quite willing to examine and reconsider the traditional policies in the light of current facts and future discoveries.

First, let us consider the basic reason for keeping poisons out of milk. Milk is a unique food. It is the principal article of diet for infants and many invalids, groups of people unable to resist physical stresses with which normal children or adults can cope.

Most of the pharmacological studies on pesticide chemicals are made on weanling animals. These studies show what level of poisonous residues in the diet of such animals causes no detectable harm, but do they show what level of poisonous residue in the diet of a suckling animal or a sick one is safe? We do not know the answer. However, there are scientists inside the government and outside it who have grave reservations about the advisability of tolerating any added poisons in milk on the basis of currently available pharmacological data. Certainly, if the Food and Drug Administration's traditional policy—"There shall be no added poisons in milk"—were to be changed, the change should come only after the most careful consideration of all available facts by scientists in the fields of pharmacology, medicine, and public health.

As mentioned above, we establish tolerance today under the Miller Amendment to the Food, Drug, and Cosmetic Act. The amendment provides that a petitioner may request a tolerance for a pesticide chemical in a raw agricultural commodity. If the petition shows that the requested tolerance level is safe and can be met and if the Department of Agriculture certifies that the pesticide chemical is useful, then the Food and Drug Administration establishes a permitted tolerance level for residues of the chemical. In harmony with the requirements of the Miller Amendment we will accept and file petitions requesting tolerances in milk, provided, however, that the basic evidence specified in the law is included in the petition. We will consider each application on its own merits and if a petition demonstrates the safety of the requested tolerance in milk we will establish a tolerance.

Prominent scientists, responsible industry members, and law enforcement officials agree that the Food and Drug Administration must require greater evidence of safety in setting a tolerance in milk than would be required to justify a tolerance on other foods. It is not known whether FDA will ever set a tolerance greater than zero for any pesticide in milk.

---

[1]Presented at the Northwest Regional Milk Sanitation Seminar, Portland, Oregon, September 12, 1957.

That is where we stand today. Our fundamental philosophy is being scrutinized and re-evaluated but it is not changed now. Milk containing residues still is illegal in interstate commerce.

Returning now to the specific problem of DDT in milk, the Food and Drug Administration has been concerned for several years that food bearing residues of this substance and other chlorinated hydrocarbon pesticides may have public health significance. It is now well established that DDT concentrates in the fat when taken into the body of an animal. In the case of dairy animals, the DDT is excreted in the milk and because of its fat solubility it will be concentrated in the fatty dairy products such as cream, butter, and cheese.

Let us make no mistake, DDT is a "poison" as the term is commonly understood—otherwise it would not be effective as an insecticide. Injury to man from consumption of foods contaminated with small amounts of DDT has not been demonstrated. However, changes in the liver have been noted in rats fed a diet containing only 5 parts per million of DDT. It is known that DDT accumulates in the fat of human beings exposed to the insecticide.

The position of milk in the American diet is supreme. Dairy products make up a little more than 29% of the average civilian diet in the United States. Fluid milk itself constitutes at least 25%. Compare this with other foods in our diet: wheat products make up 9%; potatoes, less than 8%, and no single class of fruit more than 3%. The integrity and wholesomeness of milk and milk products as the principal diet of infants and an important element of diet throughout the human life must not be brought into question.

With the development of scores of new insecticides during the last decade it has become increasingly apparent that some of these do constitute a threat to the safety of our milk supply. A number of these new insecticides have been found similar to DDT in that they are accumulated in the fat of dairy and meat animals and excreted in the milk. Let me re-emphasize, since no tolerance has been established for any pesticide in milk, milk containing DDT and these other insecticide residues is illegal under the Federal law.[2] Most states and many cities have similar laws.

This means that insecticides used on cows, in dairy barns, cream stations, and processing plants must be selected and used with great caution in order to avoid contamination of milk or other dairy products at all points from farm to consumer. To the farm producer it also means that crops grown either for use or sale for feeding dairy and meat animals must likewise be free from poisonous residues which may be transferred to the milk or meat or within any tolerance which may be set for the feed from forage crops.

During the fall of 1955 and early 1956, about 1600 samples of milk from all sections of the United States were collected by our inspectors. The samples were frozen, packed in dry ice, and shipped by air to our Washington laboratories, where they were examined for antibiotics. Half the samples also were examined for pesticide residues. Sixty-two per cent of the 800 samples tested contained pesticide residues. Pesticides were encountered in the following order of incidence: BHC 60%; DDT 54%; Lindane 26%; Rhothan 24 %, and Methoxychlor 3%. There seems to be two main sources of milk contamination: residues on forage crops, and contamination as a result of insecticide sprays either on cows themselves or in the barns and surroundings.

The presence of these residues in the nation's milk supply is a serious problem to the dairy industry and to enforcement officials alike. The Food and Drug Administration is convinced that an educational program in depth is the best solution. Acting on this belief, our first step was to transmit to the U.S. Department of Agriculture and Public Health Service the results of our 1955-56 survey, both as to pesticides and antibiotics.

The Department of Agriculture immediately initiated an extensive educational program designed to eliminate antibiotics and pesticide residues from the milk supply. During the period from February to April of this year four regional committees of State Extension dairymen met to consider the problem with State Extension directors and members of the Department of Agriculture. The recommendations of these committees for eliminating antibiotics and pesticide residues from the milk supply have been sent by the Department of Agriculture to all states for their use. The recommendations are being distributed widely through farm and trade meetings, schools, county agents, radio, TV, the press and other media.

Last month the Food and Drug Administration issued guide lines for the responsible use of pesticides to assist producers and manufacturers of dairy products in assuring the legality, safety, and wholesomeness of their products with respect to the possibility of contamination with pesticides. These guide lines are based on the best information now available, which admittedly is incompletely and subject to change in certain instances. Much of our knowledge

[2] Subsequent to the delivery of this paper, and after review and recommendation by an advisory committee, FDA established a zero tolerance for methoxychlor in milk.

in this field has resulted from very recent investigation. Where the available information is not adequate to show that no contamination of milk will result from the recommended use, we can only advise against such use until the evidence is developed. The law places responsibility for developing this evidence on the manufacturer of the pesticide or the proponent of its use for the purpose. However, it is the responsibility of the Food and Drug Administration to take whatever action is necessary for the protection of the public health and the integrity of the nation's food supply.

The following guide lines which were correct as of July 16, 1957 are quoted. We should recognize that it may become incomplete or inaccurate as more knowledge is available as new products are registered for these uses and new tolerances are established. We plan frequent revision of the statement as it may be necessary.

"1. Insecticides which are safe for spraying cows and for other uses in and around the dairy barn, provoided that utensils and the drawn milk are adequately protected:

Pyrethrins	MGK 264
Piperonyl Butoxide	MGK R-11 (repellant)
Allethrin	Tabutrex (repellant)

"2. Insecticides which may be used for fly control around dairy barns, provided the insecticides are not sprayed directly onto the cow or on the feed trough, and provided utensils and the drawn milk are adequately protected:

Diazinon—spray, bait, cords	Dipterex—bait only
Parathion—cords only	Lindane—spray, bait
Malathion—spray, bait	Methoxychlor—spray only
Chlorthion—spray, bait	TEPP—bait or *floor* spray only

"3. Certain pesticides may be used on growing crops intended for dairy cattle feed provided the amounts remaining on the feed do not exceed approved tolerance levels. When the pesticides are used according to label directions, crops sprayed with the following pesticides are within legal tolerance levels and are considered safe:

Methoxychlor	Sabadilla
Heptachlor	Ryania
TEPP	Malathion
Rotenone	Parathion

Pyrethrum (Pyrethrin-piperonyl butoxide)

"Although a number of other insecticides have been used for these purposes in years past, the recent discoveries regarding appearance of insecticides in milk from spraying of the cow or other uses around the dairy barn, have made it necessary to re-examine the propriety of uses of insecticides other than those listed above. The public should not be used as 'guinea pigs' for the testing of products which may be injurious."

TEPP when used according to directions on growing crops will not leave a residue. Rotenone, Pyrethrum, Sabadilla, and Ryania are exempt from requirement for tolerances when used according to directions on growing crops.

If you have an insect problem which cannot be controlled by one of the insecticides listed as safe, consult an expert for advice as to what may be used and what special precaution may be necessary to ensure protection of dairy products.

With the combined efforts of industry and government we are convinced substantial progress is being made. The market for dairy products depends upon continuing public confidence in their safety, integrity, and wholesomeness. Let us ensure this continued confidence. Thank you for this opportunity to discuss a most vital subject at your Milk Sanitation Seminar.

STATISTICAL COMPARISON OF LOGARITHMIC-AVERAGE, 3-OUT-OF-4, AND 3-OUT-OF-5 METHODS FOR GRADING MILK BY PLATE COUNTS

E. K. Harris, L. A. Black, and C. E. Zimmer
Robert A. Taft Sanitary Engineering Center
Public Health Service
Cincinnati, Ohio

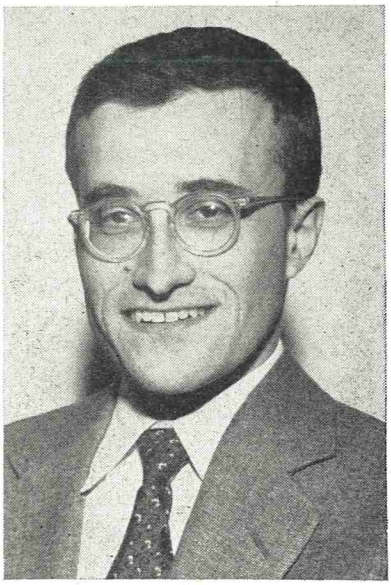
(Received for Publication May 5, 1958)

Analyses of 469 series of plate counts from milksheds in almost every region of the country showed clearly that the 3-out-of-4 method of grading bacterial quality of milk by plate counts is considerably more stringent than the log-average method. In practice a 3-out-of-5 rule yields about the same proportion of violations and degradings as the log-average. These findings held for a grade limit of 100,000 as well as 200,000 colonies per ml. Wide, roughly periodic fluctuations in plate counts were often observed, but did not appear to be related to season of the year.

The Milk Ordinance and Code *(1)* recommended in 1953 by the Public Health Service, specifically recognizes two methods of averaging total plate counts to judge compliance with bacterial standards of raw milk quality. Briefly, one rule specifies that the logarithmic (geometric) mean of the last four consecutive counts be calculated and compared with the recommended standard of 200,000 per ml. Under the second rule, the last four counts are examined separately and the milk supply is judged to comply with the standard if at least 3 of these 4 are below 200,000 per ml.

From time to time the agreement of these two methods in practice has been questioned on the grounds that a milk supply with bacterial count fluctuating close to the standard will be placed under suspicion more frequently by the 3-out-of-4 than by the log-average method. Theoretical calculations given below suggest that this is probably true. The most convincing evidence, however, has been derived from a study of several hundred series of plate counts made available through the cooperation of local sanitation and health officials. Finally, the use of punched card methods, including high-speed computing, has revealed considerable information about the distribution of serial plate counts from a milk supply.

[1] These areas were: St. Paul, Minn.; Houston, Tex.; Des Moines, Ia.; Louisville, Ky.; Jefferson City, Mo.; Tulsa, Okla.; Indianapolis, Ind.; Atlanta, Ga.; Portland, Ore.; Magnolia, Miss.; Birmingham, Ala.; Albuquerque, N. Mex.; Lynchburg and Roanoke, Va.; Dover, Del.; Rensselaer, N. Y.; Sheridan, Wyo.; and Grand Forks, N. Dak.



Dr. E. K. Harris has been in charge of statistical services at the Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio, since 1952. A graduate of Trinity College, Hartford, Connecticut, he obtained his Ph.D. from Yale University, and served for two years as instructor in biostatistics at the University of California in Berkeley before joining the Public Health Service.

Theoretical Comparisons

We assume that the logarithms of plate counts from a given milk supply arise from a homogeneous normally distributed population, at least over the six-month grading period generally covered by four or five consecutive counts. Plate count records examined in this study have shown an average geometric standard deviation (i.e., standard deviation of log count) of about .50 over the entire period of record, and this value is used in the following discussion. Actually, the relative properties of the methods for judging plate counts remain the same under geometric standard deviations as low as, say, .10 or as high as 1.2.

Assuming then that successive log plate counts within a grading period are normally distributed with mean equal to log G—where G is the true geometric mean colony count per ml.—and standard deviation .50, we compute the following probabilities: (*a*) that

a logarithmic average of 4 independent counts will exceed 200,000 *and* that the last of such counts exceeds 200,000, *(b)* that at least one of the first three counts *and* the fourth count exceed 200,000, and *(c)* that at least 2 of 4 successive counts and a 5th count exceed 200,000—an hypothetical 3-out-of-5-rule. These probabilities are listed in Table 1 for values of G ranging from 80,000 to 300,000 colonies per ml. The formulae needed to compute these probabilities are given in an appendix.

The 3-out-of-4 rule appears much more stringent than the log-average method. A less strict 3-out-of-5 rule would come closer to the log-average method but would still, in theory, yield a higher proportion of unfavorable reports.

These probabilities cannot be taken as absolute measures of the expected proportion of violations in practice. They are useful only in comparing various grading rules. There are two reasons for this limitation. First, the value of .50 used as the geometric standard deviation is an average over many months of record for each producer. Any such long series of plate counts is usually not homogeneous but consists of hills and valleys of high and low counts, reflecting changing conditions on the farm. Consequently, within any grading period, the counts are likely to show a smaller standard deviation. Second, in practice, moving sets of four counts (each set differing from the preceding in only one count) rather than completely independent sets are examined. In milk of acceptable bacterial quality during a given grading period these factors will operate to lower the probability that any individual set of counts will show a violation; in milk of poor quality they will tend to raise the probability. In other words, one may expect that in actual use the grading methods work more efficiently than is indicated by Table 1.

FIELD TEST

To check the foregoing results on observed plate counts a large volume of data was made available to the authors through the generous cooperation of milk sanitation officials, laboratory directors, and health officers in 17 metropolitan areas representing almost every region of the country.[1] In all, records of 469 producers were examined, each consisting of a series of consecutive plate counts ranging from 11 to 63 in number, with a median of 20 per farm. These records covered the years 1954-1957 and averaged two years' experience with each producer. Data were transcribed to punched cards to allow rapid computing and tabulating of moving averages and of grade limit violations as indicated by the log-average, 3-out-of-4, or 3-out-of-5 methods.

TABLE 1—THEORETICAL PROBABILITIES OF VIOLATION OF 200,000/ML. GRADE LIMIT UNDER THREE GRADING METHODS.[a]

G	Log-Average	3-out-of-4	3-out-of-5
80,000	.018	.109	.043
100,000	.041	.169	.083
120,000	.074	.229	.131
140,000	.081	.288	.184
160,000	.156	.342	.239
180,000	.203	.392	.292
200,000	.250	.438	.344
220,000	.286	.479	.392
240,000	.320	.516	.437
260,000	.352	.550	.478
280,000	.380	.580	.515
300,000	.407	.607	.549

[a]Based on geometric standard deviation equal to .50

As specified in all the rules, no violation was listed if the last count in the given set of 4 or 5 being examined fell below 200,000. A repeated violation, implying degrading or suspension of permit, was noted if an unsatisfactory count followed the original violation immediately or after no more than one satisfactory count. If more than one satisfactory count intervened it was assumed that subsequent poor counts had occurred during a new six-month grading period and therefore no degrading would be warranted. An arbitrary decision like this was necessary since collection dates of only the first and last samples in each series had been requested from the cooperating agencies.

Of the 469 plate count series examined in this study, 196 (42 percent) contained at least one violation of the 200,000 per ml. grade limit. The median count in these 196 supplies ranged from 3,000 to 320,000 per ml. with a surprisingly low average (i.e., average median) of 73,000 per ml. Seventy-five percent showed median plate counts less than 100,000 per ml., indicating that in many cases a sudden run of high counts had appeared in milk which was usually of acceptable quality.

The tabulation of these grade limit violations by grading rule showed:

(a) Log-Average Method: 162 initial violations, followed by repeated violations in 67 cases;
(b) 3-out-of-4 Method: 310 initial violations, followed by repeated violations in 130 cases;
(c) 3-out-of-5 Method: 154 initial violations, followed by repeated violations in 55 cases.

In only three instances were violations indicated by the log-average, but not by the 3-out-of-4 method.

These results partially confirm the conclusions drawn from the theoretical analysis summarized in Table 1. The 3-out-of-4 method is undoubtedly a stricter grading rule than the log-average method. On the other hand, the 3-out-of-5 method appears to yield in practice about the same proportion of violations and degradings as the log-average rule, although theoretically the former seemed slightly more stringent.

A check on agreement between the log-average and 3-out-of-5 methods revealed that the two agreed in 64 percent of 182 initial violations detected by one or both methods. Of 74 repeated violations following the initial offense the two methods agreed in 55 percent. The number of violations detected by one method but not by the other was almost identical for each.

As mentioned earlier, 273 (58 percent) of the 469 series of plate counts contained no violations of the 200,000 per ml. limit. The median count in these supplies ranged from 2100 to 88,000 per ml., averaging 17,000. Since more stringent bacterial standards are used in some localities, these counts were examined in a manner identical with the others, but using a grading limit of 100,000 per ml. Only 81 of the 273 series contained a violation of even this more severe grade limit. Tabulation by grading method showed:

(a) Log-Average Method: 34 initial violations, followed by repeated violations in 9 cases;
(b) 3-out-of-4 Method: 101 initial violations, followed by repeated violations in 36 cases;
(c) 3-out-of-5 Method: 35 initial violations, followed by repeated violations in 12 cases.

This is the same pattern of results as was observed with respect to the higher grade limit.

THE DISTRIBUTION OF PLATE COUNTS OVER TIME

Access to high-speed computing facilities allowed us to examine in detail the statistical distribution of each series of counts. Certain statistics, such as medians, geometric means and geometric standard deviations, proved useful in the present study. Other information derived from these analyses, which could not have been carried out on so many series of counts except through high-speed computing, may be considered "bonus"—not essential for the immediate aims of the present study, but possibly of value in the general sanitary control of milk.

For example, each count in a series was checked to see whether it fell above or below the median. A sequence of one or more consecutive counts all falling above, or below, the median constitutes a "run." Under the hypothesis that serial counts are randomly distributed in time about the median, statistical theory is available (2) to determine the expected frequency of runs in a series with a given number of counts. Further, percentile values may be obtained such that, for example, no more than 5 percent of series of, say, n counts randomly distributed in time should show numbers of runs fewer than the given value. We were particularly interested in testing whether observed series showed too few runs in order to check the possibility of significant periodic fluctations in counts. This point was mentioned earlier in commenting on the rather low median count typically observed among the 196 farms which committed at least one violation of the 200,000 per ml. grade limit.

Limiting our consideration to these farms, the run test revealed definite indication of such nonrandom fluctuations in the counts of many milk supplies. Whereas 5 percent of these series would have been expected by chance alone to show smaller numbers of runs than the theoretical 5 percent values, actually 20 percent (39) of the 196 series yielded such results.

Finally, to allow convenient visual inspection of each individual series, the data cards were fed through a high-speed printer which graphed the serial log counts, assuming equal intervals of time between successive counts. Although this assumption was not always valid, information on the span of months covered by each series and the number of counts included indicated that as a rule one count was obtained every three weeks to a month.

Of the 39 series of plate counts yielding too few runs, 9, or 4.6 percent of 196 did not exhibit noticeable periodic fluctuations. These series may represent the 5 percent significant results expected purely by chance. Many other series showed fluctuations of a more or less periodic nature, which appeared entirely unrelated to season of the year. Often varying from farm to farm within a milkshed, they probably depend on factors peculiar to the individual farm. In 10 percent of the 196 series discussed above, including 6 of the 29 showing significantly few runs, wide fluctuations throughout the major portion of a series were followed by consistently low counts towards the end, implying tightening of sanitary control in these cases.

SUMMARY

Theoretical comparisons indicate that the 3-out-of-4 method is considerably more stringent than the log-average method for grading bacterial quality of milk by plate counts. A less strict 3-out-of-5 rule would agree more closely with the log-average method, but in theory would still yield a higher proportion of unfavorable reports.

Detailed analyses of 469 series of actual plate counts representing milksheds from almost every region in the country clearly confirmed the theoretical comparison of the log-average and 3-out-of-4 methods and showed that in practice the 3-out-of-5 rule yields about the same proportions of violations and degradings as the log-average. These findings held for a grade limit of 100,000 as well as 200,000 colonies per ml.

Further study of these series showed that wide, roughly periodic fluctuations in plate counts often occurred. Such variations did not appear to be related to season of the year and probably reflected changing conditions on the individual farms.

APPENDIX

Formulae for Computing the Probabilities Given in Table 1:

1. Log-Average Method:

Let T represent the total of four consecutive log counts, writing $T = x_1 + x_2 + x_3 + x_4$. We require the probability that T, greater than or equal to, 4x log 200,000=21.2041 *and* x_4, greater than or equal to, log 200,000=5.3010. Using the log normal assumption, the joint distribution of T and x_4 is bivariate normal with correlation, p=½. The difficulty of obtaining probabilities under a bivariate normal distribution may be avoided through transformation mentioned by Kendall (3).

Let u denote the standardized variable

$$\frac{\text{T - mean of T}}{\text{Std. Dev. of T}} = \frac{\text{T - 4 log G}}{\text{2 x .50}}$$

where .50 is the assumed geometric standard deviation of a single plate count. Let v denote the similar variable

$$\frac{x_4 \text{ - mean of } x_4}{\text{Std. Dev. of } x_4} = \frac{x_4 \text{ - log G}}{.50}$$

Introduce the new variables

$$Z_1 = \frac{u - v}{\sqrt{1 - p^2}} = 1.1547 \left\{ \frac{T - x_4 - 3 \log G}{1.0} \right\}$$

recalling that p=½, and Z_2=v.

It is easy to show that Z_1 and Z_2 are independently normally distributed variables with zero means and unit standard deviations and that the bivariate normal distribution of T and x_4 reduces to the product of the independent distributions of Z_1 and Z_2. Therefore, to compute the probability of violating the 200,000/ml. grade limit using the log-average method, we find the area under the standard normal curve from

$$Z_2^* = 1.1547 \left\{ \frac{15.9031 - 3 \log G}{1.0} \right\}$$

to infinity and multiply this by the area from

$$Z_2^* = \frac{5.3013 - \log G}{.5}$$

to infinity. Call the latter area P, since we need to refer to it in connection with the other grading methods.

2. 3-out-of-4 Method:

The probability that at least one of the first three counts in any set of 4 will be greater than 200,000 is given by the expression, $1 - (1 - P)^3$, where P is defined above. The probability that the fourth count will be >200,000 is P itself. Therefore, the probability of a violation under the 3-out-of-4 grading rule is $P[1 - (1 - P)^3]$.

3. 3-out-of-5 Method:

The probability that at least two of the first four counts in any set of five will be greater than 200,000 is given by $1 - (1 - P)^4 - 4P(1 - P)^3$. Since the probability that the fifth count will be greater than 200,000 is P, the probability of a violation under the 3-out-of-5 grading rule is $P[1 - (1 - P)^4 - 4P(1 - P)^3]$.

ACKNOWLEDGEMENT

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A SIMPLE TEST FOR DETECTING KEEPING QUALITY FOR MILK[1]

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The keeping quality of refrigerated pasteurized milk is determined largely by the number and activity of the psychropilic population of the milk. In general the number of psychrophiles in freshly bottled milk is not considered a reliable index of shelf life of the product. However, it is conceded that pasteurized milk should at the time of bottling have none or very few psychrophiles (1, 3, 4, 8).

Wide variations occur both in the initial number of psychrophiles and the number at the time of spoilage. The organisms vary in their action on the various milk constituents as well as in the amount of by-products contributing to flavor defects. Occasionally, the so-called "inert" psychrophilic population of the milk prior to pasteurization reduced the shelf life of the pasteurized product. Weber *(9)* reported that milk which had a high psychrophilic count before pasteurization would not keep as long as milk with relatively low counts prior to pasteurization. Added to these factors are inherent differences in growth rates at refrigeration temperatures of the various psychrophiles.

Day and Doane (5) found that chemical tests were inconsistent or not sensitive enough for predicting off-flavor changes in milk. They tested protein stability and variations in nitrogen distribution of the non-casein fractions. Significant changes occurred too near the time of pronounced flavor defects to be of practical value. However, these authors developed a dye reduction test utilizing neotetrazolium which, when applied to milk after at least 3 days of refrigerated storage, provided a basis for predicting spoilage. Spoilage usually occurred 3 or 4 days after a positive test.

The methylene blue test has been used for many years as an indicator of bacterial activity and as such gives a misleading indication of keeping quality. In some early studies Hiscox *et al. (6)* deviated from the usual standard of acid production as a criterion of keeping quality and used instead taste determination. They demonstrated a marked correlation between the reduction of methylene blue at 15.5°C. and the keeping quality at the same temperature. Almost without exception, as soon as the reduction was complete, a flavor defect could be detected in a portion of milk reserved for tasting. This modification of the methylene blue test differed from others in the temperature of incubation. Thus the test measured only the biochemical activity of organisms capable of relatively rapid growth at low temperature. The close agreement between reduction time and keeping quality provided a clue to the present investigation.

A test which would detect an extremely small population, i. e. less than one organism per ml as well as a relatively large population, and would give an estimate of the activity of psychrophilic organisms might be used in predicting the keeping quality of milk. A test of such delicacy could be accomplished best by an enrichment medium, using the natural substratum, the milk under test. The medium should be selective for psychrophiles and contain an indicator capable of detecting relatively low bacterial populations.

A test for predicting shelf life of pasteurized milk must be accomplished in a relatively short period of time. The standard test for psychrophiles of seven days incubation at 4.5°C. on agar plates has only historical value. Any test dependent upon bacterial activity must be made at a temperature conductive to rapid bacterial reproduction.

Tests were made to determine the optimum temperature for the reproduction of psychrophiles by Weber *(9)*. Tests were made on three species of *Achromobacter,* four species of *Flavobacterium* and four species of *Pseudomonas,* isolated from refrigerated milk. The logarithmic average for the eleven cultures at 20°C. for 48 hours was 6.4×10^6 and at 4.5°C. for six days, 7.5×10^6. Three cultures gave higher counts at 20°C. and eight cultures gave higher counts at 4.5°C. These figures indicate that all of the psychrophiles grew well at 20°C. for 48 hours but gave slightly higher counts at 4.5°C. for six days.

Weber also made counts on various pasteurized milk samples obtained from Michigan milk plants. Logarithmic averages of 72 samples were 31,690 per ml at 20°C. for 48 hours and 389 per ml at 4.5°C. for six days. These data show that many non-psychrophiles grow in standard milk agar at 20°C. Inasmuch

[1] Michigan Agricultural Experiment Station Journal Article No. 2269.

as most of these are gram positive thermoduric bacteria, 20°C. incubation could conceivably be used provided the mesophiles were eliminated by the use of a selective medium.

In keeping with the results obtained by Mallmann and Darby *(7)* sodium lauryl sulfate was tried as an inhibitor of gram positive bacteria, but this compound tended to crystallize at 20°C. Nacconol NR SF[2] was shown by Mallmann and Darby *(7)* to have inhibitory properties similar to those of sodium lauryl sulfate. Consequently Nacconol NR SF in a concentration of 1-1000 was selected. At this concentration the surface active agent inhibited the gram positive organisms without exhibiting any adverse effect on the gram negative bacteria or precipitation at 20°C.

Earlier studies were conducted using 2, 3, 5 triphenyl tetrazolium chloride (TTC) as a coloring agent to facilitate counting of colonies where opacity of the medium was a problem *(2)*. Without exception psychrophiles, growing on tryptose glucose extract agar, reduced TTC. Using pure cultures of psychrophiles, a series of tests, comparing resazurin and TTC, indicated that the latter was more sensitive and thus would be more suitable. On the basis of these studies TTC in a concentration of 1-10,000, was selected as the reduction indicator for the demonstration of bacterial activity.

A buffer system was found necessary because some psychrophiles, being acid producers, lowered the pH of the milk and consequently interferred with the reduction of TTC. The addition of 0.5 percent K_2HPO_4 and 0.001 percent KH_2PO_4 would maintain the pH of the milk from 7 to 7.5 depending upon the milk in question.

The indicator solution was prepared as follows:

2, 3, 5 triphenyl tetrazolium chloride	0.1 gm
Nacconol NR SF	1.0 gm
K_2HPO_4	5.0 gm
KH_2PO_4	0.1 gm
Distilled water to make	100.0 ml

The above solution was placed in a dark bottle and autoclaved at 121°C. for 15 minutes. The sterile solution was stored at room temperature in the dark.

In the performance of the test 1-ml quantities of the Nacconol—TTC solution were pipetted aseptically into sterile tubes to which were added aseptically 10-ml samples of the milks in question. The tubes were shaken and incubated at 20°C. and examined after 12, 24, 36 and 48 hours. The presence of a pale pink to rose red was reported as positive at the time of reading. Occasionally a pink button was found at the bottom of the tube. This was considered negative in the absence of a pale pink color throughout the tube of milk. Duplicate Nacconol-TTC tests were made on all samples at the start of each set of samples. Replicate platings were made on tryptose glucose extract milk agar at the start and completion of each set of samples. Sets of plates were incubated at 35°C. for 2 days, 20°C. for 4 days and 4.5°C. for seven days.

Twenty-three lots of freshly pasteurized milk were obtained from twelve dairies in the Lansing area. Three quarts of each lot were pooled in a large sterile vessel to eliminate possible variations in different quart bottles. This milk was dispensed into ten sterile half-pint bottles which were chilled prior to filling. The bottles were capped aseptically and immediately stored at 4.5°C.

Preliminary testing had demonstrated that most of the milks in the Lansing area were of relatively good keeping quality. In order to approximate poor keeping quality some of the half-pint samples were stored at 4.5°C. for varying periods of time to allow the development of psychrophiles. The samples reported in Tables 3 and 4 were stored for varying periods before the start of the experiments.

Milk samples were tested organoleptically on alternate days. Questionable samples were tested again on the following days. An undisturbed bottle representative of each lot, was used for sampling. Bottles were coded to avoid bias. Prior to tasting, a portion was removed aseptically for measuring the number of psychrophiles present. Any off-flavor was considered as evidence of spoilage.

RESULTS AND DISCUSSION

In general, the initial psychrophilic bacterial counts were not directly correlated with keeping quality of the milk samples tested. These results are similar to those obtained by the other investigators cited. However, there is, a correlation, if broad ranges in counts are bracketed. Milks with initial psychrophilic counts of less than 10 per ml exhibited a greater refrigerated storage life than milks with counts in the range of 10 to 10,000 per ml. These in turn showed a longer refrigerated shelf life than those which had counts ranging from $1x10^4$ to $1x10^8$ per ml. In Figure 1 a comparison of shelf life and psychrophilic populations of pasteurized milk stored at 4.5°C. is presented. A general correlation between shelf life and psychrophilic population existed but bacterial counts showed a wide scatter from the median particularly where keeping quality ranged from 9 to 12 days. The wide variations were due in part to error inherent in the plating technique, limitation to an average of duplicate plates for each determination and variance in

[2] Product of Allied Dye and Chemical Company.

the ability of the dominant types of organism in each milk to produce off-flavor. The use of psychrophilic counts for measuring shelf life of pasteurized milk is not only limited in value by the forementioned variations but also by a long incubation of the plates at 4.5°C.

There was a relationship between the psychrophilic counts of the milk at the time of spoilage, with few exceptions, and the presence of off-flavors. The counts at the time of appearances of off-flavor ranged from $8x10^6$ to $1x10^8$ per ml. However, (Table 4) initial psychrophilic counts in milk approaching the above range did not necessarily have flavor defects. There, high initial counts were a good indication that the samples refrigerated shelf life would be very short.

Samples 31, 34, 36 and 39 (Table 3) had initial counts in the millions, yet they remained acceptable for 11, 10, 9 and 8 days respectively. These exceptions serve to point out the importance of the various types of organisms involved in off-flavor production. These same samples demonstrate the importance of the difference in growth rates of various species. The initial populations ranged from 0 to 10 organisms per ml, the generation time up to the time of off-flavor production ranged from 8.6 to 15.6 hours with an average time of 12.5 hours. Where the initial population ranged from 10-100,000 the average generation time was 16 hours and, with the exception of one sample with a generation time of 1000 hours, the samples with initial counts in excess of $1x10^5$ had an average generation time of 72 hours. These figures confirm the statement that generation times increase materially as the population reaches its maximum, when the total is considered rather than the multiplying population.

Milk with initial high populations may keep relatively long periods merely because the population is approaching a static condition so that multiplication becomes progressively slower the higher the population. To predict shelf life by psychrophilic population would be very difficult, if not impossible.

The results presented in Tables 1 to 4 inclusive, show the relationship between the positive Nacconol-TTC tests and the keeping quality of various samples of milk. When a positive test was obtained in 48 hours (Table 1) the average keeping time of the five samples was 15.6 days. The average keeping time of 14 samples, showing a positive test in 36 hours (Table 2), was 12.6 days. Eleven samples which gave a positive test in 24 hours (Table 3) had an average keeping time of 8.8 days, while the 9 samples which exhibited

TABLE 1—MEASUREMENT OF KEEPING QUALITY BY THE NACCONOL-TTC TEST OF PASTEURIZED MILK STORED AT 4.5°C. (SAMPLES SHOWING POSITIVE TEST IN 48 HOURS)

Sample number	Keeping time in days	Initial bacterial count 35°C	4.5°C	Bacterial count at time of spoilage. 4.5°C.
8	18	80	1	210,000,000
10	18	1,800	0	510,000,000
16	17	220	2	330,000,000
17	10	1,700	17	420,000,000
18	15	3,400	1	690,000,000
Average 15.60				

TABLE 2—MEASUREMENT OF KEEPING QUALITY BY THE NACCONOL-TTC TEST OF PASTEURIZED MILK STORED AT 4.5°C. (SAMPLES SHOWING POSITIVE TEST IN 35 HOURS)

Sample number	Keeping time in days	Initial bacterial count 35°C	4.5°C	Bacterial count at time of spoilage. 4.5°C.
1	9	2,100	520	890,000,000
2	13	4,500	4	80,000,000
3	19	15,000	6	12,000,000
4	18	2,800	1	7,000,000
5	13	20,000	4	260,000,000
7	13	13,000	2	180,000,000
9	9	300	3	270,000,000
12	10	15,100	11,000	460,000,000
15	12	5,800	10	100,000,000
19	13	6,400	1	250,000,000
20	9	4,900	90	210,000,000
21	15	2,100	0	220,000,000
23	10	1,000	1,000	210,000,000
26	13	25,000	8,000	12,000,000
Average 12.57				

TABLE 3—MEASUREMENT OF KEEPING QUALITY BY THE NACCONOL-TTC TEST OF PASTEURIZED MILK STORED AT 4.5°C. (SAMPLES SHOWING POSITIVE TEST IN 24 HOURS)

Sample number	Keeping time in days	Initial bacterial count 35°C	4.5°C	Bacterial count at time of spoilage. 4.5°C.
6	10	1,300	210	340,000,000
11	9	17,100	12,000	1,000,000,000
13	10	19,800	6,400	1,100,000,000
25	7	23,000	510,000	80,000,000
29	12	1,800	47,000	210,000,000
31	11	2,400,000	20,000,000	330,000,000
33	4	330,000	3,500,000	80,000,000
34	10	100,000	3,000,000	12,000,000
36	9		69,000,000	180,000,000
39	8	6,900,000	27,000,000	330,000,000
40	7	100,000	100,000	7,000,000
Average 8.82				

TABLE 4—MEASUREMENT OF KEEPING QUALITY BY THE NACCONOL-TTC TEST OF PASTEURIZED MILK STORED AT 4.5°C. (SAMPLES SHOWING POSITIVE TEST IN 12 HOURS)

Sample number	Keeping time in days	Initial bacterial count 35°C	4.5°C	Bacterial count at time of spoilage. 4.5°C.
22	3	1,200,000	27,000,000	250,000,000
24	3	3,800,000	30,000,000	890,000,000
30	3	540,000	24,800,000	1,000,000,000
35	2	14,000,000	190,000,000	340,000,000
14	4	100,000	33,000,000	260,000,000
37	7	14,000,000	25,000,000	512,000,000
38	5	3,200,000	80,000,000	690,000,000
41	6	164,000,000	190,000,000	210,000,000
43	5	140,000,000	106,000,000	210,000,000
Average 4.22				

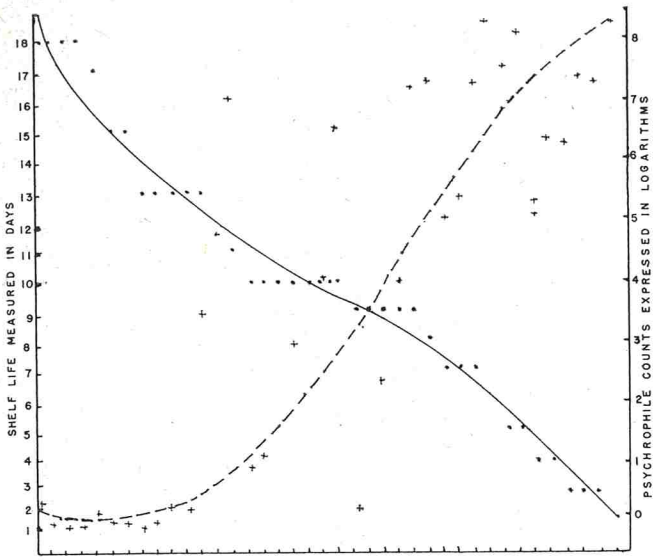

Figure 1. A comparison of the shelf life of 37 samples of pasteurized milk stored at 4.5°C. and the initial psychrophilic counts. (Shelf life indicated by solid line; psychrophilic counts indicated by broken line.)

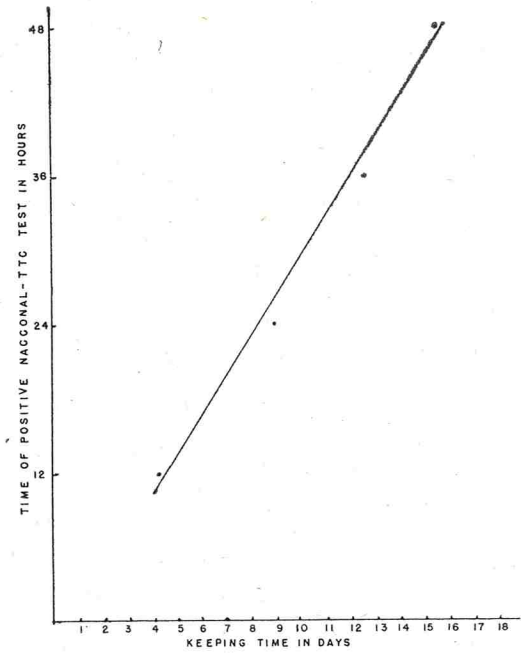

Figure 2. A comparison of the average shelf life of pasteurized milk stored at 4.5°C. and the Nacconol-TTC Test.

a positive test in 12 hours (Table 4) had a refrigerated shelf life of 4.2 days. The data in Table 4 confirm the work of Day and Doane *(5)* who demonstrated reduction of neotetrazolium in 3.78 days in advance of off-flavor production.

A direct relationship between reduction time and keeping quality is demonstrated in Figure 2 in which the average keeping time of the various milk samples was plotted against the period in which a positive test was obtained.

Of the 19 samples (Tables 1 and 2) which had a predicted shelf life of 12.6 days or more, only 4 failed to meet this prediction, but even these had a refrigerated shelf life of 9 days. On the other hand, of the 20 samples (Tables 3 and 4) judged to have poor keeping quality, 19 exhibited a shelf life of less than 12 days.

On the basis of these results, milk samples which exhibited a positive test in 24 hours or less had poor keeping quality (shelf life at 4.5°C. or less than 12 days). A positive test in 12 hours would indicate very poor keeping quality. A negative test in 24 hours would indicate good keeping quality.

The Nacconol-TTC test was designed to give a rapid test for predicting shelf life of stored pasteurized milk. The test is relatively simple to perform and can be done by anyone with a little laboratory training in pipetting and aseptic handling of equipment and milk samples.

The test separates milk of good and poor shelf life and can be used in plant operation *(a)* to measure sanitation in post-pasteurization operation and *(b)* to determine the approximate shelf life of stored pasteurized milk and dairy products.

SUMMARY

A method is described whereby a 10 ml sample of pasteurized milk with the addition of 1 ml of a Nacconol-TTC solution is incubated at 20°C. and observed at 12 hour intervals for 48 hours to estimate the shelf life of the product. The appearance of a positive tube (pale pink to rose red) is dependent upon the activity of psychrophilic bacteria. A positive test at 12 hours indicates an approximate shelf life at 4.5°C. of 4 days; a positive test at 24 hours, 9 days; a positive test at 36 hours, 12 days; and a positive test at 48 hours, 15 days.

Initial psychrophilic counts cannot be used to predict keeping quality except that milks with populations of 10 or less preferably zero have long shelf lives.

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SOME CHARACTERISTICS OF SURVIVING IODINE-TREATED PSEUDOMONAS FLUORESCENS[1]

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A study was made of some of the growth characteristics of cultures of Pseudomonas fluorescens which had received a sublethal treatment with various iodophors. Cultures grown in the presence of iodophor showed an increased lag phase at 5°C. in skimmilk and nutrient broth. However, the growth characteristics of iodine-treated cultures grown in iodine-free media were very similar to those of non-treated cultures.

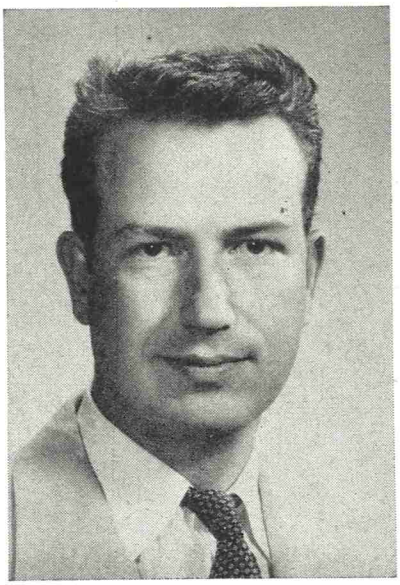
Previous investigations (2, 3, 4) have shown that the conditions for resumption of growth of heat-treated psychrophiles are not the same as those for non-heated cells. In addition to heat, chemicals such as hypochlorites, quaternary ammonium compounds, and iodophors are frequently used to sanitize utensils and equipment in the food industry. Very little information is available on the influence of chemical sanitizers on the biochemical characteristics of psychrophiles. Lawton and Nelson (4) reported that a sublethal treatment with chlorine did not change the conditions for resumption of growth of certain psychrophiles.

The present study was initiated to determine some of the characteristics of cultures of *Pseudomonas fluorescens* which received a sublethal treatment with various iodophors.

Experimental Methods

The cultures of *P. fluorescens* 2, 3, 11, 70, and E were carried in litmus milk and transferred weekly. For the majority of the experiments the cultures were grown on slants of Plate Count Agar (*1*) for 24 hours at 25°C. The growth was removed from the slants with ice cold phosphate buffer (*1*) and collected by centrifugation. The cells were washed twice and suspended in ice cold phosphate buffer. The bacterial suspensions were used immediately. In the individual trials the initial level of population in the non-treated (control) suspension was adjusted approximately to that of the treated suspension by diluting with sterile medium. The rate of dilution was calculated from population levels obtained in previous trials. The dilution factors were established by correlating number of viable cells by plating on Plate Count Agar with the density as measured with a Spectronic 20 Colorimeter.

[1]Journal Paper No. 2718 of the Texas Agricultural Experiment Station, College Station.



Dr. C. D. Heather was born in Dallas, Texas. He received the M.S. degree in Bacteriology from the University of Texas in 1950 and the D. V. M. degree from Texas A. & M. College in 1957. During his junior and senior year he was employed as a technical assistant in the Department of Dairy Science. At the present he is associated with the State Department of Public Health, Veterinary Division, Austin, Texas.

In one experimental procedure 9 ml. of an iodophor solution (2.5, 5 p.p.m. I) was added to 1 ml. of the bacterial suspension in sterile test tubes. At certain intervals (10, 20 sec.) 1 ml. of the bacteria-iodophor mixture was transferred into 9 ml. of sodium thiosulfate (0.4%) solution to eliminate action of residual iodine.

In subsequent experiments iodophors (10-200 p.p.m. I) were also added directly to certain growth media. The cultures for these experiments were grown in the same medium (without iodophors) at 25° C. for 24 hours. Unless stated otherwise, the number of survivors was determined by plating on Plate Count Agar (*1*). The plates were incubated at 25° C. for 3 days.

The sensitivity of certain cultures and isolates to various concentrations of I was also tested by the Gradient Plate Technique (5). These plates were prepared as follows: 10 ml. of Plate Count Agar were poured into a sterile petri dish which was tilted slightly. The agar was allowed to harden and with

the dish in the horizontal position 10 ml. of the same medium containing 200 p.p.m. I was poured on top of the first layer. Downward diffusion between the two layers resulted in a uniform concentration gradient across the plate. The dilution of iodine is proportional to the thickness ratio of the two layers of medium. Actual concentrations of I at various sections of the plate were not determined. The culture was streaked over the entire surface of the plate with a sterile glass rod. The method used in reading these iodine containing gradient plates (I-gradient plates) is discussed in the section on experimental results.

The following iodophors were used in this study: Iobac[2], Iosan[2], Iopipe[2], and Klenzade iodophor[3]. The concentration of I was determined by titration with thiosulfate.

EXPERIMENTAL RESULTS

Preliminary experiments indicated that no survivors could be detected when buffered (pH 7.0) suspensions of the test cultures (10^9 organisms per ml.) at 25° C. were subjected to an initial concentration of iodine of 15 p.p.m. for at least 10 sec. Approximately 10^2 to 10^3 survivors usually were found when such suspension of a test culture was treated with 5 p.p.m. of I for 10-20 sec.

In Figure 1 are presented representative data of the growth at 5° C. in skimmilk of suspensions of *P. fluorescens* 3 which were submitted to an initial concentration of iodine of 5 p.p.m. for 20 sec. The initial count of the control suspension was 69 x 10^7 per ml., the per cent survival following treatment approximately 0.00013. The level of population in the non-treated suspension was adjusted approximately to that of the treated culture by diluting it with sterile medium. Very little if any difference was noted in the growth characteristics of the I-treated and control suspensions. Similar results were obtained with the other cultures and iodophors. The same was true when the suspensions were incubated in skimmilk at 25° C.

Effect of plate incubation temperature on counts of P. flourescens surviving I-treatment.

Buffered suspensions of the test cultures were treated with the iodophors at concentrations of 2.5 and 5 p.p.m. of I for 10 and 20 sec. The inocula were prepared as described in the section on experimental methods. The initial count of the non-treated suspensions ranged from 56x10^6 to 81x10^7 per ml. Following treatment with 5 p.p.m. of I the number of survivors was in each instance less than 0.001% of the initial count. Aliquots of the I-treated and not-treated

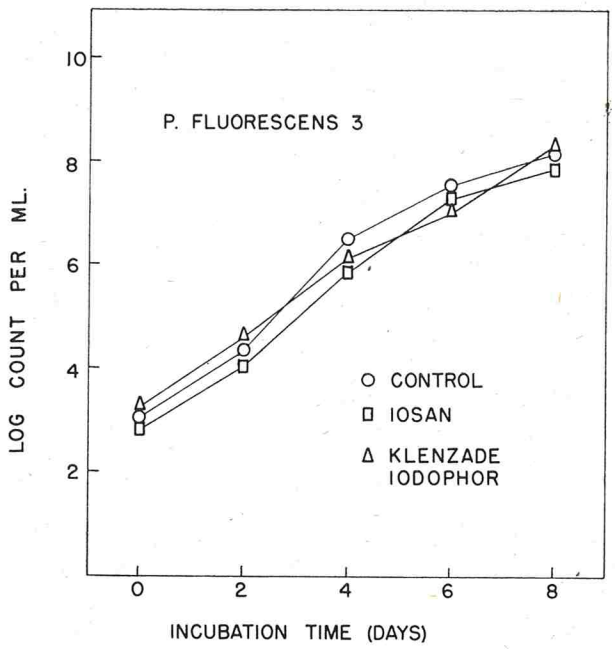


Figure 1. Growth of surviving I-treated and non-treated *P. fluorescens* 3 in skimmilk at 5°C. (Initial count 69x10^7 per ml.)

suspensions were plated on Plate Count Agar. The plates were incubated at 35° C. for 2 days, 32° C. for 2 days, 25° C. for 3 days, 15° C. for 7 days, and 5° C. for 10 days. Duplicate plates were made of each dilution for each plate incubation temperature. The counts at the different plate incubation temperatures were expressed as per cent of the count obtained after incubation at 25° C. for 3 days. The counts of both I-treated and control suspensions at the different plate incubation temperatures showed a similar pattern

TABLE 1—COMPARISON OF COUNTS AT DIFFERENT PLATE INCUBATION TEMPERATURES OF IODINE-TREATED AND NON-TREATED *P. fluorescens*

Treatment		Non-treated[a]					Iosan (5 p.p.m. 20 sec.)				
Incubation Temp. (°C.)		35	32	25	15	5	35	32	25	15	5
Incubation time (days)		2	2	3	7	10	2	2	3	7	10
P. fluorescens	2	<1	92	100	90	85	<1	85	100	101	79
	3	9	89	100	103	79	<1	96	100	107	81
	11	<1	97	100	84	70	<1	88	100	93	67
	70	<1	105	100	111	99	<1	95	100	95	99
	E	<1	91	100	101	75	<1	94	100	111	103

[a]The counts at 35°, 32°, 15°, and 5° C. are expressed as per cent of the count obtained at 25° C.

(Table 1). The counts at 32° and 15° C. were very similar to those obtained at 25° C. At 5° C. the counts were somewhat lower than those obtained at 32°, 25°, or 15° C. The lowest counts however, were obtained at 35° C. A higher survivor count was found when the initial concentration of I was reduced to 2.5 p.p.m. or the period of treatment shortened to 10 sec. However, the counts at the different plate incubating temperatures showed the same pattern as observed for suspen-

[2]Lazarus Lab. Inc. Div. of West Disinfecting Company, Long Island City, N.Y.

[3]Klenzade Products, Inc., Beloit, Wisconsin.

sions treated with 5 p.p.m. of I for 20 sec. The data obtained with the other iodophors were very similar to those obtained with Iosan.

Effect of pH of plating medium on counts of P. fluorscens surviving I-treatment.

Aliquots of suspensions of *P. fluorescens* treated with an initial concentration of iodine of 5 p.p.m. for 20 sec., and a control suspension were plated on Plate Count Agar adjusted to pH values ranging from pH 5 to 10. Before plating the level of population of the control suspension was adjusted approximately to that

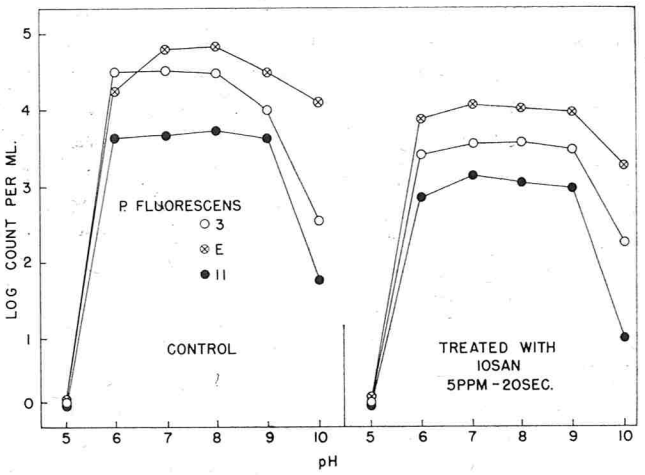


Figure 2. Effect of pH of the plating medium on the counts of I-treated and non-treated cultures of *P. fluorescens*. (Initial count of culture 3 - 98 x 10^7, culture E - 115 x 10^7, and culture 11 - 47 x 10^7 per ml.)

of the treated suspension as described in the section on experimental methods. The data (Figure 2) indicate that maximum counts of both I-treated and non-treated suspensions were obtained over the same range of pH values. Similar results were obtained with the other test cultures and iodophors.

Growth of P. fluorescens in various media containing iodophor.

Preliminary experiments indicated that cultures of *P. fluorescens* not submitted to I treatment grew equally as well in a simple synthetic (S) medium consisting of glucose and salts as on more complex media such as nutrient broth or skimmilk at both 5° and 25° C. Previous investigations (2) showed that the counts of cultures of *P. fluorescens* submitted to a sublethal heat treatment were higher on more complex media than on simple synthetic media. In addition, surviving heat-treated *P. fluorescens* did not grow as readily on the plates during the early phase of plate incubation and the lag in their development on the plates was greater at 5° than at 25° C. (3). These results prompted an investigation of the influence of growth medium and incubation temperature on the growth of *P. fluorescens* in the presence of varying amounts of iodine. The media and the initial concentration of I used were as follows:

(a) Synthetic medium (S); glucose 5 g., KH_2PO_4 1 g., $NH_4H_2PO_4$ 1 g. $MgSO_4$ 0.2 g., water 1 L., pH 7.0; 0, 10 p.p.m. I

(b) Nutrient broth; 0, 5, 50 p.p.m. I

(c) Skimmilk; 0, 50, 100, 150, 200 p.p.m. I.

The inocula were prepared as described in the section on experimental results. The data presented in Figures 3 and 4 show the pattern of response of the test cultures to various levels of I in different media at different temperatures of incubation. Minor variations, however, were observed with different test cultures and with different iodophors. With incubation at 5° C., an increased lag was noted in the synthetic medium, nutrient broth, and in skimmilk. In the synthetic medium an increased lag was observed at 25° C.

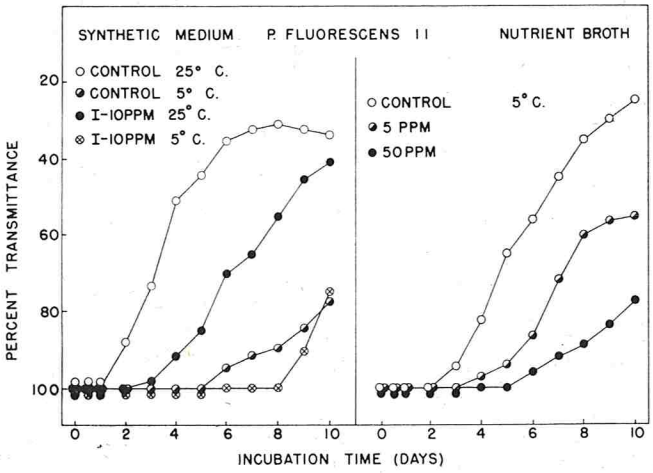


Figure 3. Growth of *P. fluorescens* 11 in synthetic medium (at 5° and 25°C.) and nutrient broth (5°C.) in the presence of Klenzade iodophor.

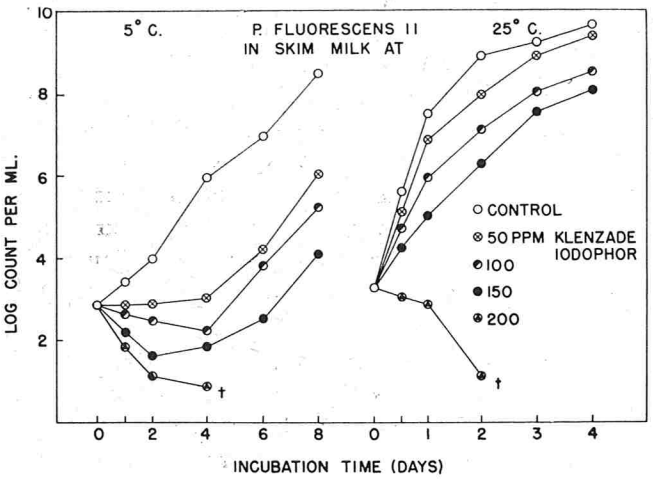


Figure 4. Growth of *P. fluorescens* 11 in skimmilk at 5° and 25°C. in the presence of various concentrations of Klenzade iodophor.

No survivors could be detected in skimmilk with 200 p.p.m. I at 5° and 25° C. after 4 and 2 days, respectively.

At this point it seemed desirable to determine whether the population which had developed after 6 to 8 days in skimmilk with I showed the same response to different concentrations of I as did a non-treated culture. One drop of an 8-day old milk culture of *P. fluorescens* 11 to which 150 p.p.m. I (Klenzade iodophor) had been added at 0 day was streaked over the entire surface of an I-gradient plate and incubated at 25° C. for 2 days. To indicate the

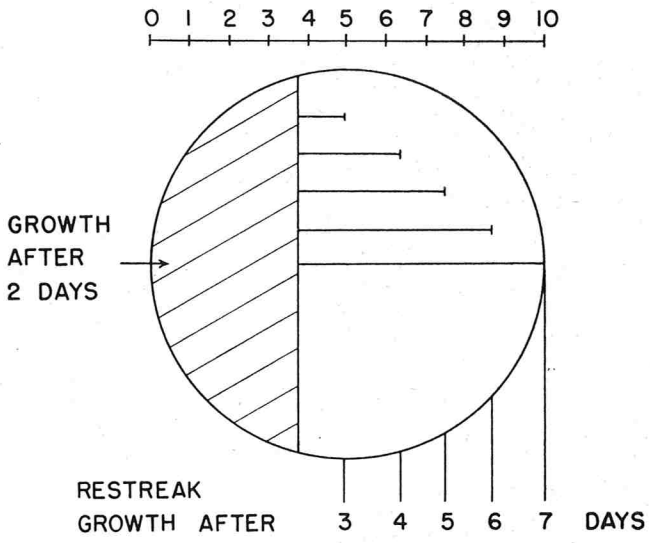


Figure 5. Growth of *P. fluorescens* 11 and daily re-streaks on an Iodine-gradient plate.

extent of growth, the plate was arbitrarily divided into 10 sections named S 1, S 2, etc. with increasing concentrations of I from left to right (Figure 5). The actual concentrations of I in various sections of the plate were not determined. After incubation at 25° C. for 2 days growth was observed up to S 3.75. A few colonies on the edge were streaked across the plate in the direction of increased concentrations of I and the plate was re-incubated at 25° C. for 24 hours. After 24 hours the growth covered one half of the plate (S 5). Restreaking of the new growth on subsequent days followed each time by re-incubation of the plates at 25° C. for 24 hours moved the area of growth to sections with higher concentrations of I (Figure 5). On the seventh day growth was observed in an area designated S 10.

Isolated colonies from the area S 7.5 to S 10 were picked and restreaked on fresh I-gradient plates. Following incubation at 25° C. for 48 hours, growth was observed only up to S 3-S 3.75 as with the original culture. The colonies which had developed in the area S 3.75-S 10 apparently did not have any greater resistance to I than did the original culture.

The possibility existed, however, that (*a*) the inhibitory activity of the I-gradient plates decreased on storage, or (*b*) that the existing growth affected the I in the rest of the plate in some manner so that growth can take place. To test these possibilities the following experiment was performed (Figure 6):

A suspension of *P. fluorescens* 11 was streaked over the entire surface of ten I-gradient plates. After incubation for 2 days at 25° C. growth in all plates had developed up to S 3.75. An additional ten I-gradient plates (non-inoculated) were stored at 25° C. Each day for the next ten days the following tests were performed: (*a*) the growth of one I-gradient plate was streaked across the plate in the direction of increased I concentration. The same growth was streaked across a fresh (not-inoculated) I-gradient plate and across an I-gradient plate (not-inoculated) which had been stored at 25° C., (*b*) the growth of a fresh stock culture in nutrient broth also was streaked across the three plates. The data in Table 2 indicate that the

TABLE 2—EXTENT OF GROWTH OF IODINE-TREATED AND NON-TREATED *P. fluorescens* 11 ON PLATES WITH AND WITHOUT PREVIOUS GROWTH

Days	I-gradient plate with previous growth		Old I-gradient plate		Fresh I-gradient plate	
	P.G.[a]	S.C.[b]	P.G.	S.C.	P.G.	S.C.
1	5[c]	5	3.75	3.75	3.75	3.75
2	6.25	6.25	3.75	3.75	3.75	3.75
3	7.5	7.5	3.75	3.75	3.75	3.75
4	8.75	7.5-8.75	3.75	3.75	3.75	3.75
5[d]	10	10	3.75	3.75	3.75	3.75

[a] Previous growth streaked across plate
[b] Stock culture streaked across plate.
[c] Section of plate beyond which no growth was observed
[d] The results for the 6th, 7th, 8th, 9th and 10th day were the same as observed on the 5th day of incubation.

inhibitory action of the iodophor did not decrease during storage of the plates at 25° C. The present data do not suggest the presence of cells with increased resistance to I in cultures previously treated with I. The presence of previous growth on the plates appears to have the greatest effect on the extent of growth of *P. fluorescens* on I-gradient plates.

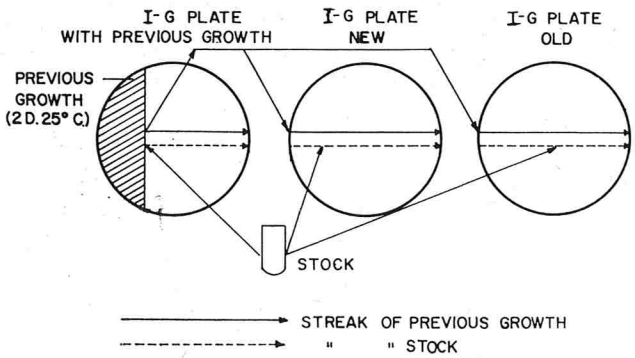


Figure 6. Growth of I-treated and non-treated *P. fluorescens* 11 on I-Gradient Plates with and without previous growth.

DISCUSSION

The results of the present investigation indicate that the growth characteristics in I-free media of cultures of *P. fluorescens* surviving I-treatment are similar to those of non-treated cells. Changes in time and temperature of incubating and pH of plating medium influenced the counts of I-treated and non-treated cultures in the same way. Obviously, the growth characteristics of surviving iodine-treated *P. fluorescens* are different from those submitted to a sublethal heat treatment.

A somewhat different growth response, however, was observed when the test organisms were grown in various media in the presence of iodophor. An increased lag phase was observed in all of the media when the cultures were incubated at 5° C. At 25° C., however, no increased lag was observed except in the synthetic medium. The factor (s) causing difference in growth characteristics at 5° and 25° C. are not known. However, there are several possibilities. Some nutritional factor might be involved. Inactivation of an essential enzyme(s) by the halogen may induce a requirement for a certain compound(s) which is (are) present in the more complex media (nutrient broth, skimmilk). In such case, however, differences in the rate of reactions involving the halogen and the essential enzymes(s) in the cell at the different incubation temperature must be taken into consideration. Because of the complexity of the media, it would be difficult to determine exactly in what form the iodine is present in the different media. However, the inhibitory effect of ionic iodine should not be ignored.

A modification of a significant portion of the proteins and amino acids in the medium by oxidation or substitution with a subsequent loss of biological activity is not very likely to occur at the levels of iodine employed in these experiments.

No increased lag phase was noted at 5° C. when surviving I-treated cells were grown in the various media without iodophor. It seems obvious that the continued presence of iodophor in the growth medium is a much more severe and complex treatment to the cells than one with subsequent growth in I-free media.

The present study does not indicate the presence in I-treated cultures of cells with increased resistance to I. The data obtained with I-gradient plates indicate, however, that the preliminary growth on the plates affects the inhibitory action of the I on the rest of the plate. Subsequent experiments in which the pH of different sections of the plate was determined did not indicate that this factor migh be responsible for this observation.

SUMMARY

The results of the present study indicate that cultures of *Pseudomonas fluorescens* surviving I treatment showed growth characteristics similar to those of non-treated cultures. However, if the cultures were grown in various media in the presence of an iodophor an increased lag was observed at 5° in skimmilk and nutrient broth but not at 25° C. except in the synthetic medium.

ACKNOWLEDGMENT

The authors are indebted to Mrs. M. Baxter and I. S. Allbritton for technical assistance.

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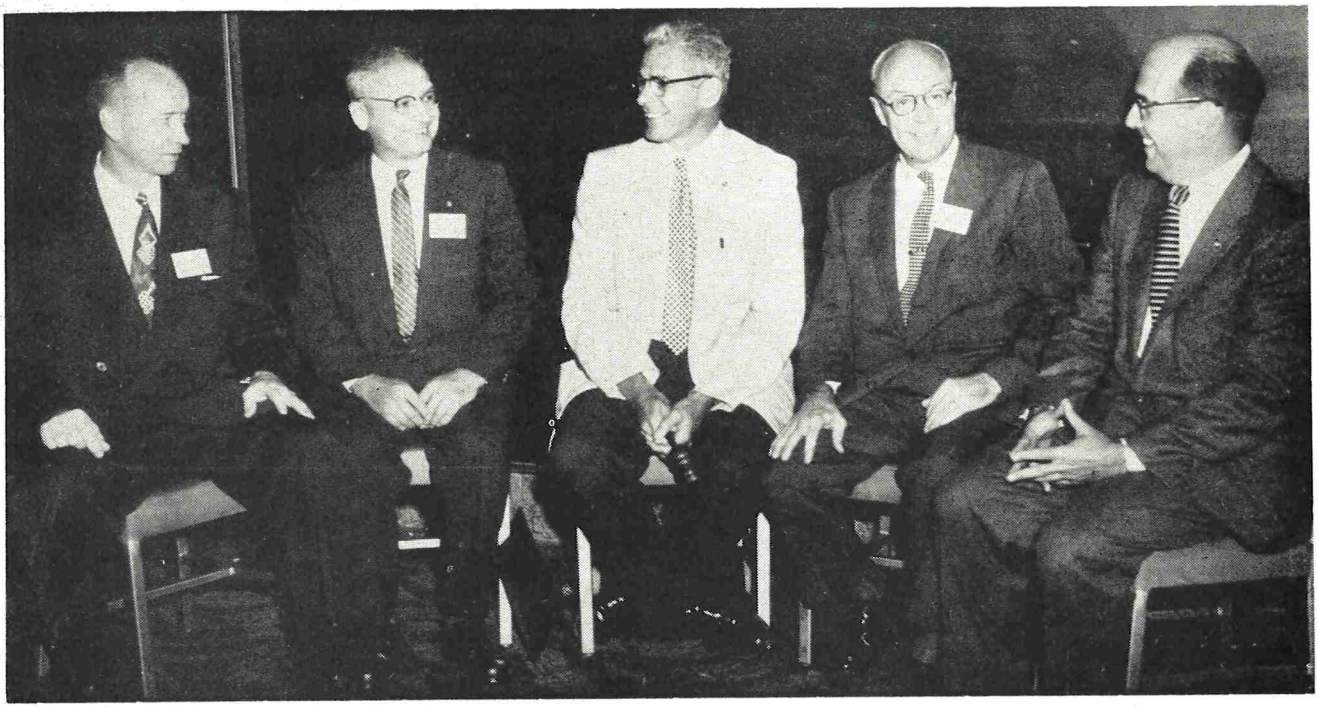
NEW YORK ASSOCIATION HOSTS LARGEST ANNUAL MEETING

The New York Affiliate Association of the International Association of Milk and Food Sanitarians played host to probably the largest annual meeting of the International ever held. Approximately 675 were in attendance during the three day session, September 8-11, 1958. Actually, the meeting was a joint one with the International, the New York State Association of Milk Sanitarians and the Cornell University Dairy Industry Conference cooperating.

Preconvention activity appeared to be at a minimum on Sunday for the local arrangements committee under the direction of James M. Sharp and Fred A. Nelson had everything in readiness for the opening sessions. As usual, the Executive Board began their executive sessions early Sunday morning and continued through Monday meeting with the local arrangements committee, the Journal Editors, Association Committee Chairmen, and the IAMFS Affiliate Council.

With the election of Mr. Charles Walton of the Laramie, Wyoming, Health Department as *Second Vice-President* and the elevation of Dr. Franklin W. Barber of the Research Laboratories Division, National Dairy Products Corporation to the office of *President* of the Association, the Executive Board now consists of Barber and Walton and the following additional members: Wm. V. Hickey, Paper Cup and Container Institute, *President-Elect;* Dr. J. J. Sheuring, Professor of Dairying, University of Georgia, Athens, *First Vice-President;* Vincent T. Foley of the Kansas City Health Department *Secretary;* and Past-Presidents, Harold B. Robinson of the U. S. Public Health Service, and Paul Corash of the New York City Health Department. Professor H. S. Adams of the Department of Public Health, University of Indiana, leaves the Executive Board. This year he completed the long term of service as an officer of the Association which began with his election

Paul Corash receives Past-President's Plaque from President H. B. Robinson at annual banquet.



Members of Executive Board (left to right) V. T. Foley, Dr. J. J. Sheuring, Dr. F. W. Barber, Wm. V. Hickey, and H. B Robinson meet with new President Barber after election. Paul Corash and Charles Walton, also members of the Executive Board were absent at time picture was taken.

as *Second Vice-President* at the annual meeting at Lansing, Michigan, in 1953.

Many Association committees held final meetings for the year on Monday reviewing reports and planning committee activities for the coming year. The Committee on Constitutional Revision presented a series of amendments which were adopted at the business meeting. One important change authorized the Affiliate Council to elect a chairman from among the delegates of the Affiliate Associations. Formerly, the Chairman of the Council was automatically the immediate *Past-President* of the Association. The proposed Constitutional changes appeared in the July 1958 issue of the Journal.

The agenda of the Affiliate Council meeting was full. Two items received major discussion. A growing feeling was evident that the name of the Association should be broadened to "International Association of Sanitarians, Inc.", thus dropping the terms "Milk and Food". The discussion of this subject which was discussed extensively in the Council meeting last year again indicated a rather strong feeling on the part of many that the Association must exert greater leadership in areas of sanitation other than milk and food. Reasons cited included the growing number of other organizations, local and national in scope, having objectives overlapping those of the International. A name implying broader interest in the field of sanitation was felt to be to the best future interest of the Association. Further study of the proposal to change the name of the Association was referred to a newly appointed committee of the International appointed by President Robinson this year. This committee is charged with conducting an overall study of the Association's activities.

The achievement of a nationwide system of registration of sanitarians was also discussed by the Council. The Association Committee on Education and Profes-

Mr. Floyd B. Carkhuff receives Emmet R. Gauhn Memorial Award from New York Association's President Wm. O. Skinner.

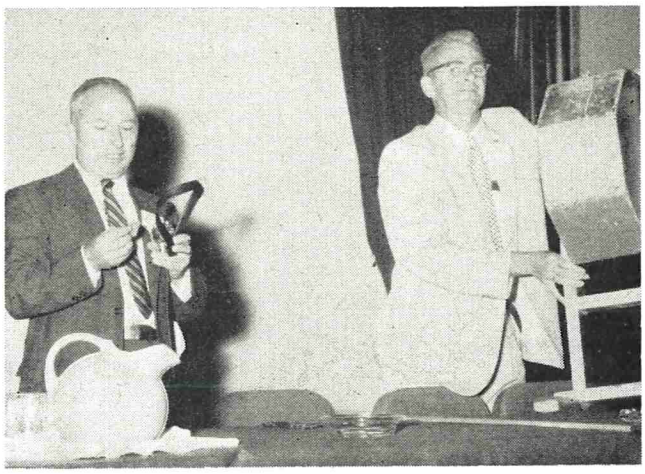
sional Development gave a great amount of study to this subject. A detailed special report of their proposal will appear in the Journal soon with the report of this Committee. Those Associations planning legislative action relative to the registration of sanitarians would do well to contact the Committee Chairman, Dr. J. J. Sheuring (see Committee list in the August, 1958 issue of the Journal).

The report of the Journal Editors indicated that an ample supply of general and technical papers is continually being submitted for publication. Good manuscripts containing helpful and applicable information for the sanitarian are always in short supply.

By Monday evening, sanitarians were conspicuous by their presence in the lobbies and eating places of the spacious Hotel New Yorker. A large crowd was on hand to enjoy the Mixer-Reception provided by the New York Association through the generous support of many industry organizations. Refreshments and food were present in abundance. As always, this pre-convention event was the meeting ground of many old friends and provided the opportunity for making new acquaintances and for the beginning of new and lasting friendships.

Members enjoy buffet supper at Mixer-Reception.

On Tuesday morning the formal program included an outstanding presidential address by Harold Robinson and later in the morning, an excellent address by Mark Hollis, Assistant Surgeon General of the U. S. Public Health Service. These and other papers will be published in subsequent issues of the Journal. Elsewhere in this issue, summaries of the papers presented throughout the meetings may be found.



New President Dr. W. F. Barber draws door prize ticket.

Wednesday's sessions were divided, a milk section and a food section holding sessions simultaneously. Both sessions were well attended.

Highlights of the annual banquet Wednesday evening included the inspiring address by J. Roger Deas, American Can Company, and the presentation of the Association awards. The Sanitarian's Award went to Carl Mohr of the Green Bay, Wisconsin Health Department, the Citation Award to Dr. Milton Fisher of the St. Louis Health Department and an Honorary Life Membership in the International to H. C. Goslee of the Connecticut Association. Paul Corash was presented with the Past-President's Plaque. Dr. George Hopson, DeLaval Separator Company, was toastmaster.

Throughout the meetings, the popular event of awarding door prizes at the beginning of each session took place. Prizes donated by various Affiliate Associations were given to the lucky ticket holders.

The annual meeting for 1959 promises to be another enjoyable occasion for the Association will meet at Glenwood Springs, Colorado. The Rocky Mountain Association will be our hosts. Many remember the outstanding convention there in 1951. The meetings will be early—August 26, 27 and 28. The natural beauty of the West and its appeal as a vacation land make this meeting a golden opportunity to combine a vacation with a convention trip. A real opportunity for members to take their families on a western vacation prior to the meetings and ending their outing at Glenwood Springs is afforded. Don't overlook considering a camping trip—you'll enjoy it!

SUMMARY OF PAPERS PRESENTED AT THE 45TH ANNUAL MEETING OF THE IAMFS

Accelerating change and its many ramifications on public health and sanitation were the keynotes set by the two lead-off speakers at the 45th Annual Meeting of the International Association of Milk and Food Sanitarians in New York City, September 9-11.

DR. ROSCOE KANDLE, Deputy Commissioner of Health, New York City, stressed that up until as recently as 30 years ago, the concept of "health" merely meant the absence of disease. Now, "health" is generally accepted as a "state of feeling well in body, mind, and spirit," or, as a document of the World Health Organization has phrased it, health is the "fitness of man to his total environment in order to function well and happily."

In adapting to his environment, however, man himself may create new diseases which are possibly harder to correct than germ-caused diseases, DR. KANDLE said. He cited such afflictions as serum hepatitis, which he said has been created by the increasing use of blood as a therapeutic agent; glaucoma which, he said, may be induced by certain medications; and lung cancer which, statistics would seem to indicate, may be partially associated with the quantity of cigarettes smoked.

Mark Hollis, Assistant Surgeon General, Dept. of Health, Education and Welfare, Public Health Service, presented one of the opening addresses at the annual meeting.

MARK HOLLIS, Assistant Surgeon General of the United States, Washington, D. C., said that among the many factors making for new approaches to public health are rapidly increasing population, growing dependence upon chemicals in industrial and agricultural processes, finite limits of air and water supplies,

Mr. H. B. Robinson gives Presidential Address.

disposal of atomic wastes, and new economic and social conditions. Among major public health sanitation problems of today are, he believes, water purification and re-use, treatment of sewage, and watchfulness to be sure that increasing use of chemicals does not result in low-level chronic illness, as contrasted with the acute outbreaks associated with public diseases of the past.

HOLLIS praised the way in which sanitarians have met their problems and encouraged the group to seek further professional status for their vocation. "Universal professional recognition of the sanitarian is long over-due," he said.

Abstracts of other papers presented are given below.

Health Hazards in Man's New Chemical Environment, by JEROME TRICHTER, Assistant Commissioner, Environmental Sanitation, Department of Health, New York, N.Y.: Citing the growth in wholesale value of chemical production from $4.8 billion in 1940 to $25 billion in 1957, the author speculated that man's bacteriological environment is being replaced by a chemical environment. More than 4,000 cases of children accidentally imbibing or eating chemical compounds are treated in New York City alone each year. As for chemicals in food, more than 400 compounds are now being employed, not all of which may have been adequately tested.

Simplified Bacteriological Screening Procedures, by JOSEPH C. MCCAFFREY, Chief, Bureau of Sanitary Bacteriology, Illinois Department of Public Health, Chicago, Ill.: Tests carried out by the Astell Roll Tube technique showed that total counts on milk samples correlated well with the standard plate count. Tests carried out by the Bacto-Strip technique showed that coliform counts were comparable to those obtained by the violet red bile agar plate count method. The procedure can

be adaptable for "line sampling" in plant sanitation. Tests carried out by the Millipore Filter technique showed that coliform counts correlated very closely with the violet red bile agar plate count. The total counts also showed a fairly good correlation with the standard plate count procedure.

The Geography of Milk, by DR. JACQUES M. MAY, Chief, Department of Medical Geography, American Geographical Society, New York, N. Y.: There are many factors governing whether milk will be part of a people's diet or not. Most important among these is tradition, then comes availability. Bodily needs come last, and in most parts of the world they are not even considered. The author concludes that because it takes advanced technology to bring wholesome milk to the consumer, then one can gauge the degree of advancement of the various countries by the ability of the local culture to produce wholesome milk.

A Progress Report on the 3-A Sanitary Standards Program and the Activity of the 3-A Symbol Council, by C. A. ABELE, Secretary-Treasurer of the 3-A Sanitary Standards Symbol Administrative Council: The painstaking development of 3-A Sanitary Standards for Dairy Equipment — from their first draft by equipment makers, to their re-draft by equipment users, to their submission to sanitarian and public health officials, to the recognition of all viewpoints of the three groups — is described, particularly for those sanitarians who may not have had first-hand participation in 3-A Standards formulation and hence may not fully realize the research and preparation — sometimes requiring years of work — embodied in each final 3-A Standard. State and local regulations which attempt to modify some 3-A Standards apparently making them more strict were decried; such modifications actually negate the purpose of the 3-A program, the author believes. Activities of the 3-A Symbol Council, now 30 months old, in authorizing use of the 3-A Symbol on dairy equipment are also described. Publication of authorizations granted occurs periodically in THE JOURNAL OF MILK AND FOOD TECHNOLOGY, and a compilation of all authorizations issued by a forthcoming

Dr. Richard P. March, New York Association Secretary leads one of the panel discussions.

Dr. George H. Hopson serves as toastmaster at annual banquet.

October date will be published as part of the Directory of the forthcoming Dairy Industries Exposition, to be held in Chicago, December 8-13, 1958.

Influence of Food Composition on Bacterial Growth, by KARLA LONGREE and JAMES C. WHITE, Cornell University, Ithaca, N.Y.: Quantity food research at the New York State College of Home Economics at Cornell has dealt with problems arising from production and service of foods prepared in large quantity. Important differences exist between large quantity and small quantity food preparation formulae and procedures; these may affect nutritive value, color, texture, flavor and bacterial counts. The purpose of the current investigation is to study the effect on the bacterial growth of some selected ingredients used in the preparation of soups, poultry stuffings, sandwich fillings and salads with mayonnaise. The results of the studies of soups and stuffings are discussed. The mixtures were prepared, rated for palatability by a panel of judges and inoculated with the test organism, *Micrococcus pyogenes* var. *arueus* S209. Bacterial growth usually decreased as pH was decreased by incorporation of acid ingredients. Food mixtures were developed which had a relative resistance to the test organism and which scored high in palatability.

Microbiological and Sanitary Aspects in the Manufacture of Citrus Products, by VIRGIL S. TROY, Senior Microbiologist, Continental Can Company, Chicago, Ill.: It is apparent that the microorganisms that are significant to the packer in the manufacture of nonsterile citrus products are those that are capable of growing in the product and causing spoilage. The prevention of spoilage and the manufacture of high quality citrus products are made possible only through the institution of sanitary production safeguards and efficient laboratory quality control methods.

Recent and Proposed Dairy Legislation in New York State, by DAVID K. BANDLER, Research Director, Joint Legislative Committee on Imitation Food Products and Problems, Ithaca, N.Y.: The committee just named was created by the New York state legislature in 1952 to study the vegetable fat substitution problem with regard to milk products. Since that time, the Committee has functioned both in the fields of imitations as well as in the modernization of milk control laws. Many of the products legalized through the efforts of the Committee have proved worth while in developing new markets for milk.

Among the more noteworthy would be the legislation that authorized the sale of half-and-half, modified skim milk, and diabetic ice cream. The Committee research staff, located at Cornell University, is currently studying proposals for legislation dealing with rejected milk, standardized milk, grade labeling of butter, stabilized cream for whipping, ice milk, and vacuum pasteurization of milk.

Progress Report on the Development of the New Public Health Service Recommended Food Sanitation Manual, by WILLIAM C. MILLER, JR., Chief, Food Sanitation Section, Division of Sanitary Engineering Services, U.S. Public Health Service, Washington, D.C.: Progress is reported on the new food establishment sanitation manual under development by the Public Health Service Food Establishment Sanitation Advisory Committee and outlines Committee recommendations covering philosophy, scope and format for the new manual. It underscores the need and value of cooperation and active participation in the project by states, communities, and the food service industry. Completion of the first working draft of the proposed manual and its distribution to official agencies and industry for review and comment are predicted for early 1959.

Bacteriological Aspects of Soft Ice Cream, by JOHN J. SHEURING, Professor of Dairying, University of Georgia, Athens, Ga.: Over 500 soft ice cream stores were visited at random over a five year period and bacteriological tests made. Sanitary conditions vary widely depending upon local regulations and their enforcement, and upon the training of personnel. A great diversity in the vocational background of store operators was noted. The handling of cans in which mix is delivered to stores is often haphazard on the part of store operators, frequently resulting in permanent damage to cans which may still be used. Insect control in stores sometimes was found to be a problem. This should be given greater attention by inspecting sanitarians. Bacteriological data collected showed in some instances rather extensive bacterial contamination of both mix and product in soft ice cream stores.

Recent Changes in New York State Milk Regulations by Revision of the Sanitary Code, by CLAUDE COLVIN, Acting Chief, Milk and Restaurant Section, New York State Department of Health, Albany, N. Y.: Changing times in the fields of milk production, processing and milk handling equipment necessitate the changing of sanitary codes and regulations dealing with the sanitation of market milk supplies. Although the New York State Sanitary Code Chapter III, which deals with sanitary aspects of milk supplies, has been amended from time to time, the introduction of bulk milk handling systems on the farm, cleaning-in-place of equipment, both on the farm and in the processing plant, and changes in related milk handling equipment and processing techniques made it desirable that regulations be revised rather extensively. Much of the revision which occurred at the June 1957 meeting of the New York State Public Health Council consisted of a re-arrangement of the items. A new approach to the control of prepasteurized milk was also adopted. The old single permit governing the processing and distribution of milk was replaced with a new type of Permit to Process, plus a Permit to Distribute. Rules governing sediment testing were expanded.

Better Dairy Farm Buildings, by HAROLD E. GRAY, Professor of Agricultural Engineering, Cornell University, Ithaca, N.Y.: Developments in the field of farm dairy buildings have been rapid during the period following World War II. The present trends appear to be toward larger size herds and loose housing systems of management. Striking developments in loose housing include improved pole frame construction, prefabricated buildings and better arrangements and equipment for milking parlors. Sanitary conditions can be maintained with loose housing systems for the production of quality milk. Similar developments have occurred in the stall barn system of housing, which is still quite popular among dairymen. Prefabricated buildings and tilt-up concrete are the newer methods of construction. Milking parlors and portable milking units are developing as means of reducing chore labor in stall barns. Cooperative efforts among all interests in milk production are essential to the continued development and improvement of farm dairy buildings.

Types of Pipeline Milker Systems, by RICHARD P. MARCH, Professor of Dairy Industry, Cornell University, Ithaca, N.Y.: Pipeline milkers are of two basic types, parlor and around-the-barn. They are fundamentally the same but the latter have longer lines usually. These systems can be washed by flush, reverse-flush and recirculation methods. The former is usually inadequate, the latter is considered best. With transport systems the milk is poured from the milker pail into a hopper and conveyed through tubing or rigid pipe to cans or bulk tank. Portable transport systems using plastic hose have been developed. Also new in this field is a true portable pipeline milker and a new type of portable milking machine. Other arrangements are cow-to-can and cow-to-tank milkers.

Design, Installation and Maintenance of Pipeline Milkers, by NELSON J. HOHL, New York State Department of Health, Albany, N.Y.: Experience has shown that dairymen will attempt to clean-in-place a pipeline milking machine without regard to the evidence that all parts are not designed for such methods. Manufacturers of pipeline milkers have an obligation to design these systems so they can be sucessfully cleaned-in-place if they are to assist in the production of the best quality milk and be universally accepted. Design possibilities are discussed, including the necessity for the reduction in the number of joints and the shape of parts designed so flowing solution at effective velocities will reach all milk surfaces. Installation discussion included the necessity for allowing for the force of linear expansion in mounting pipelines. On maintenance, the author repeats the basic tests of rinse, wash, rinse and sanitize, with particular reference to the conditioning of the wash water.

The Dairy Industry in a Changing Society, by NORMAN MYRICK, Editor, The American Milk Review, New York, N.Y.: During the last two centuries, industrialism and democracy have created an environment that has resulted in an unprecedented growth of population. Between 1776 and 1958, population increased nearly six times over the preceding sixteen centuries. This increase has been reflected in the United States. A continuing and accelerating rate of increase is predicted. Accompanying the population growth has been a rapid trend toward urbanization. Metropolitan areas have grown to the point where they overlap and produce multiple or super-metropolitan areas. There are 14 or 15 such areas emerging in the United States. It is estimated that by 1957, 70 per cent of the population of the United States will live in these inter-urban areas. Among the resulting problems are (*a*) the effectiveness of government authority based on existing political boundaries; (*b*) the greater volume of milk moving in intermarket channels as the marketing areas expand; (*c*) the intensified competition resulting from the adoption of mass production techniques which places a premium on volume; and (*d*) the decline in the number of milk processing plants and the number of dairy farms.

Complete texts of some of the above–summarized papers, in addition to some not summarized, will appear in the months ahead in *The Journal of Milk and Food Technology*.

Research and Educational Functions of Public Health Service Expanding

Through its Bureau of State Services the Public Health Service is expanding its research and education programs. This Bureau, in 1958 will oversee the allocation of some fourteen and a half million dollars for research and training.

The Bureau operating activities, supported by research, consist of professional leadership to State and local health departments, grants-in-aid to States to finance public health activities on a cooperative basis and stimulate new activities, and provision of technical assistance to states. As a projected model, the Bureau takes new findings, adapts them to public health practice through demonstrations and applied research, and then assists in the training of people required for widespread application of the new techniques. In total, these research and training activities are quite extensive. Somewhat more than half of the appropriations for all direct operations of the Bureau in 1958—$28 million—was accounted for by research—$14.5 million.

Some of the training activities at the Communicable Disease Center in Atlanta, at the Robert A. Taft Sanitary Engineering Center in Cincinnati, and the Occupational Health Field Station are acquiring qualities that deserve to be recognized as directly educational. In addition, through arrangements with certain universities and medical schools, students registered in such schools are spending an increasing amount of time in laboratory and other work at these installations. Some staff members of these installations have faculty positions in neighboring universities and medical schools. A desire has been expressed that students should be invited to work and study in the laboratories of the Bureau of State Services.

Among the special assumptions of national changes that will affect the activities of the Bureau are, of course, the impact of population growth, a shortage of personnel trained in public health professions, and certain special alterations of the environment consequent upon increasing air pollution with inanimate particulate matter. In addition, social changes affecting public health practice are foreseen.

These factors, and others, indicate that research will probably expand in absolute terms and in relative importance among the activities of the Bureau. Some of the considerations are as follows:

First, State and local expenditures for health services are rising steadily, while total Federal funds supplied to States for health services have declined since 1950. This trend will probably continue. One of the consequences will be to expand the technical advisory role of the Bureau and to contract its role as a disbursing agent. An increase in the research activities of the Bureau will result from this change in emphasis.

Second, the chronic diseases are increases and the communciable diseases are decreasing in relative importance as causes of illness and death. Much less is known about the prevention and treatment of the chronic diseases, as a group, than about communicable diseases. The role properly played by public authorities in the prevention, control and treatment of chronic disease remains to be worked out. For communities the problems created by chronic disease are social and economic, as well as medical. More intensive study of the social and economic aspects of chronic disease is indicated.

Third, health hazards arising in one State and exerting adverse effects in others, and hazards of such scope that States cannot deal effectively with them, are becoming more significant.

These hazards include the increasing use of ionizing radiation, through nuclear reactors as power sources, the introduction of new industrial processes and products, such as synthetic chemicals, with attendant potential health hazards, and more extensive air and water pollution as metropolitan areas expand and as industrial production rises. All of these forces combined demonstrate a clear need for a Federal public health research program.

HOFFMAN RECEIVES WILEY AWARD

Henry J. Hoffman, Chief Chemist, Minnesota Department of Agriculture, received the Third Annual Harvey W. Wiley Award of the Association of Food and Drug Officials at its 62nd Annual Conference. The hand-lettered, illuminated, framed scroll is awarded in recognition of outstanding service and devotion to duty in administering food and drug laws.

Mr. Hoffman has been in food work in the State of Minnesota since 1914 after receiving B.S and M.S. degrees from the University of Minnesota. He became Chief Chemist with the Minnesota Department in 1927. He served as president of the association in 1935.

The presentation of the award to Mr. Hoffman marks the third time since its inception that this award has been presented by the Association to a regulatory official. This is an annual award intended to recognize outstanding service of a public employee engaged in regulatory service. Its purpose is to emphasize the role of such control officials in the field of consumer protection.

DR. LOUIS H. BURGWALD NAMED SUPERINTENDENT OF STUDENTS' DAIRY PRODUCTS JUDGING CONTEST

The Collegiate Students' International Contest in Judging Dairy Products has a new "boss."

Dr. Louis H. Burgwald, Marketing Specialist with the Dairy and Poultry Division of Foreign Agricultural Service, U. S. Department of Agriculture, has been named Superintendent of the annual Contest, which will be held this year on December 8 in the Chicago, Illinois, area. Dr. Burgwald, who terms the appointment "a wonderful honor," succeeds the late C. J. Babcock, the former Chief of the F. A. S. Dairy and Poultry Division, who was Contest Superintendent from 1941 until his death early this year.

Dr. Burgwald is no stranger to the Contest, which was started in 1916 by American Dairy Science Association, and has been co-sponsored since 1930 by ADSA and Dairy Industries Supply Association. Before accepting his present post with U. S. D. A. four years ago, Dr. Burgwald was for 26 years a member of the Ohio State University faculty and, as Professor of Dairy Technology, coached several Ohio State dairy products judging teams for Contest participation.

The Contest and traditional Awards Banquet, which will be held the following day, December 9, in a principal Chicago hotel, will be events of major significance during a full week of dairy industrial activity centering in Chicago. From December 8 through 13, the DISA-sponsored 21st Dairy Industries Exposition will transform mammoth Navy Pier into a modern wonderland of displays featuring the latest in supplies, equipment and services for the dairy industries. Concurrent with, or occuring just before, the Exposition will be the annual conventions of national and international dairy industry organizations including Dairy Suppliers' Foundation, Dairy Society International, Milk Industry Foundation, National Association of Retail Ice Cream Manufacturers, National Ice Cream Mix Association, International Association of Ice Cream Manufacturers, National Ice Cream Mix Association, International Association of Ice Cream Manufacturers, Evaporated Milk Association, and American Butter Institute.

Serving with Dr. Burgwald as officials of the 1958 Contest are: D. R. Strobel, Chief, Foreign Marketing Branch, Dairy and Poultry Division, Foreign Agricultural Service, U. S. D. A., Assistant Superintendent; D. A. Pettee, The Creamery Package Mfg. Company, Milk Judge; H. L. Wilson Kraft Foods Company, Cheese Judge; J. Hoffman Erb, The Borden Company, Ice Cream Judge; N. E. Fabricius, Flambeau Valley Farms Cooperative, Butter Judge.

DISA Associate Judges are: Dan Roahen, The Creamery Package Mfg. Company, Milk; Neil Angevine, Meyer-Blanke Company, Cheese; Vern Wilt, The Liquid Carbonic Corporation, Ice Cream; Charles Weinreich, Cherry-Burrell Corporation, Butter.

Mr. Weinreich also serves as the DISA Chairman of the Contest and Fellowship Committee. Dr. G. M. Trout, Michigan State University, is the ADSA Chairman.

WILSON ANNOUNCES NEW LINE OF BULK MILK COOLERS

Introducing a milk-cooling system using a new type of "direct-contact cold", Wilson Refrigeration, Inc. announces a new line of direct expansion bulk milk coolers. Production is already underway at Smyrna, Delaware.

Models being made currently are in 200, 300, 400 and 500 gallon capacities—with other sizes scheduled for introduction at a later date.

The new direct expansion coolers can be installed with a compressor located outside the milk house, with the result that existing milk houses can be converted in most cases to the bulk system without extensive alterations.

The new Wilson cooler has an improved refrigeration system of coil design which provides maximum cooling by keeping the refrigerant in direct contact with the stainless steel milk cooling surface at all times during the cooling cycle. The cooler is shipped from the factory complete with all necessary controls to keep installation costs at a minimum. The exterior of the cooler, as well as the milk reservoir, is constructed of 18.8 stainless steel.

The new direct expansion units will supplement the present line of Wilson Watchman ice-bank coolers.

KEITH FITCH JOINS KLENZADE PRODUCTS

Keith A. Fitch recently joined KLENZADE PRODUCTS, INC., Beloit, Wisconsin, as sales director of the Institutional Division. Mr. Fitch is a registered professional engineer and sanitarian with a B. A. degree in Chemistry. He has had wide experience as a sanitation consultant and was executive director of a firm of consultants providing sanitation advisory services to institutions and industrial plants. He has also been a staff member with the Federal Food and Drug Administration and the California Bureau of Food and Drug Inspections.

Mr. Fitch is a Fellow of the American Public Health Association and is also a member of the American Association for the Advancement of Science; Institute of Food Technologists; Association of Food and Drug Officials of the U.S.; International Association of Milk and Food Sanitarians; National Association of Sanitarians; National Society of Professional Engineers; and other professional and technical societies. Mr. Fitch will make his headquarters at the main office of the company at Beloit.

HELPFUL INFORMATION

Editorial Note: Listed below are sources of information on a variety of subjects. Requests for any of the material listed should be sent by letter or postcard to the source indicated.

Electrobrain. (explains the Surge automatic pipeline washer) Pamphlet, no charge. Babson Bros. Co., 2843 W. 19th St., Chicago 23, Ill.

Dairy Equipment & Pipe Line Cleaners. (explain to dairymen the various Pfanstiehl cleansers for their equipment) Pamphlet, no charge. Babson Bros. Co., 2843 W. 19th St., Chicago 23, Ill.

Let's Get the Cows Up Off the Floor. 14 pge. booklet with colored illustrations. Free. Babson Bros. Co., 2843 W. 19th St., Chicago 23, Ill.

Harvesting Your Milk Crop. 18 page booklet complete with illustrations and diagrams. Free. Babson Bros. Co., 2843 W. 19th St., Chicago 23, Ill.

If You Are Thinking About a Pipe Line Milker. Free booklet. Babson Bros. Co., 2843 W. 19th St., Chicago 23, Ill.

How to Choose the Right Bulk Milk Cooler. Free booklet. Dairy Equipment Co., Dept. JMFT, 1444 E. Washington Ave., Madison 10, Wisc.

Treating Shell Eggs to Maintain Quality. Free bulletin. Mo. Agric. Expt. Sta. Bull. 659, 1955. Columbia, Mo.

Know the Eggs You Buy. Colored chart 45x30 inches. Revised January 1956. Supt. of Documents, Washington, D.C. Price 30 cents. Cat. No. A 88:38:Eg/3/2/955.

Corn's Hidden Enemies. 16mm sound film, 12 minutes. Available from Shell Chemical Corp. Film Library, Desk JMFT, 624 So. Michigan Ave., Chicago 5, Ill.

Egg Layers from Jungle Fowl. 16 mm sound film, color 27 minutes. Available from Hy-Line Poultry Farms, 1206 Mulberry St., DesMoines, Ia.

The Vitamin D Story. 16 mm sound film, color, Available from Bur. of Visual Instruction, University of Wisconsin, Madison, Wisc. Write for charges.

Diversey News Topics for Dairy Fieldmen. Circular available from The Diversey Corp., 1820 Roscoe St., Chicago 13, Ill.

Green Pastures — The Complete Story of Grassland Farming. Sound slide film in full color. Available from General Chemical Div., Allied Chemical and Dye Corp., 40 Rector St., New York 6, N.Y.

Sprinkler Irrigation Roundup. Movie showing benefits of sprinkler irrigation. Available from Reynolds Metal Co., P. O. Box 1800-SM, Louisville, Ky.

Bulk Milk Handling Equipment. Free booklet. U.S. Steel Corp., Dept. JMFT, 525 William Penn Place, Pittsburgh 30, Pa.

Soil Insects in Your Area and What You Can Do About Them. Free booklet. Velsicol Chemical Corp., 330 E. Grand Ave., Dept. JMFT, Chicago 11, Ill.

Feeding for Milk Fever Prevention. Free booklet. Available from Standard Brands, Desk JMFT, Agricultural Dept., 595 Madison Ave., New York 22, N.Y.

Certified Bulk Milk Pick Up Tanks. Free bulletin No. PUT-1, Dept. JMFT., Stainless Steel Products Co., 1000 Berry Ave., St. Paul, Minn.

Milk Packaging for Retail Distribution. Price $5.00. A. G. Hugh Printing Co., Dept. JMFT, 400 Pike St., Cincinnati, Ohio. A book.

Packaged Electrical System for 24 Hour Truck Refrigeration. Free bulletin. Dept. JMFT, General Electric Co., Schenectady 5, N.Y.

Insecticides and Repellants for the Control of Insects of Medical Importance to the Armed Forces. 91 page bulletin. Cat. No. A 1.4/2:977, 1955. Available from Supt. of Documents, Washington, D. C. Price 35 cents.

Sugar Turbidity Facts. Free bulletin. Available from Refined Sirups and Sugars, Inc., Yonkers, N.Y.

Controlled Correction of Water in Bakery Operations. Free brochure available from Hachmeister, Inc., P. O. Box 357, Pittsburgh, Pa.

DAIRY FIELDMEN AND PLANT OPERATOR'S CONFERENCES TO BE HELD AT PURDUE UNIVERSITY

The Dairy Department of Purdue University announces two one-day meetings to be held this November. On November 18th the Dairy Fieldmen's conference will be held followed by the plant operator's conference on the 19th.

These annual conferences are sponsored cooperatively with the Indiana Dairy Products Association. Dairy industry and university specialists will discuss topics selected because of their current and timely interest. Further information may be obtained from: Mr. H. F. Ford, Smith Hall, Purdue University, Lafayette, Indiana.

University of Maryland To Hold 14th Annual Dairy Technology Conference

Approximately 200 milk and dairy plant personnel, fieldmen, sanitarians, and industry representatives are expected to attend the Dairy Technology Conference at the University of Maryland on Wednesday, November 12, 1958.

Economic trends influencing the dairy industry, milk flavor improvement programs, farm sanitation, recent regulatory developments, new research findings

in milk production and milk processing technology, the status of dairy personnel recruitment and training, efficient cleaning of dairy equipment in the plant and on the farm and improving plant operations are some of the topics to be discussed by outstanding speakers.

Further information may be obtained from Professor W. S. Arbuckle of the Dairy Department.

COMPLETE PORTABLE MILK SOLIDS TESTING KITS AVAILABLE

The Dairy Cattle Research Branch of the United States Department of Agriculture at Beltsville, Maryland reports that two companies are now manufacturing complete portable kits for the lactometric testing of milk for solids. Samples of these kits have been used at Beltsville and have been found to be satisfactory.

The kits use the Watson type (102°F.) small (6") lactometers. Each test requires only about 4 ounces of milk. Each kit consists of an insulated portable water bath with the water heated electrically and circulated throughout the bath. The temperature of the water is thermostatically controlled. Included is all of the necessary glassware consisting of 36 or 40 tubes to hold the milk, two lactometers and a thermometer. The complete unit weighs about 40 pounds.

CLASSIFIED ADS

POSITIONS AVAILABLE

SANITARIANS: Philadelphia Department of Public Health has openings for Sanitarians with or without experience, salary $5045 to start. Generalized program. Retirement plan, free medical plan and life insurance, liberal holiday, sick leave and vacation benefits. Required: U. S. citizenship, graduation from four year college or university with major in Sanitary Science, Dairy or Food Technology. Other degrees will be considered with experience. Address inquiries to Myrna J. Katin, Personnel Officer, Philadelphia Department of Public Health, Room 504, City Hall Annex, Philadelphia 7, Pennsylvania.

FOR SALE

Single service milk sampling tubes. For further information and a catalogue, please write Bacti-Kit Co., P. O. Box 101, Eugene, Oregon.

Authorization To Use The 3-A Symbol

Following is a list of concerns to which 3-A Symbol Council authorization to use the 3-A Symbol have been issued since publication of the list in the August 1958 issue of the Journal. This lists supplements other listings published in earlier issues of the Journal.

AUTHORIZATION NUMBER	CONCERN AND ADDRESS	MODEL NUMBERS
	BULK MILK DISPENSERS	
108	Stevens-Lee Company 314 W. 90th St. Minneapolis 20, Minn.	Silver King Imperial SK1, SK2, and SK3.
	FARM TANKS	
19	Brown Equipment Co. Coalville, Utah	Add: A:200, 250, 300, 400, 450, 500, 600, 700, 800, 900, 1000, 1200, 1500, 2000, 2500, and 3000. B:1200 S:100, 150, 200, 250, 300, and 400. SL: 200 and 250 Delete: B: 1250, 2000, 2500, and 3000.
22	Groen Manufacturing Co. 4535 W. Armitage Ave. Chicago 39, Illinois	Add: RW, RW2, and RW3: 75, 125, 170, 230, 280, and 340 gal. RWL and RWL3: 75, 280, and 340 gal. W and WL: 300, 400, 500, and 600 gal. TW: 320, 400, 500, 600, and 725 gal.
	HEAT EXCHANGERS — PLATE TYPE	
17	DeLaval Separator Co.	Add: P13-RC, P13-EB, P13-VRB, P13-VEB, P15-RC, P15-VRB, and P15-VEB.
	STORAGE TANKS	
109	Girton Manufacturing Co. Millville, Pa.	CT-600, 800, 1000, 1200, 2000, 2500, 3000, 4000, and 5000.

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BEVERAGE PROCESSING DISCUSSION FEATURED AT INDUSTRIAL SANITATION & MAINTENANCE SHOW & CONFERENCE IN N. Y.

When the third annual Industrial Sanitation-Maintenance Show gets underway next month (November 3-6) at the New York Trade Show Building, one of the topics of interest to the Beverage and Bottling industry will be a discussion of *Beverage Processing* on November 6th.

The show and conference are sponsored by the Institution of Sanitation Management. More than 5,000 sanitation maintenance executives are expected to attend.

In addition, many of the show's exhibits are of special interest to the sanitation-maintenance executives of the beverage and bottling industry, according to Leonard Rogers, managing director of the show.

For additional information about the show and conference write to: Leonard Rogers, Orkin Expositions Management, 19 West 44th St., New York 36, N. Y.

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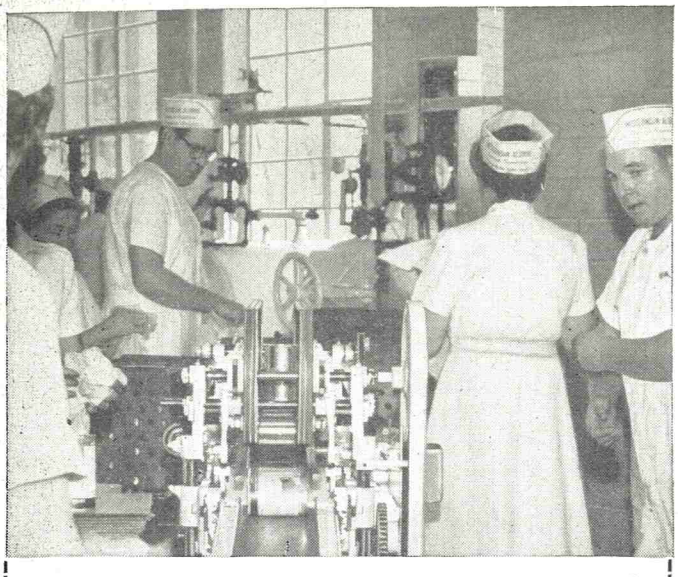

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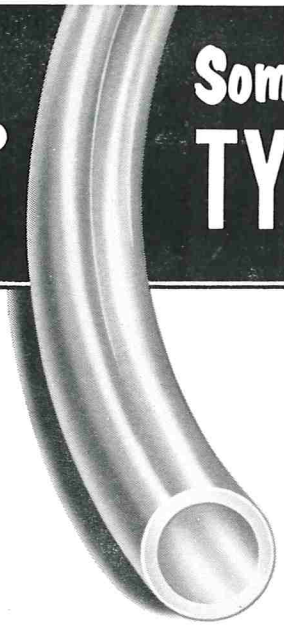
Some questions and answers about TYGON B44-4 CLEAR PLASTIC MILK HOSE



More and more manufacturers are employing Tygon B44-4, the sanitary milk tubing specifically developed to convey processed milk and milk products, on their processing machines and equipment. To help you get the most efficient service from your Tygon tubing, here are some questions frequently asked about Tygon, followed by our answers and recommendations.

1. Q: Can the same cleaners, sanitizing agents and cleaning methods used on other milk processing equipment also be used for Tygon?

A: Yes. One of the important advantages of Tygon is that it permits the use of all normally used dairy cleaners whether soaps, detergents, chlorine, or acid milkstone cleaners. For best results, of course, it is always wise to follow carefully the instructions of the manufacturers of the cleaning and sanitizing agents you use.

2. Q: Is Tygon abrasion-resistant?

A: Yes. Tygon is made extremely tough and abrasion-resistant to withstand frequent cleaning and gives unusually long wear under rugged service conditions. When handled with reasonable care, this dense, strong plastic will retain its smooth, polished surface throughout its service life. Naturally, it is best to avoid dragging the hose over concrete or sharp objects if maximum clarity is desired.

3. Q: What about clarity? Can you give me any tips on maintaining the transparency of Tygon in use?

A: Here also, with proper care, Tygon will provide the convenience of visual flow inspection throughout its service life. Clarity may be slightly affected on the outside by contact with paint, rubber, grease, or perspiration, and certain strong-colored sanitizers, such as those containing iodine or bromine, may tend to stain the inside. However, these are simply surface discolorations that in no way affect the efficiency of the tubing. And even should it have some slight discoloration, your Tygon tubing still provides a degree of solution visibility that makes it far superior to metal or rubber piping.

A slight cloudiness on the interior surface after exposure to water may be due to moisture. This is a normal occurrence—somewhat like the moisture deposited on eyeglasses when you blow on them. Clarity returns in a short time if the tubing is allowed to dry thoroughly. Should cloudiness persist, it might be well to recheck your cleaning procedure for adequate milkstone removal.

4. Q: Is Tygon suitable for use as cleaned-in-place piping?

A: Yes. In fact, Tygon is particularly ideal for this application on short connecting lines between equipment where flexibility is necessary. It shows the sanitary condition of the line at a glance and can be efficiently cleaned in place by the same cleaning methods applied to other parts of the equipment when pressure, temperature and solution concentrations are held within recommended limits.

5. Q: Why does Tygon seem to become easier to slip on and off a fitting with use?

A: The remarkable flexibility of Tygon is due to the fact that it is a thermoplastic and, like all thermoplastic materials, has a natural tendency to take a slight "set." This really presents no problem in use, however, as a snug fit can always be secured with a tight clamp. Some operators simply trim off the end of the tubing as required.

6. Q: Can you give me any suggestions for proper storage of Tygon?

A: Tygon is simple to store, requiring only the same sanitary care and handling you normally observe with your other milk processing equipment. It is well to expose the tubing to dry storage after cleaning, with ends open to permit thorough drying. It is also good practice to store the tubing loosely coiled (avoid kinking) on a clean, dry shelf.

Please write to us if you would like complete details, or have any questions about the use and care of Tygon B44-4.

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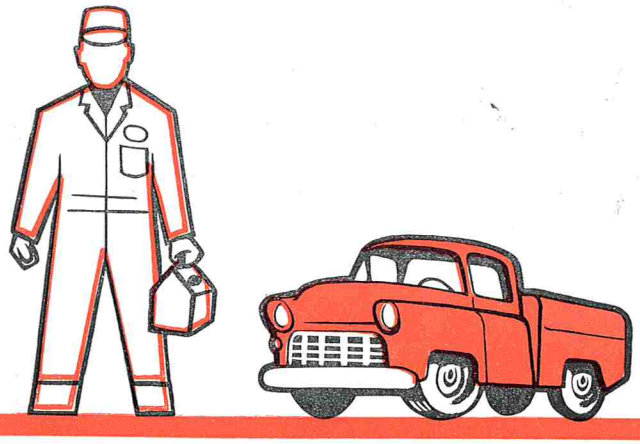

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