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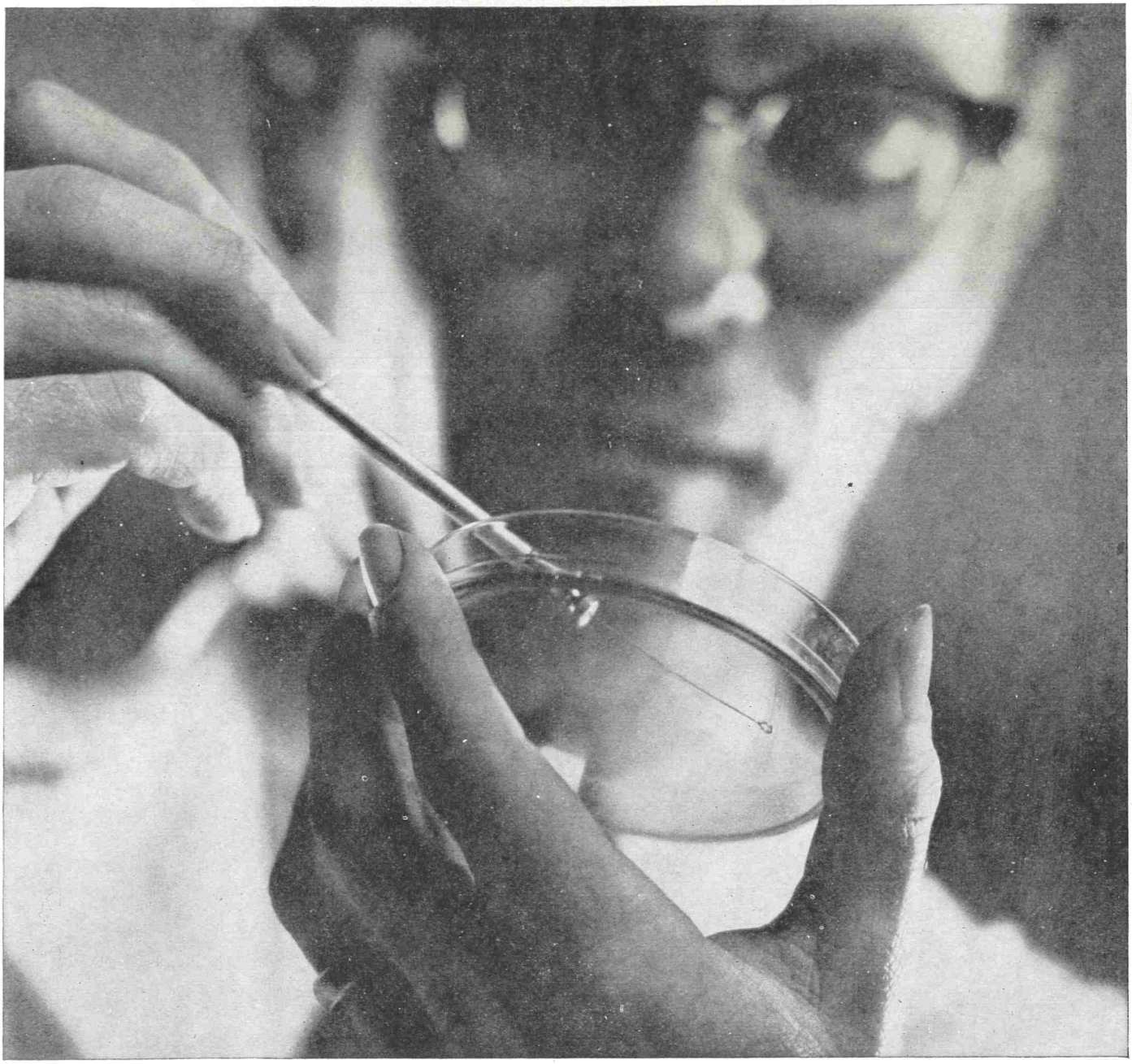
57TH ANNUAL MEETING
August 17, 18, 19, 20, 1970
Roosevelt Motor Hotel
Cedar Rapids, Iowa

Official Publication

International Association of Milk, Food and Environmental Sanitarians, Inc.



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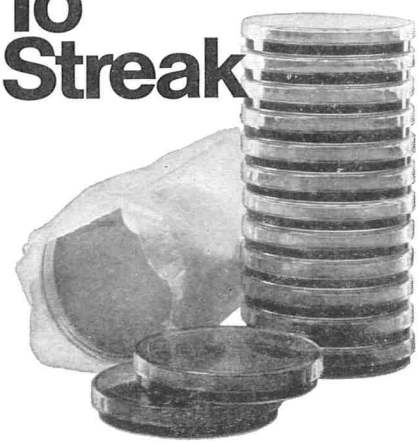

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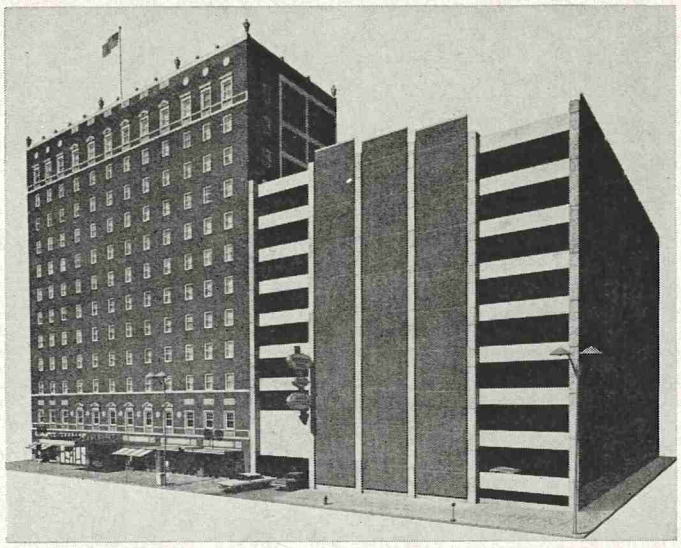

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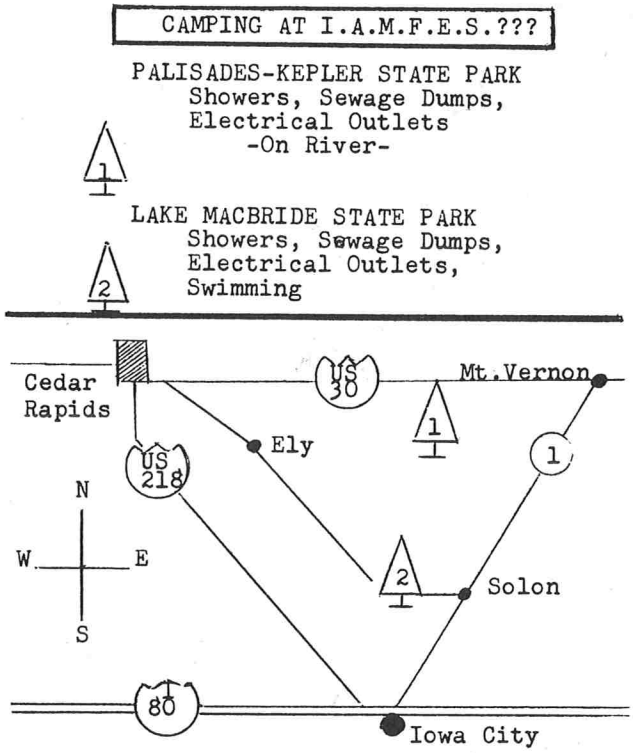

LADIES ENTERTAINMENT

The Ladies' Entertainment Committee has established the program for the International Association of Milk, Food and Environmental Sanitarians' Association annual meeting, August 1970.

This program for the ladies consists of the following activities:

1. *Tuesday, August 18.*

A bus tour of the Amana Colonies will commence by leaving the Roosevelt Hotel in Cedar Rapids at 10:30 a.m. arriving at the Ox-Yoke Inn in Amana near 11:00 a.m. After the tour guide from the Ox-Yoke Inn reviews the history of the Colonies, the ladies will tour the Woolen Mills and Furniture Factory. Luncheon will be served at 1:00 p.m. at the Ox-Yoke Inn. This luncheon will be served family style and will include 3 different meat dishes. After the luncheon the ladies will tour the Museum of Amana History and the Winery, also the Meat Market. The buses will return them to the Roosevelt Hotel, arriving by 3:30 p.m.

2. *Wednesday, August 19.*

A tour and visit to the Cedar Rapids Art Center has been scheduled for 1:30-3:30 p.m. After a short lecture on the several periods and forms of art by the Director of the Art Center and a tour of the Center, a coffee will be held at the Art Center. The Art Center is within easy walking distance of the Roosevelt Hotel.

3. A hospitality room will be available for the ladies to meet and have coffee before and after the organized activities.

4. Plenty of free time for shopping and visiting other interesting sites in the Cedar Rapids area has been provided.

5. Just a one dollar registration fee will be charged each lady for participating in the tours of the Amana Colonies and the Cedar Rapids Art Center.

WILLIAM S. LAGRANGE, *Chairman*
Ladies Entertainment Committee

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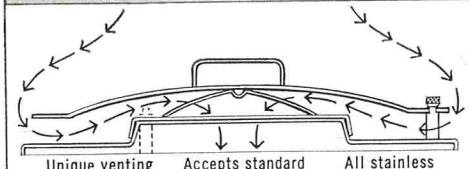

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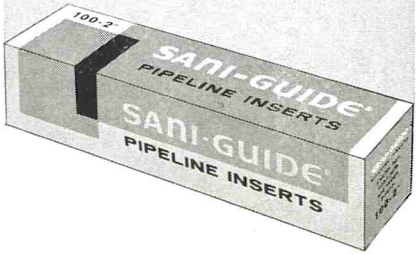

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MICROBIOLOGICAL CRITERIA IN USDA REGULATORY PROGRAMS FOR MEAT AND POULTRY[1]

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Consumer and Marketing Service
U. S. Department of Agriculture
Washington, D. C. 20250

(Received for publication November 24, 1969)

Abstract

Whereas food agencies must consider the consumer first, the expertise in microbiology lies instead in the universities, the government, and the industry. Scientists should make a point of showing businessmen many of the aspects of microbiological control that would show an economic advantage. Control of contamination and time-temperature abuse can be related indirectly to health hazard. Control of microbial level maintains natural food flavors. Low microbial level increases the shelf life of chilled products to a marked degree.

The Consumer Protection Programs of the Consumer and Marketing Service (C&MS) have many microbiological control procedures built into them: General sanitation, separation of cooked from raw products, requirement for a mid-shift clean-up (with a bacteriological monitoring system as an alternative), cooking requirements, and labeling requirements. A recent development is the decision to extend microbiological control to the use of microbiological criteria.

Microbiological criteria can be applied in three ways: *first*, by picking a figure out of the air. This is, of course, the bad way; *second*, by determining the general microbiological level in foods in commerce without regard to the effect of processing (this is a better way) and, *third*, (the best) by determining what is good manufacturing practice and then determining the microbial levels associated therewith. When a microbiological criterion is established, methods for sampling and analysis should be specified. The data both for establishment of microbiological criteria and for establishment of acceptability of given lots should be statistically significant; therefore, it is necessary to know the natural variation of levels of microbial groups within various commodities. As technology improves, it may often be necessary to re-evaluate any criteria in use. If microbiological criteria require drastic changes in an entire industry, they should be applied with great discretion to avoid seriously damaging the industry. On the other hand, those that require changes in the less satisfactory segments of an otherwise satisfactory industry could be applied more promptly.

Consumer and Marketing Service policy on microbiology criteria was reported in detail in the December 20, 1968, issue of the *Federal Register*. Our group has recently published the *Microbiology Laboratory Guidebook*, which is available on request.

Heating, adding a chemical, canning, or even freezing could be used to reduce microbial levels to meet a microbiological standard, but this is not satisfactory to the Consumer and Marketing Service.

[1]Presented at the 12th Annual Meat Science Institute, Rutgers University, New Brunswick, New Jersey, October 20, 1969.

Advantages of Microbial Control

We have 200 million silent clients—the consumers of the United States. Their total silence is undesirable, but in the area of microbiology, the average consumer has little understanding. He trusts his government to protect him against microbial hazards in foods.

We all know that technical knowledge in this area is limited to *first*, various government agencies; *second*, the universities; and *third*, the industry itself. The health agencies and universities often point up the problems, but it is largely up to the regulatory agency to encourage the industry to make appropriate corrections. And it's important that microbiologists within the industry learn to lead rather than to follow. More than ever before, their knowledge is needed to put into effect the ever tighter requirements of the food law agencies. Sanitation costs money; but there also are some favorable factors that any good businessman can recognize. It is up to the scientist to show the advantages of microbiological control to those businessmen who have not had a scientific background.

First, high microbial content is usually related to contamination and/or time-temperature abuse. These factors cause the addition of bacteria, or permit their reproduction, respectively. It is usually difficult to demonstrate a real or potential health hazard from contamination or time-temperature abuse, but conditions that permit such faulty handling are the very ones that introduce a health hazard under certain circumstances. For that reason then, microbial level can be related somewhat indirectly to health hazard. To the regulatory authorities, of course, health hazard is the primary consideration.

The *second* advantage to the control of microbial level is that natural flavor is maintained. This is not a problem of the regulatory agencies, but the industry should recognize this as an advantage in competition.

The *third* advantage to low bacterial level is that shelf life of chilled products is improved. Figure 1 shows that there is a straight line relationship between the logarithm of the initial bacterial count and

the days it takes for off odor to develop. At 4.4 C when the initial count is about logarithm 5, or 100,000 per cm^2, off odor occurs in about six days; whereas if the count is about logarithm 2, or 100 per cm^2, it takes about 14 days. This is a very strong argument for good sanitation in the meat and poultry industries.

The *fourth* advantage to lower levels is that consumer complaints of all kinds will be reduced. Certainly all of these factors are important to both the regulatory agencies and to the poultry and meat industries.

C&MS ACTIVITIES

Many of the programs of meat and poultry inspection are related to microbiological control. The inspector examines all equipment before the shift starts; this reduces contamination. Many raw meat or poultry products are required to be held at refrigeration temperatures; this slows microbial reproduction. We have recently published a *Sanitation Handbook of Consumer Protection Programs* for meat inspectors and *Guidelines for Implementation of Sanitary Requirements in Poultry Establishments* for poultry inspectors; these are available on request from the Consumer and Marketing Service. We have recently put into effect a new requirement that cooked meat and poultry products must be strictly separated from raw; this reduces the possibility that pathogens from raw foods may contaminate cooked foods. We have instigated a requirement for a mid-shift clean-up (that is, at the end of 4 hr), but permit a bacteriological monitoring system to be used in lieu of such a clean-up.

Many of our cooking requirements are directed toward the destruction of pathogenic microorganisms. When labeling must include cooking instructions, we always consider the effect of such instructions on the bacteria which might be present. All in all then, we have a very comprehensive program of microbiological control already within the meat and poultry industries. Most of this control is directed at the conditions of processing.

Recently, we have decided to extend microbiological control to the limited use of microbiological criteria. We consider a microbiological criterion to be simply another tool available to us. We expect to establish such criteria in a very reasonable manner, and expect to apply them with some discretion. The meat and poultry industries do not need to fear our use of microbiological criteria.

MICROBIOLOGICAL CRITERIA

Definitions and development

We must return to the definitions of microbiological criteria, as published by the National Academy of Sciences *(8)*: "For the purposes of this discussion a microbiological *criterion* is any microbiological specification, recommended limit, or standard. These terms are defined as follows:

(a) A *microbiological specification* is the maximum acceptable number of microorganisms or of specific types of microorganisms, as determined by prescribed methods, in a food being purchased by a firm or agency for its own use.

(b) A *recommended microbiological limit* is the suggested maximum acceptable number of microorganisms or of specific types of microorganisms, as determined by prescribed methods, in a food.

(c) A *microbiological standard* is that part of a law or administrative regulation designating the maximum acceptable number of microorganisms or of specific types of microorganisms, as determined by prescribed methods, in a food produced, packed, or stored, or imported into the area of jurisdiction of an enforcement agency."

I would like to establish one more definition—a fourth type of criterion which we are now proposing for the first time: "A *microbiological guideline* is that level of bacteria in a final product, or in a shipped product, that requires identity and correction of causative factors in current and future production, or in handling after production."

The means by which we establish microbiological criteria can vary, depending upon our intentions. Dr. E. M. Foster, of the Food Research Institute, Madison, Wisconsin, once described these techniques. He called them bad, better, and best. Here's how the bad method operates: A group of people sit around a table. They have limited knowledge of the microbiology of processing, very limited knowledge of statistical principles, and may or may not have knowledge of general microbiology. Theirs is the responsibility to establish a microbiological criterion. They decide on a figure for microbial levels with little or no scientific information to back them. They pull this out of the air.

A better method is that which the Association of Food and Drug Officials of the United States (AFDOUS) has used for developing recommended limits for beef and chicken pies *(2)*. This was a cooperative venture with the Federal Meat and Poultry Inspection Programs, and involved four laboratories: The U. S. Food and Drug Administration, the Beltsville laboratory of our own organization, the Pet Milk Company, and the Maryland State Department of Health. This was an extensive survey of the microbial condition of both beef and chicken pies that had been prepared in Federally inspected establishments. Only the final product was analyzed.

The mass of data showed what the industry at this time is producing under Federal inspection. There was no attempt to relate any of these data to the conditions of manufacture. It is well known, however, that inspectors in both the meat and poultry inspection programs have as a principal duty, the enforcement of sanitary procedures. To this extent then, one might say that these pies were prepared under good sanitary practice.

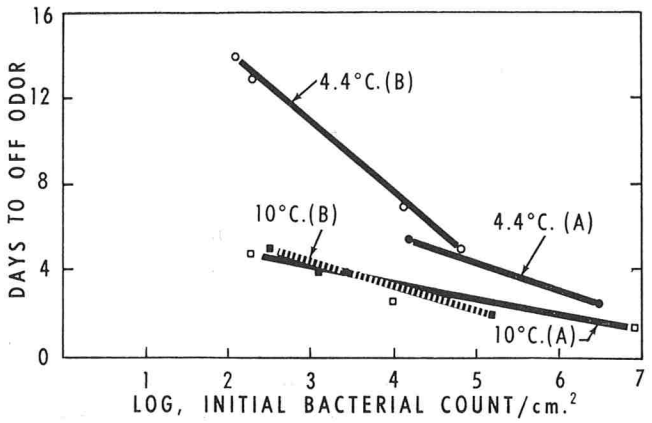

Figure 1. Shelf life of cut-up chicken as affected by initial bacterial count and storage temperature *(6)*.

The best method, however, is that which both the Food and Drug Administration and the Federal Meat and Poultry Inspection Programs are now using. This method relates the microbial levels to specific conditions of good sanitary practice. In this instance, a microbiologist-inspector team makes inspections of a large number of plants preparing the same type of food. For many foods, the microbial levels show good correlation with the sanitary observations. From this information we can then establish microbiological criteria based on product prepared under good sanitary conditions.

For each defined criterion, we could use a bad, better, or best method. Let us take the first—that is, the purchase specification. Sometimes these have been applied successfully without much background information. In fact, collection of information is often difficult for the purchaser. However, if he takes a figure out of the air and this figure is too strict, he may not be able to find enough product to meet his demand. If the figure is not strict enough, he may be obtaining rather low quality product. It is simply a matter of supply and demand. If the supply exceeds the demand, a discriminating purchaser can expect to obtain the best quality product on the market. On the other hand, if the demand exceeds the supply, he may have to reduce his requirements in order to obtain enough product for his needs. Obviously, a purchaser may be willing to pay more for the privilege of obtaining product meeting his quality requirements. It is in the best interest of the purchaser to know what the market can produce. A series of analyses of market samples is certainly worthwhile. Often this is the only way a purchaser can get the information he desires. Purchasers can rarely make investigations of the processing operation of suppliers in order to relate the microbial condition of the final product to the conditions of manufacture.

A recommended microbiological limit is generally developed by an advisory group with neither the economic sanctions of the purchaser nor the regulatory authority of a government inspection agency. Recommended microbiological limits are rarely based upon a code of good sanitary practice. The scientific literature is replete with recommended limits based upon limited investigation *(5)*. Very few organizations have the facilities, money, time, or authority to make widespread investigations either of market samples or of processing operations to give good foundation to microbiological criteria.

When an agency is establishing a microbiological standard, it must never pull a figure out of the air. The agency can get by after simply determining the levels of bacteria in foods in commerce. In some instances, this is essential, because an agency often does not have the authority or the opportunity to investigate manufacturing conditions. This applies to imports, and in the case of State or local governments, to products manufactured in other parts of the United States. It is therefore necessary to decide on the acceptability of a lot based solely upon the microbial condition of the samples received for analysis. Very often, the microbial condition of domestically prepared product, prepared under good sanitary conditions, becomes the basis for decision on imported product.

Those who apply microbiological standards must do so with great care. Whereas a purchase specification or recommended limit would not be likely to damage an industry or even to damage a small segment of an industry, a microbiological standard applied without careful consideration could seriously damage or even destroy a large segment of the food industry. It could also be far too permissive and thus would condone poor sanitation. The microbiological guideline should be applied in the same cautious manner, using the *best* method, or the better method, never the *bad* method of approach. The guideline is obviously a useful criterion only for an agency having authority over the processing and distribution of the food. It can have little value for imports.

Processing

Since we consider the relationship of microbial level to good sanitary practice to be the best means of establishing a microbiological criterion, it would be well to discuss this approach in some detail. The team making the investigation observes likely routes of contamination; time-temperature abuse; times and temperatures of processing that will destroy bacteria; types of mixing, aerating, etc., that might affect microbial growth; observes the efficiency and frequency of clean-up; considers the nature of the product as it might affect growth or destruction of bacteria (pH, moisture level, etc.); and otherwise makes note of those areas that might be likely sources of problems in the operation. Obviously, this takes a considerable amount of knowledge and experience. Microbiologists who have had this experience are best qualified, but inspectors, because of their more intimate knowledge of production methods, are a valuable addition to the team.

Sampling

First of all, the team samples all of the ingredients that go into the process, then samples the product at each step in the assembly line. A suspect process requires thorough sampling. Sampling must continue over at least one full working shift. Generally speaking, it is well to make at least two such inspections from a given firm in order to be certain that an unusual occurrence in the first inspection did not affect results. These so called "line samples" should always be followed by rather heavy sampling of the final product at the end of the processing line. In many instances, it is well to sample the final product from a previous day's production as a double check. All too often, the appearance of a bacteriologist-inspector team in the plant suddenly creates an interest on the part of the employees in producing an extremely clean product. The sampling of a previous day's production will help to illustrate this interesting phenomenon. From studies like these and with the cooperation of the industry, C&MS hopes to establish codes of good commercial practice.

It is generally agreed that methods of sampling must be established before microbiological criteria can be. The question of statistical significance of findings is probably one of the most difficult because it takes a large number of samples to establish the normal variation within a lot. AFDOUS *(1)* published the best available treatise on this subject. That report recommends ten samples to be analyzed in order to evaluate the microbial condition of a given lot of pot pies. Sampling becomes a greater problem when applied to items less homogeneous than pot pies.

Laboratory methods

The method of laboratory analysis should become a part of any microbiological criterion. The method chosen should, of course, be the best available, but it need not necessarily be the best as long as it is fully described, and functions well. Methods used for survey purposes—even for establishment of microbiological criteria—can be shortened as long as the investigator knows the limitations of the shortened methods. On the other hand, more complicated procedures are probably required when the acceptability of a given lot is in question. The methods described by the AOAC are, of course, fully standardized and studied for reproducibility. They are accepted in courts of law.

The choice of method has been largely left to the discretion of the firm or agency that establishes the criterion. For example, the Food and Drug Administration's *Bacteriological Analytical Manual* (BAM), *(7)*, has become a highly useful source of standardized methods. Although these methods have not been studied by collaborative investigation, the food industry is aware that these are the methods FDA will use to determine the acceptability of foods in commerce. By the same token, we in the Consumer and Marketing Service have recently published a similar manual, the *Microbiology Laboratory Guidebook* (MLG), *(4)*. This, because of its source, will probably become widely used by the meat and poultry industries. It is now available from my office, on request. Whereas the BAM methods of FDA are complete and sometimes lengthy, with no short cuts permitted, our MLG accepts as standard, the methods collaboratively studied by AOAC, but uses short cut procedures for which our laboratory has background data of acceptability.

Agency action

There have been instances in which regulatory agencies have kept microbiological criteria closely guarded secrets. These have been variously called "administrative tolerances," "action levels," or "administrative guidelines." Such criteria are kept secret for such reasons as these: Perhaps the agency has too little background information and thus fears a challenge. Perhaps the agency fears that the controlled industry may try to meet the criterion, instead of trying to meet the sanitary requirements themselves. Perhaps the agency may fear criticism by consumer groups for being too lenient.

C&MS has no secret criteria. We expect to divulge, in the *Federal Register*, each such proposal. After interested persons have had opportunity to comment, then a further announcement will be made, in order to make the standard part of the Code of Federal Regulations. At that time, it will have the

force and effect of law. A general policy statement was published in the *Federal Register (3)*. We expect to establish what is considered good manufacturing practice for specific commodities, and are offering the meat and poultry industries an opportunity to assist in this work. Then, we will determine the microbial levels associated with such practice. The microbial profile of the end product then becomes a microbiological criterion.

Those products that provide a definite microbiological correlation with mishandling are being given priority. Analytical procedures will be those recognized by the AOAC, when applicable. Sampling procedures will be specified. When levels in the final product exceed the microbiological criteria that are developed, then further production will be halted pending identification and correction of causative factors. Any product on hand will be retained. Final disposition of this product will depend upon several factors: *First*, the real or potential health hazard. *Second*, the statistical significance of the data. *Third*, evidence of decomposition. *Fourth*, the nature of the contaminants. *Fifth*, evidence of adulteration.

If a product is retained, it might be destroyed, reprocessed, sorted, or released. In any event, we would demand correction of the production operation for protection of future lots. The use of a procedure to destroy bacteria as a substitute for good sanitation is not permissible. Heating, adding a chemical, canning, or even freezing could be used to reduce microbial levels to meet a microbiological criterion; but this is not satisfactory to the C&MS.

C&MS will not establish and enforce unreasonable microbiological criteria. Any changes that will affect an entire industry must be made at a measured pace. Changes that affect only the bad actors in an otherwise clean industry, can be enforced more promptly.

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REPORT OF THE COMMITTEE ON FOOD PROTECTION, 1968-1969

In our report of 1968, we mentioned the plan of developing regional seminars on food protection. The purpose of these seminars is to improve and extend food protection programs through improved communications, inter-agency cooperation between government and industry.

To further develop this idea, a meeting was held on November 13, 1968. Present at the meeting were representatives of International Association of Milk, Food, and Environmental Sanitarians; American Public Health Association; Association of Food and Drug Officials of the United States, National Association of Sanitarians; Food and Drug Administration; Public Health Service; United States Department of Agriculture; and some industry representatives. The purpose of this meeting was to explore the desirability and possibility of holding a National Conference on Food Protection. It was the consensus of those attending this meeting that such a Conference would be desirable.

While at the present time a considerable amount of effort is being expended in food protection programs at all levels of government, there is a lack of uniformity, cooperation and coordination among the various agencies. Still further, there appears to be considerable overlapping and duplication of services, while at the same time, there remain a number of areas or phases of food protection which are being given inadequate attention.

New developments in foods, such as the advent of convenience foods, new types of equipment, importation of foods from foreign lands, and changed eating patterns, have been the cause of new distribution methods and facilities, some of which have created new hazards and problems. These ever increasing problems and hazards, coupled with

Continued on Page 191

MICROORGANISMS FROM ARMS AND HANDS OF DAIRY PLANT WORKERS[2]

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(Received for publication December 26, 1968)

ABSTRACT

Microorganisms shed into decontaminated air from arms and hands of four dairy plant workers were collected on plates of various selective media using a Casella sampler. Microorganisms selected for identification were representative of the types encountered. Of 256 microorganisms isolated, 55.5% were cocci, 41.4% were rods, and only 3.1% were yeasts. Thirteen species of cocci were identified. Those occurring most frequently were *Sarcina flava, Peptococcus prevotii, Sarcina aurantiaca, Sarcina hansenii,* and *Staphylococcus epidermidis,* in decreasing order of frequency. Eighteen species of rods were observed. Those identified most frequently, in decreasing order, were: *Alcaligenes marshallii, Alcaligenes bookeri, Pseudomonas synxantha, Pseudomonas iodinum, Pseudomonas aeruginosa,* and *Corynebacterium striatum.*

People are a serious source of air-borne contamination. The role of humans as contributors of air-borne microorganisms has been studied in hospitals, especially in operating rooms. In the manufacture of spacecraft equipment, ultra-clean rooms have been used to achieve a low level of particle contamination of components. Clean rooms also are used by the pharmaceutical industry to maintain aseptic conditions in production and packaging of sterile drugs.

Recent studies have shown that shedding of viable bacteria by different individuals may vary from thousands to millions of bacterial particles per minute. Several authors *(1, 7)* have found that the total number of air-borne viable particles in industrial clean rooms increased or decreased depending on the presence or absence of personnel in the area. Most of the microorganisms isolated from air and surfaces in industrial clean rooms were assosciated with the skin, nose, and mouth of humans.

Specific studies on the species of microorganisms that human beings contribute to air-borne contamination in food processing areas have been limited. The purpose of this paper is to report the results of a study of the identification of representative species of airborne microorganisms from the arms and hands of four dairy plant workers.

REVIEW OF LITERATURE

A relationship was found by early workers between air-borne infection and activities that increase air-borne particles, such as sweeping, disturbance of bedding, and body movements. Sunga et al. *(13)* reported that 44% of the viable air-borne particles in a dairy plant were 2.0 to 5.5μ in size. The percentage varied among product areas. Duguid and Wallace *(4)* studied the number of bacteria-carrying dust particles liberated into the air from a person's skin and clothing and found the number of such particles liberated to be proportional to the amount of activity by the person.

Solberg *(12)* and Noble and Davies *(9)* agreed that the ability to disperse staphylococci depended on the number of organisms present in the nose and on the skin.

According to Rothman *(10),* a complete layer of skin is desquamated every 1 or 2 days. Results reported by Davies and Noble *(2)* suggested desquamation has a major effect on dispersal of bacteria from the skin surface. Cocci, in chains and singly, as well as occasional clumps growing on epidermal fragments were seen by Montes et al. *(8)* when they used an electron microscope. Bacterial species carried on skin particles were identified as mostly cocci by Davies and Noble *(3).*

Ulrich *(15)* reported that the majority of bacteria on aerobic contact plates were coagulase-negative staphylococci, corynebacteria, and micrococci. Gram-negative bacteria and sporeformers were uncommon. An individual tended to maintain a relatively stable species distribution over a long period of time.

Heldman et al. *(5)* reported that individuals shed organisms at the rate of 0 to 95 per min from one hand and arm. The number varied among individuals, daily conditions, and treatment of arm plus hand (washed and rinsed only or washed, rinsed, and treated). Shedding was directly related to skin surface numbers.

EXPERIMENTAL

Both arms and hands of four dairy plant workers were dampened and rubbed with 3% hexachlorophene. Sufficient additional water was added to produce a lather. After much rubbing, the lather was rinsed off thoroughly with running

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[1]Present address: General Food Corporation, Battle Creek, Michigan.

[2]Michigan Agricultural Experiment Station Journal No. 4598. Supported in part by Public Health Service Research Grant UI-00284 from the National Center for Urban and Industrial Health.

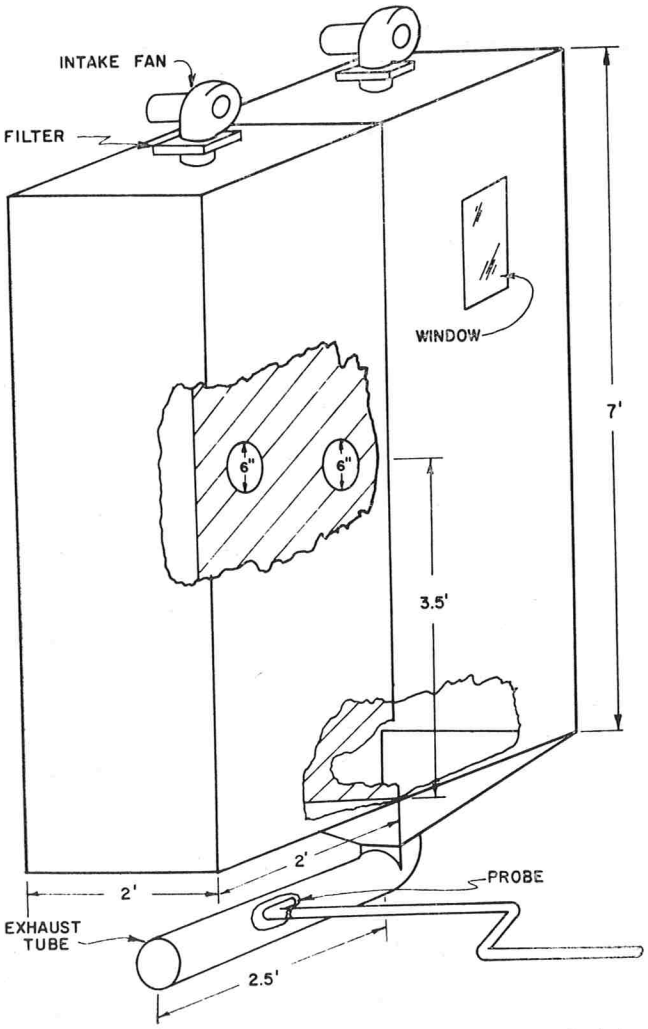

Figure 1. Chamber for sampling microorganisms shed into the air from arm and hand.

water and one arm and hand (W) of each person were dried with a sterile towel. The other arm and hand (WT) of each person were sprayed thoroughly with an aqueous solution (1:750) of benzyl ammonium chloride germicide and dried with a sterile towel. A sterile sack sleeve was used to protect the WT arm and hand until ready for exposure to the flow of sterile air.

A specially designed sampling chamber (Fig. 1) was used to obtain samples of air into which the microorganisms were shed from the arm and hand of the four workers. The bottom of the second compartment was sloped to facilitate complete air changes. Immediately after preparation of the arms and hands of a worker, he entered the first compartment of the sterilized sampling chamber and placed the W arm and hand through the restricted opening into the second sterile compartment.

Air sterilized by ultra high efficiency filters flowed over the arm and hand at the rate of 5 ft^3/min. Twenty per cent of the air was sampled with a Casella sampler at the rate of 1 ft^3/min. The microorganisms shed from the arm and hand into the air were collected on various types of agar, such as standard plate count, mannitol salt, violet red bile, or blood agars. The arm was withdrawn and the compartment was flushed thoroughly with sterile air. The sleeve was removed from the WT arm and hand and inserted in the second compartment for the air sampling.

The four dairy plant workers were sampled on five different days during August or September. Each sampling day consisted of three sampling periods in the morning and three in the afternoon with 30 min between samplings. The temperature in the sampling cabinet ranged from 18 to 23 C and the relative humidity (R.H.) from 46 to 70% in the morning. In the afternoon the range was 19 to 26 C and 43 to 65% R.H.

Incubation of the standard plate count agar plates from the Casella sampling was at 35 ± 2 C for 48 hr with aerobic or anaerobic conditions. The blood agar plates were incubated at the same temperature for 48 hr. Mannitol salt agar plates were incubated at 30 C for 48 hr.

An attempt was made to select for identification representative types of colonies from the standard plate count agar (Casella sampling) in proportion to the frequency of their appearance. Each colony was purified and maintained until testing was completed. Procedures for identification of microorganisms were those recommended in the *Manual of Microbiological Methods (11)*. They included a total of approximately 75 to 100 tests and observations on morphology, cultural characteristics, biochemical, and other tests. Because of the time factor, a few additional colonies consisting of yeasts were identified only as to the genus.

Casella-sampled colonies growing on blood agar were reported as hemolytic. Colonies (from Casella sampling) that were typical yellow or orange colored when grown on mannitol salt agar, fermented the mannitol, and were coagulase-positive were considered to be probable staphylococci.

RESULTS AND DISCUSSION

Of the 256 microorganisms investigated, 55.5% were cocci, 41.4% were rods, and 3.1% were yeasts. The types from different persons consisted of 35 rods, 63 cocci, and 5 yeasts from subject A; B had 8, 20, and 1; C had 40, 23, and 0; and D had 23, 36, and 2, respectively. Figure 2 shows the number of cocci and rods identified for each species and person. The most frequently occurring cocci that were identified and the number of each were *Sarcina flava*, 40; *Peptococcus prevotii*, 28; *Sarcina aurantiaca*, 27; *Sarcina hansenii*, 16; and *Staphylococcus epidermidis*, 11. According to Bergey's classification, the common habitats of these organisms are: air and water; skin and human sources; air and water; water and dust; and skin, respectively.

The rods identified most often and the frequency of identification were *Alcaligenes marshallii*, 29; *Alcaligenes bookeri*, 22; and *Pseudomonas synxantha*, 12. The common habitats are milk, the intestinal tract, and milk and cream, respectively.

Since many of the cocci and rods identified had a common habitat of dairy products or the dairy plant, apparently some organisms normally in the environment may become adjusted to human skin. Thus, persons exposed to a large number of organisms in their daily environment may become carriers on the skin and/or shed the organisms after frequent exposure. For example, nurses exposed to *Pseudomonas aeruginosa* in hospital wards became skin carriers *(6)*. Ulrich *(14)* observed different organisms

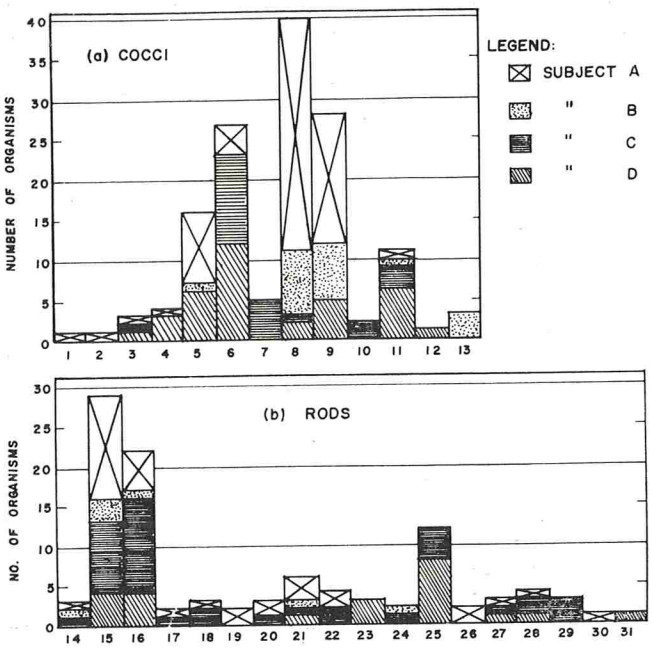

Figure 2. Number and species of microorganisms recovered from arms and hands of four dairy plant workers. Key to numbers in figure:

1. *Micrococcus flavus*
2. *Micrococcus luteus*
3. *Micrococcus caseolyticus*
4. *Sarcina lutea*
5. *Sarcina hansenii*
6. *Sarcina aurantiaca*
7. *Sarcina ventriculi*
8. *Sarcina flava*
9. *Peptococcus prevotii*
10. *Peptococcus saccharolyticus*
11. *Staphylococcus epidermidis*
12. *Staphylococcus aureus*
13. *Gaffkya tetragena*
14. *Alcaligenes recti*
15. *Alcaligenes marshallii*
16. *Alcaligenes bookeri*
17. *Alcaligenes metalcaligenes*
18. *Alcaligenes viscolactis*
19. *Alcaligenes faecalis*
20. *Pseudomonas mildenbergii*
21. *Pseudomonas iodinum*
22. *Pseudomonas aeruginosa*
23. *Pseudomonas fluorescens*
24. *Pseudomonas fragi*
25. *Pseudomonas synxantha*
26. *Corynebacterium pyogenes*
27. *Corynebacterium acnes*
28. *Corynebacterium xerosis*
29. *Corynebacterium striatum*
30. *Bacillus firmus*
31. *Bacillus megaterium*

carried by children compared to their parents. The largest number of sporeformers on children's skin was attributed to the fact that these contaminants resulted from more frequent contact of children with soil, rugs, etc.

In addition to the influence of each species and numbers of organisms in the environment on the kinds and numbers shed by various individuals, the personal characteristics and habits of the person may have an effect. These include personal hygiene, susceptibility to infections, amount of normal activity, and resulting perspiration. The species degree of resistance to the lethal effects of air-borne conditions and its ability to grow on the selective media during standard incubation conditions also are important.

On the basis of the organisms identified, results indicate that treating the arm and hand with benzyl ammonium chloride after washing (WT) did not drastically change the species of microorganisms being shed compared to the arm and hand that was washed and rinsed only (W). However, *Micrococcus luteus* and *Micrococcus caseolyticus* were recovered only from the WT arm and hand and *Micrococcus flavus*, *Peptoccus saccharolyticus*, and *Staphylococcus aureus* were obtained only from the W arm and hand. The total number identified was one each of *M. luteus*, *M. flavus*, and *S. aureus;* two of *P. saccharolyticus;* and three of *M. caseolyticus*. This minor difference in flora between WT and W arms and hands may have resulted from chance in selection of colonies for identification.

Likewise, the data do not seem to demonstrate an important difference in the species identified from the organisms shed in the morning compared to those shed in the afternoon of work days.

Quantitatively, the shedding of microorganisms after WT or W of arms and hands (5) indicated a low initial rate that increased up to approximately 6 hr. The most significant increase was during the first hour. The shedding rate increased more rapidly for WT than the W limbs. But, this was related to the more effective initial reduction of shedding of WT compared to the W limbs.

Table 1 presents the probable staphylococci and hemolytic organisms shed by the four workers during sampling onto selective media on five different days. The data did not seem to indicate a major difference of these groups between samplings from WT and W arms plus hands. However, more sampling and identification of microorganisms are necessary to draw a significant conclusion, particularly after the total viable particle shedding rate of the WT arm and hand have stablized subsequent to the application of the benzyl ammonium chloride.

No presumptive coliform organisms were observed on violet red bile agar after sampling air by the Casella method. The testing included 33 samplings of air from the arms and hands of subject A, 25 from B, 12 from C, and 29 from D. Since coliforms are commonly associated with humans, these negative results were unanticipated. In subsequent aerosol

TABLE 1. OCCURRENCE OF PROBABLE STAPHYLOCOCCI AND HEMOLYTIC ORGANISMS

Subject	Probable staphylococci					Hemolytic organisms				
	Total samplings	No. with 0 counts	Total organisms	Mean of non-zero counts	Range of counts	Total samplings	No. with 0 counts	Total organisms	Mean of non-zero counts	Range of counts
A	31	13	22	0.63	0-7	26	26	0	0	0
B	30	29	1	0.03	0-1	31	30	70	0.25	0-24
C	19	16	8	0.87	0-4	21	16	6	0.39	0-2
D	31	30	1	0.20	0-1	32	32	0	0	0

testing, a pure *Escherichia coli* culture failed to produce any colonies on violet red bile agar when aerosolized in a small chamber and the air sampled immediately by means of a Casella sampler. On the basis of these trials with a single species, one may assume that the failure to obtain coliforms during the shedding trials probably resulted from the inhibitory effect of the selective medium upon air-borne coliform organisms rather than their absence.

Eight of the 256 organisms selected for identification were yeasts. Five were from Subject A, one was from B, and two were from D. Six of the yeasts belonged to the genus *Saccharomyces* and two were *Candida*, but species identification was not conducted.

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CURRENT GOOD MANUFACTURING PRACTICES–HUMAN FOODS[1]

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Abstract

General regulations establishing good manufacturing practices (GMP's) for food establishments are now effective. Under the Food, Drug, and Cosmetic Act, FDA brought many food insanitation actions. Until recently, there were no specific standards (GMP's) dealing with the plant sanitation concept in Section 402(a)(4) of the Act. Two court opinions touching on the subject of standards (GMP's) are mentioned.

FDA's food sanitation programs now include bacteriological findings as well as the visible evidence of insanitation. The general, "umbrella" regulations will be followed by specific appendices for individual foods. If specific GMP's exist, FDA sanitary inspections will cover the key points in the GMP's.

In other instances, the general regulations will apply. Such inspections will be the usual FDA sanitary inspection. FDA will continue its present procedures including: inspector's discussion with management, written reports of observations, and post-inspection letters. If necessary, FDA can still use legal sanctions available to it.

Reasonableness and appropriate consideration to significant factors can be expected in FDA's administration of the GMP's. GMP's will be subject to updating and revision.

Some benefits of GMP's are: *(a)* industry, as well as cooperating State and local agencies, have a definite statement of FDA's requirements for food plant sanitation and for compliance with Section 402(a)(4) of the FDC Act; *(b)* GMP's will help in the planning and implementation of cooperative food inspection programs between FDA and other agencies; and *(c)* GMP's will minimize actual distribution of potentially hazardous or contaminated products to consumers.

On April 26, 1969, the Food and Drug Administration (FDA) published a set of regulations establishing current good manufacturing practices for the sanitary operations of establishments that manufacture, process, pack, or hold human foods. It might be of interest to review some of the background leading up to these regulations.

For years, FDA has been active in the areas of filth and insanitation in food processing establishments. Since 1938, Sections 402(a)(3) and 402(a)(4) of the Federal Food, Drug, and Cosmetic (FDC) Act have been the keystone of FDA's efforts in this type of work.

Section 402(a)(4) states that a food is adulterated if it has been prepared, packed, or held under insanitary conditions whereby it may have become contaminated with filth or whereby it may have been rendered injurious to health. The related Section 402(a)(3) deals with food that is adulterated because it actually consists in whole or in part of any filthy, putrid, or decomposed substance, or is otherwise unfit for food.

Since passage of the Act, many legal actions, both civil and criminal, have been brought by FDA based on these two more or less general definitions of insanitary practices and conditions. It could be said that each case was brought on its own merits. In other words, there existed no specific set of principles or standard requirements set forth in the form of regulations that might tell the food processor what he would have to do to assure the consumer of a safe and wholesome food supply.

The idea of some kind of specific "standards," or current good manufacturing practice regulations (GMP's), based on the plant sanitation concept in Section 402(a)(4) of the FDC Act has received occasional consideration since passage of the Act.

Some Court Cases

There were two court cases that spoke specifically to this subject. In 1951, a pickle processor was convicted in a criminal action based on the introduction into interstate commerce of pickles and pickle relish which were alleged to have been adulterated within the meaning of Section 402(a)(4). The defendant appealed the conviction on two grounds. One of these grounds challenged the constitutionality of Section 402(a)(4) because of vagueness. The 8th Circuit Court of Appeals dismissed this contention. The court said that anybody should know what insanitary conditions are, especially since the Act, as passed by Congress, spelled out insanitary conditions to mean those which may result in contamination of the food with filth or which may render the food injurious to health. Since the appellate court had affirmed that Section 402(a)(4) of the Act was clear and not vague, any further consideration to specific "interpretive" regulations under this Section was considered only in a limited way until recently.

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[1]Presented at the Fifty-Sixth Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, Inc., Louisville, Kentucky, August 17-21, 1969.

The other court case, in 1955, dealing with several seizures of tomato paste, is also interesting because of the view expressed by the 7th Circuit Court of Appeals. Here, the Court said that the FDC Act is broad enough to provide authority for the promulgation of interpretive regulations under Section 402 (a)(4). The Court went on to say:

"Courts know neither what is necessary for the consuming public nor what can reasonably be expected from the canning industry. Furthermore, this is not a determination that should be made individually for each case on the basis of expert testimony. The Food and Drug Administration should set definite standards in each industry which, if reasonable, and in line with expressed Congressional intent, would have the force of law."

EMPHASIS CHANGES IN FOOD SANITATION

Over the years, the concept of food sanitation has taken on deeper connotations. In the past, emphasis during the sanitary inspections of food plants was on basic physical cleanliness and on the more obvious sources of filth contamination—insects, rodents, etc. These efforts reduced the gross filth in our food supply and resulted in improvements in the overall cleanliness of plants and equipment. However, the same could not be said for certain types of microbial contamination. The concept of visible cleanliness has now been broadened to include the unseen sources that cause bacteriological contamination. While FDA still maintains an inspection program to deal with gross filth, there is increasing emphasis on bacteriological findings to evaluate food plant sanitation.

PRODUCTION STANDARDS

Certain foods, because of their very nature or because of the conditions under which they are prepared or processed, have a potential for causing illness. For example, we all know about the hazards of botulism that can result from improperly canned, non-acid foods as well as from smoked fish that has been subjected to improper handling and inadequate temperature treatment; the potential for staphylococcal food poisoning in mishandled cream-filled bakery goods; or the hazards of *Salmonella* associated with egg products and other susceptible foods, and so on.

It would seem logical that the establishment of specific standards or current good manufacturing practices for a particular industry would go far in preventing the distribution of potentially hazardous products or other contaminated foods prepared under less than satisfactory conditions.

"Umbrella" regulations

It also becomes apparent that in trying to write individual sets of standards or good manufacturing practices (GMP's), there are certain common problems that would repeatedly appear in each set of regulations. For example, such universal requirements as screens on windows, clean equipment, and other basic sanitation rules would keep reappearing in each individual set of regulations as it is written. For this reason, a set of so-called "umbrella" regulations was drawn up. This included all of the general concepts of basic sanitary plant operations which also would be found in any specific, individual GMP's that might be drawn up later.

The umbrella regulations were originally proposed December 15, 1967. Comments received in response to the proposal resulted in significant changes and led to publication of a revised proposal December 20, 1968.

The final regulations became effective on May 26, 1969, 30 days after publication in the *Federal Register*. They cover a broad range of sanitation practices designed to assure that human food is safe and has been prepared, packed, and held under sanitary conditions. Detailed criteria have been established in the following general areas: plant and grounds, equipment and utensils, sanitary facilities and controls, sanitary operations, processes and controls, and personnel.

Exclusions

Excluded from coverage are establishments engaged solely in harvesting, storing, or distributing raw agricultural products which undergo further processing before human consumption.

Detailed regulations

These general regulations will be followed by specific appendices dealing with individual food products. The priority for development of these individual GMP's depends on the potential of the product for causing illness.

Incidentally, FDA does not profess to have all the expertise necessary to write detailed GMP standards for all specific food products. We have solicited the aid and advice of the particular industry, in those areas where we have undertaken the development of individual GMP's.

Inspection guidelines

In connection with specific good manufacturing practices, FDA has already developed, primarily for internal use by our inspectors, inspectional guidelines in several food programs, such as smoked fish, *Salmonella* in non-fat dry milk, and others. These guidelines are designed to identify the significant features of specific manufacturing operations that

should receive attention during an inspection. In other words, they tell the inspector where to be sure to check to see if a violative product is being produced. Such guidelines might be regarded as forerunners of eventual GMP appendices. Our experience with these inspectional guidelines will be used when drawing up any particular, individual set of GMP's.

REGULATIONS AND INSPECTIONS

Let us consider how GMP regulations will relate to actual FDA inspections. During an inspection, the inspector will be looking at other things in addition to sanitation. What we are talking about now specifically are the sanitation aspects of the inspection.

If there is an individual GMP appendix for the particular industry involved in the inspection, we could anticipate that the GMP appendix would contain many specific key points which the inspector would check for compliance or non-compliance.

If there is no GMP apendix for that particular industry, the inspector will check for general basic sanitation. This would be the usual sanitary inspection. It is not expected that such inspections will be any different because of the GMP umbrella regulations than they were before. Certain conditions and practices have always been considered objectionable and will still be. In connection with these sanitary inspections, FDA will continue to use its present procedures. The inspected firm will still be getting written reports of the inspector's observations as required by law. At the end of the inspection, the inspector will have his usual meeting with top management to discuss any problems that may have been found. The inspector's job is to get the facts, acquaint the firm with his findings, and report these to his FDA District office.

The inspector's report is evaluated by the District. We can anticipate that FDA will use its traditional approach of reasonableness in evaluating GMP compliance. Administration of the GMP's will be in terms of factors that have significance or potential significance rather than meaningless items. If there are significant adverse conditions or potentially objectionable situations, the firm will receive a letter from the District Director or one of his staff.

We in FDA have been sending these letters now for about a year and a half. Their purpose is to provide information to industry top management about conditions that, in the District's opinion, need correction.

These letters are our answer to complaints previously heard from industry that a firm did not know where it stood after an inspection. It was claimed that if our findings were made known to the firm, improvements would be expedited. These post-inspection letters often trigger a discussion between top management of a firm and the FDA District, and so help to improve communications.

LEGAL SANCTIONS

The procedures we have been talking about of course do not obviate the fact that there are legal sanctions under the Food, Drug, and Cosmetic Act which FDA can use when it finds it necessary.

The question of whether these GMP regulations have the force and effect of law has been discussed pro and con. It is not the purpose of this presentation to enter into a legal discussion of this question. The subject could better be left for the lawyers and perhaps for final resolution by the courts.

Notwithstanding, and until such time, we can expect judgment and reason to be exercised by FDA in administering these regulations, as we mentioned earlier. Moreover, the GMP's will be subject to updating and revision as indicated by new problems or developments in technology.

CONCLUSIONS

GMP regulations—whether they are general or specific—should result in a number of benefits to all concerned. To mention a few: *(a)* Industry, both large and small firms, will have available a definite statement of what the agency (FDA) believes is necessary to comply with plant sanitation requirements i.e. with Section 402(a)(4) of the Federal Food, Drug, and Cosmetic Act. *(b)* These standards can help firms in setting up their own sanitation programs as well as measuring the plant's conformance with required sanitary practices. *(c)* State cooperating officials will also know what FDA requires on a nationwide basis in food sanitation areas. As we continue to work more and more with the States, these standards will be helpful in joint planning and implementation of cooperative food sanitation programs. *(d)* Finally, compliance with GMP's has a preventive effect, since it will minimize the actual distribution to the consumer of potentially hazardous or contaminated products. In this way, consumers will have further assurance that the food they are getting is safe and wholesome.

BEHAVIOR OF *SALMONELLA* DURING THE MANUFACTURE AND STORAGE OF A FERMENTED SAUSAGE PRODUCT[1]

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Abstract

The behavior of salmonellae during the manufacture and storage of Thuringer sausage was studied. Five serotypes of salmonellae behaved in a similar fashion during the fermentation period regardless of whether a *Pediococcus* sp. or *Lactobacillus* sp. starter culture was used. The number of salmonellae per gram of sausage emulsion decreased by 0.75 - 2.5 logs during the 18-24 hr of fermentation. Initial experiments indicated that a combination of the acidity that developed and the NaCl present was responsible for the demise of the salmonellae. Sodium nitrite, sodium nitrate, and ascorbic acid had little or no effect on the fate of salmonellae in the fermenting material. When the level of sucrose in the curing salt mixture was reduced to 0.25%, a product with a final pH of 5.2-5.4 resulted. Salmonellae were able to multiply in this sausage emulsion during the course of fermentation.

Heat treatments employing three temperatures (46, 49, 52 C) were evaluated as to their efficiency in destroying salmonellae in Thuringer sausage. The effect of these heat treatments on both 'normal' and 'low acid' sausage was examined. As expected, the highest temperature was most effective in both instances. Salmonellae were able to multiply in the low acid product while it was being heated at 46 C.

The number of viable salmonellae in finished Thuringer sausage declined during refrigerated storage of the product. The rate of decline was not sufficient to ensure complete destruction of even low levels of contamination.

Several studies have been concerned with the incidence and types of salmonellae in pork sausage *(3, 6, 11)*. Incidence figures ranging from 2.3 to 57.5% have been reported. These studies have centered on fresh sausage although in some instances smoked sausage products also were examined. These reports would indicate that salmonellae may be present in the meat used in fermented sausage products. To our knowledge, there is no published data concerning either the incidence of salmonellae in fermented sausages or the behavior of these organisms during manufacture and storage of this kind of product.

Several reports that describe the effect of sodium chloride, sodium nitrite, lactic acid, and various spices on salmonellae have appeared. Matches and Liston *(9)* and Alford and Palumbo *(1)* demonstrated that salmonellae were able to proliferate in the presence of 8% salt provided the temperature and pH were near optimum. Chung and Goepfert *(4)* reported that salmonellae were able to initiate growth in tryptone-yeast extract-glucose broth acidified with lactic acid to pH 4.3 ± 0.1. Alford and Palumbo *(1)* observed that salmonellae could grow in nitrite concentrations considerably higher than can be legally added to meat.

It is not always possible to predict the behavior of salmonellae in a given food product based on the characteristics the organisms manifest in laboratory media. This study was undertaken to accumulate information concerning the fate of salmonellae during the manufacture and storage of certain fermented sausages.

Materials and Methods

Bacterial cultures

All serotypes of *Salmonella* used in this study were obtained from the culture collection of the Food Research Institute. Stock cultures were maintained on nutrient agar slants at room temperature. Working cultures were maintained by daily transfer in trypticase soy broth.

The *Pediococcus* sp. starter culture was obtained from Dr. R. H. Deibel, Department of Bacteriology, University of Wisconsin. A culture of *Lactobacillus* sp. was obtained from Mr. C. Whiting, Oscar Mayer Co., Madison, Wisconsin. Stock cultures of each starter organism were maintained frozen in litmus milk at −20 C. Working cultures were perpetuated by daily transfer in APT broth containing 3% NaCl.

Beaker sausage production

Beaker sausage was made according to the method of Deibel et al. *(5)*. The ingredients of the sausage emulsion consisted of ground beef 100 g, glucose 1.5 g, sodium chloride 3.0 g, and sodium nitrite 0.01 g. The meat and curing salts were thoroughly mixed prior to the addition of 1 ml of a suitable dilution of a 24 hr trypticase soy broth culture of *Salmonella*. One ml of a 24 hr APT broth culture of the starter organism was admixed to initiate the fermentation. The inoculated meat emulsion was placed in a 100 ml beaker which was then covered with parafilm. Incubation temperatures of 30 C and 37 C were employed. After it was established that there was no significant difference in the behavior of the salmonellae at either temperature, all subsequent fermentations were carried out at 30 C.

[1]Published with the approval of the Director of the Research Division, College of Agricultural and Life Sciences, University of Wisconsin.

In certain experiments, a commercially prepared sausage emulsion containing sucrose 1%, sodium chloride 3.4%, and sodium nitrite 156 ppm was used in place of the emulsion described above.

Pilot plant sausage manufacture

Fifty pounds of Thuringer batter was obtained from Oscar Mayer and Co., Madison, Wis., The batter was placed in a motorized blade and paddle type mixer and held at 7 C while the salmonellae were introduced. Inoculation was performed by adding dropwise with a 10 ml pipette 100 ml of a suitable dilution of broth-grown salmonellae. The mixer was operated throughout the inoculation period to obtain a homogenous distribution of the salmonellae. After mixing, the batter was transferred to a piston-type stuffer (Lynggard Co., Copenhagen, Denmark). The batter was stuffed into 6 cm collagen casings that were prewet by soaking in water. The stuffed casings were tied off at 15-20 cm intervals resulting in a 'string' of 4-5 sausages each weighing 2-3 lb. The intact strings of sausages were hung in an Atmos smokehouse (Atmos Corp., Chicago, Ill.) and the fermentation was allowed to proceed for 18-21 hr at 27-30 C and 90-95% R. H. After fermentation, a thermocouple was inserted into the geometric center of a sausage. A second thermocouple was placed in the center of the smokehouse. The temperature of the smokehouse was increased to bring the internal temperature of the sausages to the desired test temperature (e.g. 46, 49, or 52 C) as rapidly as possible. When this was accomplished, the smokehouse temperature was reduced to 1-1.5 C above that of the sausage for the duration of the heating period. After termination of heating, the sausages were sprayed with 57 C water for 5 min. This was followed by a cold water (13 C) spray until the internal temperature of the sausages had dropped to 32 C. If the product was to be retained for storage experiments, it was held at room temperature for 12-16 hours prior to refrigeration.

Enumeration of salmonellae in meat emulsions

The 3-tube Most Probable Number (MPN) procedure was employed throughout this work. Meat samples were blended with 9 volumes of sterile 0.1% peptone-water at low speed on a Waring blender for 2 min. Prior to blending, 0.5 ml of tergitol 7 was added to the blender to aid in emulsification of the fat. All subsequent dilutions were made in 0.1% peptone water. One milliliter of each dilution was inoculated into each of three tubes of buffered nutrient broth for preenrichment at 37 C for 18-24 hr. One ml was transferred from the preenrichment to 9 ml of selenite-cystine broth. After incubation at 37 C for 18-24 hr, a loopful of culture was streaked on brilliant green sulfa agar plates. Plates were incubated at 37 C for 24 hr. Suspect colonies were confirmed as salmonellae by appropriate biochemical and serological procedures.

pH determinations

All pH measurements were performed with a Radiometer pHm 26 pH meter.

RESULTS

Behavior of salmonellae in broth culture and beaker sausage

Initially, experiments were performed to ascertain the behavior of salmonellae in laboratory media to which sodium chloride and sodium nitrite were added. Sufficient sodium chloride was added to trypticase soy broth to realize a final concentration of 3%.

TABLE 1. GROWTH OF S. *typhimurium* AT 37 C IN TRYPTICASE SOY BROTH AND TRYPTICASE SOY BROTH CONTAINING $NaNO_2$

	No added nitrite			100 ppm nitrite			200 ppm nitrite		
	pH			pH			pH		
Time (hr)	4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5
24	0[1]	+[2]	+	0	0	+	0	0	+
48	0	+	+	0	+	+	0	+	+

[1]0 No growth as determined by absence of turbidity.
[2]+ Growth as determined by turbidity.

TABLE 2. BEHAVIOR OF S. *typhimurium* IN SAUSAGE EMULSION AT 30 C

	No. of salmonellae/g	
Time (hr)	Starter culture present	Starter culture omitted
0	11,000	39
2	7,500	93
6	1,500	240
8	750	750
14	—	110,000
24	240	—

After sterilization, aliquots of filter-sterilized sodium nitrite were added to achieve a series of tubes containing 100 and 200 ppm $NaNO_2$, respectively. Sterile lactic acid (10%) was then added to adjust the pH of duplicate tubes to 4.5, 5.0, and 5.5. The tubes were inoculated in a manner to yield approximately 1 x 10^3 *Salmonella typhimurium* cells per ml. The tubes were incubated at 37 C and were examined visually at 24 and 48 hr for evidence of growth (turbidity). The results are summarized in Table 1. *Salmonella typhimurium* was able to initiate growth at pH 5.0 and 5.5 in the presence of 100 and 200 ppm $NaNO_2$. Although the growth rate of the salmonellae was not determined, it was apparent that the combination of low pH, salt, and sodium nitrite resulted in increasing the generation time of the organisms.

Beaker sausage was made according to the method of Deibel et al. (5) as described in Materials and Methods. The behavior of S. *typhimurium* during fermentation is shown in Table 2. In the presence of the *Pediococcus* starter culture, the number of viable salmonellae declined throughout the fermentation period. The magnitude of the decline ranged between 0.75 and 2.5 logs in this and replicate experiments. In the absence of the starter culture, the salmonellae were able to proliferate. In an effort to ascertain the factors responsible for the decline in recoverable salmonellae, a series of experiments was performed in which various components of the curing mixture were omitted from the beaker sausage

TABLE 3. EFFECT OF THE VARIOUS CURING SALTS ON THE BEHAVIOR OF S. *typhimurium* IN BEAKER SAUSAGE

Time (hr)	Glucose + $NaNO_2$ + NaCl No. of Sal/g	pH	Glucose + NaCl ($NaNO_2$ omitted) No. of Sal/g	pH	Glucose + $NaNO_2$ (NaCl omitted) No. of Sal/g	pH	$NaNO_2$ + NaCl (glucose omitted) No. of Sal/g	pH
0	460	5.7	460	6.0	150	5.7	460	5.9
2	93	5.3	240	6.0	1100	5.7	240	5.9
4	240	5.2	150	5.9	460	5.7	460	5.9
8	93	5.3	93	5.4	4600	5.1	150	5.6
12	—	—	150	4.7	4600	4.8	93	5.2
24	9.1	4.6	3	4.5	3	4.3	150	5.4

preparations. Table 3 summarizes the results of these experiments.

There was little difference in the pattern of behavior exhibited by the salmonellae in the sausage that contained glucose, sodium chloride, and sodium nitrite and the sausage from which sodium nitrite was omitted. On the other hand, salmonellae proliferated during the first 12 hr in the sausage that did not contain added sodium chloride. Thereafter, the salmonellae died as the pH dropped to 4.3 at 24 hr. When glucose was omitted from the curing salt mixture there was only a small change in the number of viable salmonellae during the fermentation period.

In a separate trial, $NaNO_3$ (1%) and ascorbic acid (0.01%) were added to separate 100 g quantities of meat containing the usual curing salts mixture (i.e. glucose, NaCl, and $NaNO_2$). After mixing, the starter culture and S. *typhimurium* were added. Results of these experiments showed that neither nitrate nor ascorbic acid influenced the behavior of salmonellae in the fermenting product. In each instance a 1.5 log decrease in viable salmonellae occurred during the fermentation period.

Castellani and Niven *(2)* reported that *Staphylococcus aureus* was more tolerant of $NaNO_2$ under aerobic conditions than anaerobically. More recently, Metcalf and Deibel *(10)* suggested that S. *aureus* was more acid-tolerant under aerobic conditions than anaerobic conditions. The effect of the presence and absence of oxygen on the survival of salmonellae during the fermentation period was measured. An 'aerobic' fermentation was accomplished by spreading the inoculated sausage emulsion in a thin layer in a rectangular enameled pan. For comparison, the 'anaerobic' fermentation was accomplished by completely filling several 100 ml beakers with inoculated emulsion and covering with aluminum foil. Samples for analyses of the 'anaerobic' product were taken from the lowest 0.75 inch of the beaker. The data obtained from this experiment are shown in Table 4. The number of viable salmonellae declined more rapidly in the 'anaerobic' culture than in the 'aerobic' product. However, the number of salmonellae remaining viable after the 24 hr fermentation period was of the same order of magnitude in each product. Surface and core samples of sausages manufactured in the pilot plant showed little or no difference in the salmonella counts during or after fermentation.

Since S. *typhimurium* is the serotype most often isolated from cases of human salmonellosis, it was selected as the test organism for this study. However, it was possible that its behavior was not representative of the more than 1300 serotypes that are

TABLE 4. BEHAVIOR OF S. *typhimurium* DURING 'AEROBIC' AND 'ANAEROBIC' INCUBATION OF FERMENTING SAUSAGE

	Aerobic		Anaerobic	
Time (hr)	No. of salmonellae/g	pH	No. of salmonellae/g	pH
0	24,000	5.9	24,000	5.9
3	24,000	5.8	11,000	5.7
8	2,400	5.6	93	5.6
14	1,500	5.2	75	5.1
24	93	4.5	23	4.5

TABLE 5. BEHAVIOR OF FOUR SEROTYPES OF *Salmonella* DURING FERMENTATION IN THE PRODUCTION OF BEAKER SAUSAGE

	No. of salmonellae/g			
Time (hr)	S. *thompson*	S. *cholerasuis*	S. *infantis*	S. *anatum*
0	1,100	46,000	39,000	110,000
3	460	1,100	46,000	460,000
8	4,600	—	110,000	24,000
12	1,500	43	24,000	4,600
24	240	9.1	4,600	460

TABLE 6. BEHAVIOR OF S. *typhimurium* DURING THE MANUFACTURE OF THURINGER SAUSAGE

	No. of salmonellae/g	pH
Inoculated emulsion	350,000	6.0
After fermentation	35,000	4.85
After heating to 50 C for 8 min.	2,400	4.8

now recognized. Accordingly, four additional serotypes were selected and used in beaker sausage experiments. The behavior of these organisms was similar to that observed for *S. typhimurium* (Table 5).

During the course of these studies, a *Lactobacillus* sp. starter culture was obtained. The behavior of salmonellae in beaker sausages manufactured using this starter organism was the same as when the *Pediococcus* culture was employed.

Samples of a commercially prepared sausage emulsion were obtained. The content of sucrose, NaCl, and $NaNO_2$ was 1%, 3.4%, and 156 ppm, respectively. Beaker sausages were prepared using this material and the *Lactobacillus* sp. starter culture. There was no difference in the behavior of the five serotypes of *Salmonella* from that described above.

Pilot plant studies

Since all five serotypes of salmonellae were found to respond similarly in the beaker sausage experiments, *S. typhimurium* was chosen as the test organism in the pilot plant trials. Thuringer sausage was manufactured as described in Materials and Methods. Immediately prior to stuffing, an inoculum of 24 hr broth-grown salmonellae sufficient to result in an initial population of 1×10^3 to 5×10^5 cells per gram of sausage emulsion was added. Samples were taken for analyses *(a)* after inoculation and mixing, *(b)* after fermentation, *(c)* at intervals during the heating process, and *(d)* periodically during storage of the finished product. Data obtained in the early trials indicated that the application of smoke had no effect on the survival of salmonellae. Consequently, this step was omitted from subsequent trials. The results of a single experiment in which the internal temperature of the fermented product was increased slowly to 50 C and held for 8 min are presented in Table 6.

These results indicated that salmonellae would survive fermentation and the administration of a mild heat treatment. In order to measure the effect of heat on the survival of salmonellae in normal Thuringer sausage, several batches of fermented product were manufactured. Each batch was then heated at 46, 49, or 52 C (internal temperature) for up to 6 hr. Samples were withdrawn and the viable salmonellae were quantitated. A summary of these data is shown in Table 7. As expected, the salmonellae were killed at a faster rate at 52 C than at 49 and 46 C.

Since salmonellae survived the processes in which a mild heat treatment was imposed, it was considered desirable to ascertain how long they would remain viable in the product during storage. One lot of contaminated product was manufactured and split into 3 portions. One portion was left at room temperature, another was held at 5 C and the remainder was sliced (1/8 inch thick), vacuum-packed in saran-coated mylar pouches and stored at 5 C. Samples were taken periodically for 6 weeks to assay for viable salmonellae. These data are presented in Table 8. After inoculation there were 1700 salmonellae per gram of emulsion. Subsequent to fermentation and heating to 46 C the salmonella population was reduced to 11.5 per gram. Viable salmonellae were recovered from the sliced vacuum-packed portion after 42 days and from the refrigerated whole sausage after 28 days.

Starter culture failure or a reduction in activity of these organisms might result in a product that contained subnormal levels of acid and yet was still marketable. To simulate this condition, a sausage emulsion was prepared that contained 0.25% sucrose in place of the normal 1%. Beaker sausage experiments with this batter and an active starter culture showed that the resultant product would have a pH of 5.2-5.4 after 19 hr of fermentation at 27-30 C. After fermentation, the low acid sausages made in the pilot plant were heated in a manner similar to that described above for the 'normal' Thuringer. The results of these trials are presented in Table 9. During the fermentation period, the salmonella population increased from 1900 per gram to 18,000 per gram. The salmonellae multiplied in the product while the sausage was being heated at 46 C. The organisms died at a slower rate in the low acid sau-

TABLE 7. EFFECT OF VARIOUS HEAT TREATMENTS ON THE SURVIVAL OF *S. typhimurium* IN THURINGER SAUSAGE

Treatment	No. of salmonellae/g	pH	No. of salmonellae/g	pH	No. of salmonellae/g	pH
Prior to fermentation	21,000	6.1	240,000	6.0	24,000	6.0
After fermentation	2,400	4.8	11,000	4.8	2,400	4.8
Time of heating (hr)	46 C		49 C		52 C	
1	460	–	2,100	–	<0.03	–
3	460	–	460	–	<0.03	–
5	240	–	2.4	–	<0.03	–
6	–	–	0.43	–	<0.03	–

TABLE 8. SURVIVAL OF *S. typhimurium* IN THURINGER SAUSAGE STORED AT 5 C AND ROOM TEMPERATURE

Time (days)	Average number of salmonellae/g		
	Stored at room temperature	Stored at 5 C	Sliced, vacuum-packed, and stored at 5 C
5	1.5	4.3	1.5
7	2.3	4.3	—
10	9.3	15	9.3
14	4.3	7.5	4.3
21	<0.3	0.36	0.91
28	<0.3	0.23	2.4
42	<0.3	<0.3	0.91

TABLE 9. EFFECT OF HEAT ON THE SURVIVAL OF *S. typhimurium* IN 'LOW-ACID' THURINGER SAUSAGE

Time of heating (hr)	Average number of salmonellae/g		
	46 C	49 C	52 C
0	24,000	11,000	11,000
1	4,600	11,000	24
3	110,000	2,400	<0.03
5	1,100,000	240	<0.03

sage than in the normal sausage when heated at 49 and 52 C.

DISCUSSION

It has been previously reported that salmonellae would grow in the presence of higher concentrations of nitrite than may legally be incorporated into meat products *(1)*. Koelensmid and van Rhee *(8)* demonstrated that 500 ppm of nitrite had no effect on the growth at 20 C of salmonellae in ham jelly containing 5.6% NaCl. Our data substantiate the premise that salmonellae can grow in the presence of nitrite. However, the rate of growth in broth containing 3% NaCl and acidified to pH 5.0 with lactic acid is slower in the presence of nitrite (100-200 ppm) than in its absence. It is quite likely that the nitrite effect is less profound in sausage emulsions because of binding of the nitrite by myoglobin. Because of this, it seems likely that nitrite is not one of the major environmental factors that influence the behavior of salmonellae during the manufacture of fermented meats. Evidence to support this statement is presented in Table 3. The survival of salmonellae during fermentation was unaffected by the presence or absence of nitrite in the curing salt mixture. Furthermore, incorporation of NO_3 into the curing mixture to serve as a continuing source of NO_2 by the action of salmonellae and other nitrate reducing organisms in the meat had no effect on the survival of salmonellae. The data presented in Table 3 indicate that the combination of acidity and NaCl is the major factor responsible for the demise of salmonellae during fermentation. When NaCl is omitted from the curing mixture, multiplication of salmonellae occurs until a sufficient amount of acid is produced by the starter organisms to reduce the pH of the emulsion to between 4.8 and 5.1. At more acid pH values the number of viable salmonellae decreases. In the absence of added sugar there is not sufficient fermentable carbohydrate present to permit the starter culture to produce enough acid to cause a significant reduction in the pH of the emulsion. Although it is not known with certainty why the salmonellae failed to increase in number during incubation of the sugarless batter, it may be due to their inferior number in comparison to the normal flora of the meat. The development of acidity by the starter culture may afford the salmonellae a competitive advantage over more acid-sensitive organisms such as pseudomonads.

Preliminary indications were that salmonellae died faster in fermenting sausage in the absence of air than in its presence. However, there was little difference in the behavior of salmonellae that were present at the outer rim and those in the core of the sausages manufactured in the pilot plant trials. Presumably, both areas in the sausage during the fermentation period were largely anaerobic.

It was of interest and importance to find that the five serotypes of salmonellae behaved similarly under the conditions imposed in this study. Although it remains impossible to extrapolate these data to permit an absolute prediction regarding the behavior of all of the known serotypes, one is inclined to feel more confident when the pattern of behavior is characteristic of five serotypes than if the data were gathered using a single serotype. It must be pointed out that these data concerning the five serotypes pertained only to the fermentation process and not to the subsequent heating step. Unpublished data (Goepfert and Iskandar) indicate that the various serotypes of salmonellae respond differently to heat when the water activity of the environment is less than 0.99.

Similarity in the response of the salmonellae to fermentation conditions regardless of the type of starter culture or meat emulsion employed is fortuitous. This would indicate that the data obtained in this study would be applicable to the somewhat varied conditions employed in the industry.

During the initial trials at pilot plant scale several lots of Thuringer were manufactured by a process that involved application of heat until a desired internal temperature (e.g. 46, 47, 49 C) was attained. It was suggested (Borchert, personal communication) that the processes employed in the industry were so

varied that data obtained in this manner regarding the effect of heat might find only limited application. For this reason it was decided that it would be more meaningful to approach the aspect of 'heat effect' by bringing the product to a given internal temperature as rapidly as possible and measuring the survival of the salmonellae over a prescribed period of time. This procedure was adopted for the remainder of the experiments. The 'come-up' time necessary to bring the internal temperature of the sausages from that of fermentation (27-30 C) to the test temperature (46-52 C) ranged from 45 to 60 min. Table 7 summarizes the effect of these heat treatments. As would be expected, the higher temperatures resulted in a more rapid destruction of salmonellae. An internal temperature of 46 C for 5 hr resulted in a 1 log reduction in viable salmonellae. In contrast, 52 C for 1 hr decreased the population of salmonellae by more than 99.99%. Obviously, this latter treatment affords the processor a greater degree of protection against the possibility of his product containing salmonellae.

The data show that salmonellae can survive the fermentation and a marginal heat treatment if a sufficient number of cells are present initially. The longevity of these organisms in finished products of this type was unknown. Similar studies by Goepfert et al. *(7)* on the survival of salmonellae during the ripening of Cheddar cheese showed that a slow but continuing decline in the number of viable salmonellae occurred throughout the holding period at both 7 and 13 C. To ascertain the behavior of S. *typhimurium* in the finished sausage product, one lot of Thuringer sausage was divided into three portions and stored as described in the previous section. Table 8 shows that the salmonellae decreased in number in the intact sausages held under refrigeration. Definitive statements regarding the fate of salmonellae in product at room temperature are not possible because the material used in these experiments was not adequately protected from desiccation and mold spoilage. The sliced, vacuum-packaged product remained salmonella-positive throughout the 42 day holding period. Therefore, it seems safe to surmise that extended refrigerator storage of the product cannot be relied upon to free it from salmonella contamination.

One of the most vexing problems encountered by an industry using starter cultures for fermentation is the occasional inactivity or reduced level of activity by the organisms. Questions arose concerning *(a)* behavior of salmonellae during fermentation by an 'inactive' starter and *(b)* response of the salmonellae when heated in the low acid product that resulted from this fermentation. Preliminary experiments revealed that reducing the sugar level in the cure to 0.25% resulted in a product having a pH of 5.2-5.4 after fermentation. Beaker sausage experiments indicated that salmonellae would grow in the low sugar emulsion during an 18-20 hr fermentation period. This was subsequently confirmed in the pilot plant experiments (see Table 9). Of equal importance, however, was the behavior of these organisms during the heat treatments that were given to the product. At 46 C, the salmonellae multiplied from an initial population of 24,000/g to 1,100,000/g during the 5 hr heating period. If we accept the 1 hr determination as representing an initial decline in population then the subsequent increase in number of salmonellae would represent approximately 8 generations over a 4 hr period or a generation time of about 30 min. At this elevated temperature, this is not an unreasonable rate of cell division. More likely, somewhere between 5 and 8 divisions took place, depending on the true initial concentration of salmonellae. Correspondingly, the lethality of the 49 and 52 C treatments was somewhat less in the low acid product than in the normal product.

Two points should be emphasized regarding this study and the overall picture of salmonellae in fermented meats. First, the numbers of salmonellae used in this study were relatively high. These numbers were chosen for ease in experimental design. They were not meant to approximate what exists in industrial practice because the true incidence and degree of contamination (if any) are unknown to us. It was felt that the behavior of these populations of salmonellae was representative of what might be expected from lesser numbers.

Secondly, the public health significance of salmonellae in fermented sausage has not been discussed. It is generally accepted that a large number of salmonella cells is more likely to cause illness than a small number. The data obtained in this study indicate that it would not be surprising to find salmonellae in products of this nature that were not heated or that received only a mild heat treatment during processing. However, to the authors' knowledge, there have not been any documented outbreaks of salmonellosis in which fermented meats were the vehicle. Because of this, it would only be speculative to discuss the public health significance of salmonellae in fermented sausage.

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COMMITTEE ON FOOD PROTECTION

Continued from Page 177

an increasing population, emphasizes and amplifies the need for better controls to protect foods and food products from undesirable environmental intrusions.

These developments, and the need for uniformity in criteria and standards, highlight the need for improved communications and understanding at inter-agency, consumer, and industry levels. The recent re-organization and redirection of the consumer protection agencies of the Department of Health, Education, and Welfare, similarly indicate the need for attention to communication and understanding at all levels of government, as well as between government and the consumer and industry.

The purpose of a National Seminar would be to define the problems associated with food protection at federal, state, and local levels; to seek solutions of the problem defined; to establish or suggest a priority system for enforcement agencies and industry as related to food protection problems; to suggest an inter-agency operational program which would eliminate duplication and overlapping, which would provide for coordination and cooperation on an inter-agency basis and with the industry; to establish a basis for a continued dialogue between federal, state, and local agencies as well as the consumer and manufacturer; and to provide more food protection with the technical and financial resources available.

The plan would call for implementation of a national conference by a university having an interest and concern in the food protection area. It is suggested that a university having a School of Public Health or a Department of Food Technology or Food Science might best serve in this connection.

It is felt that a broad basis of financial support would do much to gain the acceptance and implementation of the proposed programs and actions, and to establish the basis for a continuing dialogue. It is estimated that such a Conference would cost $40,000 to $50,000.

Persons invited should be from all levels of government, and include representatives from industry, universities, and professional and trade organizations.

Invitations should be extended to:

1. Federal Agencies, such as:
   a. Department of Health, Education and Welfare
   b. Department of Agriculture
   c. Department of Interior
   d. Department of Defense
2. State and Local Government representatives
3. Professional Organizations, such as:
   a. International Association of Milk, Food, and Environmental Sanitarians
   b. American Public Health Association
   c. Institute of Food Technologists
   d. National Association of Sanitarians
   e. Association of Food and Drug Officials of the United States
   f. Conference of Local Environmental Health Administrators
   g. Conference of State and Territorial Health Officers
   h. U. S. Conference of City Health Officers

The Conference should be broad based and not try to examine specific problems such as salmonellosis. The Conference should explore the following areas: (*a*) establishment of priorities in food protection, (*b*) reviewing areas of concern of the various federal agencies and their priorities, (*c*) communications, (*d*) coordination of programs, and (*e*) establishment of uniform standards and criteria.

A meeting was held on January 14, 1969 with Charles C. Johnson, Jr., Administrator of CPEHS of the Department of Health, Education, and Welfare, and members of his staff. Tom Gable of the National Sanitation Foundation, Bill Hickey and David Kronick of the International Association of Milk, Food, and Environmental Sanitarians, discussed this proposal with Mr. Johnson and his staff. While they expressed a great deal of interest in the proposal, they felt that budgetary limitations prohibit funding at this time.

The Committee on Food Protection recommends that the Executive Committee endorse the idea of a National Conference on Food Protection and that Mr. Robert Finch, the Secretary of Health, Education and Welfare and the President's Consumer Consultant, Mrs. Virginia Knauer, be notified of this recommendation.

Continued on Page 201

HEAT RESISTANCE OF ENTEROCOCCI[1, 2]

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Abstract

Fifty enterococcus cultures were exposed to temperatures of 62.8 and 71.1 C for 30 min and 71.7 C for 15 sec in skimmilk containing approximately 10 million cells/ml. *Streptococcus durans* was most heat resistant, although no culture survived 71.1 C for 30 min. Additional milk solids and fat did not provide protection from destruction by heat. In skimmilk, at population levels of approximately 100/ml, the cultures survived heat treatments of 71.7, 76.7, and 82.2 C for 16 sec by 55.2, 46.4, and 32.5%, respectively.

After pasteurization at 62.8 C for 30 min, only 8 of 426 commercial milk samples had detectable enterococci. These 8 samples contained from 1 to 30 enterococci/ml. When 55 of these more heat-resistant cultures were again laboratory pasteurized, 32 remained viable. Only 8 of these 32 cultures showed numerical increase when stored at 5 to 8 C for 7 days after laboratory pasteurization.

Before enterococci can be used as indices of bacterial quality in dairy products, their presence or absence must be related to the specific heat treatments given dairy products.

If enterococci are to serve successfully as indices of bacterial quality of certain foods *(9, 11, 12)*, more must be known about their heat resistance under defined test conditions.

The ability of enterococci to withstand elevated temperatures has been known for many years. In 1934, Sherman and Stark *(15)* reported that members of the faecalis group of streptococci could survive exposure to 65 C for 30 min in skimmilk, whereas strains of *Streptococcus lactis* could not. The greater heat resistance of enterococci prompted Sherman *(14)* to use this characteristic as an aid in classifying streptococci. Indicating the commercial significance of heat-resistant enterococci, Niven *(11)* stated that *Streptococcus faecium* is capable of surviving the minimum processing temperatures required for canned hams and that the processor has learned to cook this product to an internal temperature of at least 70 C to reduce the potential spoilage hazard associated with *S. faecium*. The frequent occurrence of enterococci in dry milk *(7)* is undoubtedly due, in part, to their heat resistance.

Many studies of the heat resistance of enterococci have been made, but the results have not always been directly applicable to dairy-processing problems. In some instances, only a few cultures have been studied *(8, 18)*; in others, skimmilk, whole milk, or cream were not used as the heating menstrua *(17, 18)*. In additional studies, measurements of resistance were not directly related to commercial industry practices *(17, 18)*.

This investigation was undertaken to determine the resistance of enterococci freshly isolated from dairy products to various heat treatments used in dairy processing. This investigation also was intended to serve as a corollary to previously reported information *(13)* on the chlorine resistance of enterococci.

Methods and Materials

Preparation of culture suspensions

Test organisms recently isolated from dairy products were transferred for 3 consecutive days in 11.0% solids, reconstituted, autoclaved nonfat dry milk and incubated at 37 C for 18 hr. Growth from the third transfer was used immediately as the test culture for heat-resistance studies. For most tests, 50 cultures were used in 3 replications; 12 strains each of *Streptococcus faecalis*, *S. faecalis* var. *zymogenes*, and *S. faecalis* var. *liquefaciens*, and 14 strains of *S. durans*. Some unclassified strains were used for other experiments.

Heating menstrua

Reconstituted nonfat dry milk (11.0% solids), whole milk (3.5% milk fat), ice cream mix (12.0% milk fat), and cream 36.0% milk fat) were used as the heating menstrua. To reduce bacterial populations of pure cultures to levels of less than 300/ml before heating, sterile skimmilk or whole milk was used as the diluent.

Laboratory pasteurization

Laboratory pasteurization was accomplished by using one of two complete submersion techniques. The first procedure, used for studying heat resistance of pure, single-strain cultures, consisted of heat-sealing 2.5-ml aliquots of the menstrua and test organisms in 10 x 75 mm previously sterilized test tubes. The sealed tubes were held in an ice-water bath until they were submerged in the laboratory pasteurizer. After heat treatment, samples were immediately removed from the pasteurizer and returned to the ice-water bath. Temperature changes were followed with a Leeds and Northrup

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[2]Data taken from a thesis submitted by the senior author to the Graduate College of the Iowa State University in partial fulfillment of the requirements of the degree Master of Science.

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TABLE 1. EFFECT OF SPECIFIC PRODUCT PROCESSING HEAT TREATMENTS ON ENTEROCOCCI.[a]

Species	Control before heating	Heat treatment[b]		
		62.8 C for 30 min	71.7 C for 15 sec	71.1 C for 30 min
	Count/ml[c]			
S. *faecalis*	83 x 10^5	810	23 x 10^5	<10
S. *faecalis* var. *zymogenes*	120 x 10^5	1,300	54 x 10^5	<10
S. *faecalis* var. *liquefaciens*	210 x 10^5	500	26 x 10^5	<10
S. *durans*	100 x 10^5	15 x 10^5	54 x 10^5	<10

[a]Twelve strains each of S. *faecalis* and its' varieties and 14 strains of S. *durans* were tested.
[b]Cultures were heated in 11% solids reconstituted nonfat dry milk.
[c]Standard methods agar, incubated at 32 C for 4 days. Each count is the average of three replicate tests of each strain, each test plated in duplicate.

thermocouple. The second procedure, the Anderson-Meanwell technique *(3)*, used for raw milk studies, consisted of placing 10-ml aliquots of samples into 15 x 125 mm rubber-stoppered, previously sterilized test tubes. These samples also were held in an ice-water bath before and after pasteurization. Come-up time for the smaller tubes was 20 sec; contents of the larger tubes required 5 min to reach indicated temperatures.

Bacterial populations and heat treatments

Initial studies, with bacterial populations of approximately 10 million/ml of the 50 known cultures, were made by using reconstituted nonfat dry milk as the heating medium. Heat treatments of 62.8 and 71.1 C for 30 min and 71.1 C for 15 sec were used. The same 50 cultures, adjusted to levels of approximately 100/ml in skimmilk, were also subjected to heat treatments of 71.7, 76.7, and 82.2 C for 16 sec. Cultures of S. *durans* in ice cream mix and cream were heat treated at 71.1 C for 30 min.

To determine the heat resistance of enterococci found in raw milk, 450 samples of grade-A and manufacturing-grade milks were obtained from Iowa dairy plants. Samples were heated to 62.8 C for 30 min and then plated.

To obtain enterococcus isolates from these commercial milk samples, 55 colonies of bacteria surviving pasteurization were picked into litmus milk, purified, and identified as enterococci. Species and variety classification was not attempted. After serial transfer, as previously described, these cultures were diluted with sterile whole milk, plated, pasteurized at 62.8 C for 30 min, and replated to determine survival. After pasteurization, surviving cultures were tested for growth at 5 to 8 C by holding in a refrigerator and determining bacterial counts after 3 and 7 days.

Plating conditions

Standard methods agar *(1)*, incubated at 32 C for 4 days, was used to enumerate known enterococcus strains. Citrate azide agar *(12)* was used in the studies with unclassified strains.

RESULTS AND DISCUSSION

The Enterococcus group of the genus *Streptococcus* is described by Breed, Murray, and Smith *(4)* as being able to survive a heat treatment of 60 C for 30 min. Foster, et al. *(6)* state that all species of this group resist 63 C for 30 min.

Minimum pasteurization requirements for fluid milk *(16)* are 61.7 C for 30 min or 71.7 C for 15 sec. Most cream intended for butter manufacture is pasteurized at not less than 71.1 C for 30 min or an equivalent exposure at a higher temperature for a shorter time. Cheese frequently is made from milk either fully pasteurized or heat treated in a plate pasteurizer at 62.8 C for 15 sec or more. Ice cream mix is commonly pasteurized at 68.3 C for 30 min, or equivalent higher-temperature, shorter-time treatments. In the manufacture of dry milk products, a wide range of temperature and time exposures may occur, depending upon the method used; however, preheating from 61.1 to 93.3 C for 10 to 30 min may occur.

The major objective of this investigation was to determine the lethal effect of heat treatments commonly used in dairy processing upon a meaningful number of enterococci.

Results of the initial heat-resistance survey of known enterococcus cultures are shown in Table 1. Previously, eight enterococcus cultures, grown in sterile, reconstituted skimmilk, were pasteurized at 62.8 C for 30 min. Standard Methods agar was compared against Eugonagar (Baltimore Biological Laboratories) for enumeration efficiency before and after heat treatment. Ten per cent V-8 juice was added to the Eugonagar. Two replicate platings, each in duplicate, were incubated for 2, 4, and 7 days. Highest recoveries were obtained on plates incubated at 37 and 32 C. Little increase in counts was noted after 4 days of incubation; consequently, incubation at 32 C for 4 days was selected for the sake of convenience.

With an initial concentration of 10 million/ml in the unheated controls, S. *durans* had the greatest resistance to 62.8 C for 30 min; equivalent numbers of

TABLE 2. SURVIVAL OF ENTEROCOCCI IN SKIMMILK AFTER LABORATORY PASTEURIZATION.[a, b]

Species	Count/ml[c] Before past.	Count/ml[c] After past.	Range of % survival by strains	Avg % survival for all strains
		71.7 C/16 sec		
S. *faecalis*	99	55	11.1 - 70.9	55.6
S. *faecalis* var. *zymogenes*	110	61	45.6 - 65.5	55.5
S. *faecalis* var. *liquefaciens*	140	78	45.0 - 64.0	55.7
S. *durans*	100	54	43.8 - 64.5	54.0
		76.7 C/16 sec		
S. *faecalis*	66	31	20.0 - 59.8	47.0
S. *faecalis* var. *zymogenes*	74	34	26.9 - 57.0	45.9
S. *faecalis* var. *liquefaciens*	180	81	21.7 - 55.6	45.0
S. *durans*	65	31	39.5 - 57.4	47.7
		82.2 C/16 sec		
S. *faecalis*	52	20	14.3 - 54.2	38.5
S. *faecalis* var. *zymogenes*	68	23	13.8 - 57.1	33.8
S. *faecalis* var. *liquefaciens*	170	49	2.5 - 47.5	28.8
S. *durans*	65	19	12.3 - 52.6	29.2

[a]Twelve strains each of S. *faecalis* and its varieties and 14 strains of S. *durans* were tested.
[b]Cultures were heated in 11% solids reconstituted nonfat dry milk.
[c]Standard methods agar, incubated at 32 C for 4 days. Each count is the average of three replicate tests of each strain, each test plated in duplicate. Only one test for each strain was performed at 82.2 C.

S. *faecalis* and its varieties were greatly reduced in comparison, survival being 15.0 to 0.014%, respectively. Greater survival at a pasteurization treatment of 71.7 C for 15 sec was noted; S. *durans* was the most resistant, with an average survival of 54.0%; 12.4-45.0% of S. *faecalis* and its varieties survived. A heat treatment of 71.1 C for 30 min reduced all strains to less than 10/ml.

To verify that fat content of the heating medium had little effect upon pasteurization requirements *(10)*, cultures of S. *durans* (approximately 10 million/ml) were heated to 71.1 C for 30 min in cream and ice cream mix. Bacterial numbers again were reduced to less than 10/ml after heat treatment. Thus, neither increased fat nor solids in cream and ice cream mix protected the enterococci from heat destruction.

From these results, it can be assumed that even abnormally large numbers of enterococci would not survive common heat treatments used to pasteurize cream for churning or ice cream mix. Their presence in ice cream or butter should indicate contamination after pasteurization or a heat treatment not equivalent to the usual pasteurization exposure.

Since experience in our laboratory indicated that grade-A raw milk produced under proper conditions would not contain large numbers of enterococci, the 50 known enterococcus cultures were then heat treated in reconstituted nonfat dry milk containing about 100/ml. Temperatures of 71.7, 76.7, and 82.2 C for 16 sec were used. Results are given in Table 2. These data show that the presence of enterococci in high-temperature, short-time (HTST) pasteurized milk should not be unexpected, nor should their presence in relatively low numbers be interpreted as having any sanitary significance. For the same reason(s) cheeses made from pasteurized or heat-treated milk also would be expected to contain enterococci as has been shown by Clark and Reinbold *(5)*. There was considerable survival of these cultures at the different temperature-time treatments (an average of 55.2% survived 71.7 C for 16 sec; 46.4% survived 76.7 C for 16 sec; and 32.5% remained viable after exposure to 82.2 C for 16 sec), with little difference in survival rates between species and strains of the enterococci.

To determine the survival of enterococci in commercial raw milk after laboratory pasteurization, 450 samples of milk were heated at 62.8 C for 30 min (Table 3). Enterococcus densities were determined both before and after heat treatment by using Citrate azide agar. To ascertain that this highly selective medium would not be inhibitory to heat-treated organisms, 16 enterococcus cultures were plated before and after laboratory pasteurization by using both Citrate azide and Standard methods agars. There was no significant difference in recovery of these cultures from either medium.

Twenty-four of the 450 unpasteurized samples contained less than 1 enterococcus/ml; 89 other samples

TABLE 3. SURVIVAL OF ENTEROCOCCI IN COMMERCIAL MILK SAMPLES AFTER LABORATORY PASTEURIZATION.[a, b]

Count in raw milk before pasteurization		No. of samples in each count range after pasteurization			
Count range (No./ml)	No. of samples in range	Count range (No./ml)			
		<1	1-10	11-20	21-30
<1	24	24			
1-10	35	35			
11-100	54	54			
110-1,000	98	96	2		
1,100-3,000	87	85	1		1
>3,000	152	148	2	1	1
Total	450	442	5	1	2

[a]Citrate azide agar, incubated at 37 C for 72 hr.
[b]Pasteurized at 62.8 C for 30 min.

TABLE 4. GROWTH OF ENTEROCOCCI AFTER PASTEURIZATION WHEN INCUBATED AT 5 TO 8 C.[a, b]

Unheated control		No. of samples in each count range (no./ml) at selected periods following pasteurization									
		0 days			3 days			7 days			
Count range (No./ml)	No. of samples in range	<1	1-10	11-20	<1	1-10	11-20	<1	1-10	11-20	21-30
1-10	1		1			1		1			
11-20	16	5	11		6	9	1	6	10		
21-30	20	4	15	1	5	14	1	5	11	2	2
31-50	5	1	4		1	3	1			3	2
51-100	5	5			5			5			
110-300	8	8			8			8			
Total	55	23	31	1	25	27	3	25	21	5	4

[a]Cultures were suspended in milk containing 3.5% milk fat and were pasteurized at 62.8 C for 30 min.
[b]Citrate azide agar, incubated at 32 C for 72 hr; counts represent average of duplicate plates.

contained from 1 to 100 enterococci/ml. No detectable enterococci survived in these samples after the heat treatment. Of the 185 raw milk samples containing from 110 to 3,000 enterococci/ml, only 4 contained viable organisms after pasteurization. One-hundred-and-fifty-two raw milk samples contained over 3,000 enterococci/ml, but again, only 4 contained viable organisms after the heat treatment. This low survival rate may be attributed to the differences in effectiveness of heat treatments (Tables 1 and 2). Other comparative studies have shown that bacterial destruction by HTST generally is not as great as that attained by the low-temperature holding method. Because of these differences in survival rates after commonly-used pasteurization methods, use of enterococci as a sanitary index in heat-treated dairy products is questionable. The more heat-sensitive coliform bacteria show far less variation in survival after comparable temperature-time exposures than is shown here.

Although the data in Tables 1 and 2 do not reveal meaningful differences in species or strain survival after HTST heat treatment, the possibility still exists that some cultures isolated from a "wild" environment might have greater heat resistance. For this reason, 55 of the colonies formed by enterococci that survived laboratory pasteurization of the raw milk samples (Table 3) were picked into litmus milk, cultivated, and purified. After verification as enterococci, they were transferred, diluted in whole milk to levels of 1 to 300/ml, and again laboratory pasteurized. Results are given in Table 4. Of the 55 cultures examined, 23 (42%) did not survive pasteurization, 31 (56%) survived in numbers from 1 to 10/ml, and 1 (2%) contained 14/ml after pasteurization at 62.8 C for 30 min. Since 32 of 55 cultures survived, it seems reasonable to assume that some recently isolated enterococci may be more heat resistant than others.

To determine if the heat-treated but still viable cultures would maintain their numbers or grow at 5 to 8 C, they were immediately cooled and stored at a temperature in this range. Bacterial estimates were made at 0, 3, and 7 days after laboratory pasteurization. One of the criteria used for identification and classification of enterococci is their ability to grow at 10 C *(4)*. Most frequently, however, inocula much greater than 1 to 14/ml are used for studies of this nature. Under the test conditions of this study, little growth occurred. At the beginning of storage, only 1 culture was in the 11 to 20/ml count range; after 3 days, 3 cultures had reached this number. After 7 days of storage, 5 cultures contained from 11 to 20/ml, and 4 cultures had increased to 21 to 30/ml. These results indicate that, if enterococci survive pasteurization, a small amount of growth may occur in milk held at normal refrigeration temperatures. Of greater significance, however, is that the increase would be negligible when compared with that commonly occurring with psychrophilic bacteria, including many strains of coliforms. If adequate precautions are taken, enterococci will not be responsible for spoilage problems in refrigerated, pasteurized milk or cream.

Since enterococci do not grow at pasteurization temperatures, but some cells of such cultures are able to remain viable, they may correctly be called "thermoduric." As is true of most attempts to group bacteria, however, their categorization as thermoduric is only as meaningful as the classification procedures can be made specific. In other words, enterococci may or may not survive pasteurization, depending upon such factors as cultural conditions before heating, the definition of "survival," recovery methods, and most importantly, pasteurization temperature and time used.

If the heating procedure (62.8 C for 30 min) currently used in the test for enumeration of thermoduric

bacteria (2) is accepted many individual cells, or clumps and chains of enterococci as found in raw milk, are not thermoduric. If cultures containing millions of cells per milliliter are used instead of cell levels commonly occurring in raw milk, then most enterococcus strains are considered thermoduric to one degree or another. Even with large numbers of enterococci initially present, the viable residue after a pasteurization heat treatment may not always contribute significantly to the Standard Plate Count of pasteurized milk or other fluid products. If HTST pasteurization is used, enterococci, even at low levels, might appear quite thermoduric and thus contribute significantly to viable counts on fluid dairy products.

Even though one of the criteria used for identification and classification of enterococci is ability to grow at 10 C, growth is not rapid between 5 and 8 C after heating. They are not psychrophilic and are not likely to cause defects in properly refrigerated, pasteurized fluid dairy products unless present under unusual circumstances.

The ability or inability of enterococci to survive certain heat treatments makes them worthy of consideration as indicators of bacterial quality in such products as ice cream mix or butter, but not in other products such as dry milk, cheese, or pasteurized fluid milk or cream. What they may do in cheese during curing, or in dry milk after reconstitution is not a matter for speculation here, but at least some of the reasons for their presence may be more clearly understood.

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CONTAMINATION OF MILK WITH AIRBORNE MICROORGANISMS THROUGH THE VACUUM DEFOAMER

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Abstract

Serratia marcescens aerosols were generated under a hood covering the filler end of a model EPCF Pure Pak milk packaging machine. When water was packaged with the machine, contamination by the test organism occurred only when the defoamer was in operation.

Milk samples were obtained from the supply line to the filler bowl, the filler bowl, and the filled package in three different plants. Airborne microorganisms were collected at the same time in the vicinity of the packaging machine by liquid impingement. Following incubation at 4.5 C and 7.0 C, the bacterial types in milk samples from the filler bowl and package but not from the supply line were similar to those in the impingement fluid for two of the trials at both incubation temperatures, and for the third at 4.5 C incubation.

Air pulled through the filler bowl at rates of 3,000 to 6,000 liters/min by the defoamer contaminated the milk with psychrotrophic microorganisms.

In processing fluid milk in a closed system, there is a limited opportunity for contact of air with the pasteurized milk. Sedimentation of airborne microorganisms from the air space of the pasteurized milk surge tank would generally not account for significant levels of post-pasteurization contamination *(4)*. However, in the operation of defoamers on paper packaging machines or of vacuum type milk bottle fillers, considerable quantities of air may be pulled through the supply tank of the filler thus affording an opportunity for airborne contamination of the pasteurized milk. Elliker *(5)* reported that improved sanitation of the filler parts of a paper packaging machine resulted in reduced contamination of the milk. He further reported lower contamination rates with a paper packaging machine equipped with a rotary type filler as compared to one with a piston type filler. Piston type fillers are generally equipped with defoamers, whereas rotary type fillers are not.

These studies were undertaken to determine if airborne contamination would occur through the defoamer of a paper packaging machine.

Experimental procedures

Phase 1

The filler end of a model EPCF Pure Pak milk packaging machine was enclosed by polyethylene sheets supported on a frame. The filler bowl was connected to the pasteurized surge tank with sanitary pipe and the assembly was sanitized by pumping 190 liters of 200 ppm chlorine solution through the system. The area under the polyethylene sheet was sprayed with 200 ppm chlorine. Following sanitization, the assembly was rinsed with water which had been chlorinated to 50 ppm available chlorine, held for 30 to 60 min, and the chlorine neutralized with sodium thiosulfate solution. Water treated in this manner was used as the test medium throughout the trials.

The general procedure followed in the trials was to fill the supply tank with treated water and start the machine. At 5 min intervals six ½-pt cartons were run through the machine, filled with water, and sealed. The last two cartons were saved for microbiological sampling. Air samples were taken at intervals from near the defoamer with the Anderson aerosol sampler *(2)* using plate count agar as the impingement medium.

At intervals following the start of the machine, aerosols of *Serratia marcescens* in nutrient broth were generated under the hood by means of a DeVilbis No. 40 nebulizer. Operation of the defoamer fan and use of steam with the defoamer were introduced as variables.

In the early trials, water was run through the filler only intermittently as cartons were filled. In the final trial, however, test water was continuously pumped into the supply tank and from the filler valve to more nearly simulate a commercial operation.

Air plates were incubated at 32 C for 24 hr. From each sample carton obtained, 25 ml of water was filtered through a 0.45μ membrane filter and colonies developed on tryptone glucose extract broth. Only red colonies typical of *S. marcescens* were counted.

Phase 2

Samples of milk were obtained at the following locations on a piston type milk packaging machine from each of three commercial dairy plants (one collection per plant): (*a*) through a rubber septum in the milk line feeding the filler supply tank with a sterile syringe, (*b*) from the filler supply tank with a sterile pipette, and (*c*) packaged milk.

At the same time, viable particle content of the air was determined on a 28.32 liter (1 ft^3) sample and a 141.58 liter (5 ft^3) sample by liquid impingement into brain heart infusion broth using a Millipore liquid impinger.

The milk samples and impingement broth were plated using standard plate count (SPC) techniques *(1)* the day they were picked up and following 7 and 14 days incubation at 4.5 C and 7 C.

At the time of enumerating colonies on the SPC plates, random colonies were picked from the dilution counted and transferred onto a master plate containing plate count agar for replica plating *(6)*. Following incubation at 32 C for approximately 16 hr, seven replica plates were stamped from the master plate in the following order: plate count agar, MacConkey agar, SS agar, Staphylococcus 110 agar, phenol red dextrose agar, CVT agar *(7)*, and plate count agar. The

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replica plates were incubated at 32 C for 18 to 24 hr and examined for growth. Growth on the final plate count agar plate was indicative of successful inoculation of all plates. Colonies on one of the plate count agar plates were examined for pigmentation and fluorescence, and a smear made for Gram staining. The plate was then flooded with freshly prepared 10% hydrogen peroxide solution to test for the presence of catalase. Spore formation of Gram positive rods was determined by inoculation of trypticase soy broth with aged colonies from plate count agar. The broth was heated to 80 C for 5 min, cooled, and incubated at 32 C for 48 hr. Growth in the heated broth was indicative of spore formation. The isolates were classified according to the scheme shown in Table 1.

Air flow through the filler bowl as a result of defoamer operation was calculated from air velocity at the exhaust as measured with a Tycos air velocity meter.

RESULTS AND DISCUSSION

Phase 1

Contamination of water from an aerosol of S. *marcescens* in a paper packaging machine is shown by the data in Fig. 1. The atmosphere under the hood was free of S. *marcescens* prior to aerosolization. It is evident from the data of Trial 1 that contamination of water in the filler bowl occurred at the time of production of the aersol with the defoamer turned on.

In a second trial the defoamer was put into operation 30 min after the start of aerosolization to determine separately the effects of aerosolization and

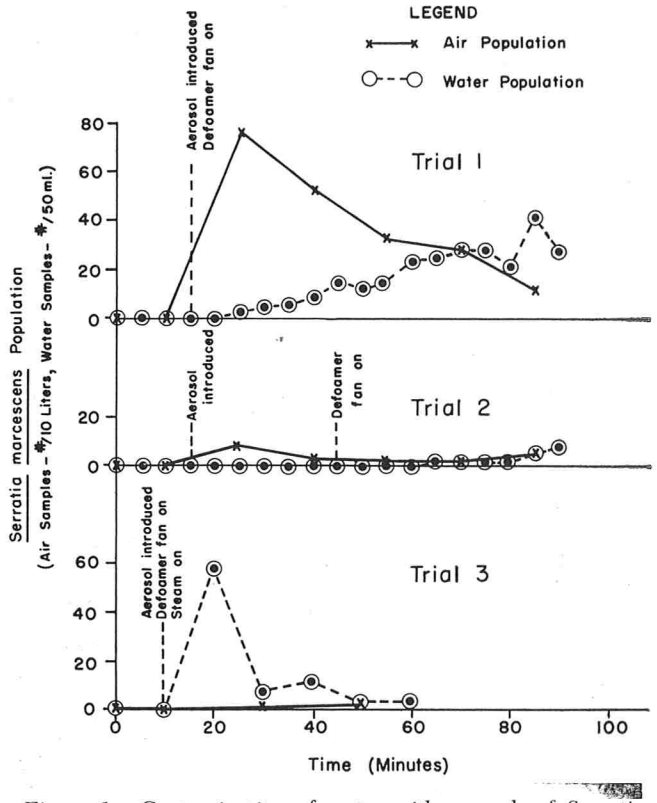

Figure 1. Contamination of water with aerosols of *Serratia marcescens*.

TABLE 1. CLASSIFICATION SCHEME FOR BACTERIAL ISOLATES UTILIZING REPLICA PLATE TECHNIQUES

Genus	MacConkey agar	SS agar	Staph 110 agar	Phenol-Red dextrose agar	CVPI agar	Gram stain	Rod	Coccus	Spore	Catalase	Pigmentation	Fluoresence
Bacilli	−				−	+	+	−	+	+		
Coryneform	−				−	+	+	−	−	+		−
Lactobacilli	−				−	+	+	−	−	−		−
Streptococci	−				−	+	−	+	−	−		−
Micrococci	−				−	+	−	+	−	+		−
Pseudomonad I	+	+		+	+	−	+	−	−	+	−	+
Pseudomonad II	+	+		+	+	−	+	−	−	+	−	−
Achromobacter	+	−	+	−	+	−	+	−	−	+	−	−
Alcaligenes	+	−	−	−	+	−	+	−	−	+	−	−
Flavobacter	+	−		−	+	−	+	−	−	+	+	−
Coliform	+	+		+	+	−	+	−	−	+	−	−
		(pink)										

[1]Crystal violet and 2, 4, 5 triphenyl tetazolium chloride added to plate count agar (7).

TABLE 2. TYPES OF MICROORGANISMS ISOLATED FROM INCUBATED MILK SAMPLES, PLANT 1

Sample	Incubation Temp. (°C)	Incubation Time (days)	No. of isolates classified as: Bacil.	Coryn.	Micro.	Flavo.	Coli	Alc.	Pseud.	Other
Header	7	5	3	3	3					1
Filler bowl				3		25	7			
Package				7			35			2
Air						17	22			
Header	7	10								3
Filler bowl			8		1				7	
Package							16			
Air			20				6	6		
Header	4.5	5	2		1					
Filler bowl					2					
Package			1		2		1			
Air					5					
Header			6	21		3		6		
Filler bowl	4.5	14		33			43			
Package			7	2	24		18			
Air			13	2						

TABLE 3. TYPES OF MICROORGANISMS ISOLATED FROM INCUBATED MILK SAMPLES, PLANT 2

Sample	Incubation Temp. (°C)	Incubation Time (days)	No. of isolates classified as: Bacil.	Coryn.	Micro.	Flavo.	Coli	Alc.	Pseud.	Other
Header	7	7		43	16					
Filler bowl			14	32			4			
Package				64			6			
Air						31	8			
Header	7	14		57						
Filler bowl			9	20	3		47			
Package			50			39	6			
Air						16	144			
Header	4.5	7	62	17	5					
Filler bowl			16	19	19	15				10
Package			18	11	42	3				12
Air							60			
Header	4.5	14		4						
Filler bowl			15	32			16			
Package			20				26			
Air			2	8			112			

operation of the defoamer. No contamination of the test medium occurred until the defoamer was put into operation, even though aersols were generated earlier. Within a short time after the vacuum defoamer was put into operation, contamination of the test medium occurred. Further, as the airborne population increased the rate of contamination of the water increased proportionally. Thus it is established that the defoamer was a probable source of airborne contamination.

Prior to aerosolization in Trial 3, the atmosphere under investigation was free of *S. marcescens*. Within a short time after aersolization with continuous flow of water through the machine, contamination of the test medium by the test organism had occurred with both the defoamer and steam turned on.

Contamination rates in the test medium reached appreciable proportions at the higher levels of airborne viable particles encountered in Trial 1, which are typical of levels encountered in milk plants *(3)*.

TABLE 4. TYPES OF MICROORGANISMS ISOLATED FROM INCUBATED MILK SAMPLES, PLANT 3

Sample	Incubation Temp. (°C)	Incubation Time (days)	No. of isolates classified as: Bacil.	Coryn.	Micro.	Flavo.	Coli	Alc.	Pseud.	Other
Header	7	7		26	6		16			
Filler bowl				11			36	1		
Package				14			33			
Air				15		9	48			
Header	7	14					48			
Filler bowl							48			
Package							48			
Air						24	24		24	
Header	4.5	7	34							
Filler bowl						4	56		12	
Package			1	6	12					
Air			24	8			48			
Header	4.5	14		11						
Filler bowl							64			
Package				2						
Air				25		13	5			

When milk is held for periods of 7 to 14 days, contamination levels of the magnitude encountered in these trials could be significant in respect to spoilage of product.

Phase 2

Changes in bacterial populations of the milk samples from the various plants are shown in Fig. 2. The samples from Plant 1 indicated definite contamination between the milk line feeding the filler bowl and the filler bowl as evidenced by the increased rate of growth in the milk samples from the filler bowl and the package at both 4.5 C and 7 C. Similar results were obtained in Plant 2 based on relative growth rates at 4.5 C. The growth rates at 7 C were similar for all samples. The changes in bacterial populations in the samples from Plant 3 were more complex. It appeared from growth rates at 4.5 C that contamination had occurred between the milk header and the filler bowl, but the contaminants had not carried through to the package. The growth rates for all three samples were similar at 7 C as was true for Plant 2. The differences in initial count could be an indication of some contamination before the milk reached the header. Since all plants utilized high temperature-short time pasteurization followed by stem injection and vacuum treatment, the 10-fold difference in count between plants 1 and 2 and the 100-fold difference between plants 1 and 3 could be a result of differences in post-pasteurization contamination prior to delivery to the filler.

The types of organisms present in the incubated milk samples and impingement fluid from the air are shown in Tables 2, 3, and 4. The samples from Plant 1, Table 2, contained a mixed flora following incubation. The flora found in the samples obtained from the milk supply line following incubation consisted primarily of Gram-positive organisms. The presence of coliforms in the incubated samples from the filler bowl, the package, and air impingement fluid from the 7 C incubation indicated the possi-

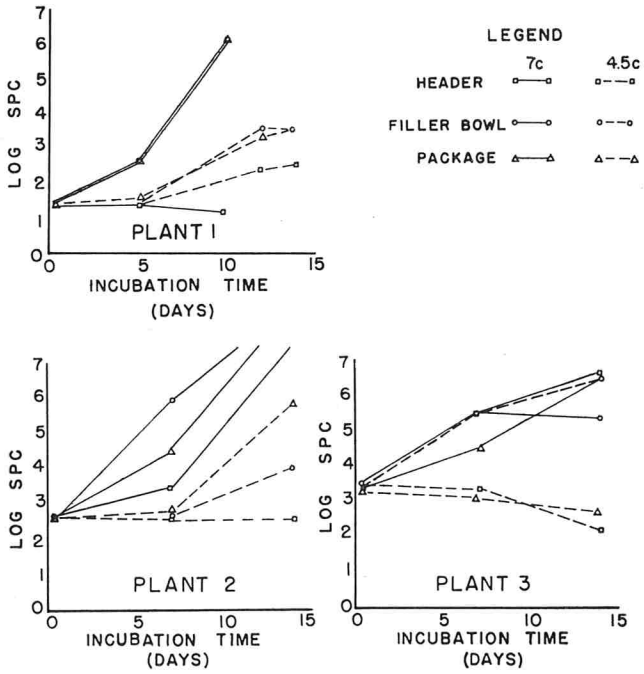

Figure 2. Growth rate of bacteria in milk samples.

TABLE 5. CALCULATED POTENTIAL AIRBORNE CONTAMINATION THROUGH THE DEFOAMER OF MILK PACKAGING MACHINES.

Plant	Air through defoamer	Airborne viable particles	Machine capacity	Calculated potential contamination rate (½ pt. pkg.)[1]
	Liters/ ml	No./10 liter	Units/min	No./10 ml
1	3256	330	20	226
2	6315	27	65	11
3	5975	16	65	6

[1]Calculated potential contamination rate = (air through defoamer) (airborne viable particles) / (machine capacity) (vol. of unit)

bility of air contamination in the filler bowl. Contamination in the filler bowl is even more apparent from an examination of the flora in the incubated samples from Plant 2, Table 3.

The bacterial flora found in the incubated milk samples from Plant 3, Table 4, tend to confirm the premise that contamination had occurred in the filler bowl but not in the package. The presence of coliforms in the samples from the filler bowl and the air following incubation at 4.5 C but not in the samples from the header and the package would indicate the entrance of a coliform strain that grows at 4.5 C into the filler bowl from the air. The presence of coliforms in all samples following incubation at 7 C would suggest contamination of the milk with coliform strains growing at 7 but not 4.5 C prior to entrance of the milk into the header lines.

Because of the higher capacity of the packaging machines in plants 2 and 3 and the lower airborne viable particle counts in the same plants, the potential airborne contamination in the milk from Plants 2 and 3 would be much lower than from Plant 1, Table 5. This, along with the lower initial SPC in the milk from Plant 1, would account for the variation in growth response from the plants tested and the more positive indication of contamination at the filler bowl for Plant 1.

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COMMITTEE ON FOOD PROTECTION

Continued from Page 191

The Committee on Food Protection also recommends that the Executive Committee endorse the proposed federal legislation placing inspection of fish under the jurisdiction of the Department of Health, Education and Welfare.

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REPORT OF THE COMMITTEE ON DAIRY FARM METHODS, 1968-1969

A. K. Saunders—*Chairman*
A. E. Parker—*Western Assistant Chairman*
J. B. Smathers—*Eastern Assistant Chairman*

The 1968-1969 Farm Methods Committee of the International Association of Milk, Food, and Environmental Sanitarians, Inc. was made up of 23 individual members, 11 state affiliate Farm Methods Committees as members, and 6 consultants.

During the two years (1968-1969) the forty members or consultants worked on one or more of the eight task committees. Each task committee has its own task committee chairman.

The eight task committees with their chairmen are listed below.

Antibiotics, Pesticides, and Other Adulterants—D. K. Summers.

CIP Cleaning and Sanitizing of Dairy Farm Equipment—R. F. Rintelmann.

Education—Vernon D. Nickel.

Plastics—Bernard Saffian.

Sediment In Fluid Milk—E. E. Kihlstrum.

Compatibility of Detergents to Farm Water Supplies and Effect of Solution Temperatures on CIP Cleaning of Farm Equipment—Stephen Spencer

Relation of Farm Water Supplies to the Quality of Milk—Henry Atherton.

Dairy Farm Management—William Arledge.

ANTIBIOTICS, PESTICIDES, AND OTHER ADULTERANTS

D. K. Summers—*Chairman*

The dairy industry, educational groups, and regulatory agencies have demonstrated progress in the elimination of antibiotics from the nation's milk supply. It is this committee's recommendation that emphasis be continued on the following control criteria to assist in the elimination of antibiotics from milk supplies: *(a)* All States and the Federal government should provide comprehensive educational and training programs for dairymen, dispensers of antibiotics, veterinarians, sanitarians, and related groups on the elimination of antibiotics from milk supplies. *(b)* Emphasis should be placed on problems relating to medicated feeding of dairy cows. *(c)* All antibiotics for use in the treatment of dairy cows should be obtained through prescriptions. *(d)* The agricultural extension programs should provide information to dairymen on problems relating to the indiscriminate use of antibiotics. *(e)* Further controls should be established on a nationwide basis to limit the dose rate of antibiotics, particularly with respect to intermuscular and intravenous injections. *(f)* Oil-base antibiotics should not be used or be considered acceptable for use in the treatment of dairy animals.

The recommendations set forth by the Task Committee are as follows:

(a) A comprehensive law or regulation governing the registration and sale of insecticides, rodenticides, and herbicides should be adopted by each State.

(b) Commercial applicators should be licensed by the States. (A provision for the periodic re-evaluation of their methods should be included in the licensing requirements.)

(c) Feed crops (hay and grain) to be consumed by dairy animals should be permitted to be sold only if such feed supplies comply with acceptable tolerance levels.

(d) The use of chlorinated hydrocarbon pesticides should be prohibited if residues cannot be controlled.

(e) The sale of dairy cows or heifers that have excessive pesticide residues should be prohibited.

Regarding the testing program for added water, it was indicated by a number of agencies and the dairy industry that they were using freezing point determinations; and test results above −0.530 C have been considered by most enforcement agencies to indicate that milk is adulterated.

The committee members reporting on the possible adulteration of milk and milk products by sanitizers, detergents, and other chemicals advise that it is their impression that a number of the regulatory agencies and the dairy industry in this country are not fully aware of the possible problems associated with detergents or sanitizers in milk and are not providing proper surveillance of this problem.

The committee recommends and encourages the establishment of research directed toward the development of suitable rapid test procedures that will detect the presence of cleaning and sanitizing chemicals in milk.

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Washington Farm Methods Committee
Indiana Farm Methods Committee
New York Farm Methods Committee
Ontario Farm Methods Committee
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CIP CLEANING AND SANITIZING OF DAIRY FARM EQUIPMENT

R. F. Rintelmann—*Chairman*

The committee recommends the use of CIP procedures and automatic equipment as opposed to manual cleaning for all applicable dairy farm milking equipment with special recommended reference to the farm bulk tank.

In the area of automatic or mechanical cleaning of farm bulk tanks, the following applies:

(a) The committee recommends permanent installation of spray balls or spray sticks in farm bulk tanks. These spray devices should be designed for ease of disassembly to remove foreign matter. Installation and design of these spray devices should have 3-A reference.

(b) In the area of 3-A reference, it appears to the committee that some CIP equipment presently on the market is not of proper design.

(c) The committee recommends that equipment manufacturers continue concerted efforts to simplify CIP equipment and its operation. It is further recommended that all contact parts be of acceptable materials.

(d) It is recommended that bulk tank agitators be wired directly into the CIP system which will automatically turn on the agitator when the system is activated.
(e) The sanitizing procedure after automatic washing, but prior to milking is sadly neglected. The CIP equipment should incorporate automatic sanitizing or it should be done by spraying with a proportioning device.
(f) The responsibility for proper cleaning and sanitizing of the farm bulk tank should be the sole responsibility of the dairyman and not of other personnel such as the bulk tank drivers.
(g) CIP systems should be considered as an adjunct to cleaning, and all parts not cleaned automatically should be manually brush-washed. Emphasis should be given to outlet valves of bulk tanks so they are completely dismantled and hand brushed each time the tank is emptied.
(h) The committee recommends continued and intensified educational efforts regarding routine and proper operation of CIP equipment.

The following is applicable regarding CIP pipeline systems:
(a) Vacuum standpipe pipeline systems will CIP only if properly installed and proper procedures are followed.
(b) Milk nipples should be properly installed to achieve cleaning and draining. Milk inlets not designed for CIP should be brush-washed. Particular attention should be paid to capping and to the care of the caps themselves.
(c) Cleanability problems were reported with electrodes and releaser jars. The committee feels that these problems primarily result from the type of material and/or design used in manufacture rather than the CIP procedure. A further and detailed investigation of this problem should be made in the area of releaser jar design, possible electrolysis, etc. The committee recommended that we should not work on the establishment of installation guidelines, but should concentrate on those factors applicable to operation of CIP equipment and its cleanability. While the committee recognizes problems that apparently can arise from poor or faulty installations, i.e. air leaks, attention should be given to the areas of time, temperature, and proper use of dilutions. This task committee has referred to the task committee on Compatibility of Detergents to Farm Water Supplies and Effect of Solution Temperatures on CIP Cleaning of Farm Equipment the applicable information.
(d) Maximum time during the wash cycle should be 10 min.
(e) This task committee defers to the task committee on adulterants, adulterations in the milk supply as it relates to wash solutions, water, and sanitizing solutions, particularly in pipeline and transfer system operations. Continued producer education on proper use dilutions should eliminate this problem.
(f) Producers should be discouraged from use of household bleach or detergents for any milk equipment application.
(g) It is the committee's opinion that when liquid sodium hypochlorites are properly used for sanitizing there should be no problem in the area of corrosion of milking equipment. Water supplies that contain troublesome quantities of iron and are affected by liquid sodium hypochlorite can be so treated or conditioned to eliminate this problem. It is expected that governmental agencies will make recommendations regarding the stability factor and possible loss of strength of liquid sodium hypochlorites.

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EDUCATION

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The Task Committee on Education has the continual assignment of gathering new material for publication in the *Journal*. This is forwarded to Dr. Elmer H. Marth, Editor of the *Journal of Milk and Food Technology*. Dr. Marth then abstracts the material for publication.

Material has come in from many areas. This Task Committee will continue to seek out up-to-date material that will be of interest to the membership of the Inernational Association of Milk, Food, and Environmental Sanitarians, Inc.

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PLASTICS

BERNARD SAFFIAN—*Chairman*

In the past, the use of plastics of many generic types, have been promoted for many applications. In 1965-1966, a report was submitted which outlined recommendations for the use of flexible lines.

During 1967-1968, surveys were made to cover other applications of plastics on dairy farms. These covered application, generic type of plastic, and observations on performance.

During 1968-1969, this committee continued to evaluate new applications and to answer questions which were not covered in previous reports.

It appears that in nearly all instances when failure of an item occurred, the choice of the specific plastic was not proper, the design was not optimum, or an improper cleaning procedure was used.

Recent findings have shown that for cleaning flexible vinyl milk lines or other flexible vinyl parts, cleaners should be used which do not contain caustic. Caustic causes cracking, crazing and etching of the vinyl surface. The same applies to polycarbonate parts which show quickly cracking and/or dissolving when in contact with concentrated caustic

TABLE 1. REVIEW OF SURVEY ON PLASTICS APPLICATIONS ON FARMS MADE DURING 1967-68. MATERIALS IDENTIFIED AND PERFORMANCE NOTED

Product	Type of plastic	Remarks and suggestions for improvement
Rigid pipeline	Polycarbonate	High degree of expansion with temperature variation
Dairy brushes	Nylon	Good cleaning job
	Alginate	Maximum use temperature is 130 F, and will not resist acid
	Polypropylene	Good—resists acid and hot water—gives long life
Wash basin, hand	Alginate	Poor—short life
Washing pail	Alginate	Fair—light in weight—does not mar stainless steel equipment when in contact
Ball check valve for dumping station	Rigid PVC	OK
Stall cocks	Rigid PVC & ABS	OK
Water lines	Rigid PVC	OK—in cold climate may freeze and be difficult to thaw unless a single heavy wire is placed in tube at time of installation
Filter pad boxes	Polystyrene	OK
Transfer hose from tank to truck	Flexible PVC	OK—if plastic meets 3-A Standards—multiple use and cleaned properly
Gaskets	Fluorocarbon	OK
Air cocks on vacuum lines	ABS	OK
Claw parts	Rigid PVC, Acetal	OK
Black vacuum line	Flexible PVC	OK
Clear transfer lines	Flexible PVC	OK—if plastic meets 3-A Standards—multiple use and cleaned properly
Milking machine sight glass	Styrene-acrylonitrile	OK
Pipeline inlet valve	Polycarbonate	OK
Vacuum regulator	Fluorocarbon	OK
Pipeline couplings—for glass pipe	ABS	Good if not tightened excessively
Pulsator body and valve	Fluorocarbon	Lubrication
Moisture traps	Polyethylene	Slight Discoloration
Milk line	Polyethylene	Must be taken apart for inspection
Inflation shells	Polycarbonate	OK
Milker unit	Polycarbonate, Styrene-acrylonitrile	OK
C.I.P. pipeline washer	Acrylic	Fair—crazing occurs with age—use annealed polycarbonate
Pulsator cylinders	Nylon	OK
Pulsator housing and rotor	Acetal	OK
Unions and elbows	Rigid PVC	OK
O-rings	Rubber, Nylon, Teflon	OK
Hose	Nylon, Fluorocarbon Flexible PVC	OK—stiffens when cold
Bulk tank manhole cover	Acrylic	Cracks easily
CIP teat cup washer	Acrylic	Crazing occurs, should use annealed Polycarbonate
Pipeline hangar clamps	Rubber Coated	OK
Milk weighing device	Polycarbonate	OK
Rigid vacuum lines	Rigid PVC, Polypropylene	OK—economical installation
Cleaning and porportioning devices and chlorinators	Acrylic, Acetal, Chlorinated Polyethylene	OK—but must be protected from freezing
Milk sample container (bottles, pipettes, bags)	Polyethylene	BAGS—leaks and cut fingers from sharp edge of metal closure band. Wire cuts other bags
Air lines	Flexible PVC	OK
Filter holder	Polycarbonate	OK—if part is annealed, otherwise cracking occurs
Pipeline gaskets	Fluorocarbon	OK
Pump seals	Fluorocarbon	Reputed to be good, but excessive wear reported in some cases

TABLE 2. REVIEW OF SURVEY ON PLASTICS APPLICATIONS ON FARMS MADE DURING 1967-68. MATERIALS NOT IDENTIFIED AND/OR PERFORMANCE NOT NOTED

Product	Type of plastic	Remarks and suggestions for improvement
Manhole cover on tank truck	?	Much breakage
Cover for milk carrying pail & strainer	?	Unsatisfactory
Milk meters	?	Air leaks, non-CIP
Shut off stem in milking head	?	Rough edges
Valve outlet cap on pipeline milker	?	Cracks easily
Float valve	?	Cracking
Milk pump impellers	?	?
Hose connections for automatic bulk tank cleaning	?	Unsatisfactory due to heat expansion

or in longer periods of time when alkaline cleaners containing caustic are used.

It is hoped that in the next two years, specific recommendations can be made as to proper selection of a plastic.

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SEDIMENT IN FLUID MILK

E. E. KIHLSTRUM—*Chairman*

Sediment does not belong in milk. The sediment test is a test that every dairy producer understands and he generally knows what steps he has to take to correct an undersirable sediment test.

This committee recommends:

(a) Sediment tests should be conducted by the dairy industry on all milk whether in cans or bulk tanks.

(b) Every milk producer should strain milk through an approved filter adaptable to the milk equipment in use.

(c) Every milk producer should be educated to use his filter after each milking as his own private sediment test.

(d) Every milk producer should be educated to use his filter after each milking as his own private method of checking on abnormal milk (Mastitis).

(e) The dairy industry should use the 12th edition of *Standard Methods,* Chapter 15, as the method to be used for sediment testing.

The committee wishes to emphasize that sediment control plays a very important part in the production of a dependable high quality milk.

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COMPATABILITY OF DETERGENTS TO FARM WATER SUPPLIES AND EFFECT OF SOLUTION TEMPERATURES ON CIP CLEANING OF FARM EQUIPMENT

STEPHEN SPENCER—*Chairman*

In recent years, there has been a rapid increase in CIP farm tank installations. Field reports indicate varied success in properly CIP cleaning them.

A survey was undertaken to ascertain both the extent of the problem and the degree of success. Thirty usable questionnaires were returned with the following results:

(a) Farm tanks under 600 gal capacity average 14.7 gal of water used in the wash cycle with a range of 5 to 30 gal. The average time of the wash cycle was 10.6 min with a range of 5 to 20 min. The temperature drop during the wash cycle averaged 34.4 F with a range of 12 to 68 F loss. The large drop in temperature was related to a small volume of water (under 8 gal) in the wash cycle.

(b) Tanks of over 600 gal averaged 19.8 gal of water in the wash cycle. The amount of water ranged from 8 to 40 gal. The wash cycle averaged 10.7 min duration with a range of 5 to 15 min. The temperature drop during the wash cycle averaged 38.9 F with a range of 15 to 80 F. Again, the large temperature drop was associated with a small volume of water (10 gal or less).

(c) Cleaning problems seemed to be associated with two major factors. (1) A temperature of under 100 F at the end of the wash cycle and (2) an inadequate detergent concentration. The users did not follow the manufacturers' recommendations in a number of instances. The time of circulation appeared to be involved in only one out of 40 instances which had a wash cycle of 30 min. This tank was not clean. The end-point temperature of the wash solution was 60 F.

This survey indicates several important considerations for the installation of CIP farm bulk milk tanks.

(a) Make sure that an adequate supply of hot water capac-

ity is available. Furthermore, make sure the water is hot!

(b) Use a large enough volume of water to maintain temperature above 100 F. This survey indicates that about 8-10 gal on small tanks and 10-12 gal on large tanks is minimal with starting temperatures of 160-165 F. Tanks over 1250 gal were not included in this survey.

(c) Use the recommended amount of the proper type cleaner. This may seem elementary but the survey indicated that a sizeable proportion of dirty tanks were not cleaned with the amount of cleaner recommended by the manufacturer. In two instances, the proper *type* of cleaner was not being used.

(d) Use a complete cleaning program. There are no known shortcuts to successfully CIP clean farm bulk tanks without providing adequate rinsing, cleaning, rinsing and sanitizing.

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RELATION OF FARM WATER SUPPLIES TO THE QUALITY OF MILK

HENRY ATHERTON—*Chairman*

Information received from subcommittee members indicates little research is being done to evaluate farm water supplies as they may affect milk quality. On the other hand, the repetition of problems discussed in past reports and unanswered questions concerning water contamination and pollution control emphasize that problems exist and that people are becoming aware of the validity of this concern.

The Federal Water Pollution Control Administration of the U. S. Department of Interior has taken action to establish water quality standards for much of our nation's water systems. A recent announcement from the agency indicates each of the 50 states has submitted water quality standards which are accepable to the FWPCA.

A report of the National Technical Advisory Committee on Water Quality Criteria was made available to the public in 1968 and is available from the Superintendent of Documents. This report contains an important section on water for agricultural uses. A second document prepared by this National Technical Advisory Committee on Water Quality Criteria defines the research needs for the five major water uses, one of which is agriculture. Eight recommendations pertinent to the Farm Methods Committee's area of responsibility are included:

(a) Equipment and controls for water purification should be developed for better utilization of available water supplies. Methods should be found also to permit constant monitoring of the effectiveness of water treating equipment.

(b) Certain organisms found in water are very resistant to all known types of chemical disinfection. Ultraviolet irradiation and heat treatments have been suggested as alternative methods for the control of those organisms resistant to chlorine. Research should be conducted: (1) to determine the nature of resistance of microorganisms to chlorine including time versus concentration relationships involved; (2) to determine whether ultraviolet irradiation and heat treatments are effective in destroying all organisms potentially troublesome in water used in milkhouse sanitation; and (3) to develop improved methods applicable to farmstead operations for controlling resistant organisms.

(c) Automated cleaning systems have become a major need on farms, creating both a water supply and waste disposal problem. Information is needed to develop water conserving methods but still assure proper sanitation in milkhouse, household, and product marketing operations.

(d) The influence of water quality on sanitation efficiency has not received enough attention. Information is needed to determine the influence of water supplies of various compositions on the efficiency of sanitation procedures and chemicals.

(e) Corrosive waters remove metal ions from piping materials and cause them to be deposited on milk contact surfaces during recirculating cleaning operations. This results in flavor deterioration of the product. The relationship of piping materials to water composition should be studied and pipes and fittings developed which are not affected by corrosive waters.

(f) Ponds, wells, and cisterns are subject to pollution from various sources. Information is needed regarding the significance of specific pollutants for various farmstead uses and the development of remedial measures. Emphasis is placed on bacterial and viral contamination of these waters.

(g) Many states have adopted different requirements governing the use of pond and cistern water. Basic requirements should be determined for such water supplies and these requirements should be acceptable to responsible agencies so that farmers in different states shipping milk to the same market can operate under comparable regulations.

(h) Rapid methods for assessing microbiological contamination in both treated and untreated water are urgently needed. Non-cultural techniques for total bacteria count and refinement of these methods to include specific organisms should be developed.

There is evidence that water supplies are being contaminated by chemicals and bacteria from feed lots and liquid manure disposal systems. One report from a midwest organization indicates that over 2500 farm water samples were analyzed there last year. One out of every three samples contained over 45 ppm nitrates, one in three had an excessive coli population, and the number of high total bacteria counts was even greater. The report stated further that nitrates were beginning to appear much more frequently and at higher levels. Nitrite levels as high as 36 ppm and nitrate, concentrations of over 400 ppm were found in this study.

While at the moment, the main concern seems to be that such waters lose their aesthetic appeal and will not pass state standards (as accepted by FWPCA), there is a growing interest in the role of nitrite-nitrate relationships in water supplies. It has been suggested that chlorination of contaminated supplies may control this situation, but, to date, no scientific evidence has been presented to your committee to verify this possibility. Research should be conducted to establish the extent of the nitrate-nitrite contamination in our farm water supplies, to determine whether or not such contaminants or other chemicals taken into the animal in the drinking water affect milk composition or quality, directly or indirectly, and to develop systems which can control the

problem. Guidelines and/or specifications for underground storage of dairy liquids and manure should be established and publicized in order to protect our ground water supplies from such contamination.

The results of another study showed that high coliform counts in raw milk were associated with the rinsing of bulk tanks with untreated water. It was also determined that farm water supplies could be a significant source of psychrophilic organisms when such supplies are used for rinsing milking equipment. Reports continue to be received of milk contamination resulting from the failure to drain and dry pumps and pipelines. Often contamination in this manner is sufficient to affect the freezing point of the milk supply. When such water is taken from an unprotected source, the resulting milk supply may contain psychrophiles, coliforms, yeasts, and other spoilage organisms. This produces a serious decline in raw milk storageability.

Information from the field suggests there is a growing awareness of the need for water testing procedures as a basis for establishing suitable sanitation programs. It would appear that the fieldmen and sanitarians recognize that some properly protected water supplies may need bactericidal treatment and that water treatment may be desirable to remove mineral contaminants prior to use of the supply in the milkhouse or farm home. The use of ultraviolet treatment to control microorganisms capable of surviving usual chlorination exposure is mentioned with increasing frequency.

Very little research pertaining to the effect of water quality has been reported to your committee. Toan and Associates at Kansas State University (*Journal of Dairy Science,* 48: 1174-1178; 1965) found that *Aerobacter aerogenes* was "the causative organism in samples of commercial milk having defects described as cowy or feedy, or both."

Morton Salt Company prepared a useful guide for presenting information on water and water conditioning to Home Economics students. This training aid might have application in presenting such information to milk producers. The Water Conditioning Association International of Wheaton, Illinois has several publications of interest in describing the value of soft water. These include a single sheet titled "Soft Water Aids Dairy Farm" and a 15 page discussion of "Solving Water Quality Problems on the Farm."

Many states are working to implement water quality standards to satisfy local responsibility under the Department of Interior's Federal Water Pollution Control Administration. The dairy industry, like other major water users, should determine what is necessary to assure that future water sources do not contribute to milk quality problems.

STEPHEN SPENCER
W. J. HARPER
WM. MCCORQUODALE
D. K. SUMMERS

KANSAS FARM METHODS COMMITTEE
OREGON FARM METHODS COMMITTEE
MISSOURI FARM METHODS COMMITTEE
ONTARIO FARM METHODS COMMITTEE

Consultants—SYDNEY E. BARNARD

DAIRY FARM MANAGEMENT

WILLIAM ARLEDGE—*Chairman*

The committee recommends a more concentrated effort be made to encourage the dairyman or milker to follow the generally accepted practices outlined below. Apparently, there is not enough concern by sanitarians, fieldmen, extension agents, etc., to continually "sell" or educate the dairyman or milker on the basic procedures of milking cows and procedures to be followed from the time a cow enters the barn until she leaves.

Results obtained by this committee's survey indicate more time should be given by all persons involved in basic education. We should not assume that the dairyman or milker "knows" in detail what to do in the process of cow milking management.

(a) The committee recommends that cow clipping should be strongly encouraged for ease of cleaning cows' teats and udders prior to milking.

(b) It is the concensus of the committee that the udder and teats should be washed with the proper concentration of warm solution of an iodine compound using individual paper towels for washing and drying. Do not use iodine solution in a galvanized pail.

(c) The committee recommends use of a strip cup prior to milking as an aid to stimulation and to detect abnormal milk. The concensus is the milk should be stripped into a strip cup and not on the floor. Routine use of a cow-side screening test such as the CMT or MQT including recording of the results of such testing should be encouraged. The survey indicates that the use of a strip cup prior to milking is seriously neglected. We recommend that a concentrated effort be made to educate the milker to use a strip cup.

(d) The majority of milkers wait well in excess of the 1 min recommended time from stimulation until the inflations are placed on the cow. It is agreed that stimulation time is very important. The committee recommends more emphasis and education on proper stimulation and why the milker should begin milking within one minute after stimulation.

(e) Overmilking is still a great problem nationally. Much emphasis has been placed on overmilking but apparently, there has been very little improvement nationally. Observations and recommendations provided as a result of milking-time inspections would be valuable in decreasing overmilking time.

(f) Since cows are generally overmilked, the need for stripping is reduced. The committee recommends close supervision of the cow during milking and removal of the inflations as soon as each quarter milks out.

(g) Very few milkers dip teats or spray teats with any solution after removing the inflations. We recommend teat dipping or spraying with an approved teat dip material for reduction in the spread of infection.

(h) Less than 50% of the milkers rinse inflations in a sanitizing solution between cows. Our survey indicated no observed difference in relation to udder health between those who rinsed inflations between cows and those who did not. The committee recommends continued investigations concerning, (1) rinsing of inflations, (2) agents to be used, and (3) proper procedures to be followed for effectiveness.

(i) Proper care, use, and cleaning procedures of milking machine rubber parts are sadly neglected. Procedures for the care and cleaning of rubber parts are well defined throughout the country. A more concentrated effort by all persons involved should be made to provide continuing education and encouragement to the milker to follow procedures recommended.

The concensus of the committee is that in all areas of the country more time should be spent in concentrated educational field visits during milking time. This should be done to point out those procedures not being followed for effective

cow-milking management. It is the committee's feeling that if emphasis is placed on the procedures being neglected, tremendous improvements can be made in total milk quality and herd health.

HENRY ATHERTON
STEPHEN SPENCER
GLENN CAVIN
J. C. FLAKE
M. W. JEFFERSON
CLARENCE GEHRMAN
D. G. RAFFEL
KENNETH HARRINGTON

NEW YORK FARM METHODS COMMITTEE
WASHINGTON FARM METHODS COMMITTEE
KANSAS FARM METHODS COMMITTEE
INDIANA FARM METHODS COMMITTEE
WISCONSIN FARM METHODS COMMITTEE
ONTARIO FARM METHODS COMMITTEE
IOWA FARM METHODS COMMITTEE

FARM METHODS

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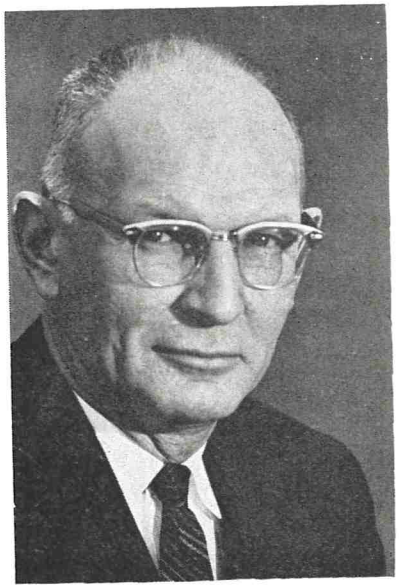
ASSOCIATION AFFAIRS

ROY B. FAIRBANKS



ROY B. FAIRBANKS

Roy Boyd Fairbanks, 58, of 210 E. Benton St., Oswego, formerly of Aurora and Springfield died Thursday, April 9, 1970 at Copley Memorial Hospital. He was born July 24, 1911, in North Henderson, Ill.

He is survived by his widow, Eleanore D.; one daughter, Mrs. Roger (Carol) Schillinger of Oswego; one son Ron of Los Angeles, Calif.; one brother, Harry of Annawán, Ill.; four sisters Mrs. Roy (Marie) Loquist of North Henderson, Mrs. Eldridge (Mae) Linberg of Jacksonville, Ill., Mrs. Mahlon (Ruth) Love of Osco and Mrs. Ray (Deloris) Day of Rock Island; three grandchildren and several nieces and nephews.

He was preceded in death by his parents Mr. and Mrs. John Fairbanks of Alexis, Ill.

He was a member of the Associated Illinois Milk Sanitarian where he formerly served as president. At the time of his death he was the secretary-treasurer of the International Association of Milk, Food and Environmental Sanitarians, Inc. He was a member of the Temple Bible Church of Springfield. He worked for the past 20 years for the city of Aurora and the State of Illinois in Milk Sanitation.

Contributions in Mr. Fairbanks' memory may be made to the American Cancer Society.

NOTICE TO MEMBERSHIP

Deadline for submission of nominations for the 1970 Annual Sanitarians Award has been extended to June 15. The award is to a local sanitarian this year (City or County). See January 1970 issue of the Journal for details.

The membership is urged to send in nominations at once and to remember that previous nominees who have not received the award are eligible for re-nomination.

A. N. Myhr, Sr. Past President
Chairman of Awards Committee

CURT CHAFFEE RETIRES FROM POST

After 28 years with the Department, and a total of 43 years in the dairy business, Curt Chaffee, of Bloomfield, Connecticut, retired as Sr. Inspector of the Connecticut Department of Agriculture and Natural Resources, Dairy Division, last November.

Curt was born in West Enosburg, Vermont, and graduated from the two-year course in dairy manufacture at Massachusetts State College in 1926. Frank Herron, whose retirement was noted in our last issue, was a class-mate of Curt's. Curt went to work in Springfield for Eastern Dairies, spent about a year in Pawtucket, Rhode Island, worked for the Dean Dairy in Waltham, Mass., and then back to Springfield. He came to Connecticut in 1935 and worked three months at the Brookside Dairy before joining R. G. Miller and Sons in Hartford, where for

five years he was in charge of the by-products division. In 1941 he took a state examination and was hired by the State as an inspector of pasteurizing plants. He was also in charge of check testing for five or six years during this period, and finally in 1956 was promoted to Sr. Inspector in charge of plant inspectors.

Curt served the Sanitarians Association as its Treasurer for 20 or more years prior to his retirement and for the last several years has devoted most of his time to supervising the office staff of the Dairy Division and maintaining the multitude of detailed records that are vital to the effective and efficient operation of the Division.

Curt and his wife, the former Christine Carter of Holyoke, Mass., have two daughters and eight grandchildren. Their only son died in 1935. The Chaffees have a camping trailer, and intend to travel extensively with it. They prefer to go where their fancy leads them, rather than following some prescribed itinerary, and have found this method of exploring the country fascinating and rewarding. They recently drove to Sheldon, Vermont, to attend the 54th reunion of Curt's grammer school class of 1916, and were amazed to find that all five original members of the class were in attendance. Apparently Curt comes from the right place to guarantee a long and happy retirement.

Reprinted from N. Y. State Association Newsletter.

28TH ANNUAL PENNSYLVANIA DAIRY FIELDMEN'S CONFERENCE

The 1970 Dairy Fieldmen's Conference will be held on Tuesday and Wednesday, June 9 and 10, 1970 at the J. O. Keller Building at The Pennsylvania State University. The Conference Center is located on the campus adjacent to the Nittany Lion Inn.

The program will include discussions on dairy farm waste disposal, new Pennsylvania milk regulations, and the mechanized Pennsylvania DHIA program. A thorough discussion of milk sampling, quality tests and their objectives will be included. Modern approaches to dairy farm sanitation will be discussed.

Current problems including the interstate abnormal milk program and multiple farm and plant inspections will be a featured part of the program. A panel discussion on the role of the fieldmen under changing farming and marketing conditions will complete the two day program.

Preregistration forms and housing information can be obtained from the Agricultural Conference Coordinator, Room 410, J. O. Keller Building, University Park, Pa. University Park is located adjacent to State College, Pennsylvania.

MISSOURI ASSOCIATION SANITARIANS SANITARIANS AWARD—1970

Mr. A. F. Crownover, (right) Supervising Sanitarian, Missouri Division of Health, District No. 4 Office, Poplar Bluff, Missouri receiving the "Sanitarian's Award" presented by Mr. William McCown, Vice-President for 1969-70.

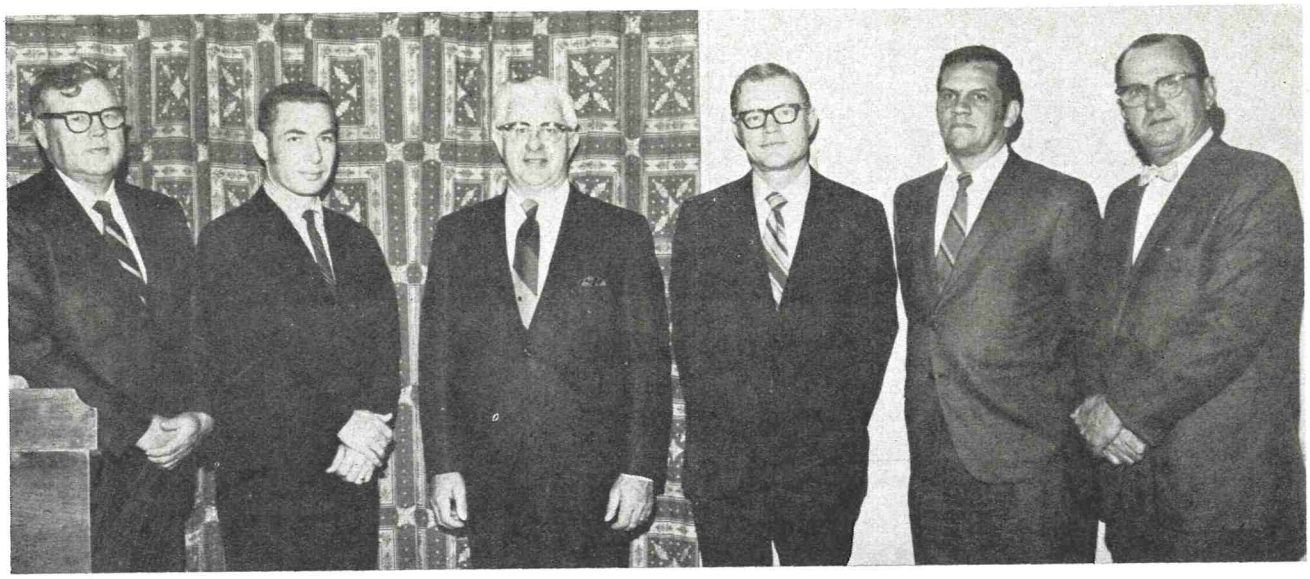
The recipient of the Missouri Association Sanitarian's Award for 1970 was born in Arkansas. There he attended school, and there he obtained his first employment. He served during World War II in the Army Air Corp as a Flight Engineer. This included 13 months in the Southwest Pacific. He was disabled during his service and spent four years recuperating.

He then returned to college and obtained the B.S.E. degree in 1952. His first post graduate employment was with the Arkansas State Board of Health. He then became City-County Sanitarian in Fort Smith, Arkansas.

In 1956 the awardee began service with the Missouri Division of Health as District Sanitarian. Soon he helped write the Grocery Store Ordinance that is presently in use in his area. This was the first ordinance of its type in Missouri. His leadership has resulted in the adoption of Milk Ordinances and Food Ordinances by many of the municipalities in his District. His effective followup activities have aided the local agencies in making the ordinances serve the needs of the communities.

Through his planning and execution improved facilities and practices were realized among slaughtering firms in his District.

Noteworthy also were his efforts in gaining compliance by motel owners with regulations on proper venting of gas appliances. Particular attention is called to his work with the Missouri Department of Liquor Control in drafting a cooperative program of



The officers and executive board of the Missouri Affiliate for the year 1970-71 are as follows: Left to right, President, William McCown, Supervisor, Milk Control, St. Louis County Health Dept., Clayton; Robert Gillilan, Hospital Sanitarian, Missouri Division of Health, Jefferson City, First Vice President; Charles Van Landuyt, Fieldman, Sealtest Foods, Versailles, Second Vice-President; Erwin P. Gadd, Bureau of Milk and Food, Missouri Division of Health Jefferson City, Secretary-Treasurer; Carl Weber, Hospital Sanitarian, Missouri Division of Health, Jefferson City, Auditor; Gerald D. Baker, Chief Food Control, St. Louis Health Dept., Auditor.

work for the purpose of upgrading tavern operations.

The scope of his work was further broadened by his recent attention to warehousing and bakery sanitation.

Not all his attention has been directed toward ordinances, regulations, compliance, control, facilities and practices. No, not by far! The recipient is dedicated, he is knowledgable, he is conscientious. But best of all his temperament and personality befit him for his profession. He is friendly, courteous and makes conversation easily. He is a communicator among professionals who depend on this tool. He renders help to the needy without thought of recompense. That he believes in his profession and wants the best for his collegues and the public is evidenced by his significant efforts to obtain registration of Sanitarians in the State.

Ardith and his wife, Lois, have also involved themselves in many school and civic activities.

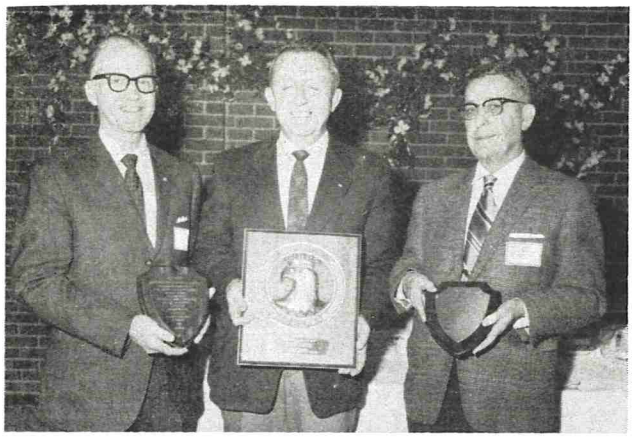
For his leadership, his foresight and perseverence; for his example, his friendliness and professionalism; the Missouri Association of Milk and Food Sanitarians bestows upon Ardith F. Crownover the Sanitarians Award for 1970 with best wishes for the future and thanks for setting a living example of dedication to a vocation found worthy of a man's perpetual self-giving.

KENTUCKY DAIRY FIELDMEN AND SANITARIANS TOLD PROPER SANITATION SPELLS SUCCESS

C. BRONSON LANE
Animal Sciences Department
University of Kentucky
Lexington, Kentucky

"An effective sanitation program is essential to maintain dairy product freshness and to prevent the invasion of unwanted contaminants," Mr. Paul Freebairn, Special Chemicals Division of Pennwalt Corporation, Philadelphia, Pennsylvania, told the 250 conferres attending the 1970 Kentucky Fieldmen's and Sanitarians' Conference at Mammoth Cave, Kentucky. Freebairn related that one must determine the type of soil, characteristics of the water supply, the volume of sanitizer needed, and the application costs and methods to establish an effective sanitation program. "Ninety-eight percent clean is two percent dirty" he said. The two percent dirty is the cause of poor keeping quality and poor flavor dairy products.

Mr. Dick Whitehead, Assistant Manager of the Food Division, Diversey Chemical Company, Chicago, Illinois, defined sanitation as the procedure and control of total environment to maintain wholesomeness of the product and to protect it from pathogenic organisms. "Cleanliness has a tremendous impact on food flavors," he continued. Whitehead challenged the fieldman to stay abreast of proper



Recognitions at the 1970 Kentucky Fieldmen's and Sanitarians' Conference went to: Left to right, A. B. White, Warren County Health Department, Bowling Green, Kentucky—outstanding sanitarian award; Bland Dorris, Pet, Inc., Bowling Green, Kentucky—outstanding fieldman award; Dan Conley, Executive Secretary of the Kentucky Dairy Products Association, Louisville, Kentucky—oustanding industry man award.

Looking over the program for the 1970 Kentucky Fieldmen's and Sanitarians' Conference are: Left to right, Mr. Floyd Fenton, Chief of Standardization Branch (Dairy Division), USDA-CMS, Washington, D. C.; Mr. Shelby Johnson, Chief of Environmental Services, Kentucky State Health Department, Frankfort, Kentucky; Mr. H. L. Thomasson, Executive Secretary of the International Association of Milk, Food and Environmental Sanitarians; Dr. C. Bronson Lane, Extension Dairy Technology Specialist, University of Kentucky, Lexington, Kentucky; Mr. Harold Thompson, Chief of Milk Section, USPHS, Cincinnati, Ohio.

sanitation practices on the farm and in the factory so they can render the proper advice to producers with milk quality problems.

The newly proposed manufacturing milk regulations can be a boon to the dairy industry commented Floyd Fenton, Chief of the Standardization Branch (Dairy Division), USDA, Washington, D. C.

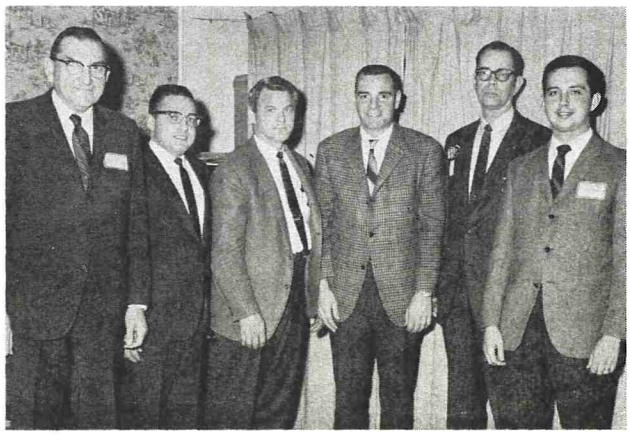
The consumer wants a quality product and stricter sanitation standards for manufacturing milk will assure her receiving it. "The producer doesn't need more equipment," continued Fenton, "but needs to employ the proper methodology to get it clean." He summarized by challenging the manufacturing milk processors to start cooperating among themselves to correct milk quality shortcomings.

"Two-thirds of the food products which will be found on the grocery shelves in 1985 haven't even been conceived as yet," commented Dr. George Muck, Research and Development Director, Dean Foods Company, Rockford, Illinois.

The dairy industry can get its share of the 1985 market by creating a consumer need and meeting this need with new dairy products which are nutritious, convenient, properly priced, palatable, and of high quality, he continued. Muck concluded by saying that the dairy industry must develop products which appeal to the changing nature of the consumer.

According to Joe Johnson, Director of Government Relations for Milk Producers, Inc., Little Rock, Arkansas, the fieldman is an ambassador for the dairy industry. Johnson said that the biggest reason why dairy farmers have gone out of business is because the fieldman has failed to discharge his responsibility correctly. "Fieldmen have got to pay for the price of success in advance," he continued. "The price of success depends on painstaking preparation, hard work, dedication, and salesmanship."

Mr. Russ Rooks, Interstate Milk Producers Cooperative, Philadelphia, Pennsylvania, speaking on discerning and correcting farm bulk tank problems, said that all farm bulk tanks should be equipped with interval timer mechanisms to insure proper mixing and increase cooling efficiency. He recommended that every-day-pickup tanks be equipped with a cooling capacity of one horsepower per one hundred



Program participants for the 1970 Kentucky Fieldmen's and Sanitarians' Conference included: Left to right, Mr. Floyd Fenton, USDA, Washington, D. C.; Dr. George Muck, Dean Foods Company, Rockford, Illinois; Mr. Dan Noorlander, Milk Producers, Inc., Arlington, Texas; Dr. C. Bronson Lane, University of Kentucky, Lexington, Kentucky; Mr. Dick Whitehead, Diversey Chemical Company, Chicago, Illinois; Bob Holt, Kentucky State Health Department, Ashland, Kentucky.

pounds of milk.

Animal waste disposal was also discussed at the conference. Mr. Ralph Pickard, Director of Environmental Health Division, Kentucky State Department of Health, Frankfort, Kentucky, commented on the policy of the water pollution control commission on the use of lagoons for dairy farm waste disposal. Mr. George Turner, an Ag engineering specialist at the University of Kentucky, said that a properly designed lagoon should theoretically let natural biological processes make the waste disappear. He emphasized that there is no financial return from this method, and whatever cost is put into construction and operation must be paid for from milk production.

The reorganization of the Food and Drug Administration was clarified by Mr. Harold Thompson, Chief of Milk Section, USPHS, Cincinnati, Ohio. Other topics covered at this event were cures for quality problems in the Grade A and manufacturing milk processing plants and Grade A and manufacturing milk industry hangups. Speakers on these subjects included: Mr. Rudy Gillon, Dairymen, Inc.—Kyana Division, Louisville, Kentucky; Mr. Bob Barkman, Broughton's Dairy, Lexington, Kentucky; Mr. T. C. Smith, Avalon Cheese Company, Leitchfield, Kentucky; Mr. Bob Goodlett, Armour Creameries, Springfield, Kentucky.

A panel discussion on mastitis highlighted the first day activities. Members on the panel who answered conferee questions on this disease were: Dr. John Mettler, DeLaval Separator Company, Poughkeepsie, New York; Dr. John Nicolai, University of Kentucky; Mr. Dan Noorlander, Milk Producers, Inc., Arlington, Texas.

At the annual awards luncheon, Mr. Dan Conley, Executive Secretary of the Kentucky Dairy Products Association, Louisville, was selected as the outstanding dairy industry man in Kentucky. Mr. Bland Dorris, Pet, Inc., Bowling Green, Kentucky, was recognized as Kentucky's outstanding fieldman, and A. B. White, Warren County Health Department, Bowling Green, won the outstanding sanitarian award. Mr. Ewing Row, Associate Editor of Hoard's Dairyman was the luncheon speaker.

The conference was sponsored by the Dairy Products Association of Kentucky, the Kentucky Association of Milk, Food and Environmental Sanitarians, and the University of Kentucky Cooperative Extension Service. Dr. C. Bronson Lane, assistant extension professor of Animal Sciences, was the conference coordinator. Program chairmen were: Bob Holt, Kentucky State Health Department, Ashland, Kentucky; Gayle Shrader, Louisville-Jefferson County Health Department, Louisville, Kentucky; Mr. Richard Turner, Cudahy Company, Tompkinsville, Kentucky; Ed Napier, Sealtest Foods, Louisville, Kentucky.

NEWS AND EVENTS

GORDON A. HOURAN HONORED BY DFISA

Gordon A. Houran, director of The DeLaval Separator Co., Poughkeepsie, N. Y., was presented with a certificate of merit by the Dairy & Food Industries Supply Assn. at its April 8-10 annual meeting in Naples, Fla.

He was applauded for his long-time work on the 3-A Sanitary Standards Committees which develop sanitary standards for food and dairy processing equipment, and particularly for his service as chairman of the Technical Committee of DFISA, the 400-member organization of equippers and suppliers to the food and dairy industries; DeLaval has been a member since 1926.

Mr. Houran has been active on various other technical, marketing, general planning and policy study committees. He has also been a director of G & H Products, Kenosha, Wisc., since 1963 and a trustee of the Wrappinger Savings Bank since 1961.

Born in 1911, he is a graduate of the University of Massachusetts. He lives in Poughkeepsie with his wife Priscilla.

JOE LARSON ELECTED DFISA PRESIDENT

Joe A. Larson, president of Sparta Brush Co., Inc., Sparta, Wisc., was elected president of the Dairy & Food Industries Supply Assn., at its April 8-10 annual meeting in Naples, Fla. Elected vice-president in 1968, he became president-elect after a change in the constitution of the 400-member organization of equippers and suppliers to the food and dairy industries.

Very active in DFISA affairs, Mr. Larson has been a member of the Exposition Floor Committee since 1958, vice-chairman since 1964; Customer Association Relations Marketing Services and Article VI Study Committees since 1960; chairman of the Show

Frequency Study and Food Industry Liaison Committees since 1965; Annual Meeting Site Selection Committee since 1965; and Executive Committee since 1965. For 18 years his company has belonged to the Association. DFISA offers marketing and technical services and stages one of the largest industrial trade shows in the U. S.

On the community level, Mr. Larson was formerly mayor of Sparta, Monroe County Republican chairman, Chamber of Commerce president and one of 100 salesmen for Wisconsin for the Wisconsin Development Authority. He is a lay speaker and leader of the Methodist Church; was nominated as one of Wisconsin's Outstanding Young Men for 1955; received the Man of the Year Award in 1956; and the Sparta Area Farmers' Award in 1954. He is director and vice-president of the Marrow Home for the Aged and director of the Farmers National Bank.

A noted speaker, Mr. Larson is forced to turn down as many appearances as he is able to accept with his "humor with a purpose" message. He lives in Sparta with his wife Esther.

NEW ELECTRONIC UNIT ELIMINATES RAT PROBLEM

A new product, as small as an electric fan, may be the means to conquer one of man's cleverest and most destructive enemies, the rat. It is a revolutionary electronic unit, product of Faraway Imports, 6311 Yucca St., Hollywood, Calif. 90028. Although harmless to humans, the device stimulates excessive secretions of adrenaline in rats and excites them to abnormal frenzied activity. In this condition, they fight each other to the death, are unable to propogate, and die.

The Electronic Rat Control Unit has been tested and used with excellent results. Compact in size, the unit measures approximately 12 inches by 9 inches, weighs 10 pounds and operates on ordinary house current, 110-120V AC. It is also obtainable for use with 220-240V AC electrical supply.

Last year, the Food and Drug Administration found it necessary to destroy millions of pounds of food because of rodent contamination. Bakeries, meat packing houses, grocery stores, restaurants—any business concerned with food storage—find the battle against rats a constant and costly one. In addition to the dollar loss caused by rats each year, the greatest danger to humans is the fact that rats are the primary or secondary carriers of such diseases as typhus, amoebic dysentery, tularemia, salmonellosis, rabies, bubonic plague and other killer diseases.

To protect foods and other merchandise from contamination, a single Electronic Rat Control Unit in a storeroom will cover an area of 2650 to 3250 square feet. The unit is guaranteed to be effective and is available through Faraway Imports, 6311 Yucca Street, Hollywood, Calif. 90028, for $159.00, f.o.b. Los Angeles. The company requests no c.o.d. orders.

AMERICAN DAIRY SCIENCE ASSOCIATION 65TH ANNUAL MEETING UNIVERSITY OF FLORIDA, GAINESVILLE

More than 1500 scientists from throughout the United States and many foreign countries will come to the University of Florida, June 28-30, July 1, for the 65th Annual Meeting of the American Dairy Science Association.

This is the first time the national meeting has ever been held in Florida, Prof. Walter A. Krienke associate dairy technologist with the Institute of Food and Agricultural Sciences, said.

Scientific papers covering all segments of dairy science and the dairy industry will be presented. Topics will reach into such closely related fields as bacteriology, chemistry, nutrition, and physiology, Prof. Krienke said.

During the four-day meeting 13 symposia are scheduled, on subjects ranging from what is expected from today's college graduate to processing milk and milk products in Latin America.

Other symposia topics receiving current attention and expected to draw big crowds, Prof. Krienke said, are public health, waste management, and pesticides.

Headquarters for the national meeting will be in the University's J. Wayne Reitz Union. Special programs, including several tours, are planned for women and youth.

SHORT COURSE IN QUALITY FOODS AND INDUSTRY REGULATION

September 14-17, 1970—Short Course in "Quality Foods and Industry Regulation" (ingredients, processing, labeling and marketing), University of Florida, Gainesville, Florida 32601. Sponsored by Florida Section IFT and Florida Cooperative Extension Service. Fee—$40.00. For further information write Dr. R. F. Matthews, Department of Food Science, University of Florida, Gainesville, Florida 32601.

CDC OFFERS COURSE ON CONTROL OF INFECTIONS IN HEALTH CARE FACILITIES

The National Communicable Disease Center announces Course 3090-G, "Control of Infections in Health Care Facilities," to be presented at the Center in Atlanta, Georgia, June 8-12, 1970.

This course is for public health sanitarians who share responsibility for curbing infection through control activities in hospital and similar institutions. It is intended particularly for persons who are assuming these responsibilities for the first time.

Introduced by a discussion of hospital environment and administrative organization, the course emphasizes concepts of surface sanitation, air hygiene, laundry handling and processing, and general housekeeping. These topics are presented by lecture, and through conference, demonstration-application, problem solving, and panel discussions.

For further information about the course, write: National Communicable Disease Center, Attention: Director, Training Program, Atlanta, Georgia 30333.

NEW YORK STATE DEPARTMENT OF AGRICULTURE AND MARKETS TO LICENSE FOR THE DMSCC, MWT, WMT

Effective January 1, 1970 the Division of Milk Control of the New York State Department of Agriculture and Markets will be licensing all personnel who perform abnormal milk tests when they are performed: (a) to determine the basis for payment to the producer, or (b) for classification purposes, or (c) as a basis of acceptance or rejection of the milk. The New York State Department of Health requires the Modified Whiteside Test to be performed as a monthly screening tests on all composite supplies of producers prepasteurized milk and all positive results must be confirmed by the Direct Microscopic Somatic Cell Count. The Division of Milk Control will license persons to perform the Modified Whiteside Test, the Direct Microscopic Somatic Cell Count, and in addition, the Wisconsin Mastitis Test.

In December 1969, the New York State College of Agriculture conducted an intensive refresher training program for 15 of the Dairy Products Inspectors to prepare them for the licensing operation. The course was conducted in the Department of Food Science at Cornell University with the following staff: Mrs. Harriet B. Emmette and Dr. Donald S. Postle of the N.Y.S. Veterinary College, Dr. Roger P. Natzke of the Department of Animal Science, and Professor Richard P. March and Mr. Robert O. Brown of the Food Science Department.

SANITIZING RINSE ADDITIVE— EVALUATION AND LISTING

The NSF Testing Laboratory has conducted, under the provisions of Items 1.03 and 1.04 of NSF Standard No. 3, a study and evaluation of a sanitizing rinse drying agent. After extensive laboratory and field testing, the Laboratory has determined that the use of this product is an acceptable substitute for 180° final rinse temperature in commercial single tank, stationary rack, door type and single tank conveyor type spray dishwashing machines.

The testing indicated that when the sanitizing rinse aid was fed in accordance with the manufacturer's instructions, and the dishwashing machine operated pursuant to their recommendations, the sanitizing rinse aid did provide proper sanitization and air drying.

The product that has been evaluated and found satisfactory is the DuBois Chemicals "Dri-San Sanitizing Rinse Aid". Further, the acceptance of this product is predicated on the use of the DuBois Special Rins-A-Troll Injection System.

A comprehensive research report was prepared by the Testing Laboratory covering all phases of the test. Copies can be obtained from DuBois Chemicals, Division of W. R. Grace and Company, 634 Broadway, Cincinnati, Ohio 45202.

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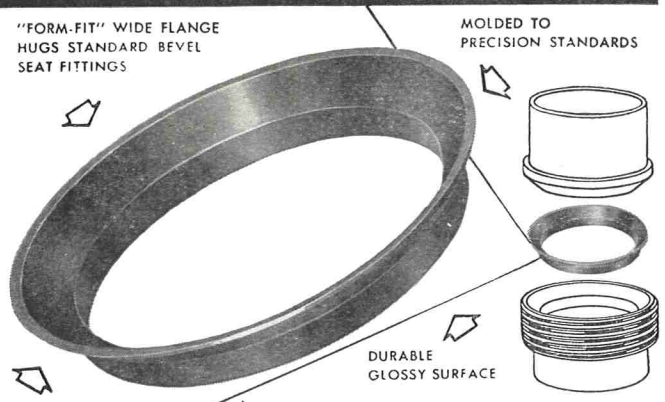

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