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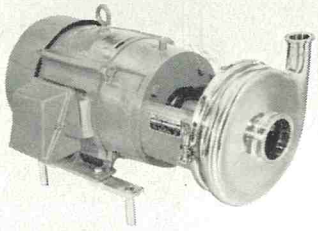

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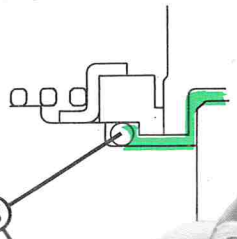

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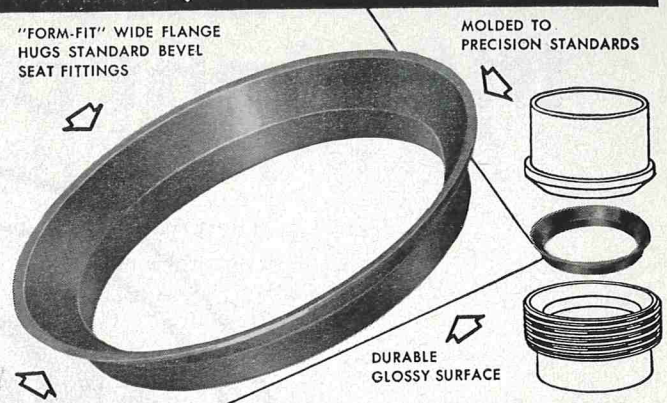

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DESTRUCTION OF SALMONELLAE BY MICROWAVE HEATING OF FISH WITH IMPLICATIONS FOR FISH PRODUCTS[1]

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(Received for publication April 15, 1971)

ABSTRACT

Since salmonellae are potential contaminants of fish, this study was undertaken to determine the adequacy of microwave heating for destruction of this microorganism. Exposure of 270 g portions of carp to microwaves (2450 MHz) for 195 sec was not adequate for complete destruction of *Salmonella typhimurium* ATCC 6994 or *Salmonella typhimurium* ATCC 13311 inoculated on the surface of the fish. One-serving portions of tuna pies, tuna casseroles, fish fillets, and fish sticks required from 49 sec to 390 sec to achieve a lethal temperature of 55 C when heated by microwaves. Under normal usage of electronic ranges one-serving portions of food would not be heated for as long as 390 sec.

The market for microwave ranges is growing rapidly, and it has been predicted that, by 1975, annual sales of microwave units will amount to 500,000 *(3)*. Since the time required for cooking foods by microwaves is from one-half to one-tenth of that required for cooking by the usual methods, which depend upon conduction and convection, the question arises as to the microbiological safety of foods cooked by this rapid method. There should be particular concern for foods which are attractive growth media for pathogenic microorganisms such as salmonellae.

Woodburn et al. *(13)* investigated the effectiveness of microwaves in pasteurizing cooked chicken, chicken and broth, and chicken and white sauce. When 50 g of product was exposed to microwaves for 120 sec, the number of *Salmonella typhimurium* was reduced to a safe level (10 per gram or less). However, this was not true when the time of heating by microwaves was limited to 90 sec. Also, in a chocolate egg-foam product, Baldwin et al. *(2)* found that microwave cooking did not result in complete destruction of S. *typhimurium*. The importance of ingredient effects was shown by the fact that S. *typhimurium* did not survive in a similar foam product containing lemon juice.

Several studies have shown that salmonellae are potential contaminants of fish, especially fish taken from water receiving sewage *(4, 5, 6, 7, 9, 10)*. Therefore this study was undertaken to investigate the adequacy of microwave heating of fish for destruction of salmonellae. In addition, implications for destruction of salmonellae in fish products were investigated by determining time and temperature relationships during microwave heating.

MATERIALS AND METHODS

Salmonella typhimurium ATCC 6994 and S. *typhimurium* ATCC 13311 were used for these experiments. Carp (*Cyprinus carpio* Linnaeus) and fish products were obtained from local markets.

Inoculum determination for salmonellae

Salmonellae were grown in Brain Heart Infusion [Baltimore Biological Laboratories (BBL) Cockeysville, Maryland] for 18-24 hr at 35 C. After incubation, the cells were centrifuged, the supernatant was decanted, and cells were resuspended in 2-3 ml of sterlized 0.1% peptone (Difco) water and the concentration of cells was adjusted to 55% T at 660 nm (Spectronic 20). The ten-fold dilutions of the cell suspension were made in 0.1% peptone water. Then 0.1 and 1 ml inoculations were made in tryptic soy agar (TSA; Fisher, Fair Lawn, New Jersey) and incubated at 35 C for 24 hr before counting.

Survival of salmonellae in carp exposed to microwaves

Pieces of carp (5 replications), weighing approximately 270 g each, were defrosted in a refrigerator. Each piece of fish was placed in a round Pyrex container (25 cm diameter, 6.4 cm depth) and 10 ml of suspension, with a predetermined number of cells was pipetted onto the surfaces of the fish. The Pyrex dish with the inoculated fish was placed in an electronic range (Tappan electronic range, Model R-4A, Mansfield, Ohio) and exposed to microwaves at 2450 MHz for 195 sec. The electronic range was operated through a control panel which indicated that the current drawn from the line was 21.7-23.8 amp and the magnetron current was 285-330 milliamp. The cooking time was chosen on the basis of preliminary trials which indicated that an adequate degree of doneness for palatability was achieved in the fish in this length of time (mean internal temperature 73 C). The Pyrex dish containing the inoculated fish (skin side up) was placed in a large paper sack so that any spatter occurring during cooking was contained. The container and sack were placed so that the fish was in the center of the shelf in the low position of the range.

After cooking, the fish was blended with 200 ml of lactose broth (Fisher, Fair Lawn, New Jersey). One milliliter of blended material was swirled with TSA in petri plates. Plates were inverted, incubated at 25 C for 48 hr, and colonies counted.

To determine the total number of salmonellae, 1 ml of blended fish suspension was inoculated in triplicate into each of the following agars obtained from BBL: brilliant green sulfa agar (BGS), and xylose-lysine brilliant green agar (XLBG). These plates were incubated at 35 C for 24

[1]Contribution from the Missouri Agricultural Experiment Station Journal Series, Number 7053.

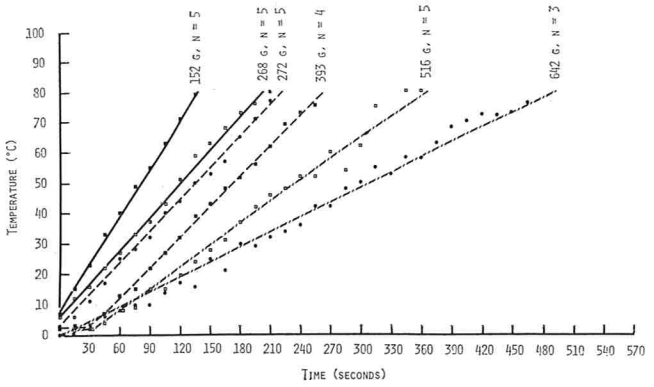

Figure 1. Relationship between temperature and time for various weight pieces of carp exposed to microwaves. (2450 MHz).

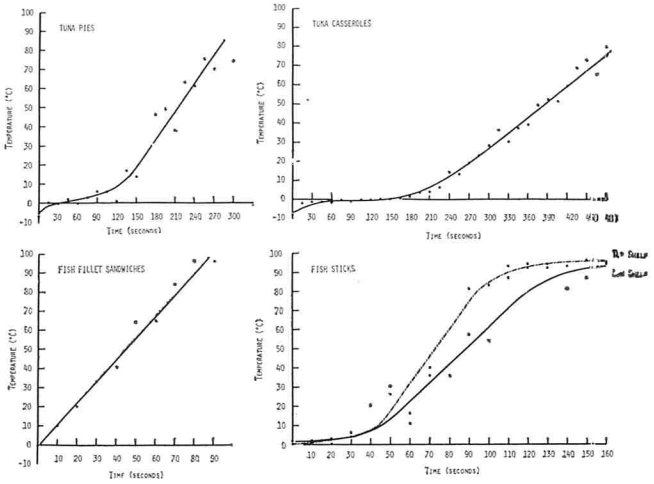

Figure 2. Relationship between temperature and time for fish products (n = 3–5) exposed to microwaves (2450 MHz).

hr. All colonies suspected to be salmonellae were confirmed by biochemical tests such as carbohydrate fermentation and triple sugar iron agar tests.

Determination of rise in temperature in fish and fish products during microwave heating

The temperature rise was determined at 15 sec intervals during microwave exposure of pieces of carp with mean weights of 152 g, 268 g, 272 g, 393 g, 516 g, and 642 g (3-5 replications). Samples were cooked as described above except for those with mean weights of 516 g and 642 g which were cooked in rectangular Pyrex containers (19 × 33 × 4.5 cm). Internal temperature measurement was made by interrupting the cooking and inserting a thermocouple (Pyrometer, Model 42 SC, Yellow Springs Instrument Co., Inc., Yellow Springs, Ohio) into the central portion of the sample.

The temperature rise was determined as described above at 10 or at 15 sec intervals in the following frozen fish products: 227 g tuna pies, 327 g tuna casseroles, 57 g fish fillets, and four frozen fish sticks, 28 g each. A minimum of three replications was completed for each product.

Containers for the fish products varied according to the nature of the food. Because metal reflects microwaves, it was necessary to remove the pies and casseroles from their aluminum foil containers and place them on paper plates for cooking. Fish fillets were sandwiched in buns during cooking. Four fish sticks were placed on paper plates for each trial, and the temperature was measured by starting at the left stick and progressing to the right.

All products were placed in the center of the electronic range shelf; and, except for the fish sticks, the shelf was always placed in the low position in the range. Fish sticks were heated both in the high and low shelf positions, and three replications were completed for each position.

RESULTS

Survival of salmonellae in carp during microwave heating

Exposure of carp (mean weight 270 g) to microwaves for 195 sec was not adequate for destruction of all salmonellae inoculated on the surface of the fish. A summary of level of inoculum and numbers of viable cells and viable salmonellae after exposure to microwaves is shown in Table 1.

Temperature rise in fish and fish products during microwave heating

Figure 1 illustrates the change in temperature in carp as a result of exposure to microwaves. The temperature increase was more uniform in the light weight samples (152 g, 268 g, 272 g, and 393 g) of fish than in the heavy pieces (516 g and 642 g).

A considerable amount of fluctuation was observed in the internal temperature both within individual tuna pies and among replications during exposure to microwaves. This variation was probably caused, in part, by the variety of ingredients in the pies. Although tuna noodle casseroles also are composed of several constituents, less variability in internal temperatures was observed in these products than in the tuna pies. In the casseroles, the mean internal temperature did not rise above 0 C until after the product was exposed to microwaves for 135 sec (Fig. 2).

The internal temperature rose quickly in the fish fillet sandwiches when they were exposed to microwaves. The rapid temperature increase in this product, no doubt, resulted from the mass (57 g) which was smaller than for any other product included in this study (Fig. 2).

Location within the electronic range influenced the rate of temperature change in the fish sticks. When this product was placed on the shelf located in the high position, the temperature rose faster than it did when placed on the shelf in the low position (Fig. 2).

DISCUSSION

Each food constituent possesses specific dielectric properties which govern the response to microwaves. Thus, the food products containing a variety of ingredients would be expected to exhibit variability in

TABLE 1. SURVIVAL OF BACTERIA IN FISH DURING MICROWAVE HEATING[a]

	S. typhimurium ATCC 6994			*S. typhimurium* ATCC 13311		
	Initial inoculum of salmonellae (cells/g)	Total viable cells after heating (cells/g)	Total viable salmonellae after heating[b] (cells/g)	Initial inoculum of salmonellae (cells/g)	Total viable cells after heating (cells/g)	Total viable salmonellae after heating[b] (cells/g)
	3.1×10^6	6.9	2.3	3.7×10^6	0.7	<0.3
	2.9×10^6	6.6	2.6	3.7×10^6	2.2	0.4
	2.9×10^6	0.5	<0.3	3.7×10^6	<0.3	<0.3
	2.9×10^6	0.8	0.8	—	—	—
	2.9×10^6	0.8	0.8	—	—	—
Mean	2.9×10^6	3.1	1.3	3.7×10^6	1.0	0.1

[a]195 sec; AC voltage: 220 volt; AC current: 22 amp; magnetron current: 300 milliamp.
[b]Average counts from XLBG and BGS agars.

internal temperatures. This was true for tuna pies and, to a lesser degree, for tuna casseroles. For products of more uniform composition, variation in thickness, within and among pieces, would cause differences in temperature rise. Where total mass is small, as with the fish fillets, a rapid increase in temperature should be expected (Fig. 1).

Investigations carried on concurrently with the experiments reported herein illustrated that the distribution of microwaves within the electronic range was uneven *(11)*. This is in agreement with the research of other investigators *(8, 12)*, and it is likely that this is characteristic of most electronic ranges currently in use. The uneven distribution may explain some of the variability in internal temperatures which was observed within and among products of similar composition and the difference in temperature attained in fish sticks when they were placed on different shelf positions during heating.

All internal temperatures were determined in the central portion of the product. Previous investigations (B. M. Korschgen, unpublished data, 1969) indicated the temperature in the outer edges of samples of carp ranging in weight from 150 g to 650 g (25 replications) were from 12-18 C higher than the final internal temperature of 77 C in the central portion. The coolest temperature was usually near the center of the sample and was not consistently related to thickness of the sample. Microwaves are directed into the edges of the sample from the top, bottom, and sides, whereas the center receives microwaves from only the top and bottom. It has been suggested *(1)* that a metal shield might be useful in protecting the edges of portions of foods from over cooking while the center of the samples achieved a satisfactory internal temperature.

Both strains of salmonellae used in this study survived on 270 g pieces of carp exposed to microwaves for 195 sec. However, numbers of salmonellae were <10/g, and the inoculum level was much higher than one would normally expect in such foods (Table 1).

Since some salmonellae survived on carp exposed to microwaves for 195 sec, there evidently were areas in the samples which did not achieve a lethal temperature of 55 C *(1)* in this length of time. Among the fish products tested, the time required to reach 55 C in the center of the product varied from about 49 sec to 390 sec in one-serving portions (Fig. 2). Under the usual conditions of operating electronic ranges, it is unlikely that one-serving portions of food would be exposed to microwaves for as long as 390 sec. Therefore, there appears to be some potential for salmonellae poisoning from fish and fish products cooked electronically.

ACKNOWLEDGMENT

The authors express appreciation to Sue Snider for her assistance with some of the laboratory work.

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A Research Note

THE EFFECT OF MIXING ON DISTRIBUTION OF SOMATIC CELLS IN BULK TANK MILK[1]

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(Received for publication April 14, 1971)

ABSTRACT

Agitation of milk in bulk tanks for at least 1 min is necessary so that representative samples for somatic cell counts can be obtained.

Improved methods have recently been developed for estimating the level of somatic cells in milk *(1, 2, 3)*. In order for test results to be useful, it is necessary to establish the amount of mixing required to obtain a representative sample from a bulk tank.

MATERIALS AND METHODS

Bulk tanks. Samples were obtained from 10 different commercial bulk tanks among which a variety of designs (cylindrical and rectangular designs with both round and flat bottoms) was represented. No attempt was made to select bulk tank types to reflect any frequency distribution in the field. The amount of milk ranged from 400 to 3,000 lb. The concentration of somatic cells ranged from 300,000 to 1,300,000/ml.

Samples. Milk samples (5-10 ml) were obtained by pipetting before agitation (tank undisturbed for > 1 hr) and after 1, 2, 3, 4, and 5 min agitation with the bulk tank agitator. Six samples were obtained at each time from each tank at each of 3 depths (surface, center, bottom) and at each of 2 locations (center and periphery).

Cell estimates. Somatic cell levels were estimated using the Direct Microscopic Somatic Cell Count (DMSCC) *(1)*.

RESULTS AND DISCUSSION

Samples were obtained from the undisturbed tank and after 1, 2, 3, 4, and 5 min agitation. Analysis of variance of results is presented in Table 1. The difference attributable to sampling location (depth) was highly significant in samples taken from the unagitated tanks. After 1 min agitation there were no significant differences in samples obtained at various depths and after additional agitation there was no further change.

TABLE 1. ANALYSIS OF VARIANCE

Source		DF	Mean squares	F-ratio
Agitation time		5	54,330	115.01**
Depth[1] within agitation time	(0)[2]	5	155,782	329.78**
	(1)	5	44	.09
	(2)	5	8	
	(3)	5	41	.08
	(4)	5	2	
	(5)	5	28	
Error		180	472	

[1]Depths: surface, middle, and bottom
[2]Minutes agitation indicated in parentheses.
**P <0.005

The data demonstrate that samples obtained from these bulk tanks after agitation for at least 1 min were representative enough for use in estimating the somatic cell counts for the entire volume of milk. It seems reasonable to require a minimum of 1 min agitation period as a standard procedure.

[1]Research supported by the College of Agricultural and Life Sciences and by P.H.S. Research Grant UI00124 from the National Center for Urban and Industrial Health. Paper No. N.S. 704.

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THE PROBLEM OF RODENTS IN OUR MODERN ENVIRONMENT[1]

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Abstract

Although two species of rats have become thoroughly domesticated and have lived parasitically in man's environment for several centuries, organized urban rat control programs are of comparatively recent origin. A brief history of commensal rats and their relationship to man is presented. Some early urban control programs are summarized. Recent social developments in cities have focused attention on rat control programs and have intensified efforts to free urban areas of rats, particularly in proverty-stricken neighborhoods. An effective community rat control program depends upon motivation and education of citizens as well as enforcement of wisely written rat control ordinances and related solid waste disposal rules. A good rat control ordinance should require rat-proofing of buildings, elimination of rat harborages and sources of food for rats, as well as rat extermination on all premises. For the future, not only will more sophisticated means of citizen motivation be needed, but further studies of the role of sewers and other heretofore neglected areas of rat control in the urban environment.

Although the brown or Norway rat and the black rat and its subspecies have lived with man for centuries, organized community rat control programs are of surprisingly recent origin. It has been only in the last 30 years that community efforts have significantly augmented individual efforts toward elimination of these pests.

Rats and History

The history of the transition of these rats from creatures of the field and forest to an exclusively commensal existence is somewhat obscure. Zinsser *(14)* believes that disease symptoms recorded in the Old Testament are suspicious of plague and may indicate that black rats were known to man at that time. Records of early epidemics, such as the Athenian Plague of the Peloponnesian Wars and the Plague of Justinian in Egypt, 540 A.D., are regarded by him as indicative of typhus and bubonic plague, respectively.

While it is generally agreed that the black rat originated in the Arabian or Near Eastern areas, the time of its domestication and introduction into Europe is disputed. Zinsser quotes DeL'isle as believing that the Alexandrian rat, the source stock of the European black rat, did not become parasitic before the 7th century and was introduced into Europe by returning Crusaders. Zinsser disputes this theory by showing the existence of rat fossils in the Pliocene period of Lombardy and the later Pleistocene period of Crete. He believes, moreover, that: "In view of the probable ancient prevalence of rats in Eastern countries and the close communication by sea between the Greeks and Mediterranean coastal cities, as well as the regular grain traffic between Egypt and Rome, it is difficult to credit complete absence of rats from the European littoral throughout antiquity."

Rats and their ectoparasites have probably been vectors of human disease for thousands of years. The best known epidemic is the "black death" of the 14th century in which 25,000,000 persons, or one-fourth of the population of Europe, were destroyed *(6)*. In a transition toward community living, the common practice of disposing of garbage and sewage in the streets provided an ideal environment for a rat population explosion and may have been the indirect cause of this disaster.

As the black rat was a common inhabitant of ships, it is likely that the first black rat arrived in the Western Hemisphere with Columbus. In any event, rat infestations in the early American colonies made their presence known by outbreaks of plague, particularly in port cities. The black rat is confined primarily to coastal and southern areas of this country.

The brown or Norway rat, believed to have originated in Asiatic Russia or Mongolia, according to Silver *(10)*, did not reach Europe until the beginning of the 18th century. The brown rat made its first appearance in the United States about the beginning of the American Revolution. It gradually spread inland until it now infests every state in the Union. Its close association with man is indicated by dates provided by Mallis *(6)* revealing that the rat arrived in California in 1851, closely following the huge influx of humans in the '49 gold rush and its late arrival in 1923 in sparsely inhabited Montana. Even now, commensal rats are generally of little impor-

[1]Presented at the 57th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, Cedar Rapids, Iowa, August 17-20, 1970.

tance in the wide open spaces of desert land in some of our southwestern states. It is reported that at least one Canadian Province is still rat free *(5)*.

EARLY CONTROL PROGRAMS

Prior to 1940, little information can be found regarding organized rat control as a community effort although short-lived rat-killing campaigns appeared sporadically in some cities. For instance, no mention of rats or rat control is made in the City of Milwaukee Health Department Annual Reports until 1942, although it is known that some primitive attempts at rat killing were made by the department in the 1930's.

The rat problem on farms, however, was recognized much earlier and rural control methods are the subject of several agricultural bulletins. Silver *(10)* estimates that in 1942 one-half of the rat population lived on farms, 26% in nonfarm country residences and cities of less than 10,000 population, and the remaining 24% in cities of over 10,000.

Increasingly high standards and demands for uncontaminated farm products as well as the economic losses have reduced the rural rat population. On the other hand, Clinton *(4)* estimated that 6% of the human farm population per year is moving into cities carrying rural habits of environmental sanitation with them. Most often, these habits are conducive to the support of rats.

A national rat control program sponsored by the U. S. Fish and Wildlife Service was begun in 1947 to initiate and encourage community rat control programs. Their 1947 Annual Report *(9)* indicates that the majority of the cities in the North Central Region offered only "lip service" in rodent control and that health department participation was lacking in 75%. Out of 206 cities involved in the study, only 16 had a good, permanent program. Much earlier than this, the U. S. Fish and Wildlife Service *(11, 12)* recognized the need for publicly sponsored organized rat control. Even then, the need was seen for ratproofing of buildings, adequate facilities for collection and disposal of waste, and adequate legislation to insure success in extirpation of rats. Silver *(12)* states: "Individual householders may wage a conscientious, but nevertheless fruitless, war against the rats on their own property simply because the rest of the community is not sufficiently concerned to take remedial action."

The advent of an affluent society has made a substantial contribution to the degree of rat infestation in urban communities. Successful, responsible city dwellers, moving in droves to the suburbs, are rapidly being replaced by the poor, who most often are experienced only in rural sanitation. He is more than likely to settle in the older central portions of the city. His lack of knowledge and concern over disposal of wastes and keeping buildings in a rat-free condition is only a part of the problem now facing city governments. Demands of citizens, recent civil disturbances, and the need for better living conditions in "core" areas have focused national attention on the urgent need for effective urban rat control programs.

RECENT CONTROL PROGRAMS

This has resulted in the creation of a federal rat control grant program. The objectives of the program are to rapidly reduce rat populations and conditions conducive to rat infestations within project areas to a level where they no longer exert a public health and economic effect upon the community. Currently 15 grants covering 19 cities have been awarded *(2)*. The target areas in these cities encompass 167 square miles in which 3.8 million people live. If the 20% of rat-infested dwellings found in these cities is extrapolated to the 60 million people comprising the nation's central city population, at least 12 million Americans now live in rat-infested dwellings *(2)*.

Control ordinances

The first step in instituting an urban rat control program is the writing and passage of suitable rat control ordinances. A good ordinance should not only enable the various city departments to participate in rat control efforts, but should place definite responsibilities upon the citizens of the community and should be enforceable. It should be remembered that ancillary environmental control regulations governing solid waste storage and disposal are an extremely important factor affecting rat control.

A good rat control ordinance should include the following:

- *(a)* A requirement for the extermination of rats on any infested property or in any infested structure.
- *(b)* Ratproof construction of buildings and provisions and specifications for the ratproofing of existing structures (Fig. 1).
- *(c)* Elimination of rat harborages. This may include provisions for proper storage of bulky solid waste, storage of lumber piles at least 1 ft above ground, and removal of abandoned automobiles.
- *(d)* Elimination of all sources of food for rats. In addition to ratproof storage of food and garbage, this also may include feeding of song birds only from ratproof, elevated trays or feeders.

Motivation of people

Just as uncoordinated individual efforts at rat control are ultimately unsuccessful, governmental control programs without full cooperation and motiva-

Figure 1. A Norway rat emerging from a nonratproof dwelling.

tion of citizens are also fruitless. This cooperation can be partly assured by adequate inspection and full enforcement of local ordinances. Voluntary citizen cooperation in extermination and elimination of all sources of food and harborage for rats is essential for ultimate success of any program.

A strong rat poisoning program by governmental agencies appears to be the best way to begin the motivation of people by showing that sincere efforts are being made to help them. Comprehensive community education programs, through the schools, advertising media, civic and neighborhood organizations, as well as personal contacts are an essential to stimulate citizen motivation. Several cities including Chicago, Milwaukee, Cleveland, and New York City are reporting success in the use of health education aides. These aides attempt to change the housekeeping habits of problem families through personal visits *(2)*. For better acceptance, the aides also provide help and information on other personal and public health problems and refer families to appropriate agencies for problems beyond their personal capabilities.

Garbage collection and building maintenance

The most important factors in control of urban rats are proper storage and frequent collection of garbage and maintenance of dwellings in a ratproof condition. The majority of the problems encountered in a city can be solved simply by keeping tight-fitting covers on the garbage cans and repairing broken basement windows. Motivation of the individual to do these two simple things would eliminate most of our urban rat problems. It is difficult to convince the hard core militant, whose battle cry against the establishment is "we *have* to live with rats and cockroaches," that he can eliminate most of his problems with an individual effort to maintain a sanitary environment. We must devise more sophisticated and persuasive methods to instill pride and convince the militant and the apathetic to help themselves by helping the community.

Rats in sewers

Some rat control problems are beyond the scope of individual responsibility and must be solved through governmental efforts. The most important of these is the presence of rat infestations in sewers. The sewer inhabiting rats serve as a source of reinfestation for the community. Although the presence of rats in sewers was recognized by Silver in 1942 *(12)*, It was not until semipermanent, paraffin-embedded baits were developed, that poison baits could be successfully used in the warm, humid atmosphere of sewers without rapid deterioration *(7)*. Rats, as long as they remain in the sewers, are not a public health problem. It is when they emerge to the surface through defective sewer laterals (Fig. 2), catch basins, and sometimes, to the surprise of the housewife, through toilet bowls (Fig. 3) that they become a community menace. In addition to a sewer baiting program, some cities are using dye or smoke tests to disclose sewer defects. Relatively little is known of the characteristics of sewer rat populations, and much research remains to be done in order to control this source of infestation. Such studies have been recently instituted in St. Louis by Barbehenn *(1)* to determine the environmental factors in sewer rat populations which may lead to better control.

Rats in other locations

Open garbage dumps have always been known to be an important source of rats and are being rapidly eliminated, but other sources are not always as easily recognized. An important source of rat food is the spillage of grain from railroad cars in transit and in marshalling yards. This, incidentally, is also the

Figure 2. Broken sewer lateral and open joint from which rats burrow to the surface.

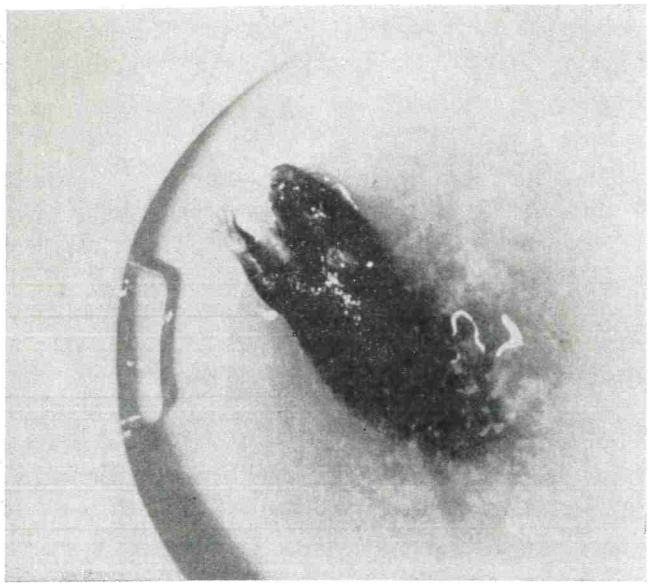

Figure 3. A live rat found in a toilet bowl by a housewife.

major food source of "tramp" pigeons. Railroads have been substituting all metal "leakproof" boxcars to eliminate grain spillage and, hopefully, all grain shipments will be made in leakproof cars within a few years. Rats are often found infesting river banks and drainage canals. The City of Milwaukee has one large colony of rats living on a steep, nearly inaccessible bank of the Milwaukee River. This colony appears to subsist, primarily, on garbage, dead animals, and aquatic life foraged from the river.

Rodenticides

Safe and effective rodenticides have been available for some time, but they must be made more attractive to compete with garbage and do an effective rat-killing job. The City of Milwaukee has been studying the effect of synthetic food flavors added to cornmeal-anticoagulant baits to enhance their attractiveness to rats *(3)*. Coconut, butter-vanilla, and maple food flavors have been shown to significantly improve acceptance of baits and other synthetic flavoring materials are being currently tested.

Chemosterilants are currently under investigation as a supplemental form of rat control. While not a panacea, they may provide additional control in conjunction with the use of toxicants and sanitation to keep rat populations at a low level *(8)*. Such exotic approaches to rat control as the use of skunk odors and electronically-generated sound *(13)* have been tried and found wanting.

Better rodenticides, better baiting methods, chemosterilants, and further studies of rat biology and ecology will enhance our efforts for better rat control. None of these, however, can work without the full cooperation of all the citizens of a community. The challenge still lying ahead of us is to fully inform, educate, and instill pride in the people so that our environment can be maintained in a manner which will not support rats. This must be a continuous effort which, together with conscientious enforcement of environmental legislation and the recognition of governmental responsibilty in this field, may assure the elimination of rats as a modern environmental problem.

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FUNGI IN FOODS

II. SOME OBSERVATIONS ON ACIDULANTS USED TO ADJUST MEDIA pH FOR YEASTS AND MOLD COUNTS[1]

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ABSTRACT

Yeast and mold counts were compared on Potato Dextrose Agar using six acidulants and an antibiotic combination for controlling bacteria. Counts on the acidified media ranged from 61 to 82% of those obtained on the antibiotic medium. The acids in order of decreasing recovery of fungi were lactic, tartaric, citric, hydrochloric, sulfuric, and phosphoric. Both gram-negative and gram-positive bacteria produced countable colonies on acidified media at a pH of 3.5. No bacteria grew on the antibiotic medium. Recovery of stored yeast cells also was conducted, and it was possible to demonstrate a population of cells which would not initiate growth at a pH of 3.5.

Although no general accord has been reached, organic acids such as tartaric and citric are the acidulants most widely used to control bacterial growth during the selective enumeration of fungi in foods.

A previous paper *(1)* pointed out some of the difficulties encountered when employing acidification for making selective counts and suggested that antibiotics were better suited for this purpose. This suggestion would be more valid if all acidulants elicited essentially the same poor response when used in media. In order to clarify this point, three organic and three inorganic acids were compared to the antibiotic medium for their effect on recovery of yeasts and molds from a variety of foods.

MATERIALS AND METHODS

Methods were essentially those described earlier *(1)* except that sets of plates were prepared with Potato Dextrose Agar (PDA) acidified following sterilization to pH 3.5 ± 0.1 with sterile tartaric (10%), citric (10%), lactic (10%), sulfuric (0.5N), phosphoric (1N) and hydrochloric (0.5N) acid. In addition an antibiotic medium was prepared by adding 100 mg per liter each of chloramphenicol and chlortetracyline HCl to PDA that had been adusted to pH 7 before sterilization. Pouring of the different media was done in a random fashion to minimize any effect caused by the time lag between sample dilution and actual pouring of the media. Incubation was at 22 C for 5 days. When bacterial growth was found on any of the media, colonies were isolated and identified by standard procedures *(2)*.

To specifically demonstrate the inhibitory effect of low pH on yeast cells, an acid-sensitive culture of *Trichosporon cutaneum* WBC 102 was harvested from a 48-hr shaken culture of yeast maintenance broth *(3)*, washed twice in 0.1N potassium phosphate buffer, pH 6.8, and resuspended in the same buffer containing 4% sodium chloride. The sodium chloride was included to inhibit "cannibalism and regrowth" of the organism, which was observed to occur in plain buffer. The cell suspension was plated immediately on antibiotic and tartaric acid media, stored at 1 C, and plated at daily intervals for 4 days.

RESULTS

As in earlier work *(1)*, particular care was taken to ensure that the increased recovery from the antibiotic medium was due to fungi and not bacteria. This was done by the routine staining of colonies selected randomly from plates, as well as the staining of any suspect colonies. In Table 1 are listed the samples and counts obtained from the seven media. The yeast and mold counts with each of the acids are also listed and ranged from 61 to 82% of that obtained with the antibiotic medium.

Although only 5 different bacteria were isolated from the acidified media, they represent rather divergent characteristics. Isolation of the more acid-tolerant gram-positive species (Table 2) was not totally unexpected, however, isolation of the two gram-negative species was.

Following identification of the bacteria, the organisms were screened for their ability to grow in each of the six acid media at a pH of 3.5 in order to determine possible inhibitory anion effects. The isolates were streaked from nutrient broth onto prepared plates of the acid media. Differences were noted (Table 2) even among isolates of the same species. The samples from which the isolates were obtained are not included in Table 1 because of the heavy growth of the contaminating organisms.

The data in Table 3 demonstrate that even within a single culture, cells can exhibit a marked difference in growth when plated on the two types of media. On zero day, recovery of *T. cutaneum* using the acidified medium containing tartaric acid was only 45% of that obtained on the more neutral antibiotic medium, and by the first day recovery had decreased

[1]Florida Agricultural Experiment Station Journal Series No. 3943.

TABLE 1. RECOVERY OF YEAST AND MOLDS FROM VARIOUS FOOD SAMPLES AS AFFECTED BY ACIDULANT

Samples	Potato dextrose agar plus						
	Antibiotic	Tartaric	Lactic	Citric	Hydrochloric	Sulfuric	Phosphoric
	(Organisms/gram)						
Fresh shrimp	7,000	3,300	4,500	6,200	7,000	6,800	4,900
Shrimp patties	190	110	140	130	140	160	110
Fish sticks	5,300	2,700	3,500	2,900	3,200	3,100	3,200
Pickled herring	1,300	1,100	1,100	1,100	1,000	1,100	1,100
Fresh mullet	1,900	1,000	1,600	1,200	1,100	1,100	1,100
Fresh crab meat	3,200	1,800	1,900	2,400	2,100	1,700	1,300
Fresh grunt	18,000	5,900	9,800	9,200	6,100	7,800	5,800
Pork sausage	21,000,000	18,000,000	18,000,000	17,000,000	17,000,000	14,000,000	13,000,000
Summer sausage	2,200,000	1,600,000	1,400,000	1,400,000	1,400,000	1,300,000	1,200,000
Link sausage	27,000	17,000	14,000	19,000	18,000	20,000	19,000
Hamburger	18,000	14,000	14,000	16,000	17,000	15,000	16,000
Weiners	78,000	53,000	47,000	49,000	57,000	50,000	49,000
Fryer thighs	17,000	3,500	4,100	10,000	6,400	9,900	3,700
Potatoes (frozen)	250	130	140	180	190	150	170
Potatoes (raw)	70,000	63,000	66,000	65,000	50,000	50,000	68,000
Radish	9,000	4,100	4,100	6,900	3,600	3,300	3,300
Mixed vegetables	780	460	570	600	560	640	580
Carrot	41,000	7,000	7,000	8,000	7,000	7,000	5,000
Bell pepper	5,100	2,600	2,400	2,800	2,700	2,700	2,700
Lettuce	2,500	800	1,400	1,600	1,300	1,300	1,400
Tomato	95,000	45,000	36,000	44,000	48,000	46,000	31,000
Cheddar	2,800	2,400	2,200	2,400	2,000	2,100	2,100
Mozzarella	1,500,000	770,000	990,000	870,000	870,000	1,000,000	780,000
Gouda cheese	53,000	30,000	41,000	35,000	40,000	39,000	38,000
Swiss cheese	320	180	,160	210	200	190	180
Cottage cheese	9,600	7,300	8,200	8,200	7,200	7,300	7,300
Apple	110	60	70	60	70	50	60
Plum	420	220	290	310	300	250	280
Fruit salad	130	120	120	120	90	100	120
Ham salad	1,600	840	830	1,000	780	890	830
Pond water	100	80	100	70	90	70	60
Cole slaw	5,400	3,500	3,300	3,900	3,800	3,500	3,800
Corn meal	1,300	800	900	700	1,200	900	900
Totals	25,175,300	20,642,000	20,666,420	19,568,180	19,558,120	16,582,100	15,250,990
Per cent recovery	100	82	82	78	78	66	61

to <10%. Incubation of the plates was extended to 8 days in this experiment to ensure maximum outgrowth of the colonies.

DISCUSSION

From the data presented it appears that regardless of the acid used, recovery is not as great as from a medium with a more neutral pH. In foods it appears that it is mainly yeasts that exhibit acid sensitivity and not knowing the past history of the products analyzed or the species present, it is difficult to speculate as to why certain samples exhibit differences in counts. It may result from past treatment of the sample or from a particular population of organisms in the sample. Studies are planned to characterize the populations in samples that exhibit these large differences and possibly answer this question.

Preliminary studies with *T. cutaneum* indicate that recovery was equally as good on PDA at pH 7.0 with or without antibiotics, but colony size appeared to be somewhat smaller in the presence of the antibiotic. This would indicate that the antibiotics have a depressing effect on growth of some fungi and points out a need for further investigations in this area. Growth on the acidified media was always restricted, even upon extended incubation. When the recovery studies were conducted in plain buffer, results were erratic because of what appeared to be "regrowth" of the organism. To overcome this pheno-

TABLE 2. CHARACTERISTICS OF SOME BACTERIA ISOLATED FROM ACIDIFIED YEAST AND MOLD PLATES

Organism	Sample	Growth on:
Aerobacter aerogenes	Raw milk I	citric, hydrochloric lactic, phosphoric, sulfuric
Aerobacter aerogenes	Raw milk II	citric, hydrochloric, phosphoric, sulfuric, tartaric
Streptococcus uberis	Raw milk II	citric, hydrochloric, phosphoric, sulfuric, tartaric
Achromobacter guttatus	Orange juice I	citric, hydrochloric, phosphoric, sulfuric, tartaric
Leuconostoc citrovorum	Orange juice I	citric, hydrochloric

menon, various concentrations of sodium chloride were added to the buffer, and it was observed that at a concentration of 4% regrowth did not occur.

In summary it appears that regardless of the acid employed, lowering the pH of a medium to make it selective generally results in reduced yeast and mold counts. This "acid sensitivity" also was demonstrated with a pure culture of yeast. The fact that both gram-negative and -positive bacteria are able to grow at pH 3.5 can at times be responsible for serious error when using an acidified medium, unless confirmation of the colonies is made.

TABLE 3. RECOVERY OF STORED *Trichosoporon cutaneum* WBC 102 CELLS FROM PHOSPHATE BUFFER USING ACID AND ANTIBIOTIC MEDIA

Days of Storage	Medium: Antibiotic	Medium: Tartaric acid	Recovery per cent
	——— (No./ml) ———		
0	1,100,000	500,000	45
1	440,000	40,000	9
2	210,000	11,000	5
3	68,000	1,700	2
4	19,000	1,400	7

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NEW LAW AFFECTS EGG AND EGG PRODUCT USERS

Do you run a restaurant, an institution such as a hospital or a school, or a food manufacturing plant such as a bakery?

If you are in one of these businesses or any other that uses shell eggs or egg products here are a few things you should know about the Egg Products Inspection Act—because it affects you.

The first part of this law, which became effective July 1, 1971, requires all egg processing plants producing liquid, frozen, or dried eggs to meet the facility, equipment, and sanitary standards of the U. S. Department of Agriculture and to operate under continuous USDA inspection.

If you have any egg products in stock that were produced before July 1 in a plant not under USDA inspection, you may still use them until July 1, 1972, provided the product is wholesome. After that date, you may use only USDA inspected egg products.

Perhaps you don't buy egg products, that is liquid, frozen or dried eggs, but purchase shell eggs to use in your business. If so, you will still be affected by the Egg Products Inspection Act. Beginning July 1, 1972, the law will control the disposition of what it terms "restricted eggs"—checks, dirties, leakers, incubator rejects, and loss eggs.

Checks and dirties may be shipped only to USDA inspected egg processing plants for proper segregation and processing. All other restricted eggs must be denatured or destroyed to prevent their use as human food. Anyone who has been using any of these types of eggs must stop doing so before next July 1.

By that date, only clean, sound shell eggs may be used in restaurants, institutions, and food manufacturing plants. All businesses that break eggs for use in their products or in preparing meals will be checked periodically by the Food and Drug Administration. They may use only U. S. Grade B or better eggs. Most retail stores, restaurants, institutions and food manufacurers are now using U. S. Grade A or higher quality eggs. But some are not. It will be illegal to use any shell eggs below U. S. Grade B in quality in your food business after July 1, 1972.

USDA's Consumer and Marketing Service urges you to check on your egg purchases and adjust procurement practices, if necessary, so that you are complying with the Egg Products Inspection Act before July 1, 1972.

If you need more information contact the C&MS poultry grading office in your area or the Poultry Division, Consumer and Marketing Service, U. S. Department of Agriculture, Washington, D. C. 20250.

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THE RELATIVE EFFECTIVENESS OF 8-HYDROXYQUINOLINE SULFATE AND ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE IN THE THE STABILIZATION OF AEROSPACE FOOD WASTE[1]

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Abstract

The relative effectiveness of 8-hydroxyquinoline sulfate and alkyl dimethyl benzyl ammonium chloride (a quaternary ammonium compound) were compared for their ability to prevent growth of microorganisms in aerospace food waste. Alkyl dimethyl benzyl ammonium chloride and 8-hydroxyquinoline sulfate were added to samples of banana pudding, chicken salad, cocoa, orange drink, and non-fat milk at concentrations ranging from 0.1 to 4%. The rehydrated foods containing the microstatic agents were incubated at 23 C for 60 days.

Microbiological analyses were performed on aliquots which were withdrawn at various intervals. Aliquots were analyzed for total aerobic count, coliforms, yeasts, and molds. No growth was observed in samples containing 8-hydroxyquinoline sulfate in concentrations >1% and stored at 23 C. Coliforms, yeasts, and molds were not detected in the initial food or during the storage period. Research toward a food waste stabilization system which would prevent growth by decreasing the water activity is recommended.

The formidable problem of food waste stabilization onboard spacecraft has been magnified by the longer flights of Gemini and Apollo. Extended manned spaceflight will pose an even greater challenge for stabilization of residual or waste food. The Skylab Program, which is tentatively scheduled for 1973, will more than double the mission length of manned spaceflight sponsored by the United States. One 28-day and two 56-day missions, with a complement of three astronauts, are projected for the Skylab Program. Food waste on Skylab will be normally disposed of by passage into an outside tank which is at temperature and pressure of the space environment. If the passage lock into this tank should fail an alternate food waste stabilization system, probably based on chemical additives must be available. No completely satisfactory chemical has yet been developed for such an application.

The Apollo Food System utilizes dehydrated, thermostabilized, and intermediate moisture foods packaged in flexible laminated plastic or rigid aluminum containers. Flight foods are consumed directly from their package. Food residue subsequently stowed aboard the spacecraft requires microstatic treatment. This residue is currently treated with 8-hydroxyquinoline sulfate (8-HQS) to prevent microbial growth and subsequent odor and gas production. Treatment is accomplished by insertion of 1 g of 8-HQS in pill form into the package immediately after the food is consumed.

Food waste from the Mobile Quarantine Facility (MQF) also must be treated with a microstatic agent. The MQF serves as a portable isolation ward for the astronauts while enroute from the spacecraft recovery area to the Lunar Receiving Laboratory at the Manned Spacecraft Center, Houston, Texas. The food system aboard the MQF consists of frozen precooked meals supplemented with canned and dried staples. Food waste from the MQF is treated with 8-HQS, sealed in double polyethylene bags, conveyed through the transfer lock, and stored for the duration of the quarantine period. Moisture contained in the food residue from both the spacecraft and the MQF is utilized to dissolve the 8-HQS.

Any remaining untreated food residue may be expected to support microbiological growth with subsequent gas production and putrefaction. If the food packages did not receive adequate microstatic treatment, odors, gases, and spores resulting from the growth of microorganisms could become a serious problem in the confined environment of the spacecraft. If there were gas production in the sealed waste containers from the MQF this could rupture the containers and cause a break in the quarantine. This investigation was prompted by the hazards of inadequate microstatic treatment of waste foods and the lack of sufficient evidence to support microstatic activities of 8-HQS in the presence of food.

[1]This work was performed under contract with the National Aeronautics and Space Administration (Contract No. NAS 9-8927).

Since they are odorless and effective in small concentrations, the quaternary ammonium compounds appeared to be more desirable for Apollo food waste stabilization than 8-HQS. Therefore this study was designed to compare the microstatic activity of 8-HQS and alkyl dimethyl benzyl ammonium chloride (ADBAC) in the presence of food.

Space food systems have been previously described by Heidelbaugh *(8)*. Methods to manufacture foods for these systems were reported by Flentge and Bustead *(6)*. The possible preservation procedures for controlling waste putrefaction during space flight were reviewed by Roth et al. *(9)*. These procedures included jettisoning, heating, refrigerating, desiccating, and treating with chemical agents. Chemical treatment of the food residue appeared to be the most feasible method.

In order to be compatible with the aerospace feeding system and the spacecraft environment, the ideal food waste stabilizer should possess the following characteristics: *(a)* odorless, *(b)* water soluble, *(c)* solid material, *(d)* non-gas forming, *(e)* non-toxic to crewmembers, and *(f)* effective in small concentrations.

The antimicrobial activity of 8-HQS is usually attributed to its capacity to form feebly dissociated chelate complexes. According to Elek *(5)*, the metal chelates are lethal to the cell. This theory was supported by Albert et al. *(1)* who have studied 8-quinolinol extensively. Gershon et al. *(7)* also agreed that the metal chelate becomes an active toxicant by combining with and blocking metal binding sites on enzymes. Albert et al. *(2)* reported that 8-HQS exhibited no antibacterial activity at any concentration in the total absence of iron or copper. Block *(4)* found 8-HQS to be fungistatic rather than fungicidal. Elek *(5)* noted that an increase in the concentration of hydroxyquinoline resulted in reduction of antibacterial action. This paradoxical effect was attributed to the fact that the complexes formed with the excess 8-HQS were less toxic.

Quaternary ammonium compounds have been utilized extensively in the food processing field as sanitizing agents and are more active than many other compounds when tested in the presence of organic material.

MATERIAS AND METHODS

Rehydratable flight food items were utilized to compare the microstatic effectiveness of 8-HQS[1] and ADBAC[2]. Banana pudding, chicken salad, and cocoa were manufactured in accordance with the requirements outlined by Flentge and Bustead *(6)*. These foods complied with the microbiological specifications for space food *(6)*. Orange drink and non-fat dry milk were packaged in the laboratory in packages fabricated from a laminate of 1.00 mil polyethylene, 0.75 mil mylar, 2.00 mil aclar, and 2.20 mil polyethylene.

The quaternary ammonium compound, 50% active ADBAC, was especially prepared for this study. This quaternary ammonium compound possessed the following properties: *(a)* compatible with nonionic surface active agents, *(b)* freely soluble in water, and *(c)* odorless in the powdered form as well as in solution. The microstatic agents, 8-HQS and ADBAC were added to the dry food through the feeding port at the following concentrations: 0.1, 0.5, 1, 2, 3, and 4%. The concentration was based on the total weight of rehydrated food. Sterile distilled water was added through the feeding port to rehydrate the food and microstatic agent mixture. Food packages were prepared for each concentration of microstatic agent and incubated at 23 C. One package of each food which did not contain a microstatic agent was stored under the same conditions to serve as a control. Microbiological analysis of each package was conducted at the following intervals: 0, 5, 15, 30, and 60 days. Eleven-gram sample aliquots were withdrawn through the feeding port and transferred to 99 ml of buffered distilled water. Total aerobic count, total coliform, and total yeast and mold counts were performed in accordance with *Standard Methods for the Examination of Dairy Products (3)*. Analysis for total coliforms was performed with Violet Red Bile Agar (Difco). Samples for total coliform, and yeast and mold were plated at dilutions of 1:1 and 10^{-1}. Total aerobic counts were plated at four dilutions. Initial samples were plated at 10^{-1} through 10^{-4}. Subsequent samples were plated at dilutions based upon the previous count. No attempt was made to inhibit the antimicrobial activity of the agents during the plating procedure because there was no confirmed method of suppressing 8-HQS activity in the presence of food.

RESULTS AND DISCUSSION

The initial total aerobic counts were all $<10{,}000$ per gram and were therefore, within the limits established for aerospace food *(6)*. No coliforms were detected in the control samples or the samples containing microstatic agents during the entire storage period. The yeast and mold counts were negative for the entire storage period. The total aerobic counts obtained at the various concentrations of microstatic agents and storage times at 23 C are shown for each food in Tables 1 through 5. Both of the microstatic agents were reasonably effective in controlling growth of microorganisms when present in concentrations greater than 1%. Growth in the chicken salad (Table 1) was more persistent and required more microstatic agent for control. In general, higher counts were obtained from the chicken salad containing 8-HQS (Table 1). However, both compounds required a concentration of 2% to prevent bacterial growth. There were no detectable differences between the two agents in the presence of non-fat milk. A concentration of 0.5% of either compound (Table 2) maintained bacteriostatic conditions throughout the storage period.

[1]Baker Chemical Co.
[2]Economics Laboratory, Inc.

TABLE 1. TOTAL AEROBIC COUNT ($\times 10^4$) OF CHICKEN SALAD STORED AT 23 C

Concentration[1] (%)	Days storage 0		5		15		30		60	
	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC
0	0	0	89	89	10,000	10,000	93	93	110	110
0.1	0	0	97	87	1,000	1,000	10,000	11,000	10,000	10,000
0.5	0	0	100	120	11,000	130	12,000	1,100	1,100	1,100
1	0	0	110	15	100	100	18,000	1,200	1,200	190

[1]Concentrations >1% produced counts <10 per gram.

TABLE 2. TOTAL AEROBIC COUNT ($\times 10^4$) OF NON FAT MILK STORED AT 23 C

Concentration[1] (%)	Days storage 0		5		15		30		60	
	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC
0	0.11	0.11	110	110	1,100	1,100	0.01	0.01	0	0
0.1	0	0	100	100	0	0	0	0	0	0

[1]Concentrations >0.1% produced counts <10 per gram.

TABLE 3. TOTAL AEROBIC COUNT ($\times 10^4$) OF COCOA STORED AT 23 C

Concentration[1] (%)	Days storage 0		5		15		30		60	
	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC
0	0	0	94	94	10,000	10,000	110	110	100	100
0.1	0	0	93	91	11,000	1,100	1	1	0	1
0.5	0	0	0	100	0	1,100	0	12	0	89
1	0	0	0	78	0	0	0	0	0	0

[1]Concentrations >1% produced counts <10 per gram.

TABLE 4. TOTAL AEROBIC COUNT ($\times 10^4$) OF ORANGE DRINK STORED AT 23 C

Concentration[1] (%)	Days storage 0		5		15		30		60	
	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC
0	0	0	0	0	0	0	10,000	10,000	0	0
0.1	0	0	0	0	0	0	1.3	1.1	0	11
0.5	0	0	0	0	0	100	0	0	0	0

[1]Concentrations >0.5% produced counts <10 per gram.

TABLE 5. AEROBIC COUNT ($\times 10^4$) OF BANANA PUDDING STORED AT 23 C

Concentration[1] (%)	Days storage 0		5		15		30		60	
	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC	8-HQS	ADBAC
0	0	0	120	120	9,800	9,800	0	0	0	0

[1]A concentration of 0.1% produced counts <10 per gram.

Samples of cocoa treated with ADBAC and stored at 23 C exhibited more growth than those treated with 8-HQS (Table 3). A concentration of 1% 8-HQS maintained microstatic conditions but a concentration of 2% ADBAC was required for the same effect. A 0.5% concentration of 8-HQS and 1% ADBAC prevented growth in orange drink stored at 23 C (Table 4). Both compounds were very effective in controlling growth in banana pudding stored at 23 C (Table 5).

Both of the microstatic agents were reasonably effective in controlling growth of aerobic bacteria when present in concentrations >1%. However, it should be noted that neither compound was tested in the presence of food and coliforms or yeast and mold because these microorganisms were not detected in the control samples. These microorganisms could be expected to be a part of the food waste flora as a result of contamination during consumption. The number of genera of microorganisms encountered in

this experiment was relatively small since only a few foods were studied and these possessed extremely low microbial counts at the beginning of the study. These data indicate that use of these agents as the sole source of control for microbial growth in food waste, over long periods of time, is not without considerable risk.

The ideal space food waste stabilization agent should be effective in low concentration and possess a broad spectrum of anti-microbial activity. A stabilization agent should also be effective for periods up to 1 year (Skylab System requirement). A mixture of compatible antimicrobial agents with different spectra of activity would be a complex solution to the problem of aerospace food waste stabilization. A satisfactory mixture would be difficult to achieve and verify since many of the antimicrobial agents are not compatible with each other or the spacecraft environment.

Other methods of food waste stabilization need to be studied. One approach could be the control of water activity. All micro-organisms require available moisture for growth; therefore, food waste stabilization could efficiently be accomplished by removal or binding of available water. This might be accomplished by the addition of sodium chloride. Such an approach could be effective against all types of microbial life. The findings of this report indicate that a study of the practical means to control water activity in food waste, as a method to control unwanted microbial growth, merits serious consideration.

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H. L. Thomasson, Managing Editor

COMPARISON OF METHODS FOR ESTIMATING SOMATIC CELL LEVELS IN BULK MILK[1]

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ABSTRACT

Various methods of estimating somatic cell levels in milk were compared with the direct microscopic somatic cell count (DMSCC). The electronic cell count (ECC) using centrifugation to separate cells from milk yielded correlation coefficients of 0.870 to 0.907 when compared to DMSCC. The Wisconsin mastitis test (WMT) yielded correlation coefficients of 0.714 to 0.753 when compared to the DMSCC. The diphenylamine filter-DNA method yielded correlation coefficients of 0.988 to 0.991 when compared to the DMSCC. The filter-DNA method was modified by using indole instead of diphenylamine to obtain color. This method reduced the time for color development from 16 hr to 10 min. The correlation coefficients were 0.987 to 0.990 using this method when compared to the DMSCC.

The purpose of this study was a comparison of various methods of estimating somatic cell levels in milk and to compare them with the direct microscopic somatic cell count (DMSCC). When the work was initiated, three methods seemed promising: Wisconsin mastitis test (WMT), electronic cell count (ECC), and DNA-filter method.

Development of the DMSCC *(1)* has provided an accurate method to estimate somatic cells in milk. In our experience it is laborious, requires careful laboratory technic to obtain repeatable results, and does not lend itself to inter-laboratory comparisons.

Reports on the ECC indicate that high correlations with the DMSCC can be obtained *(7, 8, 9, 10)*. A conventional centrifugation method was used *(3)*.

The WMT is a rapid test and has yielded highly significant correlations with the DMSCC *(10)*. It was included in the trial without modification.

The DNA-filter method has yielded highly significant correlations with the DMSCC *(4)*. However, it requires 16 hr for color development. By use of indole this time was reduced to 10 min. Two trials with each of two methods (indole and diphenylamine) were compared in this study.

[1]Research supported by the College of Agricultural and Life Sciences and by PHS Research Grant UI00124 from the National Center for Urban and Industrial Health. Paper No. NS 715.

MATERIALS AND METHODS[2]

DMSCC was performed according to the method of the sub-committee on screening tests of the National Mastitis Council *(1)*.

ECC. The instrument used in these determinations was a Celloscope. Paper mulberry pollen was used to establish the volume of particles counted at various threshold settings. The diameter of the pollen was determined using a carbon arc projector. Pollen particles (1000) were measured on a projection screen (1 inch on the screen was equal to 0.01 mm diameter). The median value was 13 μ. The machine was calibrated each day using the half count method.

Milk was prepared for use by centrifugation for 1 hr at 280 *g* in 0.85% NaCl which had been filtered using a 0.65μ membrane filter. Cells were suspended using a vortex mixer. The final dilution was 1:25. This yielded a working factor of 10,000 ($25 \times 64/0.164$). All counts were made at 6.0 μ, 6.6 μ and 7.1 μ diameter settings. All milk samples were prepared and counted in duplicate. Corrections were not made for coincidence.

DNA-filter method. The diphenylamine filter method is described elsewhere *(4)*. This method was performed in duplicate on all samples.

In addition, indole was used to develop color as a rapid method. Milk (5 ml) was filtered as in the diphenylamine procedure *(4)*. The filter was placed in a capped tube of 5 ml of a solution of 1 part 5N HCl, 1 part 0.06% indole, 2 parts 1% saline *(2)*. This tube was placed in boiling water bath for 10 min then cooled in tap water. Absorbency was determined at 490 nm using a Spectronic 20 spectrophotometer.

WMT. The Wisconsin mastitis test was performed as described previously *(10)*.

Size of trials. The number of samples tested was limited to 5 to 10 per day, with two such trials per week. Batches of ingredients were made in rather small amounts. Therefore, in a random fashion, reagents were aged or made-up as needed. A precaution observed in this regard was that the indole solution and 1% saline solution was stored in the refrigerator (4 C).

RESULTS

Each method except DMSCC was performed in duplicate (trials 1 and 2). All possible correlation coefficients for each method and each trial are presented in Table 1.

Regression equations with standard errors for in-

[2]Equipment: Celloscope, Particle Data, Inc., Elmhurst, Illinois. Spectronic 20, Bausch and Lomb, 820 Linden Avenue, Rochester, New York 14625.

TABLE 1. SIMPLE CORRELATION COEFFICIENTS.

		Filter-DNA				WMT		Electronic count					
		Indole		Diphenyl-amine				Centrifugal method					
Trial number:		1	2	1	2	1	2	1	1	1	2	2	2
Diameter:								6.0μ	6.6μ	7.1μ	6.0μ	6.6μ	7.1μ
DMSCC		.987	.990	.991	.988	.714	.753	.904	.905	.907	.870	.873	.871
Filter DNA	Indole		.993	.989	.989	.668	.716	.884	.882	.884	.853	.853	.852
				.992	.990	.674	.717	.886	.885	.885	.856	.859	.856
	Diphenylamine				.994	.677	.722	.905	.906	.908	.875	.876	.875
						.687	.728	.904	.902	.904	.863	.864	.862
WMT							.965	.686	.692	.692	.690	.697	.701
								.717	.721	.721	.739	.743	.745
	Diameter												
Electronic count (Centrifugal)	6.0 μ								.998	.997	.929	.933	.936
	6.6 μ									.999	.931	.935	.938
	7.1 μ										.933	.937	.940
	6.0 μ											.998	.997
	6.6 μ												.999

TABLE 2. REGRESSIONS

Indole filter - DNA

$\overline{\text{DMSCC} \times 10^{-6}} = 4.34 \times \text{O.D.} + 0.042$

O. D. at 490 nm in 1.25 cm cuvette Std. error B = 0.074

Diphenylamine filter - DNA

$\overline{\text{DMSCC} \times 10^{-6}} = 5.49 \times \text{O.D.} - 0.060$

O. D. at 600 nm in 1.9 cm cuvette Std. error B = 0.089

Electronic cell count

$\text{DMSCC} \times 10^{-4} = 2.72 \times \text{ECC} - 54.2$ (diameter = 6.0 μ) Std. error B = .156

$\text{DMSCC} \times 10^{-4} = 2.82 \times \text{ECC} - 48.1$ (diameter = 6.6 μ) Std. error B = .161

$\text{DMSCC} \times 10^{-4} = 2.87 \times \text{ECC} - 41.4$ (diameter = 7.1 μ) Std. error B = .167

dole and diphenylamine filter-DNA, and ECC centrifugal methods are presented in Table 2.

DISCUSSION

The filter-DNA method yielded the highest correlation coefficients with the DMSCC (0.987 - 0.991) of any of the methods. The correlation coefficient between filter-DNA trials was 0.989 to 0.994. These trials were separate from initial measurement of sample to reading on the spectrophotometer. Correlation coefficients of filter-DNA methods with WMT and ECC were nearly as high as the DMSCC with these methods. Thus, one of the filter DNA methods could probably serve as a confirmatory or a single test for somatic cell estimation without the need to conduct other tests. The method with 2 deoxy-D-ribose as a standard has the added advantage of permitting comparison between trials and among laboratories. Preliminary data from work in progress indicate that storage of milk at 4 C is adequate for preservation of samples for 4 days.

The centrifugal ECC yielded correlation coefficients of 0.870 to 0.907 with the DMSCC. Preparations of samples counted at different diameter

settings yielded correlation coefficients of 0.999 to 0.997 (within trials). However, samples prepared in duplicate (from dilution thru centrifugation yielded correlation coefficients of 0.929 to 0.938 (between trials).

These results indicate that sample preparation is important in determining correlation coefficients. Regression equations were different (Table 2) with different diameter settings. The slope of the regression line indicates that particles other than somatic cells are counted at the lower range and that cells are lost in the upper range of counts. The importance of determining the proper regression equation for source of milk samples has been reported *(5)*. These results indicate the need for some method to be developed to compare counts from different laboratories. The effect of length of time of centrifugation and the amount of centrifugal force used has not been reported. Higher correlation coefficients than those reported here have been achieved by others *(6)*.

Highly significant correlation coefficients (0.71 - 0.75) between DMSCC and WMT were obtained. This method is the most economical and rapid of all used in this trial. Results yielded more scatter in relation to DMSCC in milk with 1,000,000 or more cells per milliliter. This test properly identifies abnormal milk, and this is achieved rapidly and economically. Precautions should be observed to use only fresh milk (<24 hr after farm pick-up) which has been properly refrigerated (4 C).

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ECONOMICS LABORATORY ENTERS PROCESSING SYSTEMS MARKET

Economics Laboratory, Inc. is entering more strongly into the marketing of processing systems, according to an announcement from E. B. Osborn, president of the company.

The company has formed an Equipment-Engineering Division—Automation Systems, to serve companies that handle fluid or semi-fluid products—primarily those in the beverage and food processing fields — dairies, breweries, bakeries and processors of various types of souces and dressings.

The division, which will headquarter in Beloit, Wisconsin, will provide engineering design, installation service and equipment for processing systems that feature centralized control and automated CIP (Clean-In-Place) operation. National and international markets will be served.

Tying in closely with the formation of the new division is the company's previously announced agreement-in-principle to acquire Electrol Specialties Co., South Beloit, Illinois, manufacturer of custom-built electrical controls used in automated systems marketed by Econlab's Klenzade Automation Department, and a new marketing agreement with the Computer Concepts Corporation of Knoxville, Tennessee, suppliers of solid-state electronic equipment. The new division will apply computer technology to production problems in processing industries.

Dale A. Seiberling will have overall responsibility for the new division as Assistant Vice President. He has been Manager of the company's Klenzade Automation Department since 1960. Ronald B. Douglas will serve as Manager, and Frank J. Bazo as Western Regional Manager. Ahmad A. Jannoun will coordinate activities of the new division within International Operations.

The new division was formed to capitalize on the company's know-how in equipment engineering for the beverage and food processing industries and the increasing trend toward automation in these fields.

PLASTIC PACKAGES AND THE ENVIRONMENT

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Abstract

Contrary to popular belief and current publicity, most plastics do make good ecological packaging materials. Scientific evidence exists which dispels the stigma of non-disposability and deleterious environmental effects of plastics. Thermoplastics are by nature remeltable and therefore can be recycled by existing conversion methods to other plastic products. Their high energy content and organic composition of mainly carbon and hydrogen make them especially suitable for use in municipal incinerators for drying trash and generating power. Although they are not biodegradable, they do degrade when exposed to outdoor weathering, and they are a suitable and stable landfill material. These benefits must be weighed along with the consumer appeal, sanitary nature, safety, light weight, and protection afforded by plastics when evaluating packaging materials.

General

It's becoming more difficult every day to differentiate between the "Good Guys" and "Bad Guys" in the struggle for preservation of our environment. We are being bombarded by information to the extent that the confusion is hindering rather than helping to define the problems, primarily because so much of the information has an emotional rather than factual basis. This is becoming especially true in the contribution of packaging materials to solid wastes where the real problem is one of development and use of the proper disposal methods rather than selection of packaging materials. At the risk of adding to the confusion, and to the solid waste load with publication paper, I would ask you to consider the facts.

There's no doubt that solid waste disposal is a serious national problem and that we have a real need for proper methods of solid waste disposal and for packaging materials which can be disposed of easily. All packaging materials have problems of disposability and most packaging material suppliers are working hard to find acceptable solutions. Unfortunately, some interests are expending too much emotion and too little science in publicizing ideas which do not solve the problems. The time for emotion is past and we need to make use of technology and facts.

Magnitude of the Problem

If we exclude scrap automobiles, agricultural wastes, and mining wastes, our national solid waste load is in the neighborhood of 360 million tons per year of which 250 million tons come from residential, commercial, and institutional sources and 110 million tons is contributed by industry. This solid waste is a mixture of everything imaginable, and after it is collected, it must somehow be disposed of in socially acceptable ways. Disposal is not simple, partly because the waste is heterogeneous in nature. An analysis published by the U. S. Public Health Service *(12)* resulting from a study of municipal refuse on the East Coast shows that garbarge—or food refuse—accounts for only 12%; various forms of paper for 46%; grass and dirt, 10%; glass and stones, 10%; and metal, 8%. The balance is wood, textiles, plastics, and rubber. A further refinement of the analysis indicates that about one-fourth of the weight is moisture and another one-fourth is carbon which is contained in the paper, garbage, wood, and plastic content.

Another way to look at the composition of solid waste is to group it into packaging and other. The Bureau of Solid Waste Management has done this and found that of the 360 million tons of solid wastes generated in this counrty in 1969, about 50 million tons, or 14%, came from packaging materials of all kinds as shown in Fig. 1. Discarded packaging from dairy products accounts for about 8% of all the packaging material and $< 1.5\%$ of the total national solid waste load. The bureau also found that of the total packaging materials, less than 3% was composed of plastic. Thus plastic packaging materials account for about 0.5% of the 360 million tons of solid wastes. A closer look at the nature of the 50 million tons of packaging wastes, Fig. 2, shows that materials other than plastic account for the dominant share of packaging. The plastic portion, however, is predicted to have the fastest growth on a percentage basis, and by 1976, plastics are forecast to account for 4% of our packaging waste. This plastic portion has received much crit-

icism from various quarters.

Before we examine these criticisms, let's keep in mind some of the many benefits which we derive from the use of packages made of plastics. These packages are generally known for their appeal to the consumer. Much of this appeal results because she has found them to be clean and sanitary, light in weight, reuseable for other purposes, and their shatter-proof nature is a real safety feature. We also know that in many instances the product protection provided by plastics has meant longer shelf life and tastier, more nourishing food on the table. Most of these features are utilized by the dairy and food industries in the packaging of their products.

About 85% of plastic packaging is made from polyolefins or polystyrenes *(6)*. The polyolefins, including both high and low density polyethylene and polypropylene, account for over 65% and the polystyrenes for almost 20% of the total. The remaining 15% includes a large number of plastic material families such as vinyls, nylons, epoxies, phenolics, and polycarbonate. Both the polyolefins and polystyrenes are purely organic, containing only carbon and hydrogen in their makeup. These plastics are derived from petroleum and to a minor extent from by-products from the coking of coal. Most of the other plastics also are derived from a petroleum base but have other atoms or molecular groups substituted for some of the hydrogen.

Typical uses of these plastics in dairy and food packaging are:

POLYOLEFINS
- Milk bottles
- Coating on milk cartons
- Coating on paper tubs
- Cheese wrap
- Meat wrap
- Ice cream tubs
- Ice cream bundling

POLYSTYRENE
- Cottage cheese containers
- Yogurt containers
- Dips and deli cups
- Foam egg cartons
- Foam meat trays

Well over one-half of the cottage cheese for home consumption is now packaged in polystyrene containers and that which is still in paper employs either a polyethylene or wax (a close cousin of polyethylene) coating on the paper. The bulk of packaged milk utilizes polyethylene, either as the all plastic bottle or the paper carton which is about 7% by weight polyethylene coating. Natural and processed cheese is wrapped in either cellophane or clear plastic films, usually of the polyolefin type.

These plastics receive an unwarranted share of false publicity regarding their disposability. The criticisms most commonly voiced are: They are non-disposable—*False*; they do not biodegrade—*True*; they pollute the air with their toxic fumes—*False*; and they are not recyclable—also *False*. Each of these points will be discussed in some detail below.

Disposal Methods

Improvement of methods of disposing, or converting, our solid wastes is the direction in which we need to apply our efforts and technology before we are stampeded back to the old ways of inadequate packaging. Development and use of proper disposal methods is sadly lacking the funds it deserves and needs. Although a number of new methods such as pyrolysis and segregation are in development, their use is still many years in the future. In the interim we must work with the presently available methods of disposal.

According to the Solid Wastes Office of the Environmental Protection Agency, solid wastes are currently being disposed of as follows *(5)*.

Method	Per cent by weight
Open dumps	58
Uncollected	24
Sanitary landfill	10
Incineration	6
Salvaged, composted, dumped at sea	2
	100

Unfortunately open dumps are still the most common in number although they are rapidly being outlawed. Sanitary landfills are replacing open dumps —definitely a move in the right direction. Landfills eliminate the odors, vermin, filth, and blowing trash generated by open dumps and, when properly oper-

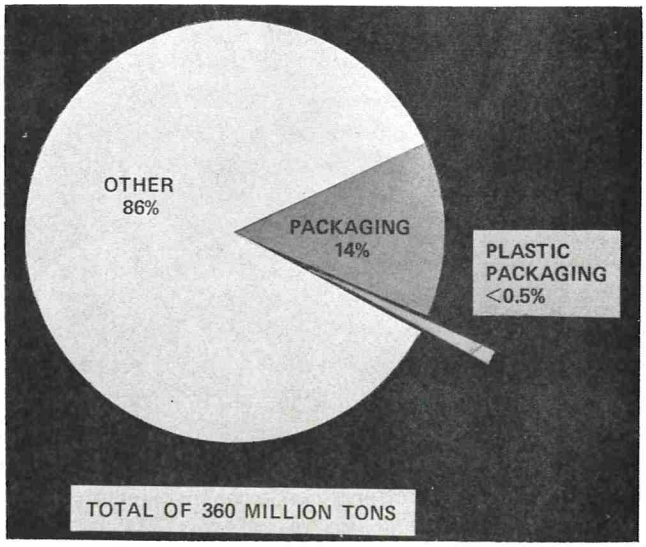

Figure 1. Residential, commercial, and industrial solid wastes produced in the United States in 1969.

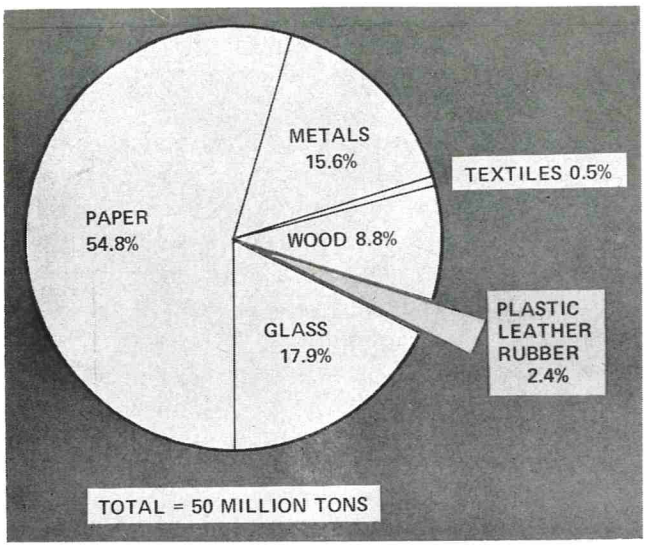

Figure 2. Composition of packaging waste.

ated, result in reclamation of submarginal land for recreational and other purposes. Where sufficient space is not available within an economical distance to use landfill, such as in large metropolitan centers, incineration is a practical and sanitary method. This is particularly true if modern-day incineration using the heat value of the trash to generate power is used. The city of Chicago now incinerates all of its refuse, 25% of it in the city's new Northwest incinerator which will generate 440,000 lb. per hour of steam from burning trash. Only a very small portion of the refuse is salvaged. True salvage or recycle accounts for less than 2% of our solid waste. A sizeable part of solid waste is not collected at all and therefore does not reach a managed disposal method. A portion of this uncollected 60 million tons is made up of litter, a people, not material problem. I'd like to discuss how plastics, particularly those used for packaging of dairy and food products, fit each of these disposal methods.

LITTER

Litter is that nuisance stuff to which so many people contribute but expect somebody else to do something about. Collection is extremely difficult and very expensive, especially roadside litter which is the most prevalent and most difficult to collect since it is spread over such a large area. A survey of litter made by the National Academy of Sciences covering 29 states gave the following results *(2)*.

Type of litter	Per cent
Paper	59
Cans	16
Bottles, jars	6
Plastic items	6
Miscellaneous	13
	100

Plastics are a very small part of the litter problem for two main reasons: first, they account for only a small portion of packaging materials, and second, most plastic packages are opened and the contents consumed in the home, school, or instiution; therefore, they become a part of the collected municipal refuse stream.

It would be nice if we could develop self-destruct packages which disappear as soon as they are emptied so that litter would not pose a collection problem. We don't yet, and perhaps never will, have the technology to do this. Many packages, however, are degradable although usually the degradation takes longer than we would like. Plastics fit the category of slowly degradable packages and research is going on to find ways of speeding plastic degradation *(9)*. Simply stated, the degradation mechanism involves breaking of the long polymer chains which give plastics their strength and flexibility. This chain breakage is initiated by ultraviolet rays from direct sunlight and results in a weakening and embrittling of the plastic so that subsequent action of wind and weather causes the plastic to break and crumble. This process yields an inert residue of crumbled plastic without adding to air or water pollution. Exposure to the elements is necessary for this to occur, and this type of degradation is important in slowly disposing of the small amount of exposed plastic packaging found in

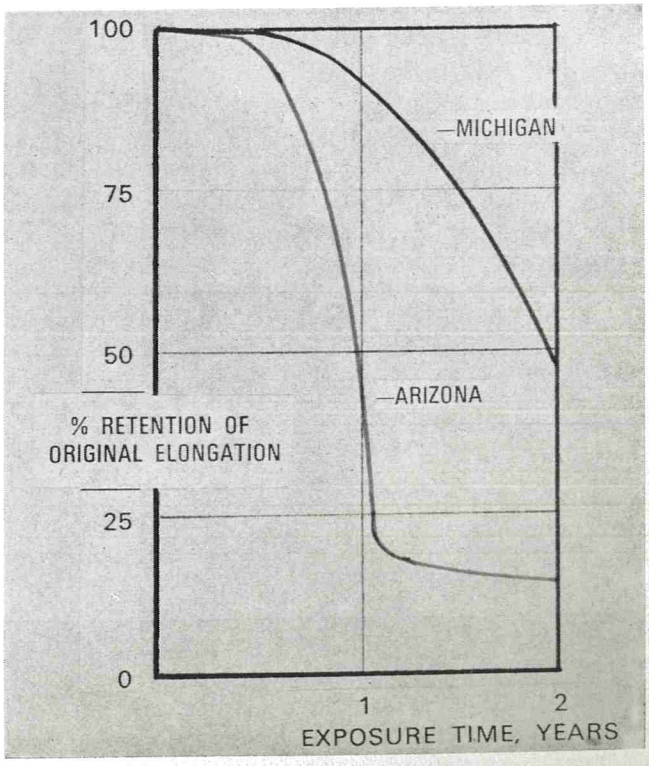

Figure 3. Photodegradation of molded polyethylene exposed to sunlight.

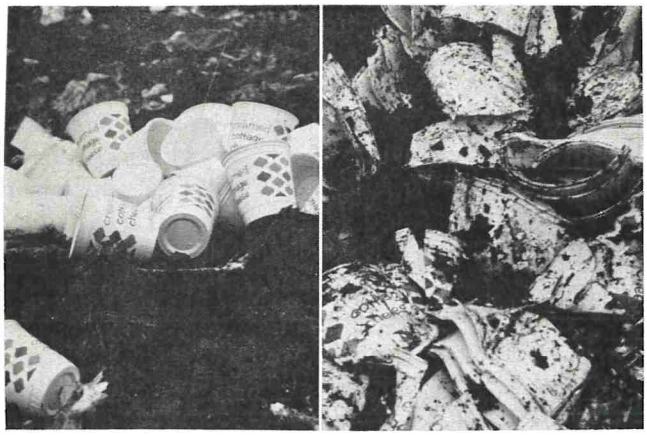

Figure 4. Left, pile of polystyrene cottage cheese containers at landfill site. Right, polystyrene cottage cheese containers compacted by bulldozer at landfill site.

uncollected litter. Buried plastic is essentially nondegraded.

This photodegradation process is not instantaneous. The time needed for weakening of the plastic depends upon both temperature and amount of sunlight. Exposure in Arizona destroys the flexibility of polyethylene much more rapidly than does exposure in Michigan. The data in Fig. 3 are from one-eighth inch thick pieces, and thinner articles such as film would embrittle even more rapidly. Arizona sun exposure of both clear and white pigmented impact polystyrene, such as used for cottage cheese containers, results in a 50% loss of strength in three months and an 80% loss after one year. Plastic packages fit the requirements for litter disposability quite well. They are degradable, they do not break to form dangerous cutting edges, and they or their decomposition products are not known to be toxic to plants or animals.

Sanitary Landfill

The disposal method which is being widely accepted in those areas where space is available is sanitary landfill. In a sanitary landfill operation, each day's deposit of refuse is spread in layers of 2 to 4 ft deep, then compacted by a bulldozer, and covered with a layer of earth which is again compacted. In a recent publication by the Bureau of Solid Waste Management *(7)*, the Bureau makes two interesting comments regarding sanitary landfills. They say, "Landfill is widely used as a method of land reclamation" and "Landfill is being conceived as a storage of resource materials pending the time when it may be economical to recover them." As a method of land reclamation, landfill is being used in some interesting ways as evidenced by building of Mount Trashmore in Du Page County, Illinois *(8)*. The hill of compacted and earth covered refuse is 125 ft high, and provides tobogganing and skiing in an otherwise flat terrain. The pit from which the earth cover was dug has become a man-made lake.

The Midwest Research Institute, under contract to the Bureau of Solid Waste Management, has suggested that material for landfills should have a high natural density, be easily compacted to occupy a small volume, and be degradable. Plastics meet these requirements at least as well as other packaging materials. They are more dense than the most widely used materials, they do compact well, and they are degradable, although they are not biodegradable. This resistance to biodegradability is, however, an advantage. Opponents of plastics have claimed that plastics are not compactable and therefore occupy too much volume. Actually, under the compaction weight of the bulldozer used in landfill operations, most plastic packages crush or crumble to a flat shape. Figure 4, left, shows a pile of plastic cottage cheese containers at a landfill. The bulldozer operator ran over them as he would in normal operation and the result is shown in Fig. 4, right. The pile was easily flattened as the plastic cracked under the weight of the compactor treads.

A very convincing story for biodegradability of packaging has been made by certain sources, but I fear that we are being brainwashed into thinking that biodegradability is a benefit. Biodegradability differs from degradability which was described earlier in that action by bacteria or fungi is required. It is a great process in the woods, swamps, and fields for slowly returning vegetation to the ground over a large area but it is not necessarily desirable for the managed disposal of massive concentrations of solid wastes. Biodegradation, Fig. 5, of exposed

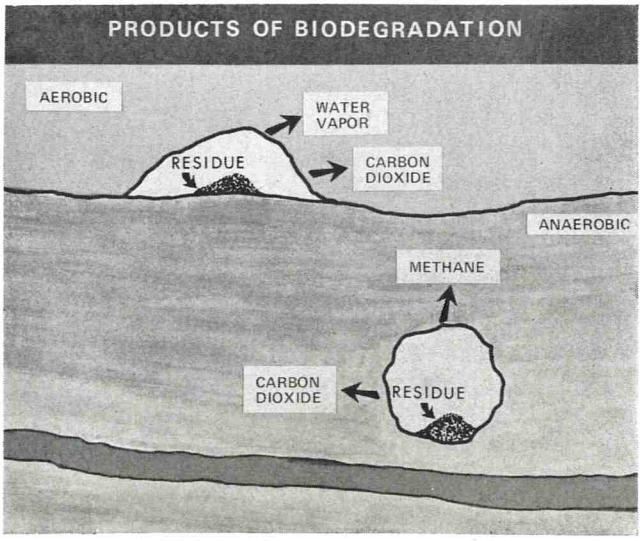

Figure 5. Decomposition products of biodegradable materials.

materials progresses via the action of aerobic bacteria which need oxygen to do their job. The products of aerobic biodegradation are carbon dioxide and water which diffuse to the atmosphere, plus a residue of the inert materials present. Within a landfill, however, where oxygen is excluded by an earth cover, we must depend on anaerobic bacteria to decompose the material. The anaerobic process generates carbon dioxide and methane gas *(1)*. Carbon dioxide, a heavy gas, dissolves in water, leaches down through a landfill, and creates a carbonic acid solution which dissolves soil substances and thus increases the hardness of ground waters. Methane, a light gas, seeps out of the fill and dissipates in the atmosphere unless it can accumulate under a structure in which case it creates an explosion hazard. After decomposition of the biodegradable material, we have a void in the fill with resultant settling of the surface requiring periodic maintenance if the ground level is to be kept constant. Settlement rates of 25 to 30% in the first year have been measured *(14)*. Plastics are not biodegradable. The Los Angeles County sanitation district, which uses sanitary landfill for disposal of 99% of solid wastes from the City and County of Los Angeles, has said that plastics are a suitable landfill material and because of their nonbiodegradability they can be considered inert and as suitable as brick, dirt, or concrete *(4)*.

INCINERATION

For those regions with insufficient space to use the landfill method, incineration is a very efficient disposal means. This is particularly true if the heat value of burning refuse is used for power generation as in Chicago's Northwest incinerator. Incineration reduces the volume of material to be buried by more than 90%, since only the ash is left for solids disposal.

Plastics aid the incineration disposal method in several ways. Plastic packages are significantly lighter than the packages which they replace, Fig 6. This means less weight to collect and less weight to burn. The advantage is greatest with foamed plastics such as used for meat trays or egg cartons where the plastic package weighs about one-third as much as other disposable packages used for these products.

The high energy value of plastics is another important aid to incinerator operation. Since they are a petroleum product, their BTU value is similar to that of fuel oil, and is a great help in driving out the moisture, which normally constitutes one-fourth of the weight of refuse, thus making the refuse burnable. True, that if burned alone in equipment not designed to handle such a good fuel, plastics can behave like petroleum to produce a smoky fire. However, when fed to incinerators in double the amounts normally present in municipal trash, they burn without excessive smoke generation.

One additional benefit is the very low nonburnables content of plastics resulting in very little ash. Ash from plastics packaging rarely exceeds 2% of the weight of the plastic.

TYPICAL SUPERMARKET PACKAGES WEIGHT COMPARISON
Weight in Pounds Per 1000 Packages

The Package	Paper	Plastic	Plastic/Paper Ratio
16 OZ. C. CHEESE	55	36	0.65
1 GAL. MILK	269	198	0.74
MEAT TRAY	40	14	0.35
EGG CARTON	110	38	0.35

Figure 6. Weight of empty packages.

Material	BTU per lb.
Paper food cartons *(13)*	7,730
Waxed milk cartons *(13)*	11,732
Polyethylene *(13)*	19,950
Polystyrene	16,000

It has, however, been said that the burning of plastics generates toxic fumes and this is as true of plastics as it is of paper, wood, or other combustible materials if they are not burned properly. The toxic gas is carbon monoxide, a possible combustion product of any carbon-containing material. When properly burned, however, as in a modern, well operated municipal incinerator with the right amount of air, carbon monoxide is not a problem.

The Underwriters Laboratories *(3)* have published data which show that the gasses from a smoldering fire of either paper or polystyrene contain 20 to 25% carbon dioxide. A free burning fire of either paper or polystyrene gives off gasses which are 7 to 10% carbon monoxide. The smoldering or free burning conditions are similar to what happens in a burning rubbish heap and are usually accompanied by voluminous smoke. Proper incineration of polyethylene and polystyrene was studied by Dr. R. Heimburg of Syracuse University *(11)*. By duplicating conditions of a well operated and properly designed municipal incinerator using excess air, Dr. Heimburg found that the combustion gasses from burning polyethylene or polystyrene contained $< 0.0015\%$ carbon monoxide. The concentration of carbon monoxide in typical automobile exhaust is over 400 times higher than this. Dr. Heimburg also found that municipal incinerators designed during the past decade give off > 15 times as much particulate matter or smoke than did polyethylene or polystyrene burned in his labor-

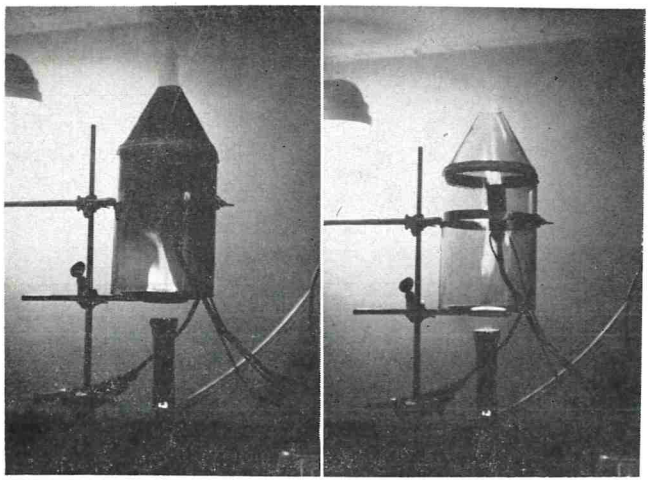

Figure 7. Left, polystyrene burning with normal draft air supply. Right, polystyrene burning with excess air and overfire.

atory incinerator.

Although the plastic content of municipal trash averages only 3%, Dr. Heimburg's work also included preliminary studies on exposure of rats and plants to the combustion gasses of pure (or 100%) burning plastic. There were no long term effects on rats or plants from burning either polyethylene or polystyrene.

The effect of burning conditions on smoke were demonstrated with a laboratory glassware incinerator. Figure 7, left, shows a piece of polystyrene cottage cheese container free burning in air. Notice the heavy black smoke spewing from the top of the cone. This smoke is unburned carbon particles, which are not toxic, but they are dirty. Excess air and an afterburner in the cone to simulate the afterburner or overfire air used in modern incinerators were added for Fig. 7, right. Notice that the particulate matter has been consumed inside the incinerator and the stack gas issuing from the cone is clean.

Plastics fit the requirements for disposal by incineration very well. They burn easily with little ash and a high heat value. Sulfur is not present in those plastics approved for food packaging, and for most plastics, there is no danger of damage to incinerators.

Reuse

The relationship of plastics to the least used but most preferred disposal method—that of recycle or reuse—deserves some attention. Recycling is not new to the plastic package manufacturer since packages like plastic milk bottles and cottage cheese containers utilize from 25 to 50% recycled material which is generated in the forming process.

Major problems with recycle of materials from solid wastes, however, are in segregation, economics, and finding markets for the segregated refuse. With today's level of technology and spending, segregation is primarily a hand operation, not considered a glamour or status job. There must be a sufficient quantity of the recovered material present to justify the cost and effort of segregation. With only about 3% plastic content in refuse, the yield of plastics from trash would be small. Finally, markets must be developed for the recovered materials. Plastic reclaimed from refuse is not suitable for conversion to food packaging, for although the heat used to remelt the plastic would sterilize it, the material could be adulterated by what people may have reused the plastic container for before discarding it. Also, since the colors used in plastic packages do not leach out or dissolve in water, the recovered plastic would be a color mixture and resultant products from it will have to be pigmented dark if they are to be of a uniform color. This, however, could be an advantage since dark pigmentation, particularly with carbon black, makes plastic quite resistant to degradation from UV light and thus suitable for products of long life requirements. The net result is that although plastics are recyclable, the actual amount of plastic being recycled from municipal trash today is small.

Figure 8. Agricultural drain tile made from recycled polyethylene milk bottles.

Some real activity does exist, however. Golden Arrow Dairy in San Diego has been operating a plastic milk bottle recycling project which they conceived following Earth Day in 1970. The dairy receives used one-way bottles via return in home delivery trucks or from bins placed at supermarkets. These bottles are ground and the polyethylene used for making industrial waste containers, lawn sprinklers, flower pots, and agricultural drain tile, a sample of which is being held by the young lady in Fig. 8. The tile is made in long coiled lengths which are easily laid by mechanical means. Other uses for recycled plastics are also being investigated. Hoffer Plastics in Illinois is developing the use of ground polyethylene scrap as an aggregate in concrete. Reportedly this makes a concrete as strong as one with stone aggregate but 10 to 15% lighter.

Good solid waste management converts wastes to resources and we certainly should not discount the energy content of waste plastics. Using waste plastic as fuel for power generation *is* the recovery of a resource and really a form of recycling.

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LETTER TO THE EDITOR

Funding for health programs

Dear Sir:

On June 16, 1971 I had the opportunity to present the following statement to the Subcommittee on Labor, Health, Education, and Welfare of the Committee on Appropriations, U.S. House of Representatives. I hope it may be of interest to readers of the *Journal of Milk and Food Technology.*

On behalf of Mayor Carl Stokes and the people of Cleveland, I am very pleased to have the opportunity to express our concern about appropriations for the Department of Health, Education, and Welfare.

May I say that I recognize that the bill before this subcommittee is one of the most difficult appropriation bills to come before you. It contains funds for many of the Nation's most important programs for the preservation and development of our human resources.

Those of us who are working with dedication in these fields and the people whose lives are directly touched by them feel very strongly about the levels of Federal appropriations. I know that you are under great pressure and your problems are compounded by the current economic atmosphere that prevails from city hall to the statehouse and finally to this chamber.

But despite these constraints I believe that we should act in a manner which reflects the overriding human needs of a nation that must continuously examine the qualitative conditions of society regularly and comprehensively. Therefore I will focus upon the need for increased appropriations for environmental health and sanitation programs designed to reduce physical and mental disease, accidental injury, and social disorder affecting individual, family, and community health.

Despite the advances in modern medicine, there is serious question as to whether the best medical care handsomely delivered to inner-city dwellers has any meaning in face of conditions that breed disease and despair far faster than they can be cured. This is why we are concerned that there is no Federal policy with respect to continued support for rat control, housing hygiene, and neighborhood improvement programs. The uncertainty created by the lack of forward funding for these essential community health services is undoubtedly one of the most frustrating aspects of Federal aid programs.

Little has to be said of the problems created for a local health agency which does not know what funds it will have available from year to year. The dilemma faced by the health commissioner attempting to eradicate disease and despair, to protect the health of a community, and attract a staff to a federally-funded project under these circumstances is self-evident. The ultimate losers are, of course, the people for whom Federal funds are appropriated. I should empha-

(Continued on Page 497)

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AN IMPROVED MEDIUM FOR DETECTION OF *CLOSTRIDIUM BOTULINUM* TYPE E

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(Received for publication May 14, 1971)

Abstract

An enrichment medium containing trypticase, peptone, glucose, yeast extract, and 1 mg of trypsin/ml (TPGYT) has been developed for detection of *Clostridium botulinum* type E. It was designed to potentiate toxin as produced and destroy the boticins of competing type E variants in cultures of foods and environmental materials. Samples of 227 sediments and 283 shellfish from different areas of the continental United States yielded 74 more positive cultures of type E in TPGYT than in the same medium free of trypsin. Type E toxin was detected in all smoked fish inoculated with 4 to 100 type E spores per fish in TPGYT. Incorporation of trypsin into the medium caused no reduction in type A or proteolytic type B toxin production from spore inocula. Toxins of nonproteolytic types B and F in pure culture were fully potentiated in the trypsin-containing medium.

There have been three known outbreaks of botulism in the United States since 1960 involving smoked fresh-water fish known or believed to have been commercially processed in the Great Lakes area *(1, 11, 16)*. The three episodes were caused by *Clostridium botulinum* type E and involved 21 cases with nine deaths. Another outbreak involving commercially canned tuna fish resulted in two deaths *(10)*.

Clostridium botulinum type E has been demonstrated as present in the water and sediments of the Great Lakes and in the intestinal contents of fish found in them, but its distribution has been uneven *(2, 3)*. The concentration of type E was very high in Green Bay of Lake Michigan, for example, but quite low in the remainder of the lake and in Lake Huron. The organism was not found in water samples or bottom sediments of either Lake Erie or Lake Superior, but type E was demonstrated in the intestinal tracts of a few fish obtained at certain locations in both of these lakes *(2)*. *Clostridium botulinum* also is found in the waters and sediments of the Atlantic and Gulf Coasts of the United States and in a variety of fish and shell fish from these areas *(19, 20, 21)*. The type of *C. botulinum* most frequently found in Blue crabs from Chesapeake Bay is type E, although other types, such as proteolytic type F, for example, are also present *(22)*. Similarly, in the Pacific Northwest, fish and sediments of the coastal waters have yielded principally type E, but nonproteolytic types B and F also have been found *(4, 6, 7)*. Thus, *C. botulinum* in aquatic environments contaminates a number of species of fish and shellfish frequently used for food. This creates a potential health hazard to the consumer if processing fails to destroy the spores or if faulty handling leads to recontamination of the product after processing

Low levels of type E botulinum toxin in samples containing considerable organic matter are often difficult to detect. These low levels may result from the growth of an abundance of other microorganisms in the enrichment cultures that inhibit outgrowth or toxin production *(9)*. Kautter et al. *(12)* have shown that some nontoxigenic variants of type E obtained from sediments of the Great Lakes and from the intestinal tract of fish produce a bacteriocin, boticin E, which is bacteriolytic for vegetative cells and bacteriostatic for spores of type E.

To overcome some of these difficulties, an enrichment medium containing trypsin has been proposed for the screening of environmental and food samples for the presence of *C. botulinum* type E *(8, 13, 14)*. It is formulated on the premise that boticins are rapidly destroyed by proteolytic enzymes, and that type E toxin is potentiated by trypsin. This paper summarizes the available data on the use of trypticase, peptone, glucose, yeast extract, trypsin (TPGYT) medium to detect type E in a variety of fishery products and sediment samples.

Materials and Methods

Media

Two enrichment media for detection of *C. botulinum* were used in these studies. One consisted of the Trypticase (BBL)[1]-peptone-glucose broth (TPG) of Schmidt et al. *(17)* but with 0.1% sodium thioglycolate supplemented with 2% yeast extract (TPGY). Fifteen milliliters of the medium was dispensed in 20-mm culture tubes or 100 ml in 6-oz prescription bottles and autoclaved at 121 C for 6 and 12 min, respectively. Immediately prior to use, the medium was steamed in an Arnold sterilizer to remove the oxygen, and cooled.

[1]Use of trade names does not imply endorsement by the Food and Drug Administration.

TABLE 1. SEDIMENT CULTURES IN TPGY BROTH POSITIVE FOR *Clostridium botulinum* TYPE E TOXIN BY THREE DIFFERENT METHODS

Source	Number of sediments	Medium: Containing 1 mg trypsin/ml		Medium: Trypsinized after growth		Medium: No trypsin	
		No. pos.	%	No. pos.	%	No. pos.	%
Great Lakes area:							
Rivers feeding Green Bay	81	37	46	21	26	14	17
Lake Erie	24	2	8	0		0	
State of Oregon:							
Alsea River	59	53	90	30	51	12	20
Umpqua River	63	34	54	25	40	6	9
Total positive sediments[a]	227	126	56	76	33	32	14

[a]From reference *14*.

TABLE 2. CULTURES OF SHELLFISH AND BLUE CRABS IN TPGY BROTH POSITIVE FOR *Clostridium botulinum* TYPE E TOXIN BY THREE DIFFERENT METHODS

Source	Type of sample	Number of samples	Medium: Containing 1 mg trypsin/ml		Medium: Trypsinized after growth		Medium: No trypsin	
			No. pos.	%	No. pos.	%	No. pos.	%
Pacific Coast	Cockle clams	22	6[a]	27	3	14	3	14
	Gaper clams	36	7	19	3	8	3	8
	Oysters	25	10[a]	40	7	28	7	28
Chesapeake Bay								
James River	Blue crab (viscera)	50	22[b]	44	18	36	12	24
	Blue crab (gills)	50	34[c]	68	19[d]	38	12[c]	24
Perrin River	Blue crab (viscera)	50	0	0	4	8	1	2
	Blue crab (gills)	50	7	14	8	16	2	4
Total positive samples		283	86	30	62	22	40	14

[a]One culture each of cockle clams and Pacific oysters contained both type E and type F.
[b]One additional culture typed as type F.
[c]Two additional cultures typed as type F.
[d]Three additional cultures typed as type F, 1 as type C and 1 as type D.

The enrichment medium containing trypsin was prepared by addition of trypsin (Difco 1:250) to the same basal medium to give a final concentration of 1 mg/ml (TPGYT). The trypsin was filtered through a 0.45-μ membrane filter to sterilize and was added aseptically to the steamed and cooled basal medium. Egg-yolk agar for spore counts consisted of 2% proteose peptone, 0.5% tryptone, 0.5% yeast extract, 0.5% sodium chloride, 0.1% sodium thioglycolate, and 2% agar, to which 2 egg yolks per 1000 ml of medium were aseptically added just prior to the pouring into plates.

Samples

All samples were kept frozen until tested, when they were thawed at room temperature and inoculated in duplicate into tubes containing 15 ml each of TPGY or TPGYT. For cultures of bottom sediments, 3- to 5-g samples taken from Lake Erie, from rivers feeding Green Bay of Lake Michigan, and from the Alsea and Umpqua Rivers of Oregon were used as inocula. For cultures of clams and oysters, individual samples were homogenized with 30 ml of gel-phosphate buffer in a Waring Blendor, and approximately 5 ml of the homogenates was inoculated into each of the two media. For Blue crabs, gills and viscera were cultured separately in the two media. All the cultures were incubated 3 days at 26 C, except some bottom sediments which were incubated 7 days.

Inoculated smoked fish

Smoked whitefish, whitefish chubs, carp, sable, and salmon lox were inoculated with spores of the Beluga strain of type E and placed individually in plastic bags. The fish were then broken up manually and divided into two equal groups. In one group, enough TPGYT to cover the macerated fish was placed in each plastic bag; in the other group, the same was done with TPGY. The bags were then heat-sealed and incubated at 26 C for 5 days, except for some whitefish chubs which were incubated 3 days. Smoked whitefish chubs inoculated with heat-shocked spores of a strain of type A (62A) and a proteolytic strain of type B (169B) were treated similarly, but were incubated at 35 C. The spore count of each inoculum was determined by plating on egg-yolk agar at the time the fish were inoculated. Colonies were counted after a 2-day incubation at 35 C in an atmosphere of N_2.

Toxin testing

After incubation, the fluid portion of all cultures was centrifuged at a relative centrifugal force of 4170 for 30 min in the cold. A portion of each of the supernatant fluids from TPGY cultures was trypsinized according to the procedure of Duff et al. *(5)*. Serial dilutions of the TPGY supernatant fluids, both before and after trypsinization, and TPGYT supernatant fluids through 10^{-5} were prepared in gel-phosphate buffer, and 0.5-ml portions of these as well as the undiluted material were injected intraperitoneally into two 20-g Swiss Webster mice. The undiluted supernatant fluids were then frozen to minimize destruction of any toxin present until it could be typed by mouse protection tests. For this,

toxic supernatant fluids were thawed, and 0.5 ml of the undiluted material and of 1:5 and 1:20 dilutions was injected intraperitoneally into mice which had been passively protected against type E with 0.5 unit of monovalent antitoxin (CDC, Atlanta, Ga.) and into a like number of unprotected controls. The antitoxin was given intraperitoneally approximately 30 min before the toxic supernatant fluids. If mice were not protected by the type E antitoxin, the test was repeated using antitoxin to types A, B, C, D, and F. All mice were observed for 72 hr for symptoms of botulism and death.

RESULTS

The effect of the addition of trypsin to TPGY when used for culturing sediment samples is shown in Table 1. Approximately four times as many positives, overall, were obtained when samples were screened with the trypsin-containing medium as when TPGY alone was used. This is almost double the number of positives obtained by trypsinizing after growth in TPGY.

Detection of type E in Lake Erie samples is of particular interest since Bott et al. *(2)* did not find type E in water or sediments from this lake. Although only two samples out of 24 were positive in TPGYT, none were positive in TPGY even when trypsinized after growth. The rate of increase in the number of positive samples in trypsinized cultures compared to untrypsinized cultures was lower for the Great Lakes samples than for the Oregon samples, whether the trypsin was incorporated into the medium or the cultures were trypsinized afterwards.

Table 2 demonstrates the increased sensitivity of the trypsin-containing medium for detection of type E in a variety of shellfish samples. The overall rate of increase in the number of positive samples with this medium is more than double that with the medium without trypsin, whereas trypsinization after growth gave only 1.5 times as many positives. Generally, samples from the Pacific Coast gave a slightly lower rate of increase in positives in the trypsin-containing medium than did those from Chesapeake Bay. Trypsinization after growth in TPGY yielded no increase in the number of positive cultures of clams or oysters, but when trypsin was incorporated into the medium, 1.5 to 2 times as many were positive. Trypsinization of TPGY cultures of gills and viscera of Blue crabs from the James River gave one-half again as many positives as the untrypsinized, but when trypsin was incorporated into the medium, the number of positives doubled or tripled. The rate of detection in cultures of the gills of Blue crabs from the Perrin River was increased fourfold by trypsinization after growth or by growth in TPGYT. Toxic cultures from the viscera of these crabs were increased similarly by trypsinization after growth, but the trypsin-containing medium failed to produce any

TABLE 3. EFFECT OF INCORPORATING TRYPSIN INTO TPGY BROTH AS AN ENRICHMENT MEDIUM FOR DETECTING *Clostridium botulinum* TYPE E IN SMOKED WHITEFISH CHUBS[a]

Spore inoculum/fish (Range)	Incubation time (Days)	Medium		
		Containing 1 mg trypsin/ml	Trypsinized after growth	No trypsin
4-27	3	12/12[b] (10T-100T)[c]	12/12 (1T- 20T)	12/12 (200-20T)
21-38	3	12/12 (100->20T)	12/12 (20->20T)	9/12 (20- 2T)
36-49	3	12/12 (200- 20T)	12/12 (1T-10T)	9/12 (20-200)
4-27	5	12/12 (200->200T)	12/12 (2T->20T)	12/12 (20-20T)
21-38	5	12/12 (200->200T)	12/12 (2T-20T)	12/12 (20-2T)
31-54	5	12/12 (10T-100T)	12/12 (10T->20T)	12/12 (1T-20T)

[a]From reference *13*.
[b]Number of toxic cultures over number tested.
[c]Range of toxin titers of positive cultures expressed as minimum lethal dose per milliliter.

TABLE 4. EFFECT OF INCORPORATING TRYPSIN INTO TPGY BROTH AS AN ENRICHMENT MEDIUM FOR DETECTING *Clostridium botulinum* TYPE E IN SMOKED WHITEFISH, CARP, SABLE, AND SALMON LOX[a]

Species of fish	Spore inoculum/fish (Range)	Medium		
		Containing 1 mg trypsin/ml	Trypsinized after growth	No trypsin
Whitefish	19-23	10/10[b] (2T-10T)[c]	25/25 (200->20T)	25/25 (200->20T)
	90-100	30/30 (200->20T)	25/25 (200->20T)	25/25 (200->20T)
Carp	70-98	30/30 (2T->100T)	10/10 (10T-20T)	10/10 (1T->20T)
Sable	22-28	12/20 (10->20T)	5/20 (20-2T)	4/20 (10-2T)
	50-85	22/30 (200->20T)		
Salmon lox	11-20	8/15 (20->20T)	8/15 (20->20T)	7/15 (20-2T)

[a]From reference *13*.
[b]Number of toxic cultures over number tested.
[c]Range of toxin titers of positive cultures expressed as minimum lethal doses per milliliter.

TABLE 5. EFFECT OF INCORPORATING TRYPSIN INTO TPGY BROTH AS ENRICHMENT MEDIUM FOR DETECTING *Clostridium botulinum* TYPES A AND B IN SMOKED WHITEFISH CHUBS[a]

Spore inoculum/fish (Range)	Type	Medium		
		Containing 1 mg trypsin/ml	Trypinized after growth	No trypsin
1-28	A	12/12[b] (20-2T)[c]	12/12 (200-10T)	12/12 (20-2T)
24-37	A	12/12 (20-2T)	12/12 (20-10T)	12/12 (20-2T)
48-67	A	6/6 (20-2T)	6/6 (20-2T)	6/6 (200)
10-36	B	8/12 (10-100)	8/12 (10-20)	7/12 (10-20)
27-84	B	8/12 (10-20)	7/12 (10-200)	5/12 (20-100)

[a]From reference *13*.
[b]Number of toxic cultures over number tested.
[c]Range of toxin titers of positive cultures expressed as minimum lethal doses per milliliter.

toxic cultures. This may be attributable to the distribution of viable spores since the number of positives would indicate a low level of contamination.

The ability of the trypsin-containing medium to support toxin production in cultures of smoked whitefish chubs inoculated with low numbers of Beluga spores is shown in Table 3. All cultures in TPGYT were positive in 3 days, whereas without trypsin, some of the group incubated 3 days were negative, although all of the group incubated 5 days were positive. Moreover, the amount of toxin in TPGYT cultures incubated 5 days was greater than that in cultures incubated 3 days or in any incubated without trypsin, although the difference after trypsinization was slight. Since this was so, all subsequent inoculated fish were incubated 5 days. Similar results have been obtained in a few comparable experiments using spores of 070 strain of type E as inoculum. The results of additional experiments with other smoked fish are shown in Table 4. All cultures of whitefish and carp were positive by all three methods, but the levels of toxicity were often higher in the trypsin-containing medium. On the other hand, some cultures of sable and salmon lox were negative by all three methods, probably because of the presence of sodium nitrite or the high salt concentration. The number of positives among the salmon lox was about the same by all three methods. The number of positives in sable increased slightly when trypsinized after growth, but when trypsin was incorporated into the medium this number more than doubled.

Data in Table 5 show that the recovery of 62A from smoked fish inoculated with minimal numbers of spores is not impaired by use of this medium. Some fish inoculated with type B spores of the proteolytic 169B strain, however, failed to produce toxic cultures by any of the three methods, but the toxicity and number of positives were about the same with both TPGYT and TPGY. A few additional experiments using the proteolytic 115B strain have given results similar to those obtained with 169B.

Examples of increased toxicity of cultures as a result of incorporating trypsin into TPGY inoculated with four samples of bottom sediments containing type E are given in Table 6. The trypsin-containing medium gave titers ranging from about 20 to 100 times that of TPGY without trypsin, whereas trypsinization after growth produced only about a tenfold increase. That TPGYT does not appreciably interfere with the growth and toxin production of other types of *C. botulinum* is shown in Table 7. The toxicity of pure cultures of type A and proteolytic types B and F was not diminished in this medium, except for the decrease shown in the 5-day TPGYT culture of 73A, compared to TPGY, whereas that of the nonproteolytic 202F and 610F strains was potentiated, giving a 10- to 100-fold increase, as with type E.

DISCUSSION

Incorporation of trypsin into TPGY improves its usefulness for detecting *C. botulinum* type E and could possibly be equally useful for detecting nonproteolytic types B and F, which have both been shown to be antigenically related to type E via the somatic antigen *(15, 18)*. Trypsin increases the detectable amount of toxin resulting from the growth of these organisms and supresses boticin production

TABLE 6. EXAMPLES OF THE EFFECT OF INCORPORATING TRYPSIN INTO TPGY AS AN ENRICHMENT MEDIUM ON THE TYPE E TOXIN TITERS[a] WITH SEDIMENT SAMPLES OBTAINED FROM OREGON

Sample no.	Medium		
	Containing 1 mg trypsin/ml	Trypsinized after growth	No trypsin
1	200	20	10
2	20	10	<2
3	200	2	2
4	>200	>20	2

[a]Toxin titers expressed as minimum lethal doses per ml.

TABLE 7. EFFECT OF INCORPORATING TRYPSIN INTO TPGY BROTH ON TOXIN PRODUCTION[a] IN CULTURES OF *C. botulinum* TYPES A, B, AND F

Type	Strain	Medium			
		Containing 1 mg trypsin/ml		No trypsin	
		3 days	5 days	3 days	5 days
A	62A	>20,000[b]	100,000	>20,000	100,000
	73A	20,000	20,000	20,000	100,000
B	115B	2,000	2,000	2,000	2,000
	169B	200	2,000	200	2,000
F	202F	2,000	2,000	20	200
	610F	2,000	10,000	20	200
	Langeland F	2,000	2,000	2,000	2,000

[a]Toxin titers expressed as minimum lethal doses per ml.
[b]Average toxin titer.

by certain nontoxigenic type E variants *(8)*. Our results show that, while trypsin treatment after growth increased the rate of detection of type E in a variety of samples, the trypsin-containing medium usually gave an even higher rate of detection. It generally yielded the highest percent of positive samples from all types of materials and all geographical areas studied.

In the procedure of Duff et al. *(5)*, *C. botulinum* toxin already potentiated by proteolytic enzymes of other organisms present in natural samples may be completely destroyed by trypsin treatment. Such a loss of toxicity in enrichment cultures has been experienced by many investigators. Although the presence of trypsin in the culture medium augmented by the enzymes of proteolytic contaminants, if present in the sample, could cause degradation of C. *botulinum* toxin, the only effect observed in these experiments was potentiation of toxin with the consequent increase in the detection rate, and no degradation occurred when cultures were incubated 3 to 5 days. That degradation may occur, however, is indicated by the decline in toxicity encountered when bottom sediments were incubated as long as 7 days in this medium.

The ability of this medium to potentiate toxin and destroy boticins is probably responsible for its efficiency when used to detect minimal levels of contamination with *C. botulinum* spores. The increased toxicity simplifies determination of the type of toxin produced by increasing titer and eliminating the testing for toxin before trypsinization.

This medium had no adverse effects on the toxin produced by proteolytic strains of *C. botulinum*. Although proteolytic type B spores were not detected in some inoculated smoked fish in either medium, the toxin produced by those which did grow in TPGYT was generally as potent as that in the medium without trypsin. At the same time, the nonproteolytic strains of types B and F, which are physiologically similar to type E, are benefited in the same manner as type E since their toxins are also potentiated by the trypsin-containing medium.

Additional advantages of this medium arise from a reduction in time, labor, and materials, i.e., fewer replicate cultures are required to detect positive samples and fewer mice are needed for toxin titrations.

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LETTER TO THE EDITOR

(Continued from Page 491)

size that local rat control programs have been more than rat-killing campaigns. They have stimulated total neighborhood improvements through a cooperative effort of city government and neighborhood residents, both inextricably tied together for the development of a safe and wholesome environment.

It is equally disturbing to note that this bill does not contain money for lead-base paint poison prevention as authorized in the Lead-Base Paint Poisoning Prevention Act. You will recall the legislation authorized $30 million over two years to control the disease. We find it hard to believe that the Administration will exhaust all possible resources to bail out an aircraft company but will not provide the necessary funds to prevent lead-based paint poisoning in 800,000 children annually plus some 4,200 more who incur brain damage, 1,000 to 2,000 of them severely enough to require care for the rest of their lives. This is indeed an imbalance in our national effort, in our national priorities, and the most baseless kind of false economics.

Another concern is the lack of funds to support research, development, and training in the Bureau of Community Environmental Management (BCEM) National Communicable Disease Center, Department of Health, Education, and Welfare. Since the inception of the U.S. Public Health Service in 1798, the mission now assigned to BCEM has provided leadership for health protection and environmental management in both urban and rural settings. Within the past two years the Bureau has provided outstanding training programs for state and local health workers, conducted significant research which has been of practical value to local environmental sanitation improvements, and offered technical assistance and advice to local health departments, thereby offsetting the universal shortage of health manpower.

The development and implementation of the Neighborhood Environmental Evaluation and Decision System (NEEDS) by the Bureau has provided an analytical tool which will enable us at the local level to make the best possible use of our limited resources. This system has been employed in our city, and we are most grateful for this help from the Federal level.

But we are distressed to learn that all of these services will no longer be available, since the Bureau will have no money to continue its research and development efforts. This is a tragedy of massive dimensions and it would be very shortsighted to abolish these programs at a time when they are badly needed.

One final concern within the purview of this distinguished committee is the false impression often created when programs are continued from one fiscal year to the next at the "same level". In such instances the commitment of the Federal Government is not maintained, as is often implied. In most programs it takes an increment of 10 to 15% merely to stand still. This year Federal appropriations include examples of the reduction in a national commitment to health programs in this Nation.

So I would respectfully urge you to make it possible for us to continue our efforts in health promotion and to view the appropriations not in light of what we can afford in the traditional sense, but in answer to a more critical question: What will be the ultimate cost to the community and to society if we fail to make appropriate investment and to take preventive action now.

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3-A SANITARY STANDARDS FOR STORAGE TANKS FOR MILK AND MILK PRODUCTS

Serial #0104

Formulated by

International Association of Milk, Food and Environmental Sanitarians

United States Public Health Service

The Dairy Industry Committee

It is the purpose of the IAMFES, USPHS, and DIC in connection with the development of the 3-A Sanitary Standards program to allow and encourage full freedom for inventive genius or new developments. Storage tank specifications heretofore and hereafter developed which so differ in design, material, fabrication, or otherwise as not to conform with the following standards, but which, in the fabricator's opinion are equivalent or better, may be submitted for the joint consideration of the IAMFES, USPHS and DIC, at any time.

A

SCOPE

A.1

These standards cover the sanitary aspects of storage tanks for milk and milk products.

A.2

In order to conform with these 3-A Sanitary Standards, storage tanks shall comply with the following design, material, fabrication, and cleaning criteria.

B.

DEFINITIONS

B.1

Product: Shall mean the milk or milk product stored in the tank.

B.2

Storage Tank: Shall mean a cylindrical, rectangular, oval or other equally satisfactory shape tank except a vertical tank whose inside height is in excess of 10 feet[1] and the tank is used for the storage or storage and cooling of a product.

B.3

Product Contact Surfaces: Shall mean all surfaces which are exposed to the product and surfaces from which liquids may drain, drop, or be drawn into the product.

B.4

Non-Product Contact Surfaces: Shall mean all other exposed surfaces.

B.5

Mechanical Cleaning or Mechanically Cleaning:

Shall denote cleaning, solely by circulation and/or flowing chemical detergent solutions and water rinses onto and over the surfaces to be cleaned, by mechanical means.

[1]Vertical tanks in excess of 10 feet inside height are defined as silo-type tanks. Sanitary criteria for silo-type tanks are covered in "3-A Sanitary Standards for Silo-Type Storage Tanks for Milk and Milk Products, Serial #2200," as amended.

C.

MATERIALS

C.1

All product contact surfaces shall be of stainless steel of the AISI 300 series[2] or corresponding ASI[3] types (See Appendix, Section E.), or stainless steel that is non-toxic and non-absorbent and which under conditions of intended use is equally corrosion resistant to stainless steel of the AISI 300 series[2] or corresponding ACI[3] types, except that:

C.1.1

Rubber and rubber-like materials may be used for umbrellas for vertical agitator assemblies, gaskets, seals and parts used in similar applications. These materials shall comply with the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Serial #1800."

C.1.2

Plastic Materials may be used in sight and/or light openings and for umbrellas for vertical agitator assemblies, bearings, gaskets, seals, and parts used in similar applications. These materials shall comply with the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000," as amended.

C.1.3

Where functional properties are required for specific applications, such as agitator bearing surfaces and rotary seals, where dissimilar materials are

[2]The data for this series are contained in the following reference: AISI Steel Products Manual, Stainless & Heat Resisting Steels, April 1963, Table 2-1, pp. 16-17. Available from American Iron and Steel Institute, 150 E. 42nd Street, New York, N. Y. 10017.

[3]Alloy Casting Institute, 300 Madison Avenue, New York, N. Y. 10017.

necessary, carbon and/or ceramics may be used. Ceramic materials shall be inert, non-porous, non-toxic, non-absorbent, insoluble, resistant to scratching, scoring, and distortion by the temperature, chemicals, and methods to which they are normally subjected in operation or cleaning and bactericidal treatment.

C.1.4

Glass may be used in sight and/or light openings and when used shall be of a clear heat resistant type.

C.2

The materials used for the lining shall not be less than No. 14 U. S. standard gauge.

C.3

All non-product contact surfaces shall be of corrosion-resistant material or material that is rendered corrosion resistant. If coated, the coating used shall adhere. All non-product contact surfaces shall be relatively non-absorbent, durable and cleanable. Parts removable for cleaning having both product contact and non-product contact surfaces shall not be painted.

D.

FABRICATION

D.1

All product contact surfaces shall be at least as smooth as a No. 4 mill finished on stainless steel sheets. (See Appendix, Section F.)

D.2

All permanent joints in product contact surfaces shall be welded. All welded areas of product contact surfaces shall be at least as smooth as the adjoining surfaces.

D.3

All product contact surfaces shall be easily accessible for cleaning, either when in an assembled position or when removed. Removable parts shall be readily demountable.

D.4

All product contact surfaces shall be self draining except for normal clingage. The bottom pitch of a vertical tank designed for mechanical cleaning shall be at least 3/4 inch per foot toward the outlet.

Horizontal rectangular tanks designed for mechanical cleaning which have a built-in bottom pitch, shall have a pitch of at least 1/4 inch per foot toward the outlet.

Horizontal tanks shall be so constructed that they will not sag, buckle, or prevent complete drainage of water when the tank has a pitch of not more than 1 inch in 100 inches. (See D.13).

D.5

If it is necessary to enter the tank to clean any or all of the product contact surfaces, the tank shall have the following minimum dimensions:

(1) 36-inches in height by 48-inches in diameter, or 48-inches square.

(2) 36-inches in height, 36-inches in width, by 48-inches in length, if oval or rectangular.

D.6

The inside radii of all welded or permanent attachments shall be not less than 1/4 inch. Where the head(s) joins the lining of the tank the radius shall not be less than 3/4 inch.

D.7

There shall be no threads on product contact surfaces.

D.8

Sanitary pipe and fittings shall conform with "3-A Sanitary Standards for Fittings Used on Milk and Milk Products Equipment and Used on Sanitary Lines Conducting Milk and Milk Products, Serial #0809," as amended.

D.9

The outer shell shall be smooth and effectively sealed except for a vent or weep hole in the outer shell of the tank. The vent or weep hole shall be located in a position that will provide drainage from the outer shell and shall be vermin proof. Outside welds need not be ground.

D.10

Non-product contact surfaces shall be free of pockets and crevices and be readily cleanable and those to be coated shall be effectively prepared for coating.

D.11

Equipment for producing and introducing air under pressure into the product and which is supplied as an integral part of the tank shall comply with the "3-A Accepted Practices for Supplying Air Under Pressure in Contact with Milk, Milk Products and Product Contact Surfaces" Serial #60400 as amended.

D.12

The tank shall be insulated with insulating material of a nature and amount sufficient to prevent, in 18 hours, an average temperature change of greater than 2 F in the tank full of water when the average difference between the temperature of the atmosphere surrounding the tank is 30 F above or below that of the water in the tank, provided that the insulating material shall have an insulating value equivalent of not less than 2 inches of cork.

Tanks specified for installation partially outside of a building shall be insulated with insulation ma-

terial having an insulating value of not less than 3 inches of cork over non-refrigerated areas. (See D.28). Insulation material shall be installed in such a manner as to prevent shifting or settling.

D.13

Means of supporting tanks.

D.13.1

The means of supporting tanks designed to be installed wholly within a processing area shall be one of the following:

D.13.1.1

With Legs. Adjustable legs shall be provided of sufficient number and strength and so spaced that the filled tank will be adequately supported. Legs shall have sealed bases. Exterior of legs and leg sockets shall be readily cleanable. Legs shall be such that the product outlet is sufficiently high to allow for adequate cleaning and will provide an 8-inch minimum clearance between the floor and the tank outlet valve or bracing whichever is lower. The legs of cylindrical horizontal tanks shall be installed so that the leg will be vertical when the tank lining is pitched 1/4 inch per foot toward the outlet.

D.13.1.2

Mounted on a slab or island. The base of the tank shall be such that it may be sealed to the mounting surface. (See Appendix, Section L.)

D.14

A hooded air vent of sufficient free opening area to prevent back pressure during filling and to prevent vacuum during emptying of the tank shall be provided in the front head near the top of the tank or in the top of the tank. (See Appendix, Section K.) The vent shall terminate in a processing area and shall drain into the tank. It shall be provided with a perforated cover having openings not greater than 1/16 inch diameter, or slots not more than 1/32 inch wide. Woven wire mesh shall not be used for this purpose. It shall be so designed that parts are readily accessible and readily removable for cleaning.

D.15

One or more fittings to accommodate indicating and/or recording temperature sensing devices shall be provided.

D.15.1

They shall conform to one of the following types:

D.15.1.1

Fittings conforming to thermometer well supplements to 3-A "Sanitary Standards for Thermometer Fittings and Connections Used on Milk and Milk Products Equipment," Serial #0900 as amended and supplements thereto.

D.15.1.2

Fittings for temperature sensing devices which do not pierce the tank lining, but which have temperature sensing element receptacles securely attached to exterior of the lining.

D.15.2

The fittings for temperature sensing devices shall be located to permit the registering of the temperature of the product when the tank contains no more than 20% of its capacity.

D.16

The outlet shall be located where readily accessible and in a position to provide complete drainage of the tank. The top of the terminal end of the outlet passage shall be lower than the low point of the bottom of the lining at the outlet. The outside diameter of the outlet opening shall be at least as large as that of 1-1/2 inch 3-A Sanitary Tubing.

D.17

Inlet and Outlet connections in the tank shall be provided with welding stub ends, bolted or clamp type flanges or 3-A sanitary threaded connections. The face of a bolted or clamp type flange or a 3-A sanitary threaded connection below the maximum normal product level shall be as close as practical to the outer shell of the tank. (See Appendix, Section G and Section H.)

D.18

The manhole shall be located at the outlet end or side of the tank or the top of the tank. The inside dimensions of the manhole opening shall not be less than 15" x 20" oval, or 18" diameter.

A top manhole opening shall be not less than 3/8 inch higher than the surrounding area and if the exterior flange is incorporated in it, it shall slope and drain away from the opening. The sleeve or collar of a manhole opening for an inside swing type manhole cover shall be pitched so that liquids cannot accumulate.

D.19

The cover for a manhole in the end or side wall shall be either of the inside or outside swing type. If the cover swings inside, it shall also swing outside, away from the opening. Threads of ball joints employed to attach the manhole cover(s) shall not be located within the lining. The cover for a manhole in the top shall be of the outside swing type.

D.20

Gaskets shall be removable. Any gasket groove or gasket retaining groove shall not exceed 1/4 inch in depth or be less than 1/4 inch wide. The minimum radius of any internal angle in a gasket groove or gasket retaining groove shall be not less than 1/8 inch.

D.21

Unless otherwise specified, means for mechanical and/or air agitation of product shall be provided that when operated intermittently or continuously shall be sufficient to maintain the butterfat content of whole milk throughout the tank within a variation of plus or minus 0.1 per cent as determined by the official AOAC Babcock Milk Fat Test[4]. The agitator, if not designed for mechanical cleaning, shall be located in such a manner that it shall be readily accessible and removable for manual cleaning.

The opening for a vertical agitator shall have a minimum diameter of 1 inch on tanks which require removal of the agitator shaft for cleaning or be of a diameter that will provide a 1 inch minimum annular space between the agitator shaft and the inside surface of the opening on a tank which does not require removal of the agitator for cleaning. An umbrella or drip shield of sanitary design that can be raised or dismantled, to permit cleaning of all of its surfaces, shall be provided to protect against the entrance of dust, oil, insects and other contaminants into the tank through the annular space around the agitator shaft. The agitator shaft, if removable, shall be provided with an easily accessible, readily demountable coupling of either a sanitary type located within the lining or a coupling located outside the lining provided that it is above the umbrella provided to protect the annular space around the shaft. A bottom support or guide, if used, shall be welded to the lining and shall not interfere with drainage of the tank and the inside angles shall have minimum radii of 1/8 inch. When the agitator shaft has a bearing cavity, the diameter of the cavity shall be greater than the depth. A seal for the agitator shaft, if provided, shall be of a packless type, sanitary in design with all parts readily accessible for cleaning. A sanitary seal for the agitator shaft shall be provided for (1) a horizontal agitator, (2) a vertical agitator when it is specified that the tank is to be located so that the portion of the shaft outside the tank is not in a processing area (See D.28.) and (3) an agitator in a tank having means for mechanically cleaning the tank.

D.22

Storage tanks having an inside height of more than 96 inches shall be provided with means (see suggestions Appendix, Section I) that will facilitate manual cleaning and inspection of all product contact surfaces or means shall be provided for mechanically cleaning the product contact surfaces of the tank and all non-removable appurtenances thereto (See suggestions Appendix, Section J).

D.23

A sample cock shall be provided. It shall be of a type that has its sealing surface relatively flush with the product contact surface of the tank and have an inside diameter no less than that of one inch 3-A Sanitary tubing.

D.24

Air Under Pressure: Means for applying air under pressure shall conform to the applicable provisions of the "3-A Accepted Practices For Supplying Air Under Pressure in Contact With Milk, Milk Products and Product Contact Surfaces" Serial #60400, as amended, except that clamp type fittings shall not be used in the product zone.

Tubing and related fittings within the tank shall be readily and easily removable for cleaning outside the tank or be designed for mechanically cleaning. If designed for mechanically cleaning, the tubing and all related fittings shall be self-draining. Permanently mounted air tubing shall be constructed and installed so that it will not sag, buckle, vibrate or prevent complete drainage of the tank or tubing and shall be located so that the distance from the outside of the tubing to the lining shall be at least two inches, except at point of entrance.

D.25

Sight and light openings, when provided, shall be of such design and construction that the inner surfaces drain inwardly, and if the tank is designed for mechanical cleaning, the inner surface of the glass (or plastic) shall be relatively flush with the inner surface of the lining. The inside diameter of the opening shall be at least 3-3/4 inches. The external flare of the opening shall be pitched so that liquid cannot accumulate.

D.26

An opening for a pressure transmitter, if provided, shall be in a portion of the tank that is in the processing area, and if the tank is designed for mechanical cleaning, the transmitter shall be relatively flush with the inner surface of the lining.

D.27

An opening for a gauge if provided, shall be in the portion of the tank in the processing area. The inside diameter of the opening shall be not less than 1.75 inches.

D.28

Storage tanks shall have an information plate in juxtaposition to the name plate giving the following information or the information shall appear on

[4]The method of making this test will be found in the following reference: Official Methods of Analysis: Available from the Association of Official Analytical Chemists. P. O. Box 540, Benjamin Franklin Station, Washington, D. C. 20004.

the name plate:

(a) The insulating value of the insulation as expressed in the following or a similar statement:
The insulation of this tank is or is equivalent to ____ inches of cork.

(b) If the tank has a vertical agitator and a sanitary seal is not provided for the agitator shaft, the following or a similar statement shall be expressed:
This tank is designed to be located wholly within the processing area.

APPENDIX

E.

STAINLESS STEEL MATERIALS

Stainless steel conforming to the applicable composition ranges established by AISI for wrought products, or by ACI for cast products, should be considered in compliance with the requirements of Section C.1 herein. Where welding is involved the carbon content of the stainless steel should not exceed 0.08%. The first reference cited in C.1 sets forth the chemical ranges and limits of acceptable stainless steels of the 300 series.

Cast grades of stainless steel corresponding to types 303, 304, and 316, are designated CF-16F, CF-8, and CF-8M, respectively. These cast grades are covered by ASTM[5] specifications A296-68 and A351-69.

F.

PRODUCT CONTACT SURFACE FINISH

Surface finish equivalent to 150 grit or better as obtained with silicon carbide, is considered in compliance with the requirements of Section D.1 herein.

G.

INLET AND OUTLET CONNECTIONS

The distance between the nearest point on the outer shell of the tank to (1) the face of a bolted or clamp type flange or (2) the face of a 3-A sanitary threaded connection on an inlet or outlet connection below the normal product level should not exceed the smaller of (1) twice the nominal diameter of the connection or (2) five inches.

H.

VALVES

Valves on inlet and outlet connections in the tank below the maximum normal product level should be of the close coupled plug-type or of the close coupled compression-type.

[5]Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.

I.

MANUAL CLEANING

If the inside height of a tank exceeds 96 inches, one means for manual cleaning is to weld a stainless steel rung on each end of the tank to support a removable platform at a height which will facilitate cleaning and inspection.

J.

MECHANICAL CLEANING

One cleaning method found to be satisfactory is to pump the cleaning solution to the dome of the tank or the upper portion of the tank surface, as the case may be, through stainless steel lines with C-I-P fittings or welded joints and distribute it in such a manner as to provide flooding over all interior surfaces. The tank should be installed with sufficient pitch to accomplish draining and to have a fast flushing action across the bottom. The pitch should be at least 1/4 inch per foot. Means should be provided for manual cleaning of all surfaces not cleaned satisfactorily by mechanical cleaning procedures. NOTE: Cleaning and/or sanitizing solutions should be made up in a separate tank —not the storage tank.

K.

AIR VENTING

To insure adequate venting of the tank which will protect it from internal pressure or vacuum damage during normal operation, the critical relationship between minimum vent-size and maximum filling or emptying rates should be observed. The size of the free vent opening of a tank should be at least as large as those shown in the table below:

Minimum Free Vent Opening Size (inches, I.D.)	Maximum Filling or Emptying Rate (gallons per minute)
1-3/4	175
2-1/4	300
2-3/4	400

The above sizes are based on normal operation and are sized to accommodate air only and not liquid. A perforated vent cover, if used, should have a free opening area equal to at least 1-1/2 times the area of the vent opening in the tank. The venting system covered in the preceding paragraphs is intended to provide for venting during filling and emptying; however, it is not adequate during cleaning. During the cleaning cycle, tanks when cleaned mechanically should be vented adequately by opening the manhole door to prevent vacuum or pressure build up due to sudden changes in tem-

perature of very large volumes of air.[6] Means should be provided to prevent excess loss of cleaning solution through the manhole opening.

The use of tempered water of about 95 F for both pre-rinsing and post-rinsing is recommended to reduce the effect of flash heating and cooling. Provisions should be made to prevent overfilling with resultant vacuum or pressure damage to the tank.

[6]For example, when a 6,000 gallon tank (with 800 cu. ft. of 135 F hot air after cleaning) is suddenly flash cooled by 50 F water sprayed at 100 gpm the following takes place:

Within one second, the 800 cu. ft. of hot air shrinks approximately 51 cu. ft. in volume. This is the equivalent in occupied space of approximately 382 gallons of product. This shrinkage creates a vacuum sufficient to collapse the tank unless the vent, manhole, or other openings allow the air to enter the tank at approximately the same rate as it shrinks. It is obvious, therefore, that a very large air vent such as the manhole opening is required to accommodate this air flow.

L.

SLABS OR ISLANDS

When a tank is designed to be installed on a slab or an island, the dimensions of the slab or island should be such that the tank will extend beyond the slab or island at least one inch in all horizontal directions. The slab or island should be of sufficient height so that the bottom of the outlet connection is not less than 8 inches above the floor. The surface of the slab or island should be coated with a thick layer of waterproof mastic material, which will harden without cracking. The junction of the outer shell of the tank and the slab or island should be sealed.

These standards are effective Feb. 19, 1972, at which time the "3-A Sanitary Standards for Storage Tanks for Milk Products (As Amended, November 9, 1955)" Serial #0101 and amendments thereto, are rescinded and become null and void.

FIFTY-EIGHTH ANNUAL MEETING OF IAMFES

San Diego, California
August 15-19, 1971

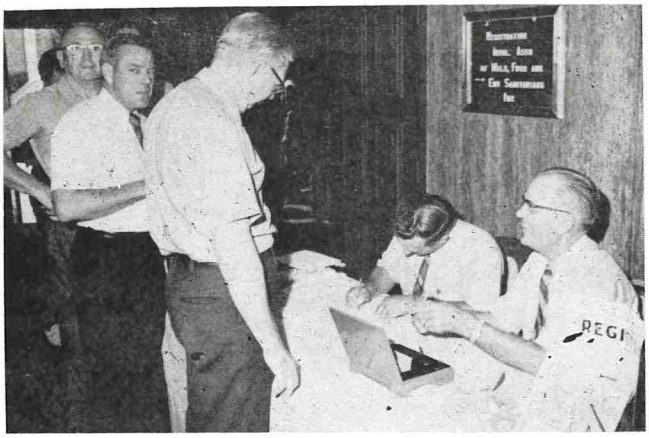
The 58th Annual Meeting of IAMFES was a triple-barreled success! First, nearly 200 persons attended the Summer Meeting of the National Mastitis Council which was held on August 16. Second, more than 300 members and guests attended the IAMFES meeting from August 17-19. Third, the California Association of Dairy and Milk Sanitarians and the California Fieldmen's Conference arranged for facilities and entertainment which were outstanding. The meeting was held at the new Sheraton Inn on Harbor Island in San Diego, California.

EXECUTIVE BOARD MEETINGS

The IAMFES Executive Board met Sunday afternoon (August 15) and continued with sessions throughout the day and evening on Monday (August 16). President Whitehead informed the Board that Elmer Kihlstrum had resigned as First Vice-President

The Executive Board of IAMFES in session before the start of the Annual Meeting.

The Sheraton Inn on Harbor Island, San Diego, California was the site of the 58th Annual Meeting of IAMFES.



Activity at the registration desk.

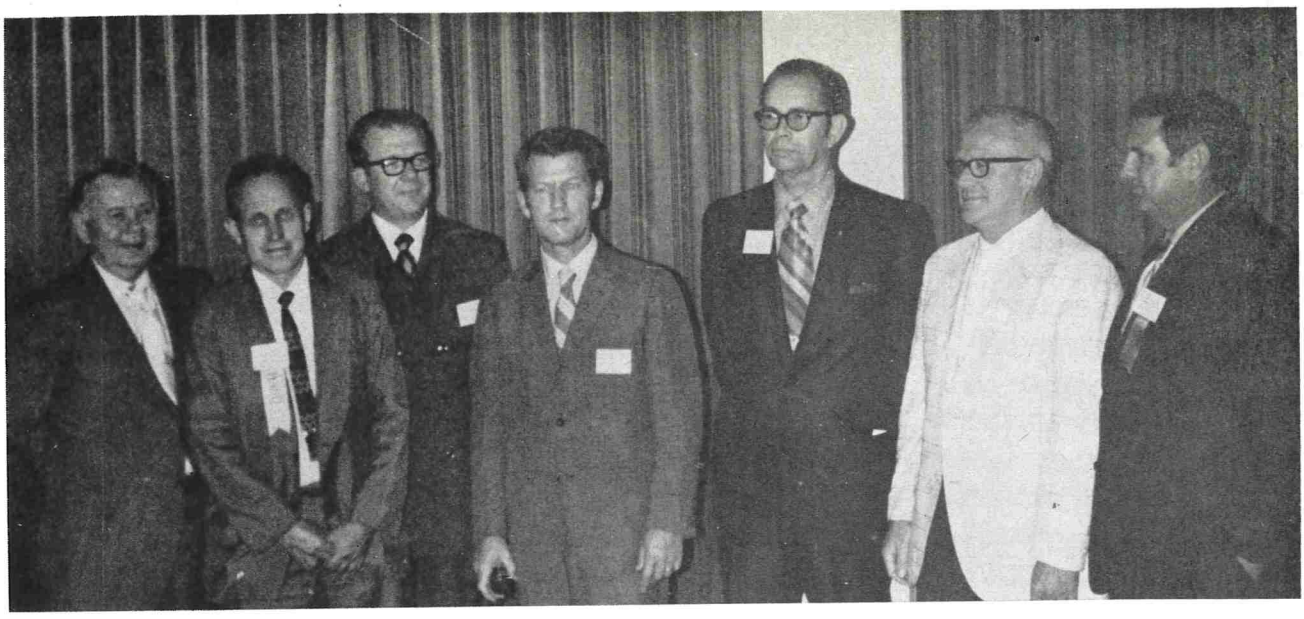
of IAMFES. After consulting the constitution, the Board agreed that Walter F. Wilson would move from Second Vice-President to President-Elect and that the newly elected Second Vice-President, Professor Earl O. Wright, would become the First Vice-President. The Board then appointed Mr. Parnell J. Skulborstad to serve as Second Vice-President until the annual business meeting. Skulborstad accepted the appointment. Several days later the membership at the business meeting voted to accept the Executive Board's recommendation that Skulborstad continue to fill the vacancy as Second Vice-President and then to advance to the various positions on the Board in the normal manner.

It was also announced by President Whitehead that Dr. F. W. Barber has resigned as Chairman of the Journal Management Committee. Dr. W. C. Lawton has been appointed to replace Dr. Barber and Dr. Lawton has agreed to serve as chairman of the committee.

Reports made to the Executive Board include those of: *(a)* Dr. E. H. Marth as Editor of the *Journal of Milk and Food Technology* (the report will appear in a later issue of the *Journal*), *(b)* Jack Fritz as the IAMFES representative to the Sanitarian's Joint Council (a meeting of the Council has been set for the APHA meeting at which time consideration will be given to: revision of the Sanitarian's Registration Act, ways to help APHA cover the costs of examinations which it administers, and inviting the National Society of Professional Sanitarians to join the Sanitarians Joint Council), *(c)* Ben Luce as Chairman of the Affiliate Council (criteria to serve as the basis for the Shogren Award have been developed), *(d)* A. E. Parker as the IAMFES representative to the National Mastitis Council and as a representative of the Dairy Farm Methods Committee (publication of the 15-year summary of annual reports should be held up until costs can be completely evaluated, the Dairy Farm Methods Committee should not get involved with mastitis problems, the task committee on Proper Milking Practices will be concerned with welded lines and their installation, the present task committee on Water Protection and Animal Waste Disposal will be split into two committees so that a separate group can handle each topic, and successors for A. E. Parker and A. K. Saunders will be needed in less than 2 years), and *(e)* Dr. L. Wayne Brown as a representative of the Wisconsin affiliate that will host the 59th annual meeting (meeting will be August 20-24, 1972 in Milwaukee at the Pfister Hotel; Robert Anderson of the Milwaukee Health Department will serve as general chairman; the meeting will be co-hosted by the Wisconsin Dairy Plant Fieldmen's Association and will be held in conjunction with the annual meeting of the National Dairy Plant Fieldmen's Association and the Summer Meeting of the National Mastitis Council).

H. L. Thomasson presented his report and indicated that the Association was financially sound. He also mentioned that increased costs would necessitate some changes in the funding of Association operations. President Whitehead appointed a committee composed of Milton Held, Walter Wilson, and H. L. Thomasson to evaluate the financial status of the Association. The committee reported back to the Board and recommended that dues of members (af-

Hospitality at one of several receptions at the 58th Annual Meeting of IAMFES.



The new Executive Board of IAMFES. Left to right: Milton E. Held, Senior Past-President; Professor Richard P. March, Secretary-Treasurer; Parnell J. Skulborstad, Second Vice-President; Orlowe M. Osten, President; Dick B. Whitehead, Junior Past-President; Professor Earl O. Wright, First Vice-President; and Walter F. Wilson, President-Elect.

filiate and direct) be raised by $4.00 per year, effective January 1, 1972. The increase in dues was necessitated by: *(a)* the need to make two more payments on the Executive Secretary's retirement program, *(b)* a 20% increase in charges by the printer, *(c)* a 20% increase in postal charges with further increases to come, and *(d)* the need to build a reserve so that a replacement for H. L. Thomasson can be hired when he retires in a few years. The Board accepted the recommendation of the Committee and secretaries of affiliates are to be notified of the change in membership dues. Other increases in charges will also be made but they did not require Board action. Included are: *(a)* a 20% increase in the subscription rates, *(b)* a 20% increase in the selling price of reprints, and *(c)* a 20% increase in advertising rates.

The Board was informed that S. O. Noles, Senior Past-President, could not be at the meeting. Milton Held was designated to handle presentation of awards at the banquet. President Whitehead also announced that C. A. Abele had resigned from the 3-A Symbol Council and that Professor E. O. Wright would succeed Abele as the IAMFES representative to the Council.

In other action the board: *(a)* requested that H. L. Thomasson prepare material on the responsibilities of board members so that this information can be given to each officer when he begins his term of office, *(b)* requested H. L. Thomasson to prepare a list of all Association committees and designate when committee appointments are to be made, *(c)* indicated that the newly elected Second Vice-President and the Chairman of the Affiliate Council should be invited to attend Board meetings, *(d)* designated Walter Wilson, Milton Held, and H. L. Thomasson as a committee to consider a replacement for Thomasson when he retires, *(e)* tentatively accepted the invitation of the Oregon affiliate to hold the 1974 meet-

Milk and yogurt break during one of the afternoon technical sessions.

Top, left, J. W. Fielder, Director of the California Department of Agriculture welcomes members and guests to the 58th Annual Meeting of IAMFES. Top, right, Ben Luce reports on Affiliate Council activities at the annual business meeting. Bottom, left, O. M. Osten, new President of IAMFES, presides at one of the technical sessions. Bottom right, P. J. Dolan, Regional Administrator of the California Department of Agriculture, presides at another technical session, Dr. J. L. Barnhardt is in the background.

ing in Portland (the 1972 meeting will be in Milwaukee and the 1973 meeting in the State of New York), and *(f)* held over for acceptance at a later date invitations from Rhode Island and Florida as hosts of the annual meeting.

AFFILIATE COUNCIL MEETING

The Affiliate Council had one of the longest and most productive meetings it has had in recent years. Ben Luce chaired the meeting on Monday evening, August 16, and Karl Jones served as secretary. By motion, the Council recommended the following to the Executive Board: *(a)* the summary of 15 annual reports prepared by the Dairy Farm Methods Committee should be published and *(b)* that a period of silence be observed at the annual business meeting to commemorate deceased members of IAMFES and that names of deceased members should not be read.

Dr. R. M. Parry reviewed the questionnaire which his committee prepared and which is to serve as the basis for annually granting the Shogren Award to an affiliate with an outstanding program. The questionnaire was accepted by the Council and it was recommended that the Shogren Award be administered by the IAMFES Committee on Recognition and Awards.

Luce encouraged affiliates to: *(a)* provide suggestions for speakers at the annual meeting (suggestions must be in by the end of November), and *(b)* nominate candidates for the Sanitarian's Award.

Reports to the Council include those of *(a)* Dr. E. H. Marth, Editor of the *Journal of Milk and Food Technology*, who encouraged affiliate representatives to make information on student subscriptions available to appropriate colleges and universities in their areas, and *(b)* Milton Held who detailed the needs for an increase in membership dues (see earlier discussion of Executive Board Meetings for details about the new dues structure). The Council voted to support the Executive Board in the action that was taken in regard to membership dues. The Affiliate Council elected Ben Luce as Chairman and Dr. L. Wayne Brown as Secretary for 1971-1972.

TECHNICAL SESSIONS

The technical sessions at the 58th Annual Meeting were among the best of those held at recent meetings of the Association. A variety of timely topics were covered by many competent speakers. Six papers were presented at the general sessions and they dealt with: the National Center for Toxicological Research, the Environmental Protection Agency, freeze-drying of food, diet as a risk factor in heart

Some of the speakers at the Summer Meeting of the National Mastitis Council which was held in conjunction with the 58th Annual Meeting of IAMFES. Top, left, Dr. J. S. McDonald; top right, Dr. F. H. S. Newbould; bottom, left, Dr. D. E. Jasper; bottom, right, F. F. Smith.

Some of the reports at the annual business meeting were given by: Professor E. O. Wright (top, left), J. Fritz (top, right), H. L. Thomasson (bottom, left), and A. E. Parker (bottom, right).

disease, the solid waste disposal program (Mission 5000), and the National Food Protection Conference.

Eight papers presented in the Milk Sanitation Section were concerned with: automation in the dairy laboratory; the milk industry in Mexico; importance of quality in dairy products; the 1971 Interstate Milk Shippers Conference; the 13th edition of *Standard Methods for the Examination of Dairy Products;* recycling of dairy wastes; management of large dairy herds; and milking requirements for dairymen, cows, and markets.

Four papers were presented in the Food Industry Sanitation Section. These papers dealt with: new ways to handle fishery products; continuous pasteurization of eggs and egg products; quality control in the confectionery industry; and wine quality and sanitation control.

There were eight papers given in the Food and Environmental Sanitation Section. Topics covered by these papers include: handling of manure to control flies, dust, and odors; a biochemical recycling process of cattle wastes; ecological significance of treated wastewater discarded into coastal waters; phosphate-based cleaning compounds; consumer protection in Los Angeles County; mechanized cheese making processes; sanitation programs in the meat industry; and microwave ovens and their public health significance.

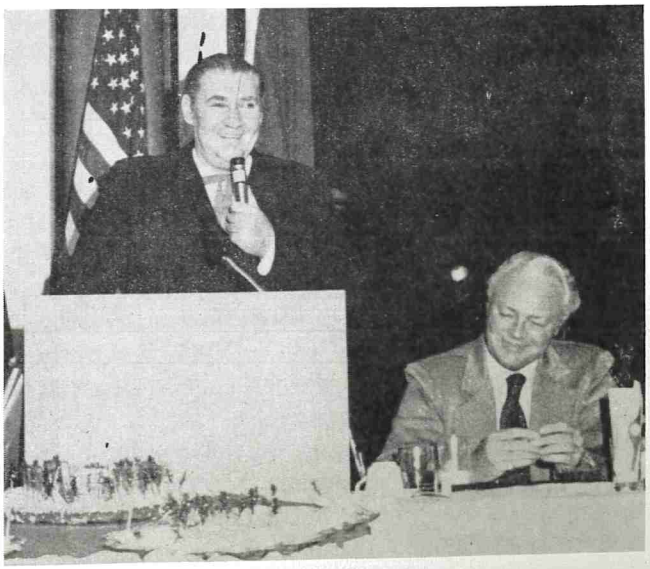
Abstracts of nearly all papers presented at the meeting appear elsewhere in this issue of the *Journal.* Most of the papers presented at the annual meeting will be published in subsequent issues of the *Journal.*

BUSINESS MEETING

The annual business meeting was called to order by President Dick B. Whitehead on Wednesday, August 18, 1971. The membership heard reports from *(a)* H. L. Thomasson on his activities as Executive Secretary and on the financial condition of the Association, *(b)* Dr. E. H. Marth on the status of the *Journal of Milk and Food Technology, (c)* Professor E. O. Wright on the 3-A Symbol Council, *(d)* J. H. Fritz on the Sanitarian's Joint Council, *(e)* A. E. Parker on the National Mastitis Council, and *(g)* Milton Held on Resolutions. Resolutions adopted at the meeting will appear in a later issue of the *Journal.*

Reports were presented by the following on behalf of their committees: A. E. Parker—Dairy Farm Methods, W. V. Hickey—Food Protection, H. Wainess—Baking Industry, Karl Jones—Food Equipment Sanitary Standards, and Dr. A. R. Brazis—Applied Laboratory Methods.

The membership voted to *(a)* accept the recommendation of the Executive Board that Parnell J. Skulborstad be appointed as Second Vice-President to fill the vacancy created by the resignation of Elmer Kihlstrum and *(b)* confer Honorary Life Membership on W. V. Hickey.



Pat Butram, star of the TV program *Green Acres* entertains at the Awards Banquet. Ted Shields, Master of Ceremonies at the banquet is on the right.

President Whitehead announced that Professor E. O. Wright was elected as Second Vice-President and that he was moved to First Vice-President when the vacancy was created by Kihlstrum's resignation. Whitehead also announced that Professor R. P. March was reelected as Secretary-Treasurer.

AWARDS BANQUET

The annual Awards Banquet was attended by more than 300 IAMFES members and guests. Ted Shields served as Master of Ceremonies and Pat Butram, star of the TV show *Green Acres*, provided the entertainment. In the absence of S. O. Noles, Milton Held presented awards to Dr. L. Wayne Brown, W. V. Hickey, and Shelby Johnson. Details about the awards and the recipients appear in an accompanying article. The menu at the banquet featured totuava steak.

The Committee on Recognition and Awards and the Executive Board selected Dr. L. Wayne Brown, William V. Hickey, and Shelby Johnson to receive the major awards which are given annually by IAMFES.

BROWN, HICKEY, AND JOHNSON RECEIVE AWARDS AT 58TH ANNUAL MEETING OF IAMFES

Dr. L. Wayne Brown, left, receives the Citation Award from Milton Held.

CITATION AWARD—DR. L. WAYNE BROWN

The IAMFES Citation Award is given annually to a member who has made substantial contributions to the growth, professional advancement, and status of the Association. The recipient, in 1971, was Dr. L. Wayne Brown.

Wayne is a native of Wisconsin; he was born in North Freedom and grew up in Milwaukee. Later he received the B.S., M.S., and Ph.D. degrees from the University of Wisconsin in Madison. During his academic career, Wayne pursued studies in Chemistry, Dairy Industry, and Bacteriology.

In 1934 Brown joined the Wisconsin Department of Agriculture as a bacteriologist. He continues to work for the same employer and now is Director of the Bureau of Microbiology.

Wayne is a long-time member of IAMFES; he joined in 1939. He was instrumental in organizing the Wisconsin Association of Milk and Food Sanitarians in 1943. In 1944 Brown was elected Secretary-Treasurer of the Wisconsin affiliate and continues in that position to the present time. Wayne initiated and continues to prepare the Wisconsin Association's Newsletter. He received the Wisconsin Sanitarian-of-the Year Award in 1968. As Secretary-Treasurer of the Wisconsin affiliate, Brown has been a representative to the IAMFES Affiliate Council for many years. On several occasions he has served the Council as its secretary and he was again elected to that position in 1971.

Wayne and his wife Marion were married in 1935. They have two children and five grandchildren. Over the years, Wayne has donated 9 gal of blood—a fact of which he is especially proud.

HONORARY LIFE MEMBERSHIP—WILLIAM V. HICKEY

The Honorary Life Membership Award is presented annually to one or several IAMFES members who have given long and faithful service to the Association. Honorary Life Members have all distinguished themselves by the very substantial contributions they have made to further the objectives of IAMFES. This year the award went to Mr. William V. Hickey.

Bill was born in Washington, D. C. He obtained his education at the University of Utah and later supplemented his training with additional work in Water Supply, Sanitation, Dairy Science, and Microbiology at the University of Utah and at Utah State University.

From 1936 to 1944 Hickey was employed as a Sanitarian by the Salt Lake City Board of Health and by the Utah State Department of Health. In 1944 he became Director of the Division of Foods and Sanitary Engineering, Salt Lake City Board of Health and continued in this position until 1957 when he joined the staff of the Plate, Cup, and Container Institute (now Single Service Institute). One of his duties

William V. Hickey, left, receives the Honorary Life Membership Award from Milton Held.

while with this organization was to edit *Health Officer's News Digest* (now *Environment News Digest*). Hickey retired from this position recently and now holds an appointment as Adjunct Professor of Environmental Science at Rutgers University, New Brunswick, New Jersey.

Bill served as President of IAMFES in 1960. He also called the first meeting on mastitis control in 1960 and this lead to formation of the National Mastitis Council. Additionally, Bill has contributed to IAMFES by serving on the Sanitarian's Joint Council, the Food Equipment Sanitary Standards Committee, and the Food Protection Committee.

Hickey also was and continues to be active in other professional societies. He is a Past-President of both the Utah and New Jersey Public Health Associations and presently serves as Secretary of the Section on Environment and as a member of the Governing Council of the American Public Health Association.

SANITARIAN'S AWARD—SHELBY JOHNSON

This award is presented annually to a member of IAMFES who, in the opinion of the Committee on Awards and Recognition, has made the greatest contribution to the field of public health during the preceding 7 years. The award consists of a plaque and $1,000. The Sanitarian's Award is sponsored jointly by the Diversey Corporation, Klenzade Products (Economics Laboratory), and the Pennwalt Corporation. Although these companies are sponsors, the award is administered by IAMFES. This year the Sanitarian's Award went to Mr. Shelby Johnson, Director of the Division of Environmental Services, Kentucky State Department of Health.

Shelby Johnson, left, receives the Sanitarians Award from Milton Held.

Shelby Johnson was born and raised in South, Kentucky. In 1950 he graduated from Western Kentucky State College with the B.S. degree in Agriculture. During 1950-1953 Johnson did graduate work in Agricultural Education at the University of Kentucky and in 1957 he received a Master's degree in Public Health Administration from the University of North Carolina.

After receiving the B.S. degree, Shelby taught Vocational Agriculture until 1954 when he joined the Kentucky Department of Health as a Food Inspector. Johnson served in this capacity until 1959 when he became Director of the Food and Drug Program of the Kentucky State Department of Health. After 8 years in this position, Shelby became Director of the Environmental Services Program in 1967. He was advanced to the position of Director of the Division of Environmental Services in March of 1971.

Johnson is a member of the Kentucky Association of Milk, Food, and Environmental Sanitarians (president, 1963-1964; received Outstanding Sanitarian Award, 1967), International Association of Milk, Food, and Environmental Sanitarians, Central States Association of Food and Drug Officials (president, 1959-1960 and 1965-1966), Kentucky Public Health Association, Southern Branch of American Public Health Association, Ohio Valley Conference of Food and Drug Officials, Association of Food and Drug Officials of the Southern States, National Environmental Health Association, and a Diplomat of the American Intersociety Academy of Sanitarians. Johnson also served on the Executive Board of the National Conference of Interstate Milk Shipments since 1965 and was Chairman of the Conference from 1967 to 1971.

Shelby has served on a number of committees in-

cluding the National Labeling Committee; Committee on Drugs, Devices, and Hazardous Substances (AFDOUS); Committee on Food Standards—Labeling and Advertising of Foods and Uniformity of Interpretation (AFDOUS); Milk Ordinance and Code Advisory Committee; and the Kentucky Registered Sanitarian's Examining Committee.

Mr. Johnson's accomplishments in the field of public health are legion and only a few can be cited here. Before 1963 milk for manufacturing purposes was not subject to regulatory control in the state of Kentucky. On the advise of Johnson, a Dairy Advisory Committee was appointed in 1962 to work with him so that a statewide regulation for producers and processors of manufacturing grade milk could be developed. The regulation was adopted late in 1963 and implementation began early in 1964. The Kentucky regulation has been used as a guideline by five adjoining states when they developed their regulations for manufacturing grade milk.

Carbonated beverage plants in Kenutcky, before 1967 were not subject to specific regulations and many of the labels used in this industry were at variance with codes prescribed in the Kentucky Food, Drug, and Cosmetic Act. Johnson held meetings with the Kentucky Bottler's Association and contacted the National Soft Drink Association, local health departments, and state regulatory officials to consider these problems. As a consequence of this effort, Johnson drafted a regulation for the soft drink industry which controls construction and operational standards for carbonated beverage bottling plants and which established standards of identity for these products. The regulation became effective early in 1967.

Johnson also recognized that Kentucky needed a uniform state-wide food service code and started working toward that goal in 1967. The code was developed with the aid of the Kentucky Restaurant Association, public health personnel, local health department representatives, and others and became effective July 1, 1969. Implementation of this code, without doubt, has resulted in an improvement in the quality and safety of prepared foods available to Kentucky consumers. Since Johnson has been with the Kentucky State Board of Health, he has developed 19 other regulations which have been adopted in the state. Johnson also has contributed to improving the facilities offered by many Kentucky trailer parks, to licensing of septic tank cleaners, and was instrumental in obtaining federal funds to study pesticide usage in Kentucky.

OTHER AWARDS

Several other awards are traditionally given at the Awards Banquet. Charles W. Felix, editor of *Environment News Digest*, awarded the President's gavel to incoming President Orlowe M. Osten. The Past-President's Award went to Milton E. Held and was presented to him by Dick B. Whitehead. A special award this year was given to Mr. Harold Y. Heiskell in recognition of his outstanding work as General Chairman of the 58th Annual Meeting of IAMFES. Milton Held made the presentation.

Milton E. Held, left, receives the Past-President's Award from Dick B. Whitehead.

Harold Y. Heiskell, left, general chairman of the 58th Annual Meeting of IAMFES receives a special award from Milton Held.

PRESIDENTIAL ADDRESS[1]

DICK B. WHITEHEAD

Division of Occupational Health
Mississippi State Board of Health
Jackson, Mississippi 39205

Dick B. Whitehead gives the presidential address.

It seems that I have been battling frustrations and obstacles for years in order to exercise this peculiar honor and privilege. So, on behalf of the officers and Executive Board of the International Association of Milk, Food and Environmental Sanitarians, Inc., I welcome you to this Fifty-Eighth Annual Meeting of our International Association.

The California Association and the California Fieldmen have been planning and working with our President-Elect, who is the Program Chairman, to make the Fifty-Eighth Annual Meeting a truly AAA production. I express our appreciation to our host in this effort, which, I am quite sure, will be a delightful menu of information both earthy and practical as well as technical for practical application. As a companion to this, you will savor the sauce of fun, relaxation, and just plain visiting with old friends and new.

The balance of my remarks will be in the form of potpourri and lagniappe—very little statistical—just enough for flavor.

A YEAR OF REFLECTION AND CHANGE

In the past several years we have seen created many conflicts and problems (some real, some imagined) and much reorganization both in government and industry. The Sanitarian has been caught in the ebb and flow of all this and to a certain extent has been subject to the whim of "the establishment."

This past year, in a sense, has been a time for us to "take stock," to reflect and evaluate our whole situation as an Association of Sanitarians. Our membership embraces the expertise of those in Industry; Regulatory, National, State and Local; and Educational Institutions. These categories involve Milk, Food, and Environmental programs and problems.

I like to think that our International member's prime interest *is in man* and the control of the total environment, in the best interest of man, and will not let environment become the "tail" that wags the dog. In many organizations, public and private, the latter has been true because of either political or economic favor or profit.

It is becoming increasingly apparent that government alone cannot control man or his environment—it is also apparent that not all of industry and agriculture is motivated to move on their own to initiate corrective measures or controls in man's best interest. Only one logical approach seems to remain—promulgation of strongly supported regulations developed and administered by Official Regulatory Agencies in consort with and in full cooperation with Industry. The Sanitarian must exercise leadership in this vital activity of public health.

Our Association must be balanced with young membership to be trained to assume leadership. The good old days are fine to talk about in a moment of reflection but should not be the plan for tomorrow. I am sure there is as much progressive leadership to be tapped as was ever afforded in the past and more adequate to cope with the challenge.

[1]Presented at the 58th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, San Diego, California, August 15-19, 1971.

THE REAL CHALLENGE

Industry is motivated by consumer demand and need, plus profit to the stockholder. The Sanitarian is motivated by the desire to provide for man a safe, adequate food supply, shelter, and a work and play environment that is adequate for his well being. It seems to me that bringing these two philosophies into working harmony is our real problem and challenge. If this is a true reflection and evaluation—International (IAMFES) with the expertise represented by its membership cannot hobble its scope of activity or pull the shade on its opportunities.

We boast of over 3,000 members, approximately 2,200 are represented in 25 affiliates leaving some 800 or so as direct members. There are some 70 countries represented in membership and/or *Journal* subscriptions. So you see, we are truly International in influence and service but we have not begun to exercise our opportunities for service. There are over 60,000 food manufacturers alone in the United States. Surely our 3,000 membership does not represent our proper obligation *or* the proper participation of this Industry in IAMFES. *With the increased coverage of this area of concern in the Journal, we should at least double our membership in this field if we wish to fulfill our obligation as an organization dedicated to preventive public health.*

One of the bright spots in initiation of a more reasonable solution to one part of man's needs for which the Sanitarian is officially responsible, was the National Food Protection Conference held in Denver, Colorado, April 4-8, 1971. A report on this conference is an important part of this meeting.

Our *liaison* with the Federal Government reorganization is being maintained in the interest of the Sanitarian and a philosophy of preventive program rather than an "after the fact" remedial posture of enforcement and prosecution for violation of regulation.

COMMITTEES AND REPRESENTATIVES

I call your attention to the Committee reports which reflect the activity, the problems, the possible solutions and accomplishments, and contributions made by the many dedicated Committee members. Our working Committees, without naming each, have been and are being structured to meet the needs of our time and the future. Many hours of effort and dedication go into the accomplishments by these Committees. I only wish there were some adequate way to recognize the dedication of the participants. Their impact on man's well being is one of the major justifications for this Association.

Both Industry and Government administrators should more fully recognize the Sanitarian's contribution to a more healthy and profitable environment for man.

It is important to note also that IAMFES is represented on the Intersociety Council on Standard Methods, the National Mastitis Council (which has just completed its meeting here), Potable Water Committee of State Sanitary Engineers, National Sanitation Foundation, and Sanitarians Joint Council.

Another point to be mentioned, the possibility of combining the two major organizations of Sanitarians into a new organization for mutual benefit is still open, should we receive any official overtures for further consideration.

MAN OR ENVIRONMENT?

This brings our thoughts to another point for reflection. Are we turning away from our main purpose—"the safe-guarding of man?" Are we more interested in the *environment* or *man?* Is our present emphasis on environment proportional to man's needs? It is true that for years now more and more natural resources have been converted to comforts and benefits without the proper regard to the effect on the future well being of the generations to come. We must learn to accomodate and plan if the comforts provided by industry are to be classed as progress. We must evaluate how far we have come and how far we can go with our present methods of control and fragmented approachs to many of our recognized problems. I do not think our total environment can be held in tolerable balance unless Industry and Regulatory become professionally compatible.

Our Sanitarians must become more conversant with the industries and the related environment they regulate. The business establishment must recognize its responsibility in its effect upon our total environment.

A part of industry is only giving lip service to the real needs. It takes money to make money and it takes money to repair polluted rivers, land, and air which in turn affects our foodstuffs. Industry should look on this as a budget requirement the same as maintenance and repair of machinery for producing goods to be sold at a profit. If this is so, industry needs trained Sanitarians and other public health professionals as part of their working staffs.

IS THE RESPONSE ADEQUATE?

What is being done to meet this challenge and need? Is the Sanitarian, by his expertise, convincing the profit oriented business man that the Sanitarian and the Public Health Professional in his

operation as well as in Government can provide answers and controls in a manner that will permit a reasonable profit. *For* if our control measures are not reasonable enough to afford a fair profit, business must reduce the level of sanitation or go out of business.

The Sanitarian and other Public Health Professionals must be better trained than at any time in history to meet the demands of our times. We cannot boast of our authority without proper training to fill the obligation. How can the required manpower be properly and adequately trained? We, as an Association, must develop a reasonably correct diagnosis and prognosis if we are to grow to meet our responsibility of the present and future. It is going to take individual determination, vision, dedication, and a great deal of salesmanship.

The people who come to our meetings cannot afford to spend the time or money to sit and listen and participate unless they take back to their area of responsibility some ideas and information that will in fact make this world a better, safer, and more healthy place to work and live.

The papers presented are timely and reflect the constant need to adjust our thinking, planning, and every-day work in our respective fields of interest, to rapidly changing national and international conditions.

Express your point of view in the discussions; exchange ideas. Your participation is your reason for being at our meeting and when the dialogue gets tense remember this "that life could be intolerable if you didn't have a sense of humor."

At home in my kitchen we have this, a plaque with the inscription: "This house is dirty enough to be happy and clean enough to be healthy."

I wish to express my appreciation to all of you who contributed to the success of IAMFES during this past year. It has been a distinct pleasure and honor to serve as your President.

ABSTRACTS OF PAPERS PRESENTED AT THE FIFTY-EIGHTH ANNUAL MEETING OF IAMFES

Abstracts of nearly all papers presented at the 58th Annual IAMFES Meeting were submitted in advance by authors and appear below. The complete texts of most of the papers will appear in subsequent issues of the *Journal of Milk and Food Technology.*

WINE QUALITY AND SANITATION CONTROL. *Maynard A. Amerine.* Department of Viticulture and Enology, University of California, Davis, California 95616.

The history of winery sanitation practices since Louis Pasteur is outlined, particularly contributions of H. W. Wiley and the Food and Drug Administration and Internal Revenue Service in this country. The present status of the legal controls on wine composition is outlined, particularly as it relates to maximum acetic acid, sulfur dioxide, sodium, lead, sorbic acid, etc. Prohibited practices and substances are given. Regulatory activities of the Food and Drug Administration and the actions of the California wine industry to conform to them are outlined.

FREEZE-DRIED FOODS AND OTHER PRODUCTS, THEIR POTENTIAL USE. *John L. Barnhart.* Department of Food Science, University of Idaho, Moscow, Idaho.

A review of research work carried out on freeze-drying of

Some of the speakers who presented papers in the technical sessions at the 58th annual meeting of IAMFES. Top, left, Dr. D. R. Lindsay; top, right, Dr. H. Lineweaver; second line, left, G. M. DeMedeiros; second line, right, Dr. J. L. Barnhardt; third line, Dr. E. H. Marth; third line, right, L. G. Carlson; bottom, left, Dr. M. R. Cordova; bottom, right, R. Fri.

food, food ingredients, and other products. A study of pore structure and acceptability of freeze-dried foods as flavoring materials. Disagrement concerning use of freeze-dried fruits and berries for flavoring frozen desserts stems from the fact that the variety of product, soil condition, fertilizer used, maturity, degree of ripeness at harvest, and treatment after harvest all have a major effect on flavor of freeze-dried fruits and berries. No research work has been completed to indicate the most desirable of the above named conditions for full flavor.

Freeze-dried colostrum milk for feeding new born lambs at multiple births has been proven very sucessful. Freeze-dried colostrum milk fortified with an *Lactobacillus acidophilus culture* has proven effective in feeding calves with "sterile" intestinal tracts. Freeze-dried acidophilus milk, flavored with freeze-dried meat has been formed into dogbones providing excellent treatment for feeding dogs after antibiotic treatment. Use of freeze-dried powdered meat mixed with potato flour in producing extruded french fries has produced a delicious French fry with "meat and potatoes" in the same French fry. The protein content of the product has been raised to a highly nutritional value.

A TOTAL BIOCHEMICAL RECYCLE PROCESS FOR CATTLE WASTES. *Lee G. Carlson.* Babson Bros. Co. Environmental Division, 461 W. Fullerton Ave., Elmhurst, Illinois.

The Babson Biochemical Recycle Process accepts cattle wastes, such as liquid manure, and recovers undigested solids, as washed and cleaned particulate matter, from a counter-current classification system. The solids are squeezed-dried and may be used as bedding or roughage. The remaining liquid, consisting of suspended and dissolved solids, is pumped to a series of vessels wherein biochemical and chemical reactions take place and a further separation of formed solid material is accomplished by flocculation from the liquid. The liquid is procesed to any degree of purity desired by ion-exchange and charcoal treatment, and also by ultra violet exposure if potable water is desired.

Floc material consisting of desirable substances can be stored and then used as a fertilizer at the operator's convenience. None of the three products has an odor. A pay-back of approximately $6000 per year on a 100-cow herd, and a 5 year amortization of equipment, has been the calculated return to be expected using this system of total recycle.

CURRENT CONCEPTS IN MECHANIZED CHEESE MANUFACTURING AS AFFECTS SANITATION PRACTICES. *Carl Christenson.* Cherry-Burrell Corporation, 7225 Bush Lake Road, Minneapolis, Minnesota 55435.

Cheese making through the years has involved much labor and hard work. In the last 10 years, our friends in New Zealand have developed a high degree of automation, reducing the labor necessary by 80%. We now have 35,000 lb. vertical cylindrical "make vats" with built in cutting knives and multiple agitation. These vats have thermistor controlled heating and bulit-in cleaned-in-place washing and sterilizing. We empty the make vats at 1000 lb./min, separating the whey from the curd by means of a pre-screen ahead of a 28 long curd draining conveyor. The curd is then blown into a 38 to 48 ft tall cheddaring tower where the curd is cheddared by its own mass weight. The curd is then milled and automatically salted on another 28 ft curd conveyor. Colby and washed curd cheese is similarly handled on a separate 28 ft conveyor (by-passing the cheddaring tower). The curd then goes to 2,000 lb. large hoops. Here the curd is pressed and vacuum treated. The curd is then cut into 40 lb blocks (or other desired sizes). All this equipment is cleaned-in place.

MILKING REQUIREMENTS FOR DAIRYMEN, COWS, AND MARKETS. *James W. Crowley.* Dairy Science Department, University of Wisconsin, Madison, Wisconsin 53706.

The routine job performed by the dairy farmer that most directly affects the total dairy industry is "milking." For the farmer it is a major use of labor, capital, and operating expense. Proper milking is essential for physiological requirements, for maintenance of sound healthy udders, and for comfort of cows. For the processing and marketing groups and the consumer, milking directly affects the quality, quantity, and value of the milk. Preventing contamination from organic matter, water, chemicals, odors, and flavors, as well as low bacterial and leucocyte levels require good milking. Milking also involves many basic academic areas such as Engineering, Veterinary Science, Bacteriology, Physiology, Dairy Management, Public Health, Food Science, and Economics. Facilities must provide comfort and efficiency for the operator, economical and convenient source of utilities, and be acceptable for waste disposal. All aspects cannot be ideal. Risk that comes from compromise in one area must be offset by benefits in another. Essential steps are not risks but the industry must agree on essential steps. The dairyman and those who provide his services must balance risk against benefit for the others.

QUALITY CONTROL IN CONFECTIONERY INDUSTRY. *Gerald S. Doolin.* National Confectioners Association, 36 South Wabash Avenue, Chicago, Illinois 60603.

Quality control in the confectionery industry is discussed with regard to factors affecting gained and non-gained confections. Trace materials found in ingredients may significally alter the texture at the temperatures used in candy manufacture. The legal responsibility of the candy manufacture to the consumer is emphasized. Special microbiological problems such as aflatoxin and *Salmonella* are discussed.

MICROWAVE OVENS AND THEIR PUBLIC HEALTH SIGNIFICANCE. *Robert L. Elder and Walter E. Gundaker.* DHEW, Public Health Service, Bureau of Radiological Health, Division of Electronic Products, 12720 Twinbrook Parkway, Rockville, Maryland 20852.

The number of microwave ovens sold in the United States is expected to increase greatly in the next 2 to 3 years. Recent field surveys have indicated that proper maintenance on the part of the owner or operator and improved servicing play an important role in controlling microwave oven leakage. The Department of Health, Education, and Welfare performance standard for microwave ovens, which will apply to ovens manufactured after October 6, 1971, cannot be truly effective unless the ovens are conscientiously maintained after purchases. The sanitarian has an extremely important role in promoting microwave oven safety, and State and local health workers are urged to take an active part in convincing owners to implement proper maintenance procedures and to practice good sanitation.

DESIGN FOR THE PROPER MANAGEMENT OF LARGE DAIRY HERDS. *W. C. Fairbank.* Department of Agricultural Engineering, University of California, Riverside 92502.

Few dairies have been adequately designed to meet changing times. Layouts of the 1960's seldom can be remodeled to meet today's needs efficiently. Society's expectations and environmental demands of the 1970's may tend to ineffectuate today's systems. Continuing expansion should be planned for. Most designers plan around a system that starts with cows, adds feed, and produces milk. Maybe they look in the

wrong direction for needed results. Manure is the most voluminous product of a dairy; milk the most profitable. What will be their disposition? How many production units (cows) will these outlets allow for? How will these units be operated and managed? What will be the form and availability of raw products? Of nonmaterial inputs? And of management?

Products of a large dairy should be the criteria of design for a constrained area. The cow management system that will produce these products can be described, a space allocation made, structures and facilities determined. Finally, the inputs to keep the system functional are considered. The Hi-Eff Dairy is an concept designed around these principles.

BETTER UTILIZATION OF FISHERY PRODUCTS THROUGH IMPROVED AND NEW HANDLING AND PROCESSING CONCEPTS. *Herman S. Groninger, Jr.* National Marine Fisheries Service, Fishery Products Technology Laboratory, 2725 Montlake East, Seattle, Washington 98102.

Some of the recent developments of our laboratory include: *(a)* CO_2 in refrigerated seawater (RSW) as a preservative; *(b)* separation of crabmeat from shell by centrifuge; and *(c)* separation of meat from skin and bones by machine separation.

The addition of CO_2 to the conventional RSW system, which is used aboard the vessel and at processing plants ashore, results in a system which has the advantage of inhibition of microbial growth, compared to the original system. The CO_2 in RSW system has been shown to be effective in maintaining the quality of salmon, rockfish, halibut, and shrimp, at higher levels, than the conventional RSW system or ice.

Through the use of a method invovling centrifugation, it has been demonstrated that as much as 15-20% of crab waste can be recovered as crabmeat. Separation of crabmeat from shell by a machine specifically designed for this purpose will be evaluated soon.

By machine separation, it has been shown that yields of edible flesh as great as 49 and 46% can be achieved for Pacific hake and silvergray rockfish, respectively. Of the many possible uses of machine-separated flesh, our laboratory has demonstrated that this type of raw material can be used to prepare such products as spreads and for the preparation of modified protein and protein isolates.

PROBLEMS IN ESTABLISHING THE ECOLOGICAL SIGNIFICANCE OF THE DISCHARGE OF TREATED WASTEWATERS INTO COASTAL WATERS. *George E. Hlavka.* Southern California Coastal Water Research Project, 1100 Glendon Avenue, Suite 1050, Los Angeles, Calif. 90024.

The Southern California Coastal Water Research Project is attempting to attain a substantial understanding of the ecology of the coastal waters of Southern California. Results are expected to provide insight into the past, present, and predicted effects of man on the ecology, particularly those caused by wastewater discharges. Findings should be useful in efforts to limit harmful effects and to promote enhancement of the coastal environment. The major effort thus far has been an information search in 17 task areas of physical and chemical oceanography, marine biology, and environmental engineering. In addition, several new research projects have been started under SCCWRP direction.

Discussed are some of the technical problems associated with such an effort such as quantifying the natural fluctuations of physical, chemical, and biological parameters; establishing environmental criteria; and correlating observed effects with pollutant distributions. Organizational problems associated with a new interdisciplinary, goal-oriented research project are also discussed.

HEART DISEASE—DIET AS A RISK FACTOR. *H. David Hurt.* National Dairy Council, 111 North Canal Street, Chicago, Illinois 60606.

Data derived from extensive population surveys and animal experiments have provided indirect evidence associating elevated blood cholesterol levels with the increased incidences of atherosclerotic heart disease. As a result of this apparent relationship, recommendations have been made regarding the kind and amount of fatty acids and cholesterol which should be consumed for optimal health. Before massive changes are made in the eating habits of our population, the actual causal relationship between dietary fat and cholesterol to subsequent blood cholesterol levels and atherosclerotic heart disease should be determined. Although several risk factors have been characterized which will possibly aid in identification of those individuals most prone to development of atherosclerotic heart disease, the potential benefit from reducing a single risk factor in prevention of the disease has not yet been conclusively demonstrated. The relative importance of dairy products as contributors of dietary saturated fatty acids and cholesterol will be discussed in relationship to their association to heart disease.

REPORT ON THE NATIONAL CONFERENCE ON FOOD PROTECTION. *Keith H. Lewis.* Food and Drug Administration, Department of Health, Education, and Welfare, 200 C Street, S. W., Washington, D. C. 20204.

The American Public Health Association sponsored the Conference under a contract with the Food and Drug Administration. It was held April 4-8, 1971, at Denver, Colorado, and was attended by 400 invited conferees from the food industries, academic institutions, consumer organizations, and all echelons of government. The conference provided a forum for discussion of practical solutions to current and foreseeable microbiological problems of food protection in the U. S. Position papers and proposed action plans were developed in advance by 10 panels relating to contamination of raw products, processed foods, food service operations, consumer education, detection of disease outbreaks, coordination of governmental and industrial control activities, training and utilization of manpower, development of public support, evaluation of program effectiveness, and research. Panel reports were revised at simultaneous 1-1/2-day workshops attended by 30 to 60 invited participants representing all identifiable interests. Final workshop recommendations will be published in the Conference Proceedings, together with statements by eminent political, social, scientific, and industrial leaders who spoke at the meeting. An analysis of this document is being made by the Food and Drug Administration as a basis for planing its food sanitation programs for 1972 and 1973.

THE NATIONAL CENTER FOR TOXICOLOGICAL RESEARCH. *Dale R. Lindsay.* Food and Drug Administration, 5600 Fishers Lane—Parklawn Bldg., Rockville, Md. 20852.

On January 27, 1971, President Nixon announced establishment of a National Center for Toxicological Research (NCTR) at Pine Bluff, Arkansas. The Food and Drug Administration will administer this facility in a manner that is responsive to the needs of the FDA, EPA, and other government agencies, when their programs require research and development suitable to the Center. The Center is to be a national resource to be shared and utilized by appropriate government agencies, academic institutions, and industry. It will not duplicate the research capabilities of existing toxicological centers rather it will build upon this existing capability and technology and augment existing research programs by undertaking projects which are not possible at other re-

search centers. The author discusses the problems that have created the need for this Center and the approaches that will be used to try to determine the risk that man runs in his every day exposure to the many hazardous chemicals in his environment.

EGGS AND EGG PRODUCTS—CONTINUOUS PASTEURIZATION. *Hans Lineweaver.* Western Marketing and Nutrition Research Div., Agricultural Research Service, U.S.D.A., Western Regional Research Lab., Berkely, Ca. 94710.

Egg products are pasteurized to assure that salmonellae, if present, are destroyed. Eggs differ markedly from milk and thus require special considerations. These differences are largely responsible for the fact that egg product pasteurization has been a general practice for only about 5 years. The temperature required to provide equal pasteurization effectiveness in 3.5 min varies from about 130 F to 146 F for the four main types of egg products—egg white, whole egg, yolk, and yolk plus salt or sugar. Functional properties of eggs are so easily damaged by heat that products are pasteurized by holding the heated egg for several minutes at a moderate temperature rather than for a few seconds at a higher temperature. Viscosities of egg products range from about 5 centipoises at 120 F for egg white to 300 centipoises for salt yolk compared to water at 0.55 centipoise. Holding time calculations therefore are made on the assumption that flow is laminar. Information on heat resistance of salmonellae, on heat stability of egg products, and on operational problems have been applied to develop reliable egg product pasteurization procedures now in use. Salmonellosis outbreaks caused by egg products have not occurred in the last 2 years.

AGRICULTURAL SANITATION OF LIVESTOCK MANURE FOR FLIES, DUSTS AND ODORS. *Edmond C. Loomis.* Department of Entomology, University of California, Davis, Ca. 95616.

Industrialized agriculture and urban-rural growth are mainly responsible for the FOD (Flies, Odors, Dusts) nuisance problems associated with livestock industries in many states. Manure from animal confinement-type operations is a major source of these nuisances. Drylot dairies, beef feedlots, and raised wire cage poultry ranches are the main industries which effect the co-existence of agricultral and suburban living. An Agricultural Sanitation Program by the University of California consists of these principle activities: research, demonstrations, and education. Physical, mechanical, biological, and chemical methods are combined into an integrated control program with major emphasis on manure management including collection disposal and use. Cooperative research programs also are made with interdisciplinary personnel representing Federal, State, and local agencies in line with unison of State and local codes and ordinances governing control of FOD problems.

REPORT ON THE THIRTEENTH EDITION OF STANDARD METHODS FOR THE EXAMINATION OF DAIRY PRODUCTS. *E. H. Marth.* Department of Food Science, University of Wisconsin, Madison, Wisconsin 53706.

An Inter-Society Council was appointed in 1968 to develop the 13th edition of *Standard Methods for the Examination of Dairy Products* (SMEDP). Council members represent professional societies, governmental agencies, industry, and academic instiutions and include: W. J. Hausler, Jr., Chairman, E. H. Marth, W. S. Clark, Jr., V. H. Nielsen, W. G. Walter, J. C. Olson, Jr., J. N. Murphy, C. Okey, J. L. Dizikes, R. B. Read, Jr., and G. Kupchik. The council has: *(a)* defined problems associated with the 12th edition of SMEDP, *(b)* initiated research to answer questions about methods (results of two studies have appeared in the *Journal of Milk and Food Technology*), *(c)* appointed committees to prepare chapters and appendices for the 13th edition of SMEDP, and *(d)* reviewed material prepared by committees. All sections for the 13th edition are to be submitted to the printer by the end of September, 1971 and publication is planned for February, 1972.

Major features of the 13th edition include: *(a)* a detailed review of pathogens which have occurred in milk and milk products, *(b)* a separate chapter on sampling methods, *(c)* a separate chapter on culture media and reagents and on methods for their preparation, *(d)* a chapter on screening and confirmatory methods to detect abnormal milk, *(e)* expansion of the chapter on chemical methods, and *(f)* inclusion of new microbiological and chemical methods in the appendices.

MILK INDUSTRY IN MEXICO. *Mario Ramos-Cordova.* Associacion National De Productores De Leche Pura, A. C. Reforma #330--Ier. Piso. Mexico 6, D. F.

General information pertaining to the milk industry in Mexico and its economic importance in relation to national economy will be presented. In addition a study of milk commercialization and analysis of the principle existing problems for the increase of milk production will be offered, along with the solution believed to be most adequate.

Among the selected solutions the most favored the author found to be: control of the importation of dried skimmed milk, revision of the present milk code, attractive prices to producers, lowering cost of production, public promotion of milk and dairy products, for increased consumption, and reorganization of the dairy industry to incorporate the most advanced technology emphasizing lower production cost and increase returns for the dairymen.

CONSUMER PROTECTION IN LOS ANGELES COUNTY. *Dale D. Reeves.* Los Angeles County Health Department, 313 North Figueroa Street, Los Angeles, California 90012.

The Los Angeles County Health Department has instituted a program of Consumer Protection. The objective of the program is to make certain that foods of acceptable quality are being sold in the 8,000 retail food markets throughout the County, that no adulteration or misbranding of food occurs, and that any hazardous food merchandizing proceedings are eliminated.

Special Consumer Protection personnel were delegated to handle the initial investigation and resulting prosecution. Several tests have been utilized for determining quality and wholesomeness of the food products in the field. One of these has been the use of a field fat analyzing machine as a screening device for ground beef violations. Initial inspections were made to ascertain problems and violations of codes and to notify operators of new inspection techniques. Where followup inspections revealed lack of compliance, Administrative hearings and other legal actions were instituted. These actions have now resulted in 60 successful court prosecutions. Results accomplished during the first year have been dramatic; this is recognized by the improvement in the quality and wholesomeness of the foods now offered for sale in Los Angeles County.

AUTOMATION IN THE DAIRY LABORATORY. *G. H. Richardson.* Department of Food Science and Industries, Utah State University, Logan, Utah. 84321.

Development of centralized milk testing laboratories that

utilize sophisticated, modern instrumentation appears to be a reality in the near future. This presentation will deal mainly with recent developments in instrumentation designed to quantitate milk payment and quality parameters. The Infra-Red Milk Analyzer, the Milko-Tester, the Darison, Fiske Instrumentation, and the AutoAnalyzer II will be reviewed. In addition, developments for automated microbiological and mastitis tests will be included.

DAIRY WASTE MANAGEMENT. *Charles L. Senn,* University of California, Los Angeles, School of Public Health Center for Health Sciences, 405 Hiigard, Los Angeles, California 90024.

An Environmental Protection Agency funded dairy waste management project has been carried out in Southern California. The program is conducted in close collaboration with the State and local health departments, farm advisors and dairy industry. A simple aeration process produces compost at low cost. The product is "pasteurized," weed-seed free and an attractive soil amendment. A re-cycling system gives promise of housing 200 cows per acre without producing surface or ground water pollution, or odor and fly nuisances.

MISSION 5000. *Thomas J. Sorg.* Environmental Protection Agency, Office of Solid Waste Management Programs, 5555 Ridge Avenue, Cincinnati, Ohio 45213.

Results of a national survey of over 17,000 land disposal sites are presented. Open dumps predominate, 94% and contribute to our environmental problems of air, water, and visual pollution. Only 6% of the land disposal sites met the very minimum requirements for a sanitary landfill. MISSION 5000, a national program to eliminate 5000 open dumps during a 2-year period, is described in detail. The Environmental Protection Agency's activities of program direction, training, and technical asistance are discussed. The activities and support of State government, civic, trade and professional organizations, and the public are also outlined. Solid waste management solutions and alternatives to open dumps are offered with the basic operational differences between open dumps and sanitary landfills highlighted. The paper concludes with a first year progress report on MISSION 5000.

1971 INTERSTATE MILK SHIPPERS CONFERENCE AND ITS FUTURE ROLE. *Earl O. Wright.* Department of Food Technology, Iowa State University, Ames, Iowa 50010.

The Thirteenth National Conference on Interstate Milk Shipments (NCIMS) was held at the Chase-Park Plaza Hotel, St. Louis, Missouri on May 16-20, 1971, with 348 in attendance. The first day of the conference was devoted to presentations concerning the future of NCIMS. D. Paul Alagia, Jr., Louisville, Ky., gave the keynote address, stressing the importance of NCIMS and pointing out changes that need to be made to keep abreast with marketing. Robert North, MIF, IAICM, and Patrick Healy, NMPA, discussed the need for the conference, changes that need to be made in organization, the recognition that should be given to industry, and that special emphasis be placed on carrying out the rules. Dr. Virgil Wodicka outlined the role of the FDA. There were eight committee reports given. Two of these reports dealt with immediate changes for the conferences; namely the Structure and Organization of the Conference and Reciprocity. Forty-six problems were divided among 9 task forces for their deliberation. Results of these task force action were voted on by the official delegates at the final session.

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Effective with volume 35 (begins with January, 1972 issue), the *Journal of Milk and Food Technology* will be available to full-time undergraduate and graduate students at a special rate of $4.00 per year.

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KENDALL INTRODUCES A NEW AND IMPROVED SOCK FILTER

A new and improved sock filter for dairymen with moderate to high pressure pipeline systems has been introduced by The Kendall Company. The manufacturer claims that this new milk filter called Kendall Super Sock is stronger, softer and easier to handle and insert than those previously available. And it is being offered at a significantly lower price.

Kendall also manufactures a premium sock filter for extremely high pressure systems, Kendall High-Pressure Sock Filter, and a low priced sock filter for extremely low pressure systems now known as Kendall Low-Pressure Sock Filter. This entire group of in-line filters has been completely repackaged and now visually ties in with the company's growing number of animal health products.

For more information and samples of Kendall milk filters, contact The Kendall Company, Fiber Products Division, Walpole, Massachusetts 02081.

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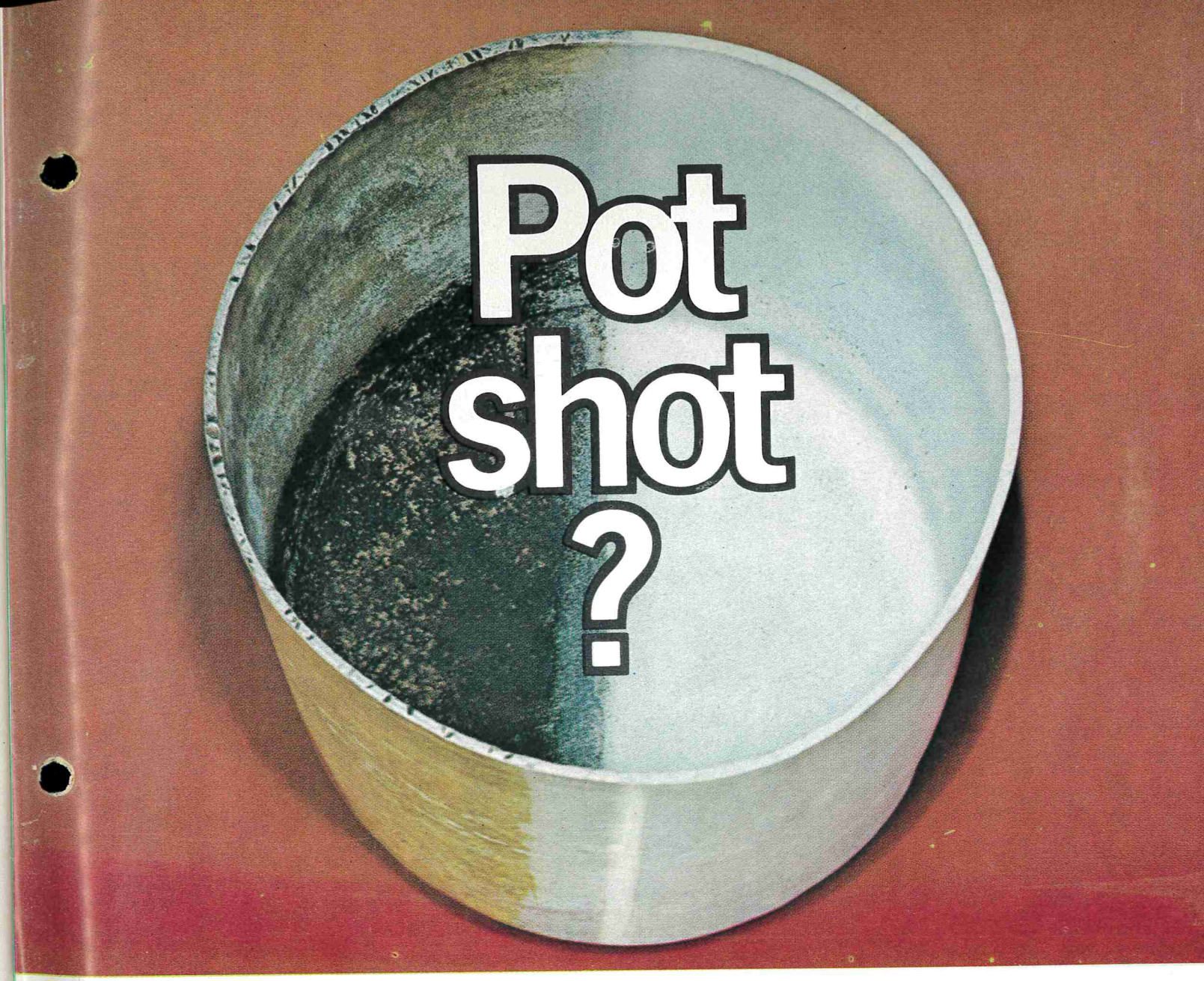

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Welded pipelines by the experts... one more reason to buy Surge

Kermit Thompson of Deer Park, Wisconsin (pictured above), wanted more than just a pipeline when he decided to get rid of the buckets. He wanted welded lines which would remain leakproof and maintenance-free for years to come. Kermit put in a 2-inch pipeline and milks his 40-head herd with Surge Mini-Cups.

John Larson of Plum City, Wisconsin figures he'll be milking for twenty years or more, so when he was planning his change, he wanted it right. He put in a welded pipeline in his 37-stall stanchion barn. "Surge gives good service; I felt that was important. They are the only ones that offer welded lines in this area."

Most health department officials are enthusiastic about welded pipelines and their contribution to clean milk. One midwest spokesman said, "We highly recommend the properly installed welded pipeline."

California health authorities have had several years of experience with welded pipelines. They state: "Welded lines are practical and functional; a real asset to modern dairying."

If you are considering a new pipeline, consider the permanence, easy cleaning and economy of a Surge welded line. See your local Surge dealer for further details.

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