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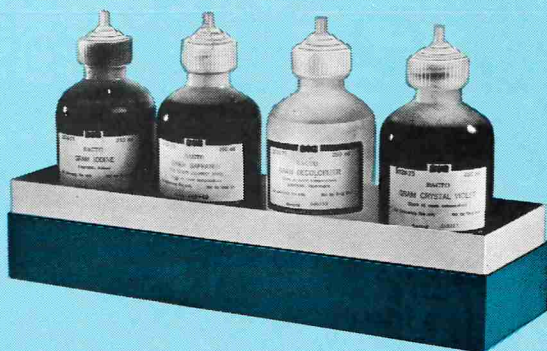
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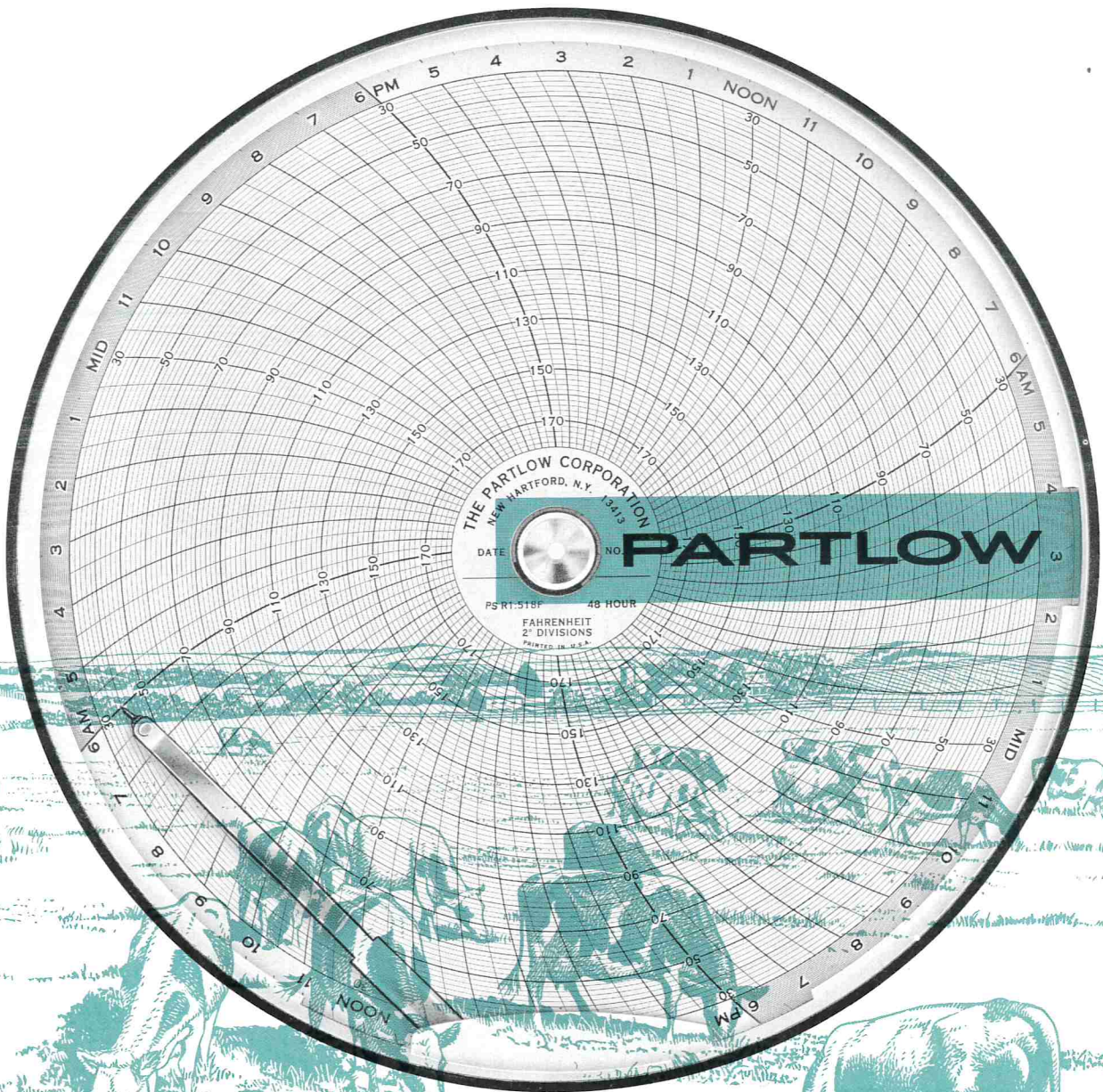
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Incidence and Levels of *Bacillus cereus* in Processed Spices

EDMUND M. POWERS, THOMAS G. LATT, and TERRANCE BROWN

Food Sciences Laboratory
U.S. Army Natick Research and Development Command
Natick, Massachusetts 01760

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ABSTRACT

Spices purchased by the Army, Navy, Marines, and Air Force were tested for incidence and levels of *Bacillus cereus*. One hundred and ten processed spices, including bay leaves, red pepper, chili powder, cinnamon, garlic powder, mustard powder, and oregano were tested. *Bacillus cereus* was found in 53% of the spices and counts ranged from 50 to 8500 per gram. Eighty-nine percent (88/99) of the isolates tested were toxigenic in rabbits, by the vascular permeability assay, and toxigenic *B. cereus* was found in each kind of spice. These data have significant implications for food safety and sanitation and for fumigation of spices by gas, or irradiation.

During a recent investigation of the microbiology of processed spices (10) appearance of *Bacillus cereus* type colonies was noted on aerobic plate count plates and this observation prompted further investigation. In addition to determining the microbiological safety of spices purchased by the military, examination of spices for *B. cereus* has important implications for writing military specifications and for the possible application of irradiation technology for radacidation (reduction of specific pathogens), or radappertization (destruction of all organisms) of spices.

Bacillus cereus has been recognized as the etiological agent in food poisoning outbreaks in Europe as far back as 1906 (4). In Hungary, it was ranked as the third most common cause of food poisoning during the period 1960-1966 (4). In the following 2 years it was responsible for 15.2% of all cases of food poisoning of known etiology (4). It is interesting to note that the high incidence of *B. cereus* food poisoning in meat was attributed to the Hungarian custom of highly seasoning meat dishes with spices which often contain large numbers of aerobic sporeformers. Numerous reports of *B. cereus* foodborne illness in Europe have been cited by Goepfert et al. (4).

In the United Kingdom, 12 reports were made of *B. cereus* food poisoning in Chinese restaurants between 1971 and 1973. Fried or boiled rice were implicated in all of the outbreaks (13).

Only 7 outbreaks of *B. cereus* foodborne illness were reported in the United States between 1968 and 1973 (13). The most recent outbreak occurred in 1975 in a family of four which purchased a meal at a fast food restaurant. Mashed potatoes from the suspect meal contained 1.8×10^7 *B. cereus* per gram with no other bacterial pathogens isolated (14).

Although a selective medium (MYP) for identification of *B. cereus* was developed by Mossel et al. in 1967 (9) and another (KG Agar) by Kim and Goepfert in 1971 (7), there have been very few reports of *B. cereus* foodborne illness in the United States and very few foods have been surveyed to determine the incidence and levels of this organism in our food supply. One study by Kim and Goepfert in 1970 found *B. cereus* in 25.3% of 170 selected dried products (8).

This investigation was undertaken to determine the safety of spices procured by the military and to ascertain the incidence and levels of *B. cereus* in spices for the purpose of writing microbiological specifications.

MATERIALS AND METHODS

Number and source of samples

One hundred and ten samples of the same spices studied earlier (10) were examined. The spices were received from 16 military bases, including the Army, Navy, Marines, and Air Force, located in different geographical areas of the United States. Spices were purchased from local supermarkets by each base and represented 10 different processors. Spices were stored in their containers at 23 C for approximately 1 year.

Preparation of samples

Samples were prepared as reported earlier (10).

Inhibition of bacterial growth by spices

It was previously determined that the spices were not inhibitory to bacterial growth at the concentration tested (10).

Media

KG agar (an egg yolk-polymyxin medium) was prepared according to Kim and Goepfert (7). Each batch of medium was tested with *B. cereus* strain B6AC (University of Wisconsin; originally from D. A. A. Mossel, the Netherlands) to determine typical growth characteristics of the organism.

B. cereus count

One-tenth milliliter of dilutions ranging from 10^{-1} to 10^{-5} was spread on the surface of duplicate plates of KG agar. Plates were incubated at 32 C for 24 h. Only typical colonies (rough, flat, dry, round or irregularly shaped, ground glass appearing, translucent to creamy white with a pink-red background) surrounded by a zone of turbidity (7, 9) were counted. Five representative colonies were examined microscopically for large celled, Group I bacilli (5, 11, 12), centrally located spore within the sporangium, and absence of parasporal inclusion bodies. Motility was determined in cystine trypticase agar incubated at 32 C for 24 h.

Demonstration of enterotoxigenicity

Ninety-nine typical isolates of *B. cereus* were cultured in the following manner: 0.4 ml of a 24-h old trypticase soy broth culture was

transferred to 125-ml shake flasks containing 40 ml of HY case (S. F. Sheffield, 2%), yeast extract (2%), Na₂HPO₄ (0.3%), Dextrose (0.4%), and 1 ml per liter of trace minerals (5.0% MgSO₄, 0.5% MnSO₄ and 0.5% Fe citrate). The medium was adjusted to pH 8.0. Cultures were shaken at 200 rpm, in a 1/2-inch circular orbit, in a constant temperature water bath at 37 C and incubated for approximately 6 h. The pH was maintained above 7.0 at all times by adding 0.5 N NaOH. Cultures were then centrifuged at 7,900 × g for 20 min. The supernatant fluid was recovered and stored at 4 C overnight.

The enterotoxigenicity of each isolate was assessed by testing supernatant fluid from each culture for activity in the vascular permeability assay of Glatz et al. (3). Female New Zealand white rabbits, weighing 2.0-2.5 kg, were used. Two determinations on each of three rabbits were averaged for each test sample. A *B. cereus* isolate was considered an enterotoxin producer when the zone of activity averaged greater than 15 mm². Sterile medium, which was used as a negative control, produced a reaction area which averaged 1 mm², or less.

RESULTS

Bay leaves

Eleven samples of bay leaves were analyzed. *B. cereus* was found in seven samples and counts ranged from 50 to 275/g (Table 1). Three samples had counts between 100 and 275/g. Eighty-two percent (9/11) of the isolates tested were toxigenic.

Cayenne pepper

Eighteen samples of ground cayenne pepper were analyzed. *B. cereus* was found in 12 samples and counts ranged from 50 to 3500/g (Table 1). Eleven samples had counts greater than 100/g and four samples had counts greater than 1000/g. Ninety six percent (24/25) of the isolates tested were toxigenic.

Chili powder

Sixteen samples of chili powder were analyzed. *B. cereus* was found in only four samples and the counts ranged from 50 to 500/g (Table 1). Three samples had counts between 100 and 500/g. All isolates tested (4/4) were toxigenic.

Cinnamon

Sixteen samples of ground cinnamon were analyzed. *B. cereus* counts ranged from 50 to 8500/g and was found in all samples except 1 (Table 1). Twelve samples had counts greater than 100/g and six samples had counts greater than 1000/g. Eighty three percent (24/29) of the isolates tested were toxigenic.

Garlic powder

Seventeen samples of garlic powder were analyzed. *B. cereus* was found in only five samples and counts ranged from 50 to 1000/g (Table 1). Three samples had counts greater than 500/g. One hundred percent (11/11) of the isolates tested were toxigenic.

Mustard powder

Fourteen samples of mustard powder were analyzed. *B. cereus* was found in only one sample and only one colony was isolated from the 1:10 dilution. The resulting count was 50/g (Table 1). The single isolate was toxigenic.

Oregano

Eighteen samples of oregano were analyzed. *B. cereus* was found in 14 samples and counts ranged from 50 to 3800/g (Table 1). Twelve samples had counts greater than 100/g and five had counts greater than 1000/g. Eighty three percent (15/18) of the isolates tested were toxigenic.

DISCUSSION

Bacillus cereus was found in 53% (58/110) of the spices analyzed and in each kind of spice. The incidence was higher than previously found in spices (40%) and more than double the incidence found in selected dry products (8). Counts ranged from 50 to 8500/g, but most of the spices (59%) had counts less than 100/g (Table 1). Only 15 samples (13.6%) had counts greater than 1000/g. No counts were obtained from 52 samples (47%) at the lowest dilution (1:10) and were reported as less than 100/g, since 0.1 ml of the 1:10 dilution (0.01 g of spice) was spread on each plate. Eighty nine percent (88/99) of the isolates tested produced enterotoxin (Table 1).

KG agar is considered a presumptive medium for *B. cereus* because it is not completely selective for the organism (7). However, it is a differential medium and colonies of *B. cereus* are easily distinguished from other contaminants. The difficulty one has with the medium is discerning the "turbid zone" (egg yolk reaction) around a colony even on plates which are not crowded with other contaminating colonies. We found that the egg yolk reaction was most easily discerned by holding the plate up to the ceiling light. In a few instances when plates

TABLE 1. *B. cereus* in processed spices

Spices	No. of samples	Range of counts/g	Percent isolates toxigenic	Number of samples containing (per gram)						
				50	<100 ^a	100-500	501-1000	1001-5000	5001 to 10,000	>10,000
Bay leaves	11	50 to 275	82 (9/11) ^b	4	4	3	0	0	0	0
Cayenne (Red) pepper	18	50 to 3500	96 (24/25)	1	6	4	3	4	0	0
Chili powder	16	50 to 500	100 (4/4)	1	12	3	0	0	0	0
Cinnamon	16	50 to 8500	83 (24/29)	3	1	5	1	4	2	0
Garlic powder	17	50 to 1000	100 (11/11)	1	12	1	3	0	0	0
Mustard powder	14	<100	100 (1/1)	1	13	0	0	0	0	0
Oregano	18	50 to 3800	83 (15/18)	2	4	4	3	5	0	0
Total	110	50-8500	89 (88/99)	13	52	20	10	13	2	0

^aNo counts per gram at 1:100 dilution.

^bNumber positive over total number of isolates.

were overly crowded with other bacterial colonies, suspected *B. cereus* colonies had to be transferred to fresh KG agar plates for confirmation and isolation.

Only colonies which exhibited typical morphology (7, 9) and were also positive for the egg yolk turbidity factor were counted as *B. cereus*. It was observed that typical colonies were always positive for the egg yolk turbidity factor.

Because aberrant and deviant strains of *B. cereus* are common, no attempt was made to characterize isolates by the usual biochemical tests (nitrate reduction, hydrolysis of starch and gelatin, acetylmethylcarbinol production, and anaerobic utilization of glucose.) The usefulness of these tests is questionable because, in addition to being time consuming they were often found to be erratic (7). Consequently, in the interest of saving time and effort, confirmation was simplified by examining five colonies from each plate microscopically, for large celled, Group I bacilli (5, 11, 12). Motility in cystine trypticase agar was also observed. Absence of parasporal inclusion bodies within the sporangium excluded *Bacillus thuringiensis* and absence of rhizoidal growth on KG agar excluded *Bacillus mycoides*. Egg yolk reaction excluded *Bacillus megaterium*. All isolates were motile which excluded *Bacillus anthracis* and *B. mycoides*.

With the exclusion of these closely related organisms the demonstration of enterotoxigenicity in rabbits served as additional confirmation of *B. cereus*, since only *B. cereus*, *B. thuringiensis*, and *B. mycoides*, of the bacilli tested by Glatz et al., produced vascular permeability factor activity (2, 3). However, these studies (2, 3) as well as this report, also indicate that 10 to 12% of the *B. cereus* strains tested may not elicit toxigenic activity. Of the 11% isolates which were not toxigenic by our criteria, only three failed to give any response. The remaining isolates gave measurable zones of activity, but they were less than 6 mm² and were considered negative.

These findings and our earlier report (10) point out that spices may be a source of contamination in the kitchen, and may introduce significant numbers of bacilli into food. Under certain circumstances *B. cereus* could multiply sufficiently to cause food poisoning. For example, foods which are highly seasoned such as Hungarian meat dishes (4), and particularly foods seasoned after cooking, such as Pommes de terre duchesse (6), may, if held at room temperature for several

hours, harbor sufficient *B. cereus* to cause illness.

It is important, therefore, that food service personnel be aware of the source of *B. cereus* and other pathogens, so that they can avoid some of the major causes of food poisoning outbreaks; i.e., improper refrigeration of foods, inadequate cooking of foods, allowing foods to remain at warm (bacterial incubation) temperatures, incorporating raw (contaminated) ingredients into foods that receive no further cooking, and cross contamination of cooked foods with contaminated raw foods (1).

While a potential health problem may be associated with these spices because of the presence of *Clostridium perfringens* (10) as well as *B. cereus*, foods which are seasoned would have to be mishandled and abused before a health hazard could actually exist.

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Postmilking Teat Dipping in a Herd of Low Infection Incidence

W. D. SCHULTZE¹, H. H. DOWLEN², E. D. MOORE², S. C. ARAPIS¹, and J. R. OWEN²

United States Department of Agriculture, ARS, Animal Physiology and Genetics Institute, Beltsville, Maryland 20705 and Dairy Experiment Station, University of Tennessee and U.S. Department of Agriculture, Lewisburg, Tennessee 37091

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ABSTRACT

A commercial teat dipping preparation formulated to have good detergency and emollience but no germicidal activity and a commercial iodophor teat dip of 1% available iodine were tested sequentially for efficacy in preventing new intramammary infection. Teats on one side of the udder of 150 Jersey cows were dipped in the test material after each milking; the opposite teats were undipped controls. Duration of the trials was 12 months for the detergent-emollient dip and 8 months for the iodophor dip. Intramammary infection was determined by bacteriological evaluation of monthly quarter foremilk samples. Neither dip was associated with reduction in new infection rate. Possibly because of its low level of total infection and of *Staphylococcus aureus* and its lack of *Streptococcus agalactiae*, this herd was unable to demonstrate prophylaxis against intramammary infection by postmilking teat dipping and was unsuitable for testing efficacy of the tested products.

Postmilking dipping of cows' teats in an effective germicide is commonly accepted as an important element in prevention of new intramammary infection during lactation (9, 13). Because of the difficulty of assessing prophylaxis in the field, the Teat Dip Committee of the National Mastitis Council has concluded that dairymen should be provided evidence of teat dip efficacy determined in half-udder studies of incidence of new infection under carefully controlled conditions (17). In a previous publication from this laboratory (18) the failure of a commercial teat dip to show evidence of efficacy was documented. We now report results of subsequent testing of two other commercial teat dip formulations in the same dairy herd.

MATERIALS AND METHODS

The detergent-emollient dip consisted of coconut oil/isopropanol and potassium hydroxide (green soaps); glycerine; processed cocoa

butter; isopropanol, sodium tetraborate, alkyl aryl sulfonate; ethylenediamine tetraacetate; and essential oils.^{3,4} Its formulation was dictated by the manufacturer's hypothesis that a teat dip need not contain a germicide and that colonization of the teat orifice by potentially pathogenic bacteria can be prevented by use of a product of high detergency and emollience (1). The concentrated product was mixed with 5 parts of hot water and used at 110-120 F. Pursuant to the manufacturer's instructions, the dip was used in conjunction with a premilking udder wash⁵ of similar composition but diluted 1:450 (vol/vol) with warm water. Udder washing was done with a common sponge. It was then wrung out and used to absorb excess liquid from the udder and teats.

The dip was tested in the dairy herd of the Dairy Experiment Station (DES), University of Tennessee and the U.S. Department of Agriculture, Lewisburg. The herd of Jersey cows was maintained under good and closely controlled management. Cows were housed in a free stall barn, with sawdust bedding replenished as needed (at least once a month in winter), and had access to a dirt lot in spring and summer. Milking was done in two milking parlors, in each of which one man operated two DeLaval 100⁴ machines and weigh jars. Vacuum pump capacity (48 CFM for four machines) was adequate for the installation. Teat cups were rinsed with cool tap water after removal from each cow.

During the 12-month trial of the detergent-emollient dip, the right-front (RF) and right-rear (RR) teats of the approximately 150 lactating cows were dipped in the test material, and the left-front (LF) and left-rear (LR) teats were not dipped. After this study, a similar 8-month trial was conducted using a commercial iodophor teat dip⁶ at 1% available iodine on the right udder halves. A commercial iodine udder wash was used before milking. Sampling and culturing procedures have been published previously (18).

RESULTS

At the beginning of these trials, the DES herd had a very low level of quarter infection, 14.5%, distributed evenly among right and left udder quarters except for a preponderance of *Staphylococcus aureus* (9 of 13) and of *Staphylococcus epidermidis* (20 of 34) in right quarters. Figure 1 shows the stability of infection level and distribution for the left (undipped) quarters in the absence of special hygienic control measures during the period of these and the previously reported teat dip studies.

Results of bacteriological samplings were not communicated to the herd manager, and antibiotic therapy (both lactational and dry) was administered solely on clinical indications. Infections tended to long duration except for those of coliform etiology, which

¹Beltsville, Maryland

²Lewisburg, Tennessee

³Medi-Cow Teat Dip, Schuyler Development Corporation, Reading, PA.

⁴Mention of a trade name, proprietary product, or specific equipment does not constitute a guarantee or warranty by the U.S. Department of Agriculture and does not imply its approval to the exclusion of other products that may be suitable.

⁵Udder-Matic, Schuyler Development Corporation, Reading, PA.

⁶Bovadine, West Agro Chemical, Long Island, NY.

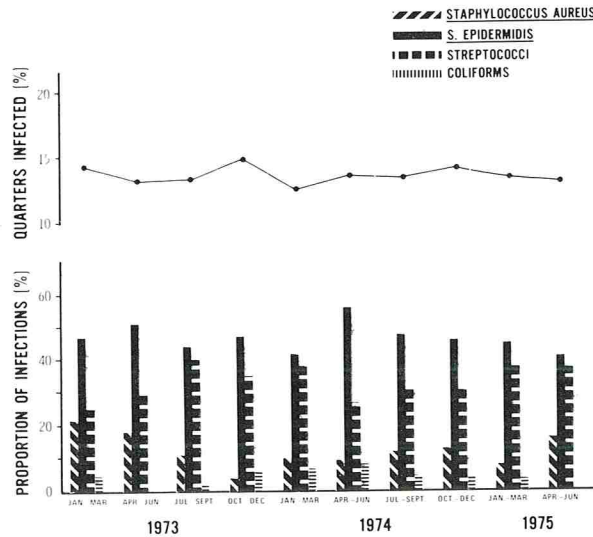


Figure 1. Extent of quarter infection and distribution of pathogens among undipped half udders.

almost always (32 of 38) required early treatment. *S. aureus* infections and, at lesser frequency, streptococcal infections often required lactational therapy but on occasion persisted through one or even two lactations

without clinical manifestation. Many infections barely met our criterion of recovery from successive monthly samples before they disappeared spontaneously. In the absence of a concurrent test for mammary inflammation, we assumed a large but indeterminate proportion of these to have been mere streak canal habitations. Even so, their presence denotes a passage of the teat orifice barrier. Among the large porportion of *S. epidermidis* infections that fell into this category, however, were 11% of the total that required therapy to alleviate clinical signs.

During the period of testing the detergent-emollient dip on right udder halves, there was no significant difference in new infection rates between treated and control quarters when analyzed by Chi-square Test (Table 1). However, using the more powerful "u" Test (7), certain means among dipped quarters computed as significantly greater than the analogous means among undipped quarters: overall new infection incidence ($P < .10$), new streptococcal infection ($P < .05$), and new clinical cases of undetermined etiology (P slightly $> .05$). We are not inclined to place much reliance on these computed distinctions. As regards the results of testing the iodophor teat dip (Table 2), there was no statistically significant difference in new intramammary infection

TABLE 1. Numbers of new intramammary infections¹ under natural conditions during use of a detergent-emollient teat dip on right udder halves only

Pathogen	Udder halves	New infections in successive months												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
(No.)														
<i>Staphylococcus aureus</i>	Left				3		2	1	3				1	10
	Right			1		2	2	1	1	1	1	1	1	11
<i>Staphylococcus epidermidis</i>	Left	5	3	2		1	3	4	2	1			3	24
	Right	1	3	4			2	1	1	1			1	14
Streptococci ²	Left	3		3	2	3		1	1			1	1	15
	Right	1	3	2	4	6	1	5		2	1	2	2	27
Coliforms	Left			3	3	1		2		2	1	1		13
	Right	1		1	2	2		1	3	1	2			13
Undetermined ³	Left	1	2	5	5	2		2		1	1	4	1	24
	Right	2	2	3		3	2	2	3	1	11	7		36

¹Quarters available to become infected averaged 258 in the undipped group and 250 in the dipped group.

²Chiefly *Streptococcus uberis*.

³This group comprised new infections detected by onset of clinical signs justifying antibiotic therapy. No pathogen was recovered from culture of pretreatment quarter milk sample.

TABLE 2. Numbers of new intramammary infections¹ under natural conditions during use of a commercial iodophor teat dip on right udder halves only

Pathogen	Udder Halves	New infections in successive months								Total	
		1	2	3	4	5	6	7	8		
(No.)											
<i>Staphylococcus aureus</i>	Left		1			1		6		3	6
	Right	1	1	2			3	1		2	10
<i>Staphylococcus epidermidis</i>	Left	4	5	3				2			14
	Right	8	4	1	1	1			1	2	18
Streptococci ²	Left	2	3	2	5						17
	Right	1	1	5	2		5		1	2	17
Coliforms	Left			1	1				1		3
	Right				1	2					3
<i>S. aureus</i> plus streptococcus	Left				1			1			2
	Right				1			1			2
Undetermined ³	Left		4	1	2	2	2		2	2	15
	Right		3	4	1	1		3	2	2	14

¹Quarters available to become infected averaged 268 in the undipped group and 269 in the dipped group.

²Chiefly *Streptococcus uberis*; one *S. agalactiae* infection in a left udder half.

³This group comprised new infections detected by onset of clinical signs justifying antibiotic therapy. No pathogen was recovered from culture of pretreatment foremilk sample.

rates, either overall or for any infection category, between treated and control quarters.

DISCUSSION

The first two teat dips studied in the series of trials conducted in the DES herd were selected because the novelty of their formulation aroused question of their practical value. After failing to demonstrate efficacy for the iodine-in-oil dip, as previously reported (18), and then for the detergent-emollient dip, we felt it necessary to examine the applicability of this herd as a test system. Bovadine and similar proprietary formulations of iodophor teat dip have proved efficacious in studies conducted in this laboratory (16) and in others (4, 5, 21). Thus, our failure to show a reduction in new intramammary infection in the DES herd when the iodophor dip was used does not, in our opinion, incriminate the product. Rather, it suggests that this herd is not suitable for testing teat dip efficacy. It follows that our results do not speak to the question of efficacy of the detergent-emollient dip. Furthermore, we must reconsider the results of the earlier trial involving an iodine-in-oil teat dip. Again, the lack of difference in new infection incidence between treated and control quarters when the iodine-in-oil teat dip was used at 1% iodine concentration cannot be assumed to reflect lack of efficacy under other test conditions. However, the finding that use of this product at the lower concentration, 0.5% available iodine, resulted in a statistically significant increase in *S. aureus* infection in contrast to that in control quarters is not called into question. Note that comparable conclusions as to lack of efficacy of this iodine-in-oil teat dip have been drawn from results of an independent study conducted in a herd in which efficacy of other teat dips has been shown (14).

The obviously unique attribute of the DES herd was the low level of quarter infections and the great preponderance among these of rather low-grade pathogens commonly found in the cow's environment. The consensus, supported by several publications (9, 12), is that *Streptococcus uberis* is not well controlled through teat dipping because teat apex colonization is not important in its transmission (10). Failure has rarely been absolute (5); usually control has been only partial (3, 12, 21).

Despite its minimal significance in mammary pathology, *S. epidermidis* is an active colonizer of the teat orifice (15) and for that reason seemed a valid indicator organism for demonstration of teat dip efficacy in inhibiting passage of the teat orifice barrier. In other studies (12, 16), *S. epidermidis* has shown a high degree of susceptibility to control through germicidal teat dipping. Accordingly, we feel that distribution of pathogenic types is not a sufficient explanation for the consistent failure of teat dips to influence new infection rate in the DES herd.

The occurrence of new *S. aureus* infections in control udder halves during both trials reported here was

sufficiently frequent to have permitted a significant level of dip-mediated reduction, had this occurred. Results from application of milking hygiene control among 15 herds by the research team at the National Institute for Research in Dairying, England (9) were variable. The impression is gained from their graphic presentation that the lesser efficacy of milking hygiene in preventing new infection and specifically *S. aureus* infection was more frequent in the herds of low infection incidence.

It is difficult to suggest why a low level of intramammary infection should be related to failure of prophylaxis by an otherwise effective teat dip, except that the time required for proof of efficacy will vary inversely with the new infection rate. The probability of germicidal prevention of a specific transmission event involving a susceptible pathogen should be independent of factors other than at the teat apex. Penetration of the mammary gland can presumably occur during the intermilking period or during actual milking, mediated by the machine itself (2, 20). The latter means of traversing the streak canal is presumably not susceptible to control by teat dipping. The mechanism may also operate at such low frequency as to contribute little to the incidence of new infection experienced in most herds (19).

We can suggest, however, that in a herd such as DES superior management has reduced the environmental load of potential mastitis pathogens on the teats during intermilking periods to such an extent that what we might term "dip-controllable" new infection is infrequent. Thus, pathogen penetration mediated sporadically by the milking machine, perhaps during teat cup drop-off or cluster removal, could assume a proportionately greater role in overall incidence of new infection. This shift in relative likelihood of intermilking and intramilking penetration is likely to occur only in herds experiencing an unusually low incidence of infection. Our observations of the milking installation and operation at the DES disclosed no obvious reason to suspect an unusually high frequency of machine-mediated infection of the mammary gland except for use of a common sponge for prewashing udders. This practice has been shown to be undesirable (11) but its potential for disease transmission has not, to our knowledge, been quantified.

A few other researchers have reported failure to reduce new infection rate by application of a reliably attested teat dip. Morse (8) used the highly regarded 4% sodium hypochlorite dip on half udders of a small research herd and found no difference between sides in new infection rate. All the common pathogenic types were present, and the new infection rate was quite high—one per 12 quarters per month. Grootenhuis et al. (6) used the half udder technique to study efficacy of 0.2% chlorhexidine, applied as a teat spray, and of a commercial iodophor dip of 0.23% available iodine content. Neither treatment reduced new intramammary infection by *S. aureus*, *Streptococcus agalactiae*, or *Streptococcus dysgalactiae*. As Grootenhuis et al. pointed out, the low iodine concentration in their iodophor dip might be criticized;

on the other hand, it was not vitiated by admixture of a skin emollient. Although both *S. aureus* and *S. agalactiae* participated in the new infection picture, the overall rate of new infection was apparently extremely low. We estimate it from their data at one per 150 quarters per month. Rates were far higher in the chlorhexidine trials, estimated at one per 13-25 quarters per month and involving nearly equal proportions of *S. aureus* and streptococci. Incorporation of a blue dye in some spray preparations indicated that they were applied correctly and consistently.

To the extent that comparison is possible among these reports and our observations of the DES herd, we perceive no common factor in herd management, infection level, pathogen distribution, nature of germicidal dip, or method of application to explain the failure to achieve prophylaxis. Casual comments from other researchers, however, suggest that this failure is more common than has been recognized. We recommend that when a half udder trial of teat dip efficacy is designed to be conducted in a single herd, a positive control group be included, which will be dipped in a formulation of previously well-documented efficacy.

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Effect of Rosemary Spice Extractive on Growth of Microorganisms in Meats¹

M. I. FARBOOD, J. H. MacNEIL, and K. OSTOVAR

Department of Food Science
 The Pennsylvania State University
 University Park, Pennsylvania

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ABSTRACT

A study was conducted to examine the possible bacteriostatic and bactericidal effect of rosemary spice extractive (RSE) on growth of selected microflora and total bacterial populations in mechanically deboned poultry meat (MDPM), turkey breast, and beef. Definite bactericidal effect by 0.1% RSE became evident when a pure culture of *Staphylococcus aureus* was tested in a bacteriological medium. Such an effect was not observed when *Escherichia coli*, *Enterobacter aerogenes*, *Pseudomonas fluorescens*, and *Salmonella typhimurium* were tested. When various types of meat were used as growth media, RSE showed a bactericidal effect on *S. aureus* only at 5% concentration. Such an effect was not observed on total plate counts of the meat samples.

Many investigations have been conducted on the antiseptic effect of different spices and their essential oils. The effect has been mainly attributed to their essential oils. However, at present there appears to be no research information which explains the antiseptic power of the non-volatile fractions of spices.

Experiments on solubility of tooth enamel, in which spices such as marjoram, rosemary, sage, tarragon, and thyme were tested, showed that there was a 10 to 95% reduction in acid production by *Streptococcus salivarius* as well as a 55 to 92% decrease in enamel solubility. A large part of the enamel protection was attributed to buffering or common ion effects of the spice ash (4).

Eiserle (6) reporting on his preliminary studies indicated that rosemary spice extractive (RSE) behaved as a fungistat and bacteriostat. Additional studies on flavor characterization of mechanically deboned poultry meat (MDPM) with added RSE showed that there was a reduction in bacterial numbers of the spiced samples (8). MacNeil and Mast (9) using a level of 0.08% RSE in the production of frankfurters without nitrates and nitrites observed lower levels of microbial growth for an extended period.

The objectives of this study were to determine the effective levels of RSE on inactivation of the selected microorganisms and to investigate the probable mode of action of RSE on growth of these microorganisms.

MATERIALS AND METHODS

Stock cultures of *Escherichia coli*, *Enterobacter aerogenes*, *Pseudomonas fluorescens*, *Salmonella typhimurium*, and *Staphylococcus aureus* were prepared by culturing the test organisms in test tubes containing 5 ml of tryptic soy broth (TSB). After an incubation of 18 h at appropriate temperature (28 or 35 C) they were streaked on tryptic soy slants and incubated for another 18 h. Cultures were then stored under refrigeration, transferred, and checked for purity every 2 weeks. Inoculum for all experiments was prepared by transferring one loopful of the stock culture into tubes containing 5 ml of TSB and incubated at 28 or 35 C for 18 h.

Preparation of suspensions

In all experiments, the meat or tryptic soy agar (TSA) suspension was prepared by weighing 20 g of meat or TSA in a sterile Mason jar containing 180 ml of sterile saline. The mixture was then blended for 3 min using a commercial Osterizer. Serial dilutions for each test were prepared using 9-ml sterile dilution blanks.

Preparation of meat samples

Treatment samples used in this study consisted of MDPM, beef, and turkey breast meat. Before their use a proximate analysis was done on all samples (Table 1). All the meat samples were analyzed for natural staphylococcal contamination levels using the method of Baer (2).

TABLE 1. Comparison of proximate data of mechanically deboned poultry meat, turkey breast and beef with tryptic soy agar, tryptic soy broth and tryptic soy agar+20% corn oil

Substrate	Moisture (%)	Protein (%)	Fat (%)	Agar (%)
Mechanically deboned poultry meat ^a	65.60	9.19	22.10	—
Turkey breast ^a	73.00 ^b	24.60 ^b	1.40	—
Beef ^a	65.04	19.02	14.21	—
Tryptic soy agar ^c	96.00	2.00	—	1.50
Tryptic soy broth ^c	97.00	2.00	—	—
Tryptic soy agar + 20% corn oil	76.00	2.00	20.00	1.50

^aAverage of duplicate samples.

^bBermice and Annabel (3)

^cDifco Supplementary Literature (5).

Fresh MDPM was obtained from a Pennsylvania commercial poultry processing plant, in flat 30-lb. cartons. After arrival at the laboratory, they were divided into 2-lb. portions and placed in sterile bags. The bags were then quick-frozen at -33 C and stored at -17 C. For each experiment, one bag of meat was allowed to thaw overnight at room temperature (22 C). Fresh ground beef, obtained from a local supermarket and turkey breasts from The Pennsylvania State University turkey flock were also treated the same way as MDPM. For each test, a 2-lb. portion of thawed meat was placed in a sterile beaker and mixed thoroughly for 5 min using a sterile wooden spoon.

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The effect of RSE on the growth of *E. coli*, *E. aerogenes*, *P. fluorescens*, *S. typhimurium*, and *S. aureus* was observed by inoculating 1 ml of the test organisms into a shaken culture of TSB containing 1% of (W/V) RSE. All cultures were incubated for 20 h at appropriate temperatures (28 or 37 C) and any possible antimicrobial effect was examined.

The effect of RSE on growth of *S. typhimurium* and *S. aureus* was further investigated using various concentrations of RSE ranging from 0.05 to 0.9%. These concentrations were prepared either by addition of sterilized RSE to sterile medium or by sterilizing a mixture of RSE and growth medium together. For each test 0.1 ml of prepared inoculum was added to 100 ml of growth medium. All cultures were placed on a shaker at 37 C and samples were obtained at 1-h intervals for 7 h. Pour plates of TSA were made from sterile dilutions of the cultures using 0.1% peptone water as diluent.

In this part of the experiment the effect of 0.1 and 1.0% RSE on growth of *S. aureus* added to the three types of meat both raw and sterile (sterilized at 121 C for 20 min) was also investigated by blending 0.2 and 2.0 g of RSE with 200 g of meat using an Osterizer. The mixture was then inoculated with 0.1 ml of an 18-h old culture of *S. aureus* to give an approximate cell population of 5.0×10^5 /g of meat. In each experiment, a control sample containing meat and inoculum without the RSE was also tested. Samples were incubated at 35 ± 1 C; a 20-g portion of each meat was sampled at 0, 3, 6, and 9 h of incubation. Enumeration of coagulase-positive staphylococci was done according to the procedure outlined by Baer (2). Total plate counts (TPC) of raw meat samples were obtained at 0 and 9 h of incubation. All plates were incubated at 35 ± 1 C for 48 h and colonies were counted with the aid of a Quebec colony counter.

In an extended storage study the effect of 0.1, 1.0, and 5.0% RSE on growth and survival of *S. aureus* added to raw MDPM and stored at 5 C for 12 days was also examined. All samples were prepared as described previously. A 200-g portion of raw untreated MDPM was sampled simultaneously to establish a base level for *S. aureus* contamination. However, in this experiment jars containing samples were stored at 5 C for 12 days and samples were obtained at 0, 3, 6, 9, and 12 days of storage. Coagulase-positive staphylococci and TPC were analyzed as in previous experiments.

To study the effect of RSE on *S. aureus* in a medium of high fat content, 20% corn oil was added to the test medium. The experiment was done by adding 0.1% RSE into two flasks—one having 200 ml of solidified TSA and the other containing 160 ml of solidified TSA and 40 ml corn oil. The contents of both flasks were blended at high speed for 3 min until fine particles were obtained. A control sample without RSE was also done simultaneously. All three jars were then inoculated with approximately 5.0×10^5 cells of *S. aureus*/ml, mixed thoroughly, and then incubated at 35 C. Samples were obtained at 3-h intervals for 9 h and tested for *S. aureus*.

RESULTS

Results showed that a 1.0% concentration of RSE had very little effect on growth of *E. coli*, *E. aerogenes*, and *P. fluorescens*. However, when the same concentration was used against the other two organisms (*S. typhimurium* and *S. aureus*) 43.2 and 99.9% reductions, respectively, were observed in the population of the test organisms.

Figure 1 shows the effect of RSE on growth of *S. typhimurium* using two methods of preparing sterilized meat and several concentrations of RSE. Generally it can be seen that levels of 0.7 to 0.9% RSE sterilized separately from the medium resulted in an extended lag phase. However a substantial increase in the viable cells became apparent after 9 h of incubation. When RSE and the growth medium were sterilized together, a decrease of 1.5 log in counts was noticed after 9 h of incubation at 35 ± 1 C and at a concentration as low as 0.6%.

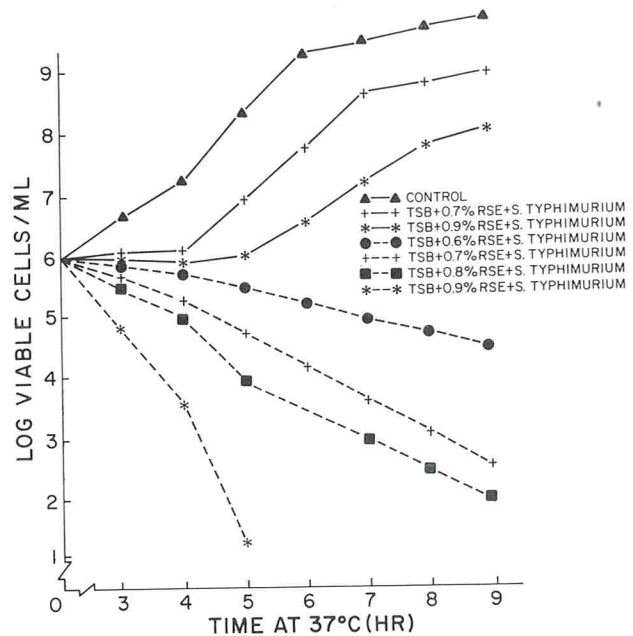


Figure 1. Effect of various concentrations of rosemary spice extractive (RSE) on inactivation of *S. typhimurium*. Solid lines indicate that the growth medium (tryptic soy broth; TSB) and RSE were sterilized separately. Broken lines indicate that the growth medium and RSE were sterilized together.

A 2-log reduction in *S. aureus* became evident when a separately sterilized RSE (0.1%) was mixed and incubated with the medium for 9 h (Fig. 2). However,

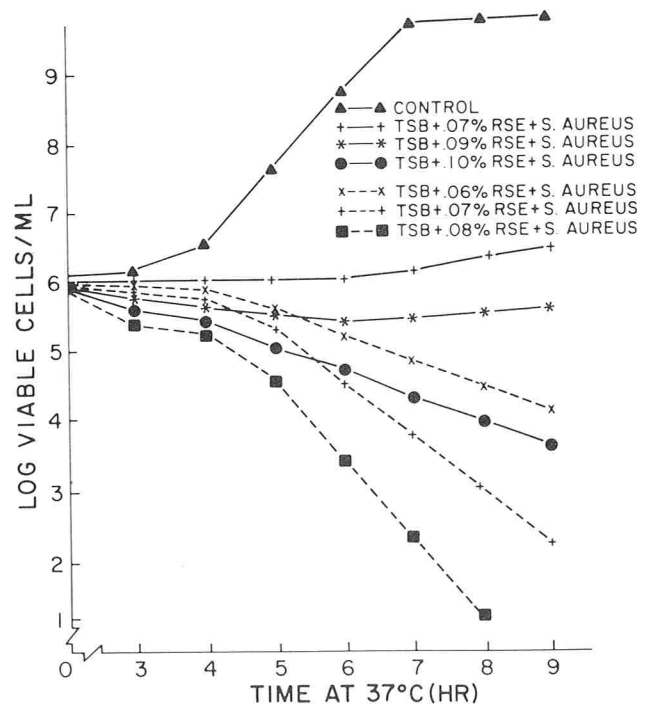


Figure 2. Effect of various concentrations of rosemary spice extractive (RSE) on inactivation of *S. aureus*. Solid lines indicate that the growth medium (tryptic soy broth; TSB) and RSE were sterilized separately. Broken lines indicate that the growth medium and RSE were sterilized together.

when 0.07 and 0.09% RSE were used, an extension in lag phase was noticed. Figure 2 also illustrates the effect of various concentrations of RSE on growth of *S. aureus* when the medium and the spice extractive were sterilized together. 0.06 and 0.07% concentrations resulted in approximately a 2 to 4 log reduction in count after 9 h of incubation, respectively; whereas 0.08% RSE resulted in complete inactivation of the test organism after 8 h of incubation.

Figure 3 presents the effect of 0.1 and 1.0% RSE on

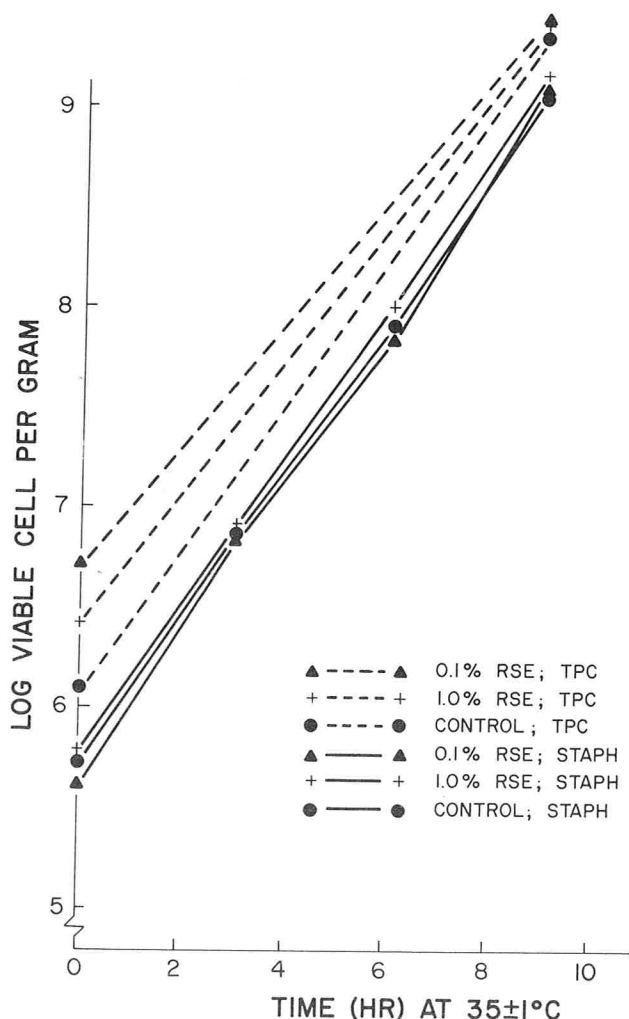


Figure 3. Effect of 0.1 and 1.0% concentration of rosemary spice extractive (RSE) on the growth of coagulase-positive staphylococci and total plate counts (TPC) of raw mechanically deboned poultry meat. Each point represents averages of duplicate samples of two trials.

growth of *S. aureus* added to raw MDPM. At these levels, RSE did not exert any effect on growth and survival of staphylococci. Also it did not have any effect on the total plate count of the raw MDPM. In all instances, a 3-log increase in number of coagulase-positive staphylococci became apparent after 9 h of incubation at 35 ± 1 C. Similar results were also obtained when 0.1% RSE was added to MDPM before sterilization (Figure 4). When beef and turkey breast meat were used, comparable results were also obtained.

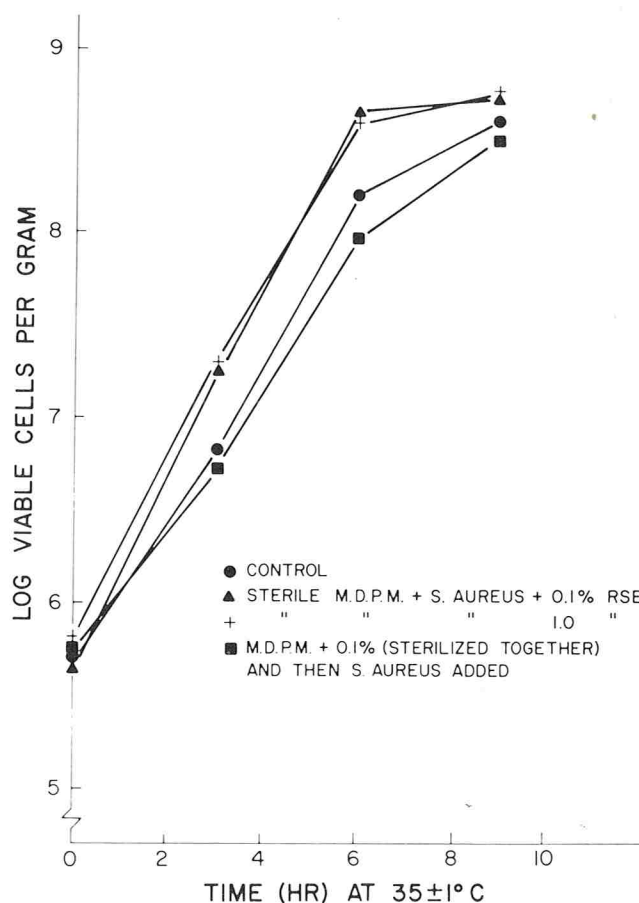


Figure 4. Effect of 0.1 and 1.0% concentration of rosemary spice extractive (RSE) on the growth of *S. aureus* added to sterile mechanically deboned poultry meat (MDPM). Each point represents averages of duplicate samples of two trials.

Figure 5 presents the effect of different concentrations of RSE on survival of *S. aureus* added to raw MDPM and stored at 5 C for 12 days. Results indicated that the counts of coagulase-positive staphylococci in the control and in samples containing 0.1 and 1.0% RSE, remained relatively constant throughout the storage period. As to the effect of RSE on total plate counts, no bacteriostatic effect became evident and an increase of 4 logs in the counts was observed after 12 days of storage at 5 C.

The effect of 0.1% RSE on *S. aureus* in a medium containing 20% vegetable (corn) oil is presented in Figure 6. At zero-time, the *S. aureus* count of the medium containing 20% oil was found to be 2.0×10^5 cells/g which gradually increased to 9.0×10^5 cells/g after 9 h of incubation at 35 ± 1 C. However, the corresponding values for the sample without oil decreased from 2.0×10^5 cells/g at zero-time to 3.2×10^4 cells/g after 9 h of incubation.

DISCUSSION

It would appear from the results obtained that *S. aureus* was more sensitive to RSE than were the other test organisms. Such findings generally agree with those of Fabian et al. (7) who reported that gram-positive organisms including *S. aureus* failed to grow in the

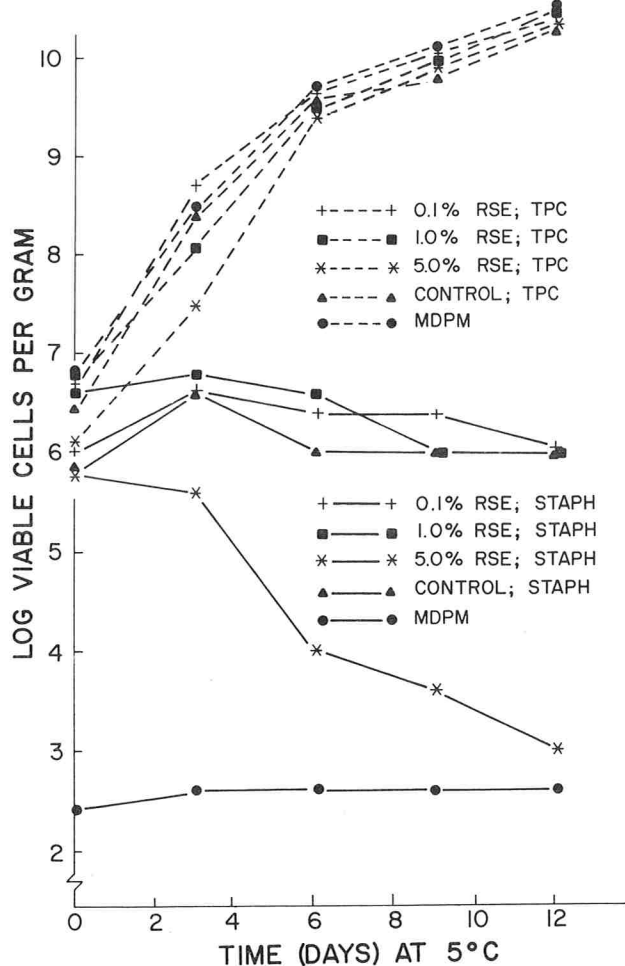


Figure 5. Effect of various concentrations of rosemary spice extractive (RSE) on the growth of coagulase-positive staphylococci and total plate counts (TPC) of mechanically deboned poultry meat (MDPM), stored at 5°C for 12 days. Each point represents averages of duplicate samples of three trials.

presence of spices. It also became evident that sterilization of RSE and the growth medium together enhanced the lethal effect of the extract on both *S. aureus* and *S. typhimurium*. Such an effect can be attributed to chemical reaction between RSE and the medium constituents which could result in extraction of lethal components from RSE into the aqueous phase.

RSE at a concentration of 0.1% exerted a definite bactericidal effect on *S. aureus* added to a pure bacteriological medium. However, further experimentation with meat showed that RSE at concentrations of 0.1 and 1.0% did not have any effect on growth of *S. aureus* or TPC. Such a difference can be attributed to the insolubility of RSE in water or to increases in the solid phase of the substrates. According to Oka (10) food preservatives could be classified into two groups based on their mechanism of action. One of those groups is considered to be dependent upon the absorption of the preservative on the solid phase of microbial cells. This absorption is equilibrated by the concentration of preservative in the water phase and not by the average concentration of RSE in the food. A comparison of the constituents of TSB with MDPM (Table 1) shows that

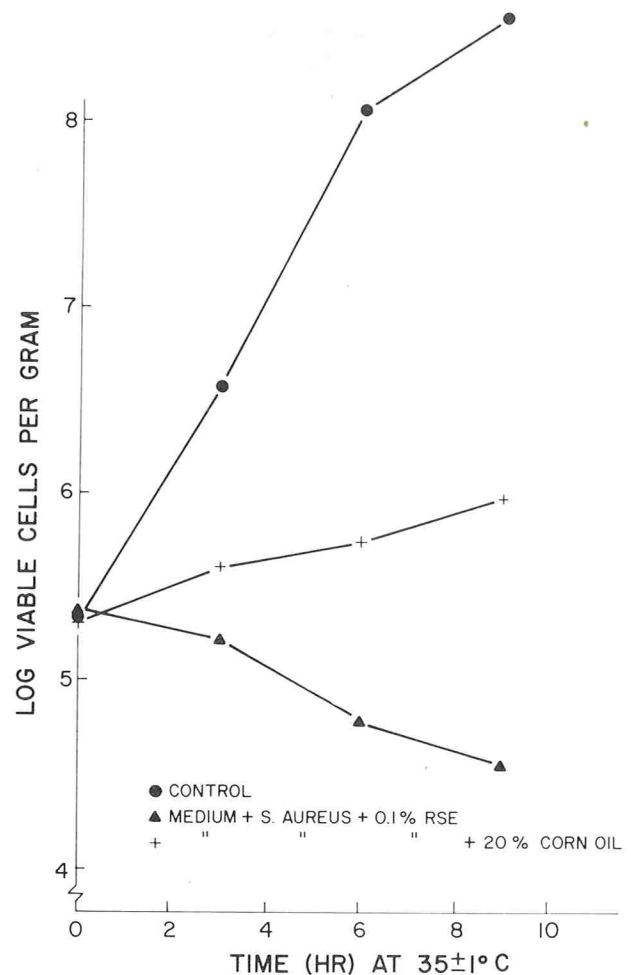


Figure 6. Effect of 0.1% concentration of rosemary spice extractive (RSE) on the growth of *S. aureus* added to solid medium and solid medium containing 20% corn oil. Each point represents averages of duplicated samples of two trials.

TSB has 97% water, whereas the water content of the meat samples range from 64 to 73%. Higher lipid and solid content of meat might result in a higher absorption of RSE by the lipid and solid phase, therefore a drastic decrease in the concentration of RSE by the aqueous phase and thus an absence of bactericidal or bacteriostatic effect of RSE in meat systems. The probability of a decrease in the penetration of RSE into the cell due to its being coated by meat lipids cannot be ignored.

It would appear that the observed bacteriostatic effect in the meat stored at 5°C was not due to the influence of RSE, but to the low temperature (5°C) and possible presence of competitive psychrotrophic microorganisms. It has been reported that psychrotrophic organisms do account for a high percentage of total microflora of raw poultry products and contribute to low temperature spoilage (1, 11, 12). The bactericidal effect of RSE at 5.0% on *S. aureus* can possibly be attributed to sufficiently high concentration of RSE in the aqueous phase. However, the possibility of synergistic effect of RSE, low temperature of storage, and repression by the growth of psychrotrophic should not be overlooked.

Increase in total plate counts could have been due to presence of psychrotrophic microorganisms and the absence of bactericidal effects of RSE on gram-negative bacteria (4, 7).

Since the sample with oil contained 20% less water than the sample without the oil, it can be assumed that more RSE was absorbed by the oil and therefore the RSE concentration was lowered in the aqueous phase. Thus the observed effect of RSE on *S. aureus* in a sample containing oil may be considered bacteriostatic rather than bactericidal. The probability of bacterial cells being coated with oil could also be considered as an additional factor which aids in lowering the penetration rate of RSE into the cells. This experiment appears to support the absorption theory of Oka (10) in explaining the bacteriostatic and bactericidal effect of spices on meat substrates. Since the exact chemical nature of RSE is not known, it would be difficult to fully describe the possible mechanism involved. However, like many other spices and herbs, it is safe to assume that this extract does contain certain phenolic compounds which at a given concentration can be bacteriostatic or to some extent bactericidal.

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A Research Note

Modified Water Rinse Sampling for Sensitive, Non-adulterating Salmonellae Detection on Eviscerated Broiler Carcasses

L. C. BLANKENSHIP and N. A. COX

*Richard B. Russell Research Center
United States Department of Agriculture
P.O. Box 5677, Athens, Georgia 30604*

(Received for publication March 1, 1976)

ABSTRACT

Non-destructive, whole carcass, water rinse sampling followed by addition of sterile, dry lactose broth for pre-enrichment is shown to be a sensitive method for detection of small numbers of salmonellae on experimentally contaminated eviscerated broiler chicken carcasses.

A program to establish a baseline for the extent of salmonellae contamination of raw meat and poultry products (by product type) for monitoring contamination levels and effectiveness of control programs was among recommendations made in the General Accounting Office report to Congress on salmonellae contamination in raw meat and poultry (8). The most sensitive sampling and detection methods available are needed to meet this recommendation. For eviscerated broiler carcasses which may be contaminated with small numbers of salmonellae, Surkiewicz et al. increased sensitivity fourfold by incubating 270 out of 300 ml of lactose broth used for rinsing compared with 10 ml of the rinse (6). The International Commission on Microbiological Specifications for Foods (ICMSF) (2) recommends rinsing a carcass in 300 ml of lactose broth in a plastic bag and adding an additional 300 ml of double strength lactose broth for enrichment of salmonellae. Rinsing carcasses in lactose broth, however, might be considered an adulteration of the product. Cox and Blankenship (1) recently described a sensitive sampling method in which the entire carcass was incubated in lactose broth for pre-enrichment. Use of this method results in carcass destruction and requires a substantial amount of incubator space (about 0.34 ft³). Simonsen (4) mentioned use of water rinsing of eviscerated carcasses, but did not report sensitivity. We report herein a modified water-rinse method, which could be used in-plant, and is non-destructive, non-adulterating, and requires minimum incubator space with little sacrifice in sensitivity compared to incubating the carcass in lactose broth.

MATERIALS AND METHODS

Effectiveness and sensitivity of this method were tested by sampling freshly processed carcasses which had been contaminated with small numbers of a nalidixic acid-resistant *Salmonella typhimurium*. A saline suspension from an 18-h old nutrient agar slant culture was diluted with saline to absorbance 0.20 at 540 nm (2×10^8 cells/ml). Dilutions of this suspension served as inoculum and the exact cell numbers used were determined as the mean count from five direct platings. The inoculum (total volume 0.15 ml) was equally divided between the breast, thigh, and wing, vigorously rubbed with a sterile bent glass rod, and allowed a 15-30 min contact time before sampling. Growth of the contaminant during the contact time was unlikely because carcass temperatures were about 4 C at the time of inoculation and did not increase greatly during the contact time.

A carcass to be sampled was placed in a plastic sterilization bag (12 × 18-inch size, Laboratory Research Co., Los Angeles, Calif.), 500 ml of sterile distilled water were added, then bag with carcass was vigorously shaken for 1 min. The carcass was drained into the bag for 30 sec, removed, and then the rinse was pre-enriched by adding sterile, dry lactose broth, in either tablet form (Oxoid, Oxo Limited, London) or powdered form (Difco), in quantities to achieve single strength final concentration. Powdered lactose broth was weighed into small polyethylene bags, vacuum sealed, and radiation sterilized (courtesy of Radiation Laboratory, U.S. Army Natick Laboratory, Natick, Mass.) before use. The rinse sampling bag was closed with a twist tie and placed in an 800-ml beaker during incubation (24 h, 35 C). Ten ml of the lactose broth culture were transferred to 90 ml of Tetrathionate (TT) broth base (Difco) and incubated 24 h at 35 C. The marker organism was detected by streaking three, 3-mm loopfuls of TT broth culture on MacConkey agar (Difco) containing 100 μg of nalidixic acid per ml. Previous experience (1) showed that only the marker organism would grow on nalidixic acid MacConkey agar. For detection of naturally occurring salmonellae contaminants accepted methods (7) should be used for isolation and confirmation from TT broth cultures.

RESULTS AND DISCUSSION

Binomial sampling statistical analysis of contaminated carcass detection for samples having a mean inoculum of 22 cells per carcass (range = 8-52 cells per carcass, 500 ml of rinse volume, Table 1) predicted a 92% ($P < 0.05$) probability of detecting a positive. This compares favorably with the eight cell per carcass sensitivity reported for the carcass-in-lactose broth

TABLE 1. *Detection of Salmonella typhimurium inoculated onto processed eviscerated broiler carcasses*

Expt. No.	Inoculum (cells/bird)	Rinse vol. (ml)	No. positive carcasses out of 10 inoculated
1	8	500	10
2	13	500	10
3	16	500	9
4	17	500	10
5	32	500	9
6	33	500	10
8	52	500	10
9a	11	300	9
9b	11	500	8
9c	11	1000	7
10a	15	300	10
10b	15	500	10
10c	15	1000	10
11a	20	300	10
11b	20	500	10
11c	20	1000	10

sampling method (1). Rinse volumes of 300, 500, and 1000 ml were essentially equal in recovery efficiency.

Sterile distilled water was selected as the rinse medium because it is non-adulterating and would permit sampled carcasses to be returned to the processing line should the method be used for in-plant sampling. Although some food contaminants, such as aerobic spore formers and pseudomonads, do not survive well in distilled water, salmonellae are reported to survive brief periods without diminished numbers (3, 5). The exposure to distilled water in our sampling method does not exceed 3 min before addition of lactose broth. Further, protective organic matter and salts are washed into the rinse from carcasses during sampling.

Addition of sterile, dry lactose broth to samples permits enrichment of large samples, thereby enhancing

sensitivity, without increasing sample volume. Sterile powdered lactose broth is not commercially available, however, but could be produced if this sampling method should become widely used.

The 300- or 500-ml volume rinse can be conveniently incubated in an 800-ml beaker requiring about 0.086 ft³ incubator space. Thus, incubator space needed is only one-fourth that necessary for incubation of a carcass plus rinse (0.34 ft³).

ACKNOWLEDGMENTS

The authors acknowledge Debbie Tanner for excellent technical assistance and Ruel Wilson for assistance with statistical analyses.

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A Research Note

A Phage Typing System for Salmonellae: *Salmonella senftenberg*

M. GERSHMAN

*Departments of Microbiology and Animal and Veterinary Sciences
 University of Maine, Orono, Maine 04473*

(Received for publication March 25, 1976)

ABSTRACT

A system is described for phage typing of *Salmonella senftenberg*. The system was developed using a number of bacteriophages that were isolated from sewage.

Salmonellae are one of the most common causes of food poisoning. These microorganisms are widely distributed throughout the animal kingdom and are frequently found in food of animal origin (1, 7).

An estimated two to four million people are infected annually in the United States alone (5). The incidence is in part due to diseased food handlers, contaminated food, and to consumption of refrigerated foods and convenience products which require little or no cooking before eating.

Outbreaks of salmonellosis can be controlled, if not prevented, if the presence of the organism can be established and appropriate action taken. Many apparently unrelated outbreaks of salmonellosis have been linked through the serological identification of the serotype involved, and, on occasion, the identity has led to the source of the infection (4). This is particularly true when the isolate represents an unusual type. However, if a particular species is fairly common and widely disseminated, it becomes difficult, if not impossible, to assess its role in an outbreak of disease. Unfortunately, commonly occurring species cannot be as easily related to a problem at hand unless methods are first employed to establish strain diversities, only then can the origin of an infection be traced by virtue of the unique characterizations possessed by the strains involved.

In 1938 Craigie and Yen (2, 3) introduced a phage typing scheme for *Salmonella typhi*. Its success led to the development and acceptance of the phage typing technique as a reliable procedure for characterizing and delineating ubiquitous microorganisms.

Phage typing sets have been devised for a number of *Salmonella* serotypes. In keeping with our immediate interests and circumstances a phage typing potential for

Salmonella senftenberg, a serotype frequently isolated from food products, has been developed in our laboratory.

MATERIALS AND METHODS

Cultures used in this project were obtained from our own diagnostic service and the National Animal Disease Laboratory, Ames, Iowa.

The phages, in this study, were isolated from untreated sewage samples obtained from local treatment plants. Aliquots of sewage (100 ml) were inoculated with a 1½-h old nutrient broth culture of one of the biochemically and serologically confirmed *S. senftenberg* isolates collected for this investigation. The samples were incubated for 18 h at 37 C and passed through a 0.45 µ membrane filter. The filtrates were then assayed for the presence of phage by plating them onto the culture initially used as the inoculum. Phage isolates were purified by serial, single plaque passages and brought to titer using the procedure described by Swanstrom and Adams (6). Phages of sufficiently high titer were then diluted and tested against the *S. senftenberg* cultures in our collection. All of the phages employed in this study were used at a routine test dilution (RTD) of not less than 10⁻³. Phage isolates were selected and maintained for regular use if they were stable and potentially suitable for type differentiations.

Cultures to be typed were lightly inoculated into 3 ml of nutrient broth and incubated at 37 C for 1½ h or until turbidity was barely detectable. A small quantity of the broth culture was then flooded onto a nutrient agar plate, allowed to dry for approximately 15 min and spotted with drops of phage using a 1-ml syringe with a 26-gauge needle. The plates were incubated overnight at 37 C and read the following day. The cultures are examined with the aid of an ×10 aplanat hand lens and viewed through the bottom of the plate. Susceptibility of a phage was demonstrated by areas of clearing that ranged from isolated plaques to confluent lysis. Phage activity was recorded on the basis of the reactions described in Table 1.

TABLE 1. *Method for recording degrees of lysis*

CL	confluent lysis
OL	opaque lysis (opacity due to heavy secondary growth)
SCL	semi-confluent lysis
<SCL	less than semi-confluent lysis
+++	120 plaques
+++±	81-120 plaques
++	61-80 plaques
+±	41-60 plaques
+	21-40 plaques
±	6-20 plaques
-	0-5 plaques

RESULTS AND DISCUSSION

Six phages were isolated. The lytic pattern of these phages is described in Table 2. Using these isolates, 250

TABLE 2. Reactions of type strains of *Salmonella senftenberg* with typing phages at routine test dilutions

Type strains	Typing phages						Strains of <i>S. senftenberg</i>	
	1	2	3	4	5	6	No.	%
1	CL	—	CL	—	—	—	18	7.2
2	—	CL	—	—	—	—	12	4.8
3	SCL	—	CL	—	—	SCL	25	10.0
4	—	—	—	CL	OL	—	4	1.6
5	SCL	—	—	—	CL	+±	14	5.6
6	CL	—	—	—	<SCL	CL	9	3.6
7	—	—	—	—	SCL	SCL	26	10.4
8	SCL	—	+	SCL	SCL	—	31	12.4
9	<SCL	—	<SCL	SCL	SCL	SCL	14	5.6
10	—	—	—	SCL	—	—	24	9.6
11	CL	—	—	SCL	—	—	33	13.2
12	CL	—	—	—	—	—	15	6.0
13	CL	—	CL	—	SCL	—	25	10.0

strains of *S. senftenberg* were classified into 13 distinct phage types. It is conceivable that more types exist and will be revealed as new cultures are examined. The characteristic pattern of the phage types established were readily reproducible reflecting the stability and practicality of the phages employed. Some of the phages were observed to affect both serologically related and dissimilar species of *Salmonella*. Efforts are now being

made to utilize these phage isolates to characterize a number of other *Salmonella* serotypes.

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A Research Note

A Comparison of Microbial Counts on Conventionally and Hot-boned Bovine Carcasses¹

C. L. KASTNER², L. O. LUEDECKE, and T. S. RUSSELL

*Department of Food Science and Technology
 Washington State University, Pullman, Washington 99163*

(Received for publication January 22, 1976)

ABSTRACT

The objective of this study was to compare the total aerobic mesophilic and psychrotrophic surface counts for beef halves held at 16 C for 6, 8, or 10 h postmortem as compared to the corresponding halves held at 2 C for the same periods. Five choice and good grade heifers were utilized in this study. At each postmortem sampling time, statistically non-significant differences ($P > 0.10$) were observed between the hot boning and conventional treatment means for corresponding mesophilic and psychrotrophic counts. For each postmortem sampling time, in general, halves to be hot-boned gave lower total mesophilic and psychrotrophic counts than did the corresponding conventionally chilled halves. Beef carcasses held at 16 C for up to 10 h postmortem give a product of acceptable bacteria counts when compared to conventionally chilled carcasses.

The processing of bovine carcasses soon after slaughter (hot boning) is of current interest and has been investigated by Schmidt and Gilbert (6), Kastner et al. (2), Schmidt and Keman (7), and Kastner and Russell (3). These workers have proposed postmortem holding period and temperature combinations varying from 2-48 h and 7-16 C. Schmidt and Gilbert (6) excised bovine muscles within 2 h postmortem, and conditioned these muscles in vacuum packages at 15 C for 24 or 48 h postmortem. Kastner et al. (2) excised bovine muscles and muscle systems after holding intact halves at 16 C for 2, 5, or 8 h postmortem within 1 h postmortem. Schmidt and Keman (7) excised bovine muscles and muscle systems which were subsequently held 4 h at 7 C, chilled overnight at 1 C, vacuum packaged, and held at 1 C until 7 days postmortem. In more recent work, Kastner and Russell (3) excised bovine muscles and muscle systems after conditioning the intact halves at 16 C for 6, 8, or 10 h postmortem.

These conditions may encourage growth of both spoilage and potentially pathogenic bacteria. Beef carcasses aged at 16 and 22 C for 2 days, and subsequently held 2 days at 2 C, yielded retail cuts exhibiting statistically different ($P < 0.05$) and greater

mesophilic and psychrotrophic counts than those carcasses held at 2 C for 4 days postmortem (5). However, Schmidt and Gilbert (6) concluded that beef cuts excised pre-rigor, vacuum packaged, and held at 15 C for 24 or 48 h postmortem could yield a product of satisfactory microbiological quality. These same workers found surface bacteria counts of 10^2 to $10^4/\text{cm}^2$ for wholesale meat cuts sampled immediately upon excision at 24 and 48 h postmortem. Control sides held at 9 C for 24 h generally yielded surface counts of less than $10^3/\text{cm}^2$.

Surface counts of 10^2 - $10^3/\text{cm}^2$ were viewed as quite low by Kraft and Ayres (4) as these workers did not detect off odors in fresh beef until surface counts of $2 \times 10^6/\text{cm}^2$ were observed. Definite off odors were detected when surface counts reached $10^7/\text{cm}^2$.

This preliminary study was designed to evaluate the total aerobic mesophilic and psychrotrophic surface counts for beef halves held at 2 C and 16 C until 6, 8, or 10 h postmortem.

EXPERIMENTAL

Five choice grade heifers were slaughtered in the conventional manner with special care taken to avoid contamination during skinning and evisceration. After splitting, halves of each carcass were washed 2 min with tap water, beginning at the hind shank and continuing anteriorly. Sanitized waxed paper templates were affixed to the flank and plate region of each half in such a way as to standardize sample location and removal. At 2 h postmortem, halves of each carcass were randomly assigned to either conditioning at 16 C or chilling at 2 C.

Two 2.54×12.7 cm (1×5 in) strips were removed from each half carcass to achieve 25.4 cm^2 (10 in^2). Samples were taken at 2, 6, 8, and 10 h postmortem and samples were aseptically dissected by scoring the muscle adjacent to the interior perimeter of the templates. Removal of the intact strips of muscle was accomplished by cutting to the underlying intermuscular fat.

Each set of samples was placed in 100 ml of buffered sterile rinse solution containing 1.25 ml of stock phosphate buffer solution (pH 7.2), 5 ml of 10% aqueous sodiumthiosulfate, 4 g of Asolectin, and 10 g of Tween 80 per liter, made to volume with distilled water (1). All samples were held in the rinse solution for 1 h. Before plating, each sample was shaken vigorously by making 25 complete cycles of 6 inches within 10 sec; striking the palm of the hand at the end of each cycle. Appropriate dilutions were made in 0.1% peptone broth (pH 7.0), and pour plates were made using Standard Plate Count Agar (Difco). Two sets of triplicate plates, for each dilution were prepared. One set was

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²Present address: Department of Animal Sciences, Kansas State University, Manhattan, Kansas.

incubated at 32 C for 48 h and the other set for 10 days at 7 C. Average counts obtained from the plates, held at each incubation temperature, represented total aerobic mesophilic and psychrotrophic populations, and are expressed as log counts per cm².

The sources of variation in the analysis for the initial (2 h) counts and postmortem holding periods (6, 8, or 10 h) were treatments, animals, and animal × treatment, so that means for total aerobic counts had five observations (animals).

RESULTS AND DISCUSSION

At each postmortem sampling time (2, 6, 8, or 10 h), no statistical differences ($P > 0.10$) were observed between the hot-boning (16 C) and conventional (2 C) treatment means for corresponding mesophilic and psychrotrophic counts (Table 1). Both total mesophilic and psychrotrophic counts for the halves to be conventionally and hot-boned ranged from 10^2 - 10^3 /in². These results agree with those of Schmidt and Gilbert (6) even though these workers utilized the swab method of sampling.

These results indicate that if carcass halves are held as long as 10 h postmortem at 16 C, total aerobic mesophilic and psychrotrophic counts will be

comparable to the halves held an equivalent time at 2 C.

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TABLE 1. Total log count means per 25.4 cm² for aerobic mesophilic and psychrotrophic bacteria on bovine carcass halves to be conventionally or hot-boned^a

Postmortem sampling times (h)	Mesophiles		Psychrotrophs		
	Hot-boned (16 C)		Conventional (2 C)	Hot-boned (16 C)	Conventional (2 C)
2 ^b	2.82		3.21	2.65	3.09
S _{x̄}		0.35			0.34
6 ^c	2.90		3.38	2.86	3.26
S _{x̄}		0.39			0.38
8 ^c	3.06		3.41	3.02	3.27
S _{x̄}		0.41			0.39
10 ^c	3.23		3.26	3.14	3.06
S _{x̄}		0.32			0.30

^aNo statistical significant differences were found between hot-boned and conventional carcasses at any of the evaluation times.

^bInitial counts taken at 2 h postmortem.

^cPostmortem sampling times for carcass halves to be conventionally or hot-boned.

N-Nitrosamines and their Precursors in Bacon: A Review

J. I. GRAY

Department of Food Science
 University of Guelph, Guelph, Ontario N1G 2W1, Canada

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ABSTRACT

Since certain N-nitrosamines are highly carcinogenic, formation and isolation of N-nitrosopyrrolidine from bacon has recently received much attention. This review examines the possible precursors contributing to N-nitrosopyrrolidine formation in bacon, how cooking procedures influence the amount of N-nitrosopyrrolidine formed and the possible effects curing ingredients have on the N-nitrosation reaction.

Nitrates and nitrites, employed without reservation in the curing of meat for many years, have in the past decade, become the center of widespread controversy. This is the result of the interaction of nitrite with secondary amines present in meat to produce N-nitrosamines. Most of these compounds are carcinogenic and in addition some exhibit mutagenic, embryopathic and teratogenic effects (12, 38).

The necessity for studying formation and occurrence of N-nitrosamines in cured meats and other food systems derives from the absolute nature of the Food and Drug Regulations which denies use of any food additive, which in itself is carcinogenic or produces carcinogens in the food. Nitrites are used in many countries as deliberate food additives. These (a) produce the characteristic cured-meat color (5), (b) contribute the characteristic cured-meat flavor (1, 7, 44), (c) have potent antioxidant properties and eliminate the problem of warmed over flavor (1, 59), and (d) retard botulinal toxin development, particularly under conditions of product mishandling (8, 9, 30). Without use of nitrite a large class of traditional cured-meat products would be no longer available.

Unfortunately, N-nitrosamines are formed in cured-meat products under certain conditions and have been found sporadically in hams, wieners, bologna, and similar products. In most instances, amounts of N-nitrosamine have been below 25 ppb. Although no satisfactory explanations have been put forward to explain this sporadic isolation of dimethylnitrosamine (DMN), it has been suggested that localized high concentrations of nitrite in wiener emulsions due to inadequate homogenization during processing may be a factor (17). These authors also reported that it was difficult to induce N-nitrosamine formation in wieners, even with the addition of 1500 ppm of nitrite. Another possible explanation for the presence of N-nitrosamines in these products was presented by Sen et al. (55) who

showed that the occurrence of N-nitrosamines coincided with the use of curing premixes. These premixes which contained both sodium nitrite and sodium nitrate, on analysis, revealed N-nitrosopyrrolidine (N-Pyr) and N-nitrosopiperidine. The reaction between nitrite and black pepper was responsible for formation of N-nitrosopiperidine, whereas paprika predominantly produced N-Pyr. This has led to a change in practice in handling curing premixes so that formation of N-nitrosamines is no longer possible.

Bacon, on the other hand, presents a more serious problem since N-Pyr has been isolated consistently from cooked bacon (Table 1). Although no N-Pyr is detected in

TABLE 1. N-Nitrosamine formation in fried bacon

Investigators	N-Nitrosopyrrolidine (ppb)		Dimethylnitrosamine (ppb)
	Bacon	Cooked-out fat	Bacon
Crosby et al. (11)	tr ^a -40	—	tr
Sen et al. (52)	4-25	—	2-30
Fazio et al. (15)	10-108	45-207	—
Fiddler et al. (20)	2-28	6-24	—
Sen et al. (54)	15-75	—	0-3
Pensabene et al. (48)	11-38	16-39	—
Kushnir et al. (35)	7-17	—	—
Gray et al. (25)	tr-23	tr-41	—

^atr: trace

uncooked bacon, it is found almost invariably after cooking. The levels depend on cooking conditions and other less well defined factors. This paper will examine the possible precursors contributing to N-Pyr formation in bacon, how cooking procedures influence the amounts of N-nitrosamine formed and the possible effects curing ingredients have on the N-nitrosation reactions.

N-NITROSAMINES IN BACON

Recent research has indicated that N-Pyr occurs in fried bacon but not in other cured meat products. Fazio et al. (15) found no N-Pyr in fried ham or Canadian bacon but were able to isolate this N-nitrosamine in fried bacon and cooked-out fat. The reasons for this have not been fully elucidated but one possible explanation is the fat to lean ratio in bacon. Gray and Collins (22) showed that the adipose tissue varied from 42 to 63.1% of total weight for five pork bellies. On frying, the fat is rapidly released, thereby creating an excellent heat-transfer

medium. Fazio et al. (15) theorized that since N-Pyr was fat soluble, it was protected from volatilization during frying and was retained in the fat on the bacon strips. Volatilization of N-Pyr supposedly occurred during frying of leaner cuts of Canadian bacon and ham.

Fiddler et al. (20) examined ham, Canadian bacon (back bacon), and beef bacon-like products but failed to detect N-Pyr in either the fried products, their cooked-out fat, or vegetable oil in which they were fried. These authors also investigated the role of lean and adipose tissues of bacon as precursors of N-Pyr and reported that N-Pyr is derived from the adipose tissue and not the lean portion. It was concluded therefore that the precursor(s) of N-Pyr exists in the adipose tissue of raw bacon. Scanlan (50) pointed out that it is possible that different internal temperatures are reached when lean and adipose are fried, as a result of the differences in moisture content and specific heats of the two tissues. A higher internal temperature might be reached in the adipose tissue because of its lower moisture content and the relatively low specific heat of fat, thereby influencing the levels of N-Pyr formed.

PRECURSORS OF N-NITROSOPYRROLIDINE

It is very evident that N-Pyr formation in bacon depends on temperature stresses and the nature of these stresses. This is supported by the fact that no N-Pyr has been isolated from raw bacon. The isolation of this N-nitrosamine has aroused considerable interest as to its mode of formation and consequently many investigators have suggested a number of possible precursors (Table 2).

TABLE 2. Possible precursors of N-nitrosopyrrolidine formation in cooked bacon

Compound	Investigators
Nitrosoproline	(2, 19, 48)
Proline	(2, 13, 23, 31)
Collagen	(23, 31)
Putrescine	(2, 31)
Spermidine	(2, 16, 29)
Pyrrolidine	(2, 31)
Glycyl-L-proline	(31)
L-Prolyglycine	(31)

The most probable precursor of N-Pyr in bacon appears to be proline. Proline is a natural component of many foods and is especially abundant in connective tissue. Schweigert and Payne (51) showed that proline constitutes 4.6% of the crude protein in pork. The amino acid composition of connective tissue protein is markedly different from that of muscle and organ meats in that it contains relatively large amounts of proline and hydroxyproline. Crevasse et al. (10) reported values of 15.04 and 13.10% for proline and hydroxyproline in acid soluble collagen from the epimysium of normal pork muscle. Gray et al. (25) reported free proline contents ranging from 18.3 to 31.6 μM per 100 g of tissue for five bacon samples.

How N-Pyr is formed from proline is, as yet, not firmly established. Several pathways have been proposed (Fig.

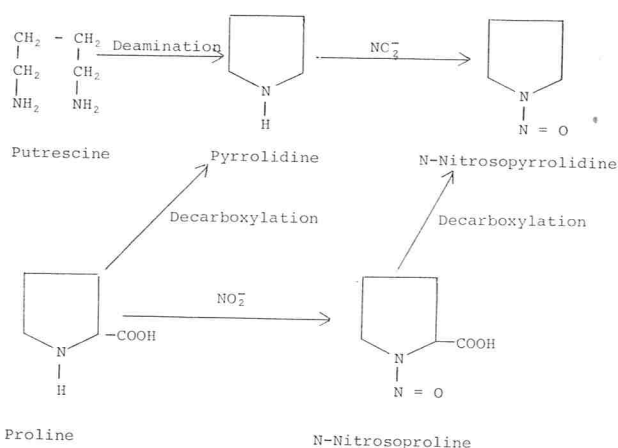


Figure 1. Possible pathways for the formation of N-nitrosopyrrolidine in fried bacon (20).

1). Ender and Ceh (13) studied the formation of N-Pyr from proline and nitrite in a dry starch matrix and suggested that proline can be decarboxylated to form pyrrolidine with subsequent formation of the N-nitroso derivative. Lijinsky and Epstein (37) proposed that proline could be N-nitrosated and subsequently decarboxylated to N-Pyr. This latter suggestion appears the more likely since proline and nitrite are present in the bacon system, and proline having a pK_b value of 12.0 is readily N-nitrosated. This mechanism is further supported by the isolation of N-nitrosoproline from raw bacon in amounts up to 1.18 mg/kg (35). Recently, Ivey (33) reported that bacon cured in brines containing 1,600 ppm of nitrite and having a residual nitrite content of 100 ppm, contained greater than 100 ppb of N-nitrosoproline. Frying of bacon reduced the N-nitrosoproline concentration by 86-100%. Studies by Bills et al. (2) and Pensabene et al. (48) confirmed that such a decarboxylation reaction can readily take place in model systems simulating the pan-frying of bacon. Although the formation of N-Pyr from proline and sodium nitrite has been largely confined to model system studies, these have served to elucidate reaction parameters governing N-Pyr formation.

Although recent investigations have tentatively established proline as the principal precursor of N-Pyr in cooked bacon, the possibility of other precursors being involved cannot be discounted. Collagen has been shown, under certain conditions, to be capable of producing N-Pyr. Huxel et al. (31) and Gray and Dugan (23) showed that high temperatures (greater than 195 C) were required to produce N-Pyr from collagen in a dry system. Any conclusions from these studies regarding the significance of collagen as a precursor should be tempered because of the abnormally high concentrations of nitrite used to generate positive N-Pyr formation. Indeed, a recent paper by Patterson et al. (46) discounts the theory that collagen is a major precursor. These investigators demonstrated that N-Pyr was found almost exclusively in the residual fatty tissue and cooked-out fat and was only just detectable in the lean and rind. They

concluded that since rind contains approximately 20% collagen, greater yields of N-Pyr in the rind would be expected if collagen was a significant contributor to the formation of this N-nitrosamine.

Primary diamines should also be considered as possible precursors of N-nitrosamines, especially in foods exposed to high temperatures. These diamines can undergo various rearrangements to produce compounds capable of N-nitrosation. Putrescine, which is a decomposition product of arginine, may undergo cyclization to pyrrolidine during the cooking of fish and meat (37). A proposed pathway for this rearrangement is given by Scanlan (50). Formation of N-Pyr from putrescine and sodium nitrite in an oil-water system at 170 C was investigated by Bills et al. (2). They reported a yield of 0.04% which corresponded to an approximate 10-fold decrease in N-Pyr formation when compared to proline. Putrescine has been reported in amounts of 1.7 to 189.3 mg/100 g of fresh pork and 1.1 to 50.4 mg/100 g of butt portions of commercially cured and smoked hams (36). Heating to 71 C resulted in a substantial decrease in concentration of the amine which may be due to volatilization. However, there have been no reports on what percentage of putrescine is converted to pyrrolidine and subsequently to N-Pyr during this temperature treatment. Bills et al. (2) again reported that pyrrolidine when heated with nitrite in an oil-water system at 170 C gave a 1% theoretical conversion to N-Pyr.

The aliphatic polyamines, spermidine [$\text{NH}_2(\text{CH}_2)_3\text{NH}(\text{CH}_2)_4\text{-NH}_2$] and spermine [$\text{NH}_2(\text{CH}_2)_3\text{NH}(\text{CH}_2)_4\text{NH}(\text{CH}_2)_3\text{NH}_2$] are widely distributed in biological material, including viruses, bacteria, plants, and animal tissues (56). These polyamines have been reported in soybeans (58), barley and wheat (43), and more importantly in some samples of pork and cured, smoked hams (36). These latter investigators reported maximum values of 125 mg and 1013 mg of spermidine per 100 g of tissue for fresh pork and putrefied pork. Spermine values were 55.7 mg and 2769 mg per 100 g of fresh and putrefied pork, respectively. Ferguson et al. (16) reported that N-Pyr was apparently produced on heating spermidine with sodium nitrite. However, a much more comprehensive study by Hildrum et al. (29) revealed the complexity of products produced during this N-nitrosation procedure, at least five different N-nitrosamines being formed. The principal volatile N-nitrosamine was γ -butenyl (β -propenyl) nitrosamine with lesser amounts of N-Pyr, γ -butenyl (γ -propanol) nitrosamine, δ -butanol (β -propenyl) nitrosamine and δ -butylchloride (β -propenyl) nitrosamine being produced. This plethora of products is not surprising since primary amino groups can undergo N-nitrosation to form carbonium ions. These are unstable and can undergo three main types of reaction: (a) combination with a nucleophile, (b) elimination of a proton, and (c) rearrangement of structure. These reactions can explain the presence of the N-nitrosamines identified by Hildrum et al. (29). As yet, none of these N-nitrosamines except N-Pyr have been identified in

cooked bacon.

Other compounds that have been investigated as N-Pyr precursors include L-prolyglycine, glycyl-L-proline and hydroxyproline. Huxel et al. (31) produced measurable quantities of N-Pyr from the first two compounds but failed to detect either N-Pyr or N-nitrosohydroxyproline when hydroxyproline and nitrite were heated at 170 C for 2 h. Similar results were obtained by Gray and Dugan (23). Recently, however, Gray et al. (25) formed N-nitrosohydroxyproline in a model system and concluded that a polar solvent such as methanol was necessary to extract this particular N-nitrosamine from the model systems. No N-nitrosohydroxyproline was isolated from cooked bacon which may have been partly due to the extraction procedure (only a 20% recovery of added N-nitrosohydroxyproline was obtained) or because the free hydroxyproline content in bacon is almost negligible. In the same study, the N-Pyr levels obtained ranged between traces and 23 ppb in the fried bacon.

FACTORS INFLUENCING N-PYR FORMATION

The formation of N-Pyr during cooking of bacon is still not fully understood. However, certain parameters influencing N-Pyr formation have been investigated both in model and cured meat systems. While it is not always feasible to extrapolate results from model systems to more complicated cured meat systems, these studies contribute significantly to the problem of N-Pyr formation in cooked bacon samples. Among the factors which influence formation of N-Pyr are methods of cooking, nitrite concentration, salt concentration, and presence of ascorbic acid. Of course, nitrite, salt, and ascorbic acid are classical curing agents for meat.

Pensabene et al. (48) studied the effect of frying and other cooking conditions on N-Pyr formation in bacon and concluded that N-nitrosamine formation is primarily dependent on frying temperature and not time. Samples from one belly formed no N-Pyr when fried for 105 min at 99 C, while samples from the same belly, fried to the same "doneness" at 204 C for 4 min produced 17 ppb of N-Pyr. Although bacon is usually prepared by pan-frying, these investigators examined several other alternative cooking procedures (Table 3). Their results

TABLE 3. Effect of cooking methods on N-nitrosopyrrolidine formation in bacon(48)

Cooling method	N-Pyr, ppb (Uncorr) Sample		
	1	2	3
Raw	0	0	—
Fried (cold pan)	9	17 ^a	11 ^a
Fried (hot pan)	5	20 ^a	19 ^a
Bake	35 ^a	13 ^a	12 ^a
Broil	12 ^a	12	14 ^a
Baconer	9	7 ^a	16 ^a
Microwave	2	0	3

^aConfirmed by mass spectrometry

indicated that standard frying procedures produced high yields of N-Pyr (5-20 ppb) while one baked sample

produced 35 ppb. Microwave cooking produced essentially no N-Pyr. This same trend was also reported by Herring (27) (Table 4) who showed higher N-Pyr con-

TABLE 4. Effect of added sodium nitrite level on formation of N-nitrosopyrrolidine during cooking (27)

Sample and cooking method	Added sodium nitrite, ppm					
	0	15	30	60	120	170
<i>Bacon</i>						
Pan fried	0	0	5 ^a	10	14	24
Oven baked	0	0	0	6	6	14
Microwave	0	0	4	3	5	2
<i>Fat cook-out</i>						
Pan fried	0	0	10	10	26	30
Oven baked	0	0	4	6	15	14
Microwave	0	0	4	5	12	6

^appb N-nitrosopyrrolidine

tents in both bacon and cooked-out fat in pan-frying than in microwave cooking. N-Pyr levels in the fat cook-out were slightly higher than in the bacon, but they were variable. A recent article by Gough et al. (21) reported the distribution of both N-Pyr and DMN in cooked bacon, in the resulting cooked-out fat, and in the vapor produced during cooking. Up to 10% of DMN was found in the bacon and up to 20% in the cooked-out fat. For N-Pyr the corresponding maximum figures were 25 and 30%, respectively. These results support the unpublished data of Gray and Collins (22) which show that approximately 30% of the N-Pyr is vaporized during the cooking process. These investigators did not study the distribution of DMN during or after the frying of bacon.

Since the rate of N-nitrosation of secondary amines is directly proportional to the square of the nitrite concentration (34, 39), it is not surprising that the amount of nitrite permitted in bacon has received considerable attention. Although nitrate has been extensively used in the past, it only serves as a source of nitrite, being readily reduced by bacteria. The effects of various amounts of nitrite on the formation of N-Pyr during cooking of bacon has been studied by Sen et al. (54). Using bacon samples, prepared with 0, 50, 100, 150, and 200 ppm of nitrite, these authors clearly demonstrated a gradual increase in amounts of N-Pyr in fried bacon with increasing nitrite concentration. The amounts of N-Pyr produced correlated well with the initial concentration of nitrite but not with that of nitrite found in the raw bacon. Herring (27) also showed that increasing nitrite amounts markedly affects N-Pyr formation (Table 4). Since N-nitrosamine formation is directly related to the initial concentration of nitrite, a recent amendment (April, 1975) to the Food and Drug Regulations (Canada) regarding use of nitrites and nitrates in bacon has been made (B. 16. 100, Items P₁ and P₂, Table X1, Part 1). The amount of nitrite to be used in the preparation of side bacon has been reduced to 150 ppm, calculated before any smoking, cooking, or fermentation. Use of nitrate in pumping pickle has also been prohibited.

Since sodium chloride is an important ingredient in

cure mixtures, its effect on the N-nitrosation reaction has been widely studied. The catalyzing effect of certain anions on the N-nitrosation reaction has been well documented. Thiocyanate, iodide, bromide, chloride, and acetate have all been shown to have accelerating effects (4, 14, 32, 49). The order of catalytic activity of the halogens is I > Br > Cl. Fan and Tannenbaum (14) showed the catalytic effect of chloride ions on the N-nitrosation of morpholine at pH 0.5, whereas Boyland et al. (4) were only able to show a very slight accelerating effect at pH 2.0. Fiddler et al. (19) reported no effect of sodium chloride on the formation of DMN in a pH 5.6 buffer. Mirvish et al. (40) investigated the effect of 0.05, 0.15 and 0.50 M sodium chloride on the N-nitrosation of sarcosine at pH 1.5, 2.5, and 3.0 and reported 34 and 55% reductions in N-nitrosation by chloride ions at pH 2.5 and 3.5, respectively.

Sodium chloride has been recently shown to affect the N-nitrosation of proline at different pH values (28). They demonstrated a definite accelerating effect by chloride ions at pH 0.5, a very slight inhibitory effect at pH 2.5, and moderate inhibition at pH 4.0 and 5.5. These investigators explained these phenomena by the nature of the N-nitrosating species existing at the various levels of pH. The enhanced rate of N-nitrosation at pH 0.5 was probably due to formation of activating nitrosyl chloride. The accelerating effect of nitrosyl chloride outweighs the inhibitory effect of the chloride ions. At intermediate acidities (pH 2.5), formation of nitrosyl chloride was not as great as at higher acidities and a slight inhibiting effect of sodium chloride on N-nitrosation was observed at this pH. It was also suggested that the N-nitrosating species were a mixture of nitrosyl chloride and nitrous anhydride. At lower acidities (pH 4.0 and 5.5), the promoting effect of nitrosyl chloride was negligible and the nitrous anhydride mechanism was predominant at these levels of pH.

As yet, there have been few data published on how sodium chloride affects formation of N-Pyr in bacon. Scanlan (50), however, concluded that since the pH of most foods to which nitrite and chloride are added is above pH 4.0, it is expected that chloride ions would have an inhibitory rather than an accelerating effect on N-nitrosamine formation.

Ascorbic acid, sodium ascorbate, erythorbic acid, and sodium erythorbate have been used for many years to improve the color characteristics of cured meats. While levels of ascorbic acid permitted in pumping pickles fall within the category of "Good Manufacturing Practice," the amounts used in Canada generally lie within the range, 0.0225 to 0.047% for side bacon (57).

In addition to improving the color and flavor of cured meat products such as ground pork, ascorbic acid has been recently shown to be an effective inhibitor of the N-nitrosation reaction (14, 24, 41). Fiddler et al. (18) showed that frankfurters prepared with either 550 or 5500 ppm of ascorbic acid and 1500 ppm of nitrite and processed for 2 h had no DMN present, in

comparison with the approximate 10 ppb present in the samples made with nitrite alone. Brown et al. (6) evaluated hams, cured with various amounts of nitrite and ascorbic acid for flavor and texture desirability. Their studies revealed that hams treated with sodium ascorbate had lower residual nitrite than non-ascorbate treated hams. Higher levels of ascorbate, as expected, resulted in increased nitrite depletion.

The effect of increasing amounts of ascorbic acid on N-Pyr formation in bacon containing typical sodium nitrite cures has also been extensively studied (27). Bacon, stored for 1 and 13 days at 40 F before curing and containing 1000 ppm of sodium ascorbate did not produce any N-Pyr on frying (Table 5). Decreasing the

TABLE 5. Effect of ascorbate level on N-nitrosopyrrolidine level (ppb) in fried bacon (27)

Added ascorbate (ppm)	Storage condition	
	1 day ^a at 40 F	13 days ^a at 40 F
0	7 ^b	18
250	6	11
1000	0	0

^aDays after cut of carcasses

^bppb N-nitrosopyrrolidine

amount of ascorbate to 250 and 0 ppm increased the amount of N-Pyr formed. A series of experiments conducted jointly by the American Meat Industry, United States Department of Agriculture-Agricultural Research Service (USDA-ARS), and the Food and Drug Administration (FDA) further investigated the potential of increasing ascorbic acid amounts in the cure as a means of controlling N-Pyr formation in bacon (26). Two amounts of sodium ascorbate (330 and 1000 ppm) were investigated and the results are presented in Table 6.

TABLE 6. Effect of sodium ascorbate levels on N-nitrosopyrrolidine formation in fried bacon (analyses by USDA-ARS, U.S. commercial plant bacon study) (26)

Ascorbate levels (ppm)	N-Pyr (in ppb) assays of fried bacon (170 ppm nitrite)			
	with 0.4% tripolyphate		without tripolyphosphate	
	fried by packer	fried by ARS	fried by packer	fried by ARS
330	4	11	15	3
1000	3	0	3	0

This reduction of N-Pyr formation in both phosphated and non-phosphated bacon with increased ascorbate amounts was also demonstrated by FDA analyses of similar samples (26).

Mottram et al. (45) investigated the influence of ascorbic acid and pH on formation of DMN in cured pork containing added dimethylamine (0.1%). Addition of sodium ascorbate to the brine was shown to suppress DMN formation. Heating of the cured pork by canning or frying resulted in formation of small amounts of DMN in the lean and considerably higher concentrations in the fried fat. However, the lowest amounts of DMN were found in the bacon cured in the presence of ascorbate.

A recent investigation by Sen et al. (53) showed that treating bacon with 1000 ppm of propyl gallate,

piperazine, sodium ascorbate, or ascorbyl palmitate before frying, markedly reduces the formation of N-Pyr during cooking. It was also reported that sodium ascorbate was not as effective as inhibitor as the other three compounds.

At the International Symposium of nitrite in meat products held in Zeist in September, 1973, one of the conclusions of the chemical and technical session was that ascorbic acid appeared to be the most promising means of suppressing N-nitrosamine formation in cured meat products. However, as pointed out by Greenberg (26) it remained to be determined whether such large amounts of ascorbate would remove sufficient nitrite from the product so as to create a hazard from *Clostridium botulinum*. However, a recent publication by Bowen et al. (3) shows that this is not likely to be a problem. These investigators studied the effect of ascorbate on the effectiveness of nitrite in controlling formation of botulinal toxin in wieners. Wieners prepared with various amounts of nitrite and ascorbate and containing approximately 1000 spores of *C. botulinum* per gram of raw premix were stored for 8 weeks at 28 C. The number of toxic samples declined rapidly for all ascorbate levels after the level of 50 ppm of nitrite, from which the investigators concluded that the presence of sodium ascorbate in vacuum-packed wieners did not adversely affect inhibition of botulinal toxin formation by sodium nitrite.

CONCLUSIONS

Since the specter of N-nitrosamine formation is unfortunately very real, the bacon industry is striving to reduce the amount of N-Pyr formed during frying. Certain steps have already been taken such as lowering the permitted amount of sodium nitrite. However, the extent to which this can occur is limited because of the hazard of botulinal toxin formation. Development of a suitable preservative would certainly permit a reduction in amount of nitrite. Development of an adequate substitute for nitrite is another possibility, but it is going to be extremely difficult to find any one substance which will effectively replace nitrite. It is very likely that a combination of substances is necessary to provide the desirable color, flavor, antioxidant, and preservative effects usually associated with nitrite.

Ascorbic acid and its salts currently appear to be the best means of inhibiting N-nitrosamine formation. However, as pointed out by Pensabene et al. (47), they do not completely inhibit the N-nitrosation reaction. This may be due to the limited solubility of these reductants in adipose tissue.

While most of the recent N-nitrosamine research has concentrated on N-Pyr and its precursors in bacon, there have been several reports of DMN being present in both raw (52) and cooked bacon (11, 21, 52). As yet, there have been no reports as to the actual precursor of this N-nitrosamine in bacon. Model system studies have implicated several compounds including sarcosine (13)

and lecithin (42). This problem should be further studied in light of the extreme carcinogenicity of DMN.

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3-A Sanitary Standards for Polished Metal Tubing for Dairy Products

Number 33-00

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. Specifications for polished metal tubing heretofore or hereafter developed which so differ in material, construction, or otherwise, as not to conform with the following standards, but which in the manufacturer's or 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 polished metal tubing used to conduct dairy products in processing lines or systems that also may include sanitary fittings. These standards do not apply to tubing used in pneumatic conveying systems for dry milk and dry milk products.

A.2

In order to conform to these 3-A Sanitary Standards, tubing shall comply with the material and fabrication sections.

B. DEFINITIONS

B.1

Product: Shall mean the dairy products conducted in and/or processed in tubing.

B.2

SURFACES

B.2.1

Product Contact Surfaces: Shall mean all surfaces which are exposed to the product.

B.2.2

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

C. MATERIALS

C.1

Product contact surfaces shall be of stainless steel of

¹The data for this series are contained in the following reference: *AISI Steel Products Manual, Stainless & Heat Resisting Steels, December 1974, Table 2-1, pp. 18-19. Available from American Iron and Steel Institute, 1000 16th Street NW, Washington, D.C. 20036.*

²Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

the AISI 300 series¹ (See Appendix, Section E.), or stainless steel of other AISI series which under conditions of intended use is at least as corrosion resistant as stainless steel of the AISI 300 series and is non-toxic and non-absorbent.

D. FABRICATION

D.1

Product contact surfaces shall have a ground and/or polished finish at least as smooth as a No. 4 finish on stainless steel sheets free of imperfections such as pits, folds and crevices. (See Appendix, Section F.).

D.2

Tubing shall be of the seamless or welded types.

D.3

Stainless steel tubing shall comply with the applicable provisions of ASTM² Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing Designation A270-75. The finish of product contact surfaces shall be as provided in D.1 above.

D.4

Non-product contact surfaces shall have a smooth surface and be free of pockets and crevices.

APPENDIX

E. STAINLESS STEEL MATERIALS

Stainless steel conforming to the applicable composition ranges established by AISI¹ for wrought products, should be considered in compliance with requirements of Section C.1 herein. Where welding is involved, the carbon content of the stainless steel should not exceed 0.08 percent. The reference cited in C.1 sets forth the chemical ranges and limits of acceptable stainless steels of the 300 series.

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.

TUBING INSIDE DIAMETER

To provide complete drainage of product contact surfaces of sanitary product pipelines that include polished metal tubing and sanitary fittings, the tubing and the fittings should have the same nominal inside diameter.

These standards are effective January 12, 1977.

3-A Sanitary Standards for Batch and Continuous Freezers for Ice Cream, Ices and Similarly-Frozen Dairy Foods

Number 19-02

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. Specifications for batch and continuous freezers for ice cream, ices and similarly-frozen dairy foods heretofore or 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 IAMFES, USPHS, and DIC at any time.

A.

SCOPE

A.1

These standards cover the sanitary aspects of batch and continuous freezers for ice cream, ices and similarly-frozen dairy foods and equipment integral therewith, including pumps, equipment for incorporating air or introducing flavoring material into the product and mix supply tanks attached to and made a part of the freezer. These standards cover equipment designed for the freezing of ice cream, ices and similarly-frozen dairy foods which are to be subsequently hardened in cold storage rooms, cabinets, tunnels or boxes. They do not pertain to equipment designed for freezing soft ice cream, malts, custards, and similarly-frozen products which are served to the consumer without further hardening.

A.2

In order to conform with these 3-A Sanitary Standards, batch and continuous freezers for ice cream, ices and similarly-frozen dairy foods shall comply with the following design, material, and fabrication criteria.

B.

DEFINITIONS

B.1

Batch Freezers: Shall mean equipment designed to be operated intermittently with the cycle consisting of (1) admitting the product to the freezing cylinder, (2) partially freezing and incorporating air into the product, (3) adding fruits, nuts, and flavoring materials when desired and (4) discharging the product,

the cycle to be repeated as required.

B.2

Continuous Freezers: Shall mean equipment designed to be operated in such a manner as (1) to partially freeze and incorporate air into the product as it flows continuously through the freezing cylinder and (2) discharge the product.

B.3

Product: Shall mean the liquid ice cream, ices and similarly-frozen dairy food mixes and the viscous, semi-solid material, to which may have been added fruits, nuts, and other flavoring materials, with or without incorporated air resulting from the partial freezing of these mixes.

B.4

Surfaces

B.4.1

Product Contact Surface: Shall mean all surfaces which are exposed to the product and surfaces from which liquids and/or solids may drain, drop or be drawn into the product. Lines for air under pressure shall be considered product contact surfaces from the point of entrance to the freezing cylinder or product contact point to the product check valve.

B.4.2

Non-Product Contact Surface: 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.

B.6

Engineering Plating: Shall mean plated to specific dimensions or processed to specified dimensions after plating.¹

C.

MATERIALS

C.1

Sanitary fittings and pumps that have product contact surfaces that are integral parts of and furnished with freezers shall comply with applicable material provisions of the 3-A standard for sanitary fittings, Number 08-17 or to the applicable material provisions of the 3-A standard for pumps, Number 02-06, respectively.

C.2

Other product contact surfaces shall be of stainless steel of the AISI 300 series² or corresponding ACI³ types (See Appendix, Section E.), or metal which under conditions of intended use is at least as corrosion-resistant as stainless steel of the foregoing types and is non-toxic and non-absorbent, except that:

C.2.1

Freezing cylinder liners or tubes made of the materials provided for in C.2 may be covered with an engineering plating of chromium.

C.2.2

Freezing cylinder liners or tubes may also be made of other non-toxic structurally suitable heat-exchange metal made corrosion-resistant and wear-resistant by covering the product contact surface(s) with an engineering plating of chromium.

C.2.3

Bearings, springs, shafts, couplings, drive and mounting pins, and scraping parts may also be made of stainless steel of the AISI 400 series or may be made of non-toxic, non-absorbent metal that is as corrosion-resistant, under conditions of intended use, as stainless steel of the AISI 400 series or is made as corrosion-resistant by a covering of an engineering plating of nickel or chromium.

C.2.4

Solder shall be non-toxic and non-absorbent.

C.2.5

Silver soldered or brazed areas and silver solder or braze material shall be non-toxic, non-absorbent and corrosion-resistant.

C.2.6

Rubber and rubber-like materials may be used for bearings, metering devices, air tubing, port covers, and multi-use gaskets, seals and parts used in similar applications. These materials shall conform to the applicable provisions of the 3-A standard for rubber and rubber-like materials, Number 18-00.

C.2.7

Plastic materials may be used in sight openings and for bearings, metering devices, air tubing, port covers, and multi-use gaskets, seals and parts used in similar applications. These materials shall comply with the applicable provisions of the 3-A standard for plastic materials, Number 20-00, as amended.

C.2.8

Rubber and rubber-like materials and plastic materials used for bonded gaskets having product contact surfaces, shall be of such composition as to retain their surface and conformation characteristics when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment.

C.2.9

The final bond and residual adhesive, if used, of bonded rubber and rubber-like materials and bonded plastic materials shall be non-toxic.

C.2.10

Glass of a clear heat-resistant type may be used in sight openings.

C.2.11

Where materials having certain inherent functional properties are required for specific applications, such as scraper parts and seal parts, tungsten carbide or carbon or ceramic materials may be used. Tungsten carbide, carbon and ceramic materials shall be inert, non-porous, non-toxic, non-absorbent, insoluble, resistant to scratching, scoring and distortion when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment.

C.2.12

Single-service sanitary-type gaskets may be used on parts which must be disassembled for cleaning.

C.3

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

¹QQ-C-320a *Federal Specification for Chromium Plating (Electrodeposited)* July 26, 1954. (Available from General Services Administration, Seventh and D Streets, SW, Washington, D.C.)

QQ-N-290 *Federal Specification for Nickel Plating (Electrodeposited)* April 5, 1954, and Amendment I, December 13, 1961. (Available from General Services Administration, Seventh and D Streets, SW, Washington, D.C.)

²The data for this series are contained in the following reference: *AISI Steel Products Manual, Stainless and Heat Resisting Steels*, December 1974, Table 2-1, pp. 18-19. Available from American Iron and Steel Institute, 1000 16th Street NW, Washington, D.C. 20036.

³Alloy Casting Institute Division, *Steel Founders' Society of America*, 20611 Center Ridge Road, Rocky River, OH 44116.

D.

FABRICATION

D.1

Product contact surfaces shall be at least as smooth as a No. 4 finish on stainless steel sheets free of imperfections such as pits, folds and crevices. (See Appendix, Section F.).

D.2

Permanent joints in metallic product contact surfaces shall be continuously welded. If it is impractical to weld, they may be silver soldered or brazed; or if this is not practical, the joint may be fitted in a manner that it will be completely rigid and without pockets or crevices. These areas having product contact surfaces shall be at least as smooth as a No. 4 finish on stainless steel sheets free of imperfections such as pits, folds and crevices.

D.3

Solder and silver solder may be used around blade mounting pins, shafts, bushings, and bearings for flushing joints and for producing fillets for minimum radii.

D.4

The thickness of engineering plating on product contact surfaces shall be not less than 0.0002 inch except that when these surfaces are other than stainless steel, the thickness of engineering plating shall be not less than 0.002 inch.

D.5

Product contact surfaces not designed to be mechanically cleaned shall be easily accessible for cleaning and inspection either when in an assembled position or when removed. Removable parts shall be readily demountable.

D.6

Freezers that are to be mechanically cleaned shall be designed so that product contact surfaces (1) can be mechanically cleaned and (2) are accessible for inspection.

D.7

Gasket retaining grooves in product contact surfaces shall be no deeper than their width.

D.8

Radii

Internal angles of 135° or less on product contact surfaces shall have radii of not less than ¼ inch except that:

D.8.1

Smaller radii may be used when required for essential functional reasons such as sealing ring grooves, scraper blade mounting pins, holes or grooves, guides for batch freezer discharge gates and other assemblies of machined parts.

D.8.2

The radii in grooves for standard ¼ inch O-Rings shall

be not less than 3/32 inch and for standard 1/8 inch O-Rings shall be not less than 1/32 inch.

D.8.3

When for functional reasons the radius must be less than 1/32 inch, in such applications as flat sealing surfaces, the product contact surface of this internal angle must be readily accessible for cleaning and inspection.

D.9

Sanitary tubing, fittings and connections shall comply with the applicable fabrication provisions of the 3-A standard for sanitary fitting, Number 08-17.

D.10

Pumps having product contact surfaces shall comply with the applicable fabrication provisions of the 3-A standard for pumps, Number 02-06.

D.11

There shall be no threads on product contact surfaces, except those in pumps as provided for in the 3-A standard for pumps, Number 02-06.

D.12

Coil springs having product contact surfaces shall have at least 3/32 inch openings between coils including the ends when the spring is in a free position.

D.13

Shafts of freezers shall have a seal of a packless type, sanitary in design.

D.14

Openings in the freezing cylinder liner shall be fitted with a permanently installed sanitary pipeline fitting unless the opening is closed by another part of the freezer such as the shaft and seal or the front head.

D.15

When air drawn from the atmosphere is introduced into the product in a continuous freezer a single service filter shall be installed in the air line as close as practicable to the point of air application, and a spring loaded product check valve of sanitary design shall be installed between the filter and the point of air application.

D.16

When air under pressure is introduced into the product, a single service filter shall be installed in the air line as close as practicable to the point of air application, and a product check valve of sanitary design shall be installed downstream from the filter.

D.17

The filter required in D.15 and D.16 shall be capable of removing particles of 5 microns (0.0002 inch) or larger in size.

D.18

Equipment for producing air under pressure and/or air piping which is supplied as an integral part of the freezer shall comply with the applicable provisions

of the 3-A accepted practices for supplying air under pressure, Number 604-03.

D.19

Gaskets having a product contact surface shall be removable or bonded.

D.20

Bonded rubber and rubber-like gaskets and bonded plastic gaskets shall be bonded in a manner that the bond is continuous and mechanically sound and so that when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment the rubber or rubber-like material or the plastic material does not separate from the product contact surface.

D.21

Freezer Supports

The means of supporting a freezer shall be one of the following:

D.21.1

With legs: Legs shall be smooth with rounded ends, have no exposed threads, and shall be of sufficient length to provide a clearance between the lowest part of the base and the floor of no less than 6 inches. Legs made of hollow stock shall be sealed.

D.21.2

Mounted on a slab or island: The base shall be designed for sealing to the slab or island surface. (See Appendix, Section G.).

D.21.3

Mounted on a wall or column: The point of attachment of a freezer cylinder(s) to its mounting shall be designed for sealing. The mounting, if supplied by the freezer manufacturer shall be designed for sealing to the wall or column. The design of a freezer with a cylinder(s) to be mounted on a wall or column shall be such that there will be at least a 4-inch clearance between the outside of the cylinder(s) and the wall or column.

D.22

A freezer designed to be installed partially outside a processing area, shall be provided with a plate or other suitable member to close the opening in the processing room wall or ceiling and shall be such that it can be sealed to the wall or ceiling.

D.23

Guards required by a safety standard that will not permit accessibility for cleaning and inspection shall be designed so that they can be removed without the use of tools.

D.24

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.25

Mix Supply Tanks

Integral mix supply tanks, if used, shall comply with the following:

D.25.1

The tank shall be provided with a cover. Tank covers (1) shall be self-draining, (2) shall be provided with a handle(s) of sanitary design, (3) shall have downward flanges not less than 3/8 inch along each edge and (4) shall be close fitting.

The edges of openings in the cover shall extend upwards at least 3/8 inch or be fitted with a permanently installed sanitary pipeline fitting. Openings in the cover not fitted with a permanently installed sanitary pipeline fitting shall be provided with removable covers having downward flanges of not less than 1/4 inch. Non-removable covers shall be designed so that when the covers are in any open position, liquid from the exterior surface will not drain into the tank and shall be designed so that when in their fully opened position, drops of condensation on the underside will not drain into the tank.

D.25.2

Tank valves shall conform to the applicable provisions of the 3-A standard for sanitary fittings, Number 08-17.

D.25.3

Tanks having a capacity of such volume that the contents of the tank will normally not be transferred to the freezing cylinder within 30 minutes shall be so designed that the temperature of the mix will not exceed 45°F (7.2°C) at any time. In determining conformance with this temperature requirement, the test shall be conducted in an ambient temperature of 100°F (37.8°C).

D.25.4

Sight 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 tank or cover. The inside diameter of the opening shall be at least 3 3/4 inches.

D.26

Fruit and/or flavor funnels and observation ports shall be provided with self-draining removable covers having downward flanges of not less than 1/4 inch and handles of sanitary design.

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.2 herein. Where welding is involved, the carbon content of the stainless steel should not exceed 0.08 percent. The first reference cited in C.2 sets forth

the chemical ranges and limits of acceptable stainless steels of the 300 series. Cast grades of stainless steel equivalent to types 303, 304, and 316 are designated CF-16F, CF-8, and CF-8M respectively. These cast grades are covered by ASTM⁴ Specifications A296-68 and A351-70.

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.

SLABS OR ISLANDS

When a freezer is designed to be installed on a slab or island, the dimensions of the slab or island should be such that the base of the freezer will extend beyond the slab or island at least 1 inch in all horizontal directions. The slab or island should be of sufficient height so that the bottom of all product connections are not less than 4 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 freezer base and the slab or island should be sealed.

H.

INFORMATION PLATE

Manufacturers should provide an information plate in juxtaposition to the name plate giving the following information or the information should appear on the name plate:

- (1) If the freezer is or is not designed for mechanical cleaning.
- (2) A statement that to prevent corrosion the recommendations of the freezer manufacturer should be followed with respect to time, temperature and the concentration of specific cleaning solutions and chemical bactericides.

These standards shall become effective January 22, 1977 at which time the "3-A Sanitary Standards for Batch and Continuous Freezers for Ice Cream, Ices and Similarly-Frozen Dairy Foods, Serial #1900" and the amendment to it, Serial #1901 are rescinded and become null and void.

⁴Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

Amendment to 3-A Sanitary Standards for Centrifugal and Positive Rotary Pumps for Milk and Milk Products

Number 02-06A

*Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee*

The "3-A Sanitary Standards for Centrifugal and Positive Rotary Pumps for Milk and Milk Products, Serial Number 02-06" are amended by the deletion of subsection D.18 of Section D. FABRICATION.

This amendment is effective October 16, 1976 for an interim period pending resolution of the matter on a permanent basis.

Amendment to 3-A Sanitary Standards for Scraped Surface Heat Exchangers

Number 31-00A

*Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee*

The "3-A Sanitary Standards for Scraped Surface Heat Exchangers, Serial Number 31-00" are amended by deleting the following in subsection D.17 of section D. FABRICATION:

(2) If the SSHE is or is not designed for mechanical cleaning.

This amendment is effective October 16, 1976 for an interim period pending resolution of the matter on a permanent basis.

Amendment to 3-A Sanitary Standards for Uninsulated Tanks for Milk and Milk Products

Number 32-00A

*Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee*

The "3-A Sanitary Standards for Uninsulated Tanks for Milk and Milk Products, Serial Number 32-00" are amended by the deletion of subsection D.24 of section D. FABRICATION.

This amendment is effective October 16, 1976 for an interim period pending resolution of the matter on a permanent basis.

Amendment to 3-A Sanitary Standards for Batch and Continuous Freezers for Ice Cream, Ices and Similarly-Frozen Dairy Foods

Number 19-02A

*Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee*

The "3-A Sanitary Standards for Batch and Continuous Freezers for Ice Cream, Ices and Similarly-Frozen Dairy Foods, Number 19-02" are hereby amended by deleting the following in APPENDIX, SECTION H:

(1) If the freezer is or is not designed for mechanical cleaning.

This amendment is effective January 22, 1977 for an interim period pending resolution of the matter on a permanent basis.

Amendment to 3-A Sanitary Standards for Equipment Packaging Frozen Desserts, Cottage Cheese and Similar Dairy Products

Number 23-01A

*Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee*

The "3-A Sanitary Standards for Equipment for Packaging Frozen Desserts, Cottage Cheese and Similar Dairy Products, Number 23-01" are hereby amended by deleting the following in APPENDIX, SECTION I:

(1) If the filling equipment is or is not designed for mechanical cleaning.

This amendment is effective January 22, 1977 for an interim period pending resolution of the matter on a permanent basis.

Presidential Address

HAROLD E. THOMPSON, JR.

*Food and Drug Administration
 200 C Street, S.W., Washington, D.C. 20204*

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This is the year of the Bicentennial, a year of nostalgia embracing the principles, thoughts, and hopes of those who helped create the United States. As has been noted many times and particularly emphasized this year, the principles set forth by a group of men in Philadelphia in 1776 still remain viable and the bases of our Nation today. So it is with the International Association of Milk, Food and Environmental Sanitarians.

Thirty-five men met in 1911 and created the International Association of Milk Inspectors. From their deliberations came two basic objectives for the new association which were incorporated into our first constitution. They were service and leadership; service to the sanitarians and through the sanitarians to the public and industry; leadership by providing the sanitarians and others with knowledge and training to develop this service. These objectives are and should be the prime consideration of IAMFES. True, the scope of our service and leadership has expanded to include areas not even thought of or considered at that first meeting. This is as it should be as change is inevitable. Our Association has always been cognizant of change and yet has never lost sight of our basic objectives. Our performance in these areas is the reason the Association is recognized as a leader in our field.

A YEAR OF CONSOLIDATION

The past year, while successful, probably can best be described as a year of consolidation. Past gains were strengthened and new ideas advanced for solving our problems. Progress was made, not perhaps as great as was desired, but it was significant and certainly strengthened the Association.

I should like to share with you some of the progress and success, the problems and the direction the Association is going.

MORE CONTACTS WITH AFFILIATES

One of the significant actions taken which certainly should strengthen the contacts between the Association and our members and affiliates is the addition to the staff of Barbara Lee as Assistant Executive Secretary and Associate Editor of the *Journal*. It has been recognized for some time that better liaison and better communication with our affiliates, educational institutions, the sanitarians, and others is necessary if we are to maintain our leadership. We feel that Mrs. Lee will

help us fill this gap. Mrs. Lee's responsibilities will include liaison with state and national affiliate groups, coordination of workshops and short courses sponsored by IAMFES, supervision of production of the *Journal*, and organization of student affiliate groups. Mrs. Lee brings talent and enthusiasm to her new position and I wish to welcome her aboard.

FINANCES SOUND

Our financial position remains sound primarily due to our Executive Secretary and the newly formed budget committee. They have worked together long and hard to provide a sound basis for operation of the Association. I should note that the budget committee will report on their activities at the business meeting. While our present financial situation is sound, it does not provide for some activities which are necessary to strengthen the Association. It hardly seems necessary to remind you of the economic situation that exists today. Limitations on travel and other expenditures have hampered our efforts to institute many worthwhile projects. A great deal of thought has been given to ways to provide more consistency in our essential activities. A foundation has been established within the Association. This foundation will receive monies and will administer, separate from the finances of the Association, those funds according to the need.

COMMITTEES

I should like to spend just a few minutes in discussing the importance of our many committees. The significance of the work of these committees cannot be over emphasized. Despite a critical problem with travel which does not permit these committees to meet as they should, they have continued to maintain their important place in our Association. The work of these committees continue to exert a significant influence on food protection, both nationally and internationally. Work of the 3-A Sanitary Standards Committee, the Bakery Industry Committee, and the National Sanitation Foundation has had far reaching effects on equipment used in the production and processing of food. Our Applied Laboratory Methods Committee is deeply involved with revision of *Standard Methods for the Examination of Dairy Products* and our Farm Methods Committee continues to make significant contributions to improvement of animal health and sanitary

procedures of dairy farms.

The Committee on Communicable Diseases Affecting Man for the past several years has worked long and hard to complete a revision of the *Procedures to Investigate Foodborne Illness*. Previous editions of this booklet have received wide acceptance and have proved a valuable guide in epidemiological investigations. This new edition I'm sure will continue to contribute to furthering the improvement of epidemiological techniques. The new edition is now available.

MEMBERSHIP

While our membership increased in the past 2 years, there has been no significant increase this year. In fact, it appears we have reached what I hope is a temporary plateau. This is of concern to your Executive Board and will be given a great deal of study. We are striving to continue our growth and our efforts to strengthen our relationship with our affiliates and provide more direct contact and services to our membership. In our endeavors we need everyone's help and I most sincerely solicit your assistance. We need your help to reach the great number of unaffiliated sanitarians who most certainly will benefit materially as members of this Association.

Again, we have not been able to work as closely with the affiliates as we had anticipated. However, with Mrs. Lee on our staff we should overcome many of the problems.

I am pleased to announce that we have a new affiliate, the National Association of Dairy Fieldmen. It was in recognition of the need to maintain a professional organization that the Board of Directors and advisors of the National Association of Dairy Fieldmen recommended that the organization become an affiliate of IAMFES. Both organizations should benefit as reports of the Fieldmen's Association will appear in the *Journal* as well as articles of interest to the professional fieldmen as well as sanitarians.

You will note that included in the Wednesday afternoon program is a special session devoted to the dairy fieldmen. We welcome these new affiliates and look forward to a long and beneficial association.

THE JOURNAL

The *Journal* continues to gain in stature as evidenced by its wide circulation throughout the world including 72 countries outside the United States. In the past year there have been a number of papers from foreign countries which in itself testifies to the recognition the *Journal* is receiving. Several changes have been made which hopefully will strengthen the *Journal* and make it more effective. As you have probably noted by now, the name *Journal of Milk and Food Technology* will be changed to *Journal of Food Protection*. This change was not made lightly but after careful deliberations and was considered to have these advantages: (a) the new name more accurately reflects the content of the *Journal*; (b) the new name reflects more accurately the major objective of IAMFES; (c) the word "technology" which

is overused in titles of many journals has been eliminated; and (d) the change will in no way affect the wide recognition that the *Journal* now enjoys.

The change in the name will become effective January, 1977. As you will note the new title has appeared in subdued type and will become bolder as January, 1977 approaches with the simultaneous fading of the present name.

The price of the *Journal* to subscribers, that is libraries, institutions, and others, has been raised from \$16 to \$32 per year. You will be pleased to hear that this has had no negative effect on the number of subscribers.

We are still striving to balance the *Journal* with respect to technical and nontechnical articles. However, it seems we still must contend with the lack of desire or interest to prepare and submit nontechnical articles to the editor. I am sure many of you are engaged in projects and activities that would be of great interest and assistance to your fellow sanitarians. Why not take the time to tell us about these through the *Journal* and allow us all the benefit.

RELATIONSHIP WITH NEHA

As you know a little over a year ago our Executive Board and the Executive Board of the National Environmental Health Association (NEHA) met to discuss the feasibility of unification of the two organizations. During this discussion a timetable proposed by the IAMFES Executive Board was agreed to which would permit positive action in exploring the feasibility of unification. Last year, in his presidential address, Parnell Skulborstad made you aware of the background and purpose of this timetable. Unfortunately, this timetable has not been adhered to. Planned meetings between the two Executive Boards which are necessary to thoughtfully prepare for future joint action have not taken place. In order for the membership of each organization to become acquainted with the purposes and activities of the other, the timetable called for a joint annual meeting in 1979 at a mutually agreed on site. We have selected a site committee to work with NEHA but it is our understanding that NEHA has already made its selection for 1979. Whether this indicates a lack of interest or concern on NEHA's part I do not know. I do know that any efforts toward unification have been postponed as your Executive Board firmly believes that if unification is to be approached or considered it must be through the type of proposal or timetable that was agreed to by the respective Executive Boards.

CONSTITUTIONAL CHANGES

As you will recall last year we approved certain changes in the Constitution and Bylaws. Final approval were given the changes by the membership through a mail ballot. The most significant was the Constitutional change which made the Secretary-Treasurer a fullfledged member of the Executive Board. In recent years the role of the Secretary-Treasurer had diminished

as the Executive Secretary had taken over practically all of the responsibilities. As was previously explained, some thought had been given to abolishing the office of Secretary-Treasurer. However, we were advised that such an office was necessary as in an emergency a Secretary-Treasurer would be available to carry on the duties of the Executive Secretary. Therefore, as was true this year and will continue in the future, we will vote for a Secretary-Treasurer rather than a Second Vice President. The newly elected person will then advance through the Association's offices as is done presently. Perhaps I have discussed this in more detail than was necessary. However, inquiries concerning the recent election indicated there was some confusion as to the role of the Secretary-Treasurer. As you probably know, Dick March who has been our Secretary-Treasurer for the past several years was selected to continue in the new position.

THE FUTURE

Earlier I spoke of change and that change is inevitable. We either meet these changes independently or someone else will take over. While we can profit by our past experience, we must face the future and not back into it. To accomplish this we cannot afford to work in a vacuum, each of us working by ourselves. There must be close ties within our Association and within our committees and a two-way flow of ideas, information, and problems among our membership. Our greatest hurdle is to learn to work together, to recognize the

interdependence of the Association and members and their contributions. Each of us need to be concerned with what each of us can contribute. The needs of the Association demand this and in the final analysis a viable, healthy, progressive Association must have this cooperation.

The future is bright for our Association but it will remain so only if we are prepared to meet it with vigor and ideas and positive action. These are challenging days for our Association. Our responsibilities are great, but the opportunities and rewards are even greater.

IN CONCLUSION

In closing I ask your indulgence to inject a personal note. I would like to express my appreciation to you for allowing me to serve as an officer of the Association. This service has afforded me a rich experience that has given me more than I have given. I would like to express my gratitude to the men with whom I have served on the Executive Board and to express to them my appreciation for their ever present willingness to assume responsibility and to work at the many tasks which have been necessary during the past year. I would also like to thank the chairmen and members of committees for their support and continuing efforts. I am confident of and have, with the spirit of cooperation, leadership and service that prevails, a growing optimism for the future of the International Association of Milk, Food and Environmental Sanitarians.

Abstracts of Papers Presented at the Sixty-Third Annual Meeting of IAMFES

Arlington Heights, Illinois, August 8-11, 1976

The program of the 63rd Annual Meeting included both contributed research papers and invited papers. Abstracts of all the research papers and most of the invited papers appear below. The complete text of many of these papers will appear in future issues of the *Journal of Food Protection*.

CONTRIBUTED RESEARCH PAPERS

Handling Perishable Foods. Sidney E. Barnard, Morris G. Mast, and Gerald R. Kuhn, *Food Science Department, The Pennsylvania State University, 9 Borland Laboratory, University Park, Pennsylvania 16802.*

Food service industry management has been interested in helping to meet sanitary regulations, reduce food spoilage, lengthen keeping quality, and prevent foodborne illness. Materials were developed for 1-day workshops to provide practical suggestions for handling perishable preserved foods. Products included were meats, poultry and eggs, milk and dairy products, delicatessen, fruits, vegetables, and seafood. A 200-page reference book and 12 sets of slides or filmstrips were used to outline spoilage, food poisoning, personal hygiene, equipment sanitation, and proper food handling practices. A pilot program has been conducted at seven locations in Pennsylvania. Participants have been supervisors from stores, schools, hospitals, nursing homes, restaurants, vending companies, and fast food operations. Educational materials and programs will train food service personnel how to handle perishable foods.

Thermal Inactivation of *Clostridium botulinum* Type A Toxin in Acetate Buffer. J. G. Bradshaw, J. T. Peeler, and R. M. Twedt, *Food and Drug Administration, 1090 Tusculum Avenue, Cincinnati, Ohio 45226.*

More data on inactivation of *Clostridium botulinum* toxins are needed to evaluate the potential of these toxins to persist through the heat process used in preparation of foods. To determine the time-temperature relationship for inactivation of one type of botulinum toxin, we prepared *C. botulinum* type A crude toxin from three strains (62A, V141, and 73A), diluted these to approximately 30,000 MLD₅₀ per ml in 0.1 M acetate buffer at pH 5.0, and heated at temperatures ranging from 71.1 C (160 F) to 80 C (176 F). The maximum times for toxin inactivation of 62A toxin to less than 1 MLD at 160, 164, 168, and 172 F were 163.8 min, 38.9 min, 13.9 min, and 1.52 min, respectively. Inactivation times for V141 toxin at the same temperatures were 76.9, 26.9, 7.31, and 2.62 min, respectively. Type A toxin from strain 73A was inactivated at 46.96, 14.97, 4.0, and 1.03 min, respectively, for 164, 168, 172, and 176 F inactivation temperatures. These data were obtained in acetate buffer as a first step in a study on inactivation in foods. Caution should be used in the application of these data to foods.

Toxinogenic Potential of Molds Isolated from Moldy Cheese Trimmings. L. B. Bullerman, *Department of Food Science & Technology, University of Nebraska, Lincoln, Nebraska 68583.*

Moldy cheese trimmings were obtained from commercial outlets and representative molds were isolated directly from the samples. All isolates were screened for mycotoxin production on yeast-extract sucrose broth at 13 C. Presence of known mycotoxins in culture extracts was determined by thin-layer chromatography. Moldy cheese trimmings were also extracted and examined for known mycotoxins. All mold isolates were further tested for resistance to potassium sorbate using Czapek's agar incubated at 5 and 21 C. A total of 327 molds were isolated from various samples and classified as *Penicillium* (93%), *Cladosporium* (4.0%), *Fusarium* (0.9%), and other genera (1.8%). No *Aspergillus* species were found. Four culture extracts contained penicillic acid, one contained patulin, and one contained ochratoxin A. Potentially toxinogenic molds, therefore, comprised only 2% of all molds isolated. One sample of cheese contained ochratoxin A and one appeared to contain aflatoxin B₁. However, there was not enough sample remaining for confirmatory tests. More than 50% of molds isolated were resistant to sorbate. These data indicate that known mycotoxins would not likely be found in cheese as a result of mold growth at low temperatures. However, most molds found were resistant to sorbate and still constitute a persistent nuisance in stored products.

Biodegradation of Aflatoxin by Toxigenic *Aspergilli*. M. P. Doyle and E. H. Marth, *Department of Food Science, University of Wisconsin, Madison, Wisconsin 53706.*

Mycelia from several strains of *Aspergillus parasiticus* and *Aspergillus flavus* were fragmented separately and added to a salts medium containing aflatoxin but deficient in nutrients to support mold growth. Of the five strains tested, some had no effect on aflatoxin but others degraded various amounts of the toxin. For example, during 4 days at 28 C the fragmented mycelium harvested from a 9-day-old culture of *A. parasiticus* NRRL 2999 reduced the concentration of aflatoxin in the salts medium from 1194, 67, 456, and 30 to 617, 22, 314, and 7 µg of B₁, B₂, G₁, and G₂/50 ml, respectively. Strains able to degrade the toxin did so most effectively when the mycelium was harvested from cultures that were 9 to 10 days old rather than from younger or older cultures. Degradation of toxin by mycelia was maximal at 28 C and pH 6.5. Growth of molds on substrates which flavored aflatoxin production yielded mycelia with maximal ability to degrade the toxin. For example, glucose salts, YES, and Y-M media supported substantial production of aflatoxin and yielded mycelia that degraded an appreciable amount of toxin. In contrast, Potato Dextrose Broth and Czapek Dox Broth supported minimal toxin production and yielded mycelia that degraded a small amount of toxin.

Enumeration and Fate of Enteropathogenic and Non-pathogenic *Escherichia coli* During the Manufacture of Camembert Cheese. J. F. Frank, E. H. Marth, and N. F. Olson, *Department of Food Science, University of Wisconsin, Madison, Wisconsin 53706.*

Coliforms in soft ripened cheeses can cause both gassy defects and foodborne illness. We compared the fate of several strains of *Escherichia coli*, pathogenic and nonpathogenic, during manufacture and ripening of Camembert cheese. Also compared were the Most Probable Number, Violet Red Bile Agar (VRBA) pour plate, and Trypticase Soy Agar surface plating plus a VRBA overlay techniques to enumerate *E. coli*. Effects of coliform contamination on the surface of cheese during ripening were evaluated. Adding 100-200 *E. coli*/ml of pasteurized milk from which cheese was made resulted in a maximum of about 10^4 *E. coli*/g 6 h after start of manufacture. After salting, *E. coli* near the surface of cheese were less numerous than at the center, sometimes resulting in absence of detectable *E. coli* near the edge and presence of viable *E. coli* at the center. Cheese 24 h after manufacture was at pH 4.7 or lower and this was accompanied by a decline in *E. coli* population. When the pH of cheese began to rise because of ripening, numbers of *E. coli* declined at a slower rate than earlier but many times became undetectable after 1-3 weeks of storage. When *E. coli* was inoculated onto the surface of ripening cheese, rapid growth occurred with the population reaching over 10^6 /g and remaining at a high level during storage. The surface plating technique was best for recovery of *E. coli*, especially from cheese having a low pH.

Statistical Summary of Public Health Evaluations of Milk Quality on Louisiana Dairy Farms. R. M. Garrett and J. H. Gholson, *Department of Dairy Science, Louisiana State University, Baton Rouge, Louisiana 70803.*

This study was originated to find what, if any, significant statistical correlations exist between various factors of a state health department farm inspection and the corresponding total bacterial count and mastitis test score. Monthly inspection records of 700 dairy farms, taken from March, 1972 to February, 1974, were statistically correlated with their corresponding Oval Tube Method bacterial count and Wisconsin Mastitis Test score. From the farm inspection sheet 73 different variables originating from the areas of the milking barn, milkhouse, toilet and water supply, utensils and equipment, milking personnel, and insect and rodent control, were analyzed. Those factors found to correlate significantly ($P < .05$), with the bacterial count or mastitis test score, were present in the areas of milking barn construction and cleanliness, utensils and equipment construction and sanitization, and the care and sanitization of the teats; other factors related to general farm maintenance were shown to correlate less significantly ($P < .1$).

Evaluation of a Fast Food Management Training Program—One Year Later. Bruce Jackson, Jack Hatlen, and Bradley Palmer, *Department of Environmental Health SC-34, University of Washington, Seattle, Washington 98195.*

A management training program was undertaken in a fast food restaurant chain in 1975. A followup study was done—1 year later—to determine the long term effectiveness of this effort by careful re-inspection of all 35 retail outlets. The results involved a significant increase in sanitation violations among newly hired managers who had no previous contact with the training program, and a general improvement among those managers who had.

Sporeformers in Raw Milk and their Outgrowth in Heated Milk at 7 C. E. M. Mikolajcik and N. T. Simon, *Department of Food Science and Nutrition, Ohio Agricultural Research and Development Center, Columbus, Ohio 43210.*

A microbiological survey was made of 89 raw milk samples and of the same milk after heating (80 C-12 min) and subsequent storage at 7 C for 1 and 4 weeks. For 60 samples, a 2-week storage was included. The SPC of the raw milk averaged 125T/ml. "Gram-negative" organisms growing on SPC agar containing 5 IU penicillin G/ml constituted 58% of the SPC. Immediately following heating: mesophilic (32 C) spore counts ranged from <1 -1300/ml with 96% of the samples having counts ≥ 2 /ml; spore counts at 21 C (intermediates) ranged from <1 -530/ml with 94% of the samples having counts ≥ 2 /ml; and psychrotrophic (7 C) spore counts ranged from <1 -100T/ml with 42% of the samples having counts ≥ 2 /ml. After 1 week of storage of heated samples, microbial populations were: mesophiles, 99% of the samples had counts ≥ 2 /ml with a range of 2-140T/ml; intermediates, 92% of the samples had counts ≥ 2 /ml with a range of 2-30T/ml; and psychrotrophs, 67% of the samples had counts ≥ 2 /ml with a range of 2-10T/ml. After 2 weeks of storage, 85% of the samples had psychrotrophic counts ≥ 20 /ml with a range of 20-330M/ml. After 4 weeks of storage, 89% of the samples had psychrotrophic counts ≥ 10 T/ml with a range of 10T-180M/ml. It was concluded that outgrowth of psychrotrophic sporeformers may cause spoilage of heated milk.

Bacteriology of Ground Beef and Soy-Extended Ground Beef. I. Wilfred Obioha and A. A. Kraft, *Department of Food Technology, Iowa State University, Ames, Iowa 50011.*

Incidence and numbers of *Staphylococcus aureus*, *Clostridium perfringens*, other bacteria growing anaerobically, and aerobic bacteria were determined in retail ground beef and ground beef extended with soy additive. The investigation considered effects of freezing, frozen storage, and subsequent thawing of the products. Frozen samples were held up to 56 days at -29 C, and thawed at about 5 C in a retail type display case for various time periods. Bacterial counts were made during intervals of storage. Survival rates of aerobic and anaerobic organisms were higher in the soy-beef patty mix than in ground beef alone; growth of anaerobic bacteria was enhanced by the soy additive in frozen and refrigerated patties. No significant differences were noted between the two types of products with regard to content of staphylococci in the frozen items. The day of the week on which products were prepared in the retail store influenced bacteriological quality; samples collected later in the week had higher counts than those obtained early in the week.

Microbiological Studies on Aging of Intact and Excised Beef Muscle. C. R. Rey, A. A. Kraft, and F. C. Parrish, Jr., *Department of Food Technology, Iowa State University, Ames, Iowa 50011.*

Beef cattle from the University herd were used for these studies; aging treatments after slaughter were as follows: (a) sides were held at room temperature, (b) sides were held at 2 C, (c) sides were kept for 6 h at room temperature and then the round was removed and placed at 2 C for 18 h, (d) sides were held for 3 days at 2 C, then the excised round was kept for 4 days at 2 C for a total of 1 week of low temperature aging. After aging by procedures described, steaks were cut from the round, packaged, and stored in a display case at about 5 C. Similar treatment was given to ground beef prepared from the same round muscles. Holding an entire side of beef at high temperature for 24 h promoted bacterial growth on the surface with subsequent proliferation on retail cuts. Shortening the aging treatment at high temperature resulted in reduced bacterial populations on

packaged items. Highest bacterial loads and most rapid spoilage resulted from excising the muscle after low temperature holding and then continuing to hold the muscle in the cooler. This treatment was even more conducive to spoilage than was holding at room temperature for 24 h, and is not to be recommended.

Microorganisms Isolated from Bread Doughs of Bakeries in Shiraz, Iran. Reza A. Tadayon, *Pathobiology Department, School of Veterinary Medicine, Pahlavi University, Shiraz, Iran.*

Iranian bakeries use the previous day's sour doughs as leavenings. Dough samples from 43 different bakeries in Shiraz, Iran were examined for presence of yeasts and bacteria. Total and differential yeast and bacterial counts made showed that the total approximate number of yeasts and bacteria was 155×10^3 and that 13×10^3 and 142×10^3 of them belonged to yeasts and bacteria, respectively. On the basis of colonial characteristics, 92 different yeast cultures were isolated. Eighty-one of the yeast cultures were characterized using standard procedures. Results showed that eight of the yeast cultures did not sporulate and 36 of the sporulating yeasts differed biochemically from the genus *Saccharomyces*. Based on biochemical results, only 34 of the remaining 37 sporulating yeasts were similar to *Saccharomyces cerevisiae* and the remaining three could belong to the genus *Saccharomyces*. In addition to the yeasts eight different genera of bacteria were isolated from the dough samples. These bacteria were also characterized and seemed to be of the genera *Corynebacterium*, *Lactobacillus*, *Staphylococcus*, *Streptococcus*, *Bacillus*, *Arizona*, *Edwardsiella*, and *Neisseria*.

Characterization of Psychrotrophic Bacteria from Aged Beef. M. Valland and A. A. Kraft, *Department of Food Technology, Iowa State University, Ames, Iowa 50011.*

This study was undertaken to classify and determine characteristics of bacteria isolated from retail beef cuts that were prepared from beef carcasses aged at high or low temperatures. An examination was made by replica plating and computer analyses of 728 isolates from a low temperature aging treatment (2 C for 11 days) and 559 isolates from a high temperature aging treatment (20 C for 24 h followed by 2 C for 3 days). Elevated temperatures have been considered for accelerating tenderization of beef, and one purpose of this work was to determine the influence of such treatment on changes in bacterial flora as compared with beef conventionally aged at low temperature. For screening isolates, an improved apparatus for replica plating was constructed so that 64 isolated could be plated at one time. A more heterogeneous bacterial flora resulted from high temperature aging than was observed with low temperature holding. *Pseudomonas* were not as dominant, but a greater proportion of *Aeromonas* resulted. Further, a more active spoilage flora was also recovered.

A Collaborative Study to Determine the Feasibility of Using 0.40-, 0.20-, 0.14-, and 0.10-Inch Diameter Discs to Measure Sediment in Fluid Milk. Earl O. Wright, Warren S. Clark, Jr., Richard W. Webber, William L. Arledge, Michael H. Roman, and Donald K. Hotchkiss, *IAMFES, Inc., P.O. Box 701, Ames, Iowa 50010; American Dry Milk Institute, Chicago, Ill.; Dairy Division, AMS, U.S. Dept. of Agriculture, Washington, D.C.; Dairymen, Inc., Louisville, Ky.; New York State Dept. of Agr. and Markets, Lowville, N.Y.; and Dept. of Statistics, Iowa State Univ., Ames, Iowa.*

This collaborative study was done to determine whether laboratory personnel could successfully grade raw milk for sediment content using 0.40-, 0.20-, 0.14-, and 0.10-inch diameter sediment discs. The

0.40-inch disc presently is the accepted size disc for grading sediment in mixed bulk milk samples. Technicians in 17 separate laboratories made 1,360 determinations (80 per laboratory) or 20 determinations for each size of sediment disc. Each laboratory graded the same set of samples. Samples were graded by use of photoprint standards that were prepared for this study. The laboratories were evaluated on laboratory technicians' ability to grade the various sizes of sediment discs within each laboratory. Technicians in 13 of the 17 laboratories graded the samples showing no significant differences in their ability to grade the various size diameter sediment discs. Four laboratories were not consistent in their ability to grade discs and showed significant changes in agreement with the stated sediment level as the diameter of the disc was reduced. Based on these results it is indicated that most of the laboratories are capable of grading sediment diameter discs of 0.40-, 0.20-, and 0.14-inch with very good consistency. With properly trained personnel in the laboratories the study indicates that the 0.10-inch diameter disc can be used for grading sediment in milk.

INVITED PAPERS

FDA and Enforcement of Food Regulations. George M. Burditt, *Burditt and Calkins, 135 South LaSalle Street, Chicago, Illinois 60603.*

Enforcement of food regulations by FDA has become increasingly strict in recent years. FDA's budget has increased from 5 million dollars in 1955 to an estimated 500 million dollars in 1980, which has enabled FDA to do a far more effective job in inspecting food establishments. The traditional enforcement methods under the Federal Food, Drug, and Cosmetic Act are seizure, injunction, and criminal prosecution. Criminal prosecutions of food warehouses and other establishments alleging violations of Sections 402 (a) (3) and (4) of the Act, including prosecutions of individual officers of firms, have received wide-spread attention, particularly because of the United States Supreme Court case of *U.S. v. Park*. A recent trial is discussed. To the traditional enforcement procedures has been added a further enforcement tool not authorized by the Act: recalls. Recalls based on alleged insanitary conditions have removed substantial quantities of food from the market.

Freezing Points and Milk Adulteration. Sidney E. Barnard, *Food Science Department, 9 Borland Laboratory, The Pennsylvania State University, University Park, Pennsylvania 16802.*

Over 2,000 universal samples of milk from farms and over 600 retail samples of processed homogenized milk were analyzed for freezing point. Data suggest the need for continuing surveillance of both raw and pasteurized milks. Over 5.0% of raw samples and over 10% of pasteurized milks exceeded the legal limit of -0.525 C. This is the highest freezing point now permitted in Pennsylvania for any milk offered for sale. During the study the incidence of freezing points above -0.530 C in processed milk dropped markedly. This seemed to be due to an awareness of the situation. A list of possible causes of added water was prepared and distributed to producer and processor organizations.

Value of National Association of Dairy Fieldmen Affiliating with IAMFES. Sidney H. Beale, *Michigan Milk Producers Association, 24270 West Seven Mile, Detroit, Michigan 48219.*

The Board of Directors of the National Association of Dairy Fieldmen has studied and evaluated the importance of sustaining the Association. As a result of this evaluation it has been decided the NADF should apply to become an affiliate member of the IAMFES. The application was made and accepted. The feeling is that this move will help up-grade and correlate the out-put of fieldmen and

sanitarians working in the milk industry. It will also enable the NADF to participate in the many important committees that function under the guidance of the IAMFES; such as the Farm Practices Committee and Educational Planning Committee. The IAMFES has been the leader in setting up many programs which the NADF hopes to work with in the future and to feel that our group can and will have some input.

Significance of Mycotoxins to Food Safety and Human Health. L. B. Bullerman, *Department of Food Science and Technology, University of Nebraska, Lincoln, Nebraska 68583.*

Mycotoxins are secondary metabolites of molds and may cause toxic responses in man and animals. These toxins can be produced by a variety of molds on various food and feedstuffs. The toxins are also quite varied in their chemical structures. These compounds may cause disease in man and animals with either acute or chronic symptoms. Exposure is normally by ingestion of a food or feed, and the effects may be rather dramatic in the event of acute toxicity or rather mild but insidious in the event of chronic toxicity. Some mycotoxins also have carcinogenic and teratogenic properties. Aflatoxins, for example, are the most potent hepatocarcinogens known. Many of the toxins are hepatotoxins, but other organs such as kidneys, intestines, bone marrow, and reproductive organs may be affected. Mycotoxins can be produced on products in the field, during harvest and processing, and during storage. The problem is worldwide and extremely complex and difficult to deal with. The implications to food safety and human health are many and varied.

A Look at the U.S. Whey Processing Industry. Warren S. Clark, Jr., *Whey Products Institute, 130 N. Franklin St., Chicago, Illinois 60606.*

Development of the U.S. whey processing industry, since organization of the Whey Products Institute in 1971, will be discussed. Estimated fluid whey production in the U.S., based upon USDA cheese production figures, for 1972, '73, and '74 was 28.1, 28.7, and 30.5 billion pounds, respectively. Whey solids represented by the fluid whey were 1.8, 1.9, and 2.0 billion pounds, respectively, for the same period. It is estimated that during this period, between 53 and 57% of the whey solids produced were processed. In 1975, total fluid whey was estimated at 29.4 billion pounds, 25.2 billion of which were sweet-type whey and 4.2 billion pounds were acid-type whey. Whey production statistics, tabulated for the first time, indicated approximately 1.1 billion pounds of whey solids were manufactured (57% of the solids available.) Of this production, 638 million pounds represented products for human food and 376 million pounds were animal feed products. Principle markets of whey utilization in 1975 were: human food-dairy, bakery, infant foods, blends, dry mixes, confectionery; animal feed-dairy and beef, swine, pet rations, poultry.

Developments in Food Virology. D. O. Cliver, *Food Research Institute (Department of Food Microbiology and Toxicology) and Department of Bacteriology, University of Wisconsin, 1925 Willow Drive, Madison, Wisconsin 53706.*

Most viruses detected or transmitted in foods emanate from the human intestines. Shellfish (bivalve molluscs) acquire viruses from sewage-polluted water; most other foods which become contaminated have been mishandled by an infected person, frequently during final preparation. Many intestinal viruses can be recovered from foods by filtration. Virus extracted from food is detected when it infects a susceptible tissue culture; commercially grown cultures are available for this purpose. No culture or other laboratory host is yet adapted to detection of food-borne infectious hepatitis virus or the viral agents thought to cause some food-associated gastroenteritis. Characterization of these viruses is progressing. The world's literature on many aspects of food virology is collected at the World Health Organization

Collaborating Centre on Food Virology at Madison and a sister establishment at Brno, Czechoslovakia. A mechanical retrieval system provides selective access to the data. Other aspects of the W.H.O. Food Virology Programme foster communications among laboratory food virologists around the world.

In Defense of Technology. F. M. Clydesdale, *Department of Food Science and Nutrition, University of Massachusetts, Amherst, Massachusetts 01002.*

High yields, efficient harvesting, sanitary and rapid processing, high quality distribution and retailing—factors of which any country should be proud. However, for some strange reason these are the very factors that are coming under attack by a vociferous group of individuals who seem bent on destruction of American Food Technology as we know it today. The reasons for the screams of outrage hurled at this Technology escape logical analysis. In this Country today we have the potential to be the best fed people in the history of the world with the products at our disposal. Food is now not only nutritious, but it is safe, convenient, of high quality, flavorful, and presented to the consumer at a cost, relative to earnings, which is competitive with any other country in the world at any other time in history, or the present. It is a gross injustice for consumers to have their confidence in the safety and nutritive value of their food supply destroyed without presenting them with all the facts. Perhaps it is necessary to present all the realities of nutrition to the consumer rather than simply nutrients. Perhaps it is time for science and technology to present the facts of an overpopulated-under-energized world to the American consumers who take for granted the food supply at their disposal without an understanding of the technology it involves. It is ludicrous to believe in the natural way. A morally responsible usage of technology, not a profit-at-any-cost technology is the way to solve the hunger problems of the world. This information must be conveyed to the consuming public as part of a nutrition education if we are to have a well fed and healthy nation without paranoia about its food supply.

Sanitation Training for Food Service Managers—A Must! A. Sidney Davis, *Division of Food Service, Food and Drug Administration, Washington, D.C. 20204.*

In the past two decades, growth of the foodservice industry has been sensational, and this means greater opportunities for consumers to become victims of foodborne illness. Safety of food is a responsibility of industry, and establishment managers carry the burden of that responsibility. Sanitation training for foodservice managers offers great promise for improving food protection. Industry must assume the lead role in sanitation training, with cooperation and support of regulatory agencies.

Foodservice Certification—The NIFI Program. Chester G. Hall, *National Institute for the Foodservice Industry, 120 South Riverside Plaza, Chicago, Illinois 60606.*

A trend toward tightening sanitation regulations is spreading across the nation. Supported by an increasing number of health jurisdictions at all levels (city, county, and state) and by the industry's customers in every state, new regulations are becoming a way of life for every restaurateur. Courses at all degrees of technical specificity, length and cost have appeared, culminating in what has been called "cross-country chaos." The NIFI course, "Applied Foodservice Sanitation," meets the FDA's recently-issued recommendations in every respect and is finding increased acceptance each day. It serves as the basis for the Illinois mandatory program and is accepted as one means of obtaining certification in the other two state mandatory programs (Florida and Washington, D.C.). Statewide voluntary programs are in full operation in Wisconsin, Michigan, Missouri, and Massachusetts and have started in Hawaii, South Carolina, Southern California, and Pennsylvania. Pilot programs are underway in Indiana and Kentucky and have been approved for early implementation in the state of Washington.

Approximately 5,000 foodservice managers and supervisors have been certified by NIFI, and more than 15,000 textbooks are in use. NIFI has been chosen by the Food and Drug Administration to develop a plan for implementing a uniform national foodservice sanitation training and certification program.

History and Role of the IAMFES Farm Methods Committee.

M. W. Jefferson, *Division of Markets, Department of Agriculture and Commerce, Commonwealth of Virginia, Richmond, Virginia 23219.*

This paper will cover the history and role of the Farm Methods Committee for the past 40 years—1936 through 1976. It will focus on the topics of concern to the milk producing industry, the leaders of the committee, and the group of people allied to achieve a goal of making firm recommendations to improve the production and marketing of quality, safe milk throughout the nation.

Dating of Food Products—Politics or Public Health? C.

Bronson Lane, *Dairy and Food Nutrition Council of Florida, P.O. Box 7813, Orlando, Florida 32804.*

The consumerism movement of the late 60's and early 70's was in large part responsible for renewed focus on the open-dating issue. The outspoken consumerist leaders gained a sympathetic press and support from opportunist politicians in their efforts to have a pull date (the last day a product should be offered for sale) printed on dairy food packages. Their efforts resulted in passage of a plethora of legislation mandating open-dating. At present, according to the Milk Industry Foundation, 15 states, the District of Columbia, and three cities require a pull date on milk and/or milk products. Proponents of open-dating claim that the purchaser has the "right to know" product age and that the requirement has enabled retailers to better inventory and rotate their stock. Opponents of the practice claim it to be a boondoggle because it stifles competition and costs both consumers and processors thousands of dollars per year. In the author's opinion, dairy food processors in states without open-dating laws would do well to consider the following: (a) implement the practice on a voluntary basis, and (b) collectively introduce legislative bills which would allow them to determine their own product shelf life and mark the packages accordingly. By so doing, the open-dating issue—long regarded as a political football—would be deflated and regulatory agency enforcement could hopefully be kept to an absolute minimum.

Assessing Post-Pasteurization Contamination—Predicting Shelf-Life of Fluid Milk Products. C. E. Parmelee, *Purdue University, Department of Animal Sciences, Smith Hall Lafayette, Indiana 47907.*

The assurance of long shelf life in fluid milk products in the U.S. is needed because of the shorter work week, longer hauling distances, changes in collection and distribution systems, and consumer buying habits. These studies were made to develop quick methods to predict shelf-life based on microbiological quality and indirectly on flavor and chemical quality. Modifications of the resazurin reduction test of Catchick and Gibson have resulted in a method, which in 16 h, will detect milk which will have a psychrotrophic count of 1 million or more per ml after storage for 10 days at 7 C, with an accuracy of about 80%. Pre-incubation of the samples at 21 C for 15 h before making the test increases the accuracy by about 10% but extends the time to 31 h. Psychrotrophic counts of raw and pasteurized milk were determined in 25 h with an accuracy of 95% by plating 1 ml of the 1 to 10 dilution with Standard Methods Agar, incubating the plates at 21 C for 25 h and counting all visible pinpoint colonies with a Quebec Colony Counter. Psychrotrophic counts of larger quantities of milk were determined by a membrane filter technique. Ten ml of whole milk were passed through a membrane filter after dilution with 99 ml of sterile 5% solution of Triton X-100. The filter was incubated at 21 C for 20 h on an absorbent

pad saturated with 2 ml of Standard Methods broth. The colonies were stained with Loeffler's alkaline methylene blue stain, and were counted under 7 \times magnification. Counts agree well with the plate counts incubated at 21 C for 25 h.

Present Status and Trends in Tuberculosis and Brucellosis in Cattle. E. A. Schilf, *U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, Washington, D.C. 20250.*

The incidence of brucellosis and tuberculosis in the livestock population have been reduced tremendously through efforts of the eradication programs for each of these diseases. Initially these diseases were more prevalent in dairy herds, however, currently this has been reversed. The low level of tuberculosis has contributed to a complacency which has allowed a slight increase in the number of infected herds found. Both of these diseases are now under a surveillance system dependent on inspection at slaughter for lesions of tuberculosis and blood sample collection for brucellosis. Identification of the animal before slaughter directs the veterinarian to the infected herd, eliminating the testing of millions of negative animals. Refinements are continually being made in methods of diagnosis of each of these diseases.

Testing for Antibiotics in Milk—Field Observations. Peter Schoech, *Yankee Milk, Inc., 100 Milk Lane, Newington, Connecticut 06111.*

Four tests are currently being used at several locations throughout New England. They are: the Disc Assay, Hood Modified Disc Assay, Delvotest-P, and Cylinder Plate Method. The Disc Assay methods are used mainly for fluid milk, while the Delvotest-P and Cylinder Plate methods are used for manufactured products. The incidence of positive test results for antibiotics in fluid milk is lower in percent now than 2 years ago; however, the total number of positive results are about the same. Most positive tests are being found now with the 14-h Disc Assay only and not with the 4-h Disc Assay as they were 2 years ago. This leads me to believe that our members, through education and penalties, are trying to do a better and more conscientious job than previously. The sensitivity of the Disc Assay methods have been increased during this same period.

Somatic Cells in Milk—Significance and Relationship to Milk Composition. L. H. Schultz, *Department of Dairy Science, University of Wisconsin, Madison, Wisconsin 53706.*

Somatic cells in milk include epithelial cells from the mammary gland and leucocytes from blood. Epithelial cells increase in very early and very late lactation while leucocytes increase during mastitis. The leucocytes have bactericidal and phagocytic properties and combat invading organisms. Daily variation in the somatic cell count of the milk of individual cows is considerable. Over a 1-month period, cows with (a) no udder infection, (b) non-pathogens, or (c) pathogens, had mean daily levels of (a) 169,500, (b) 225,800, and (c) 997,800 cells per ml of bucket milk, with coefficients of variation of 94, 66, and 82%. Milk loss in subclinical mastitis is related to somatic cell counts. On a quarter basis, losses started at 500,000 cells and progressed to 7.5% at 1 million, 15% at 2 million, and 30% at 5 million. Literature data show the following changes in milk composition when normal quarters are compared to opposite quarters positive to mastitis screening tests based on cell counts (values in parentheses indicate direction and % change): total solids (-8); lactose (-15); fat (-12); total protein (0); casein (-18); whey proteins (+62); sodium (+36); chloride (+61); potassium (-9); pH (+5); lipase activity (+16); acid degree value (+83).

Toxicological Considerations in the Selection of Flexible Packaging for Foodstuffs. Fred B. Shaw, *Flexible Packaging Division, Continental Group Technical Center, 1200 W. 76th Street, Chicago, Illinois 60620.*

High molecular weight polymers are the "backbone" of the flexible packaging industry, altho a variety of papers, fabrics, and metallic foils are also employed. Almost without exception, high molecular weight polymers are physiologically inert and therefore pose no toxicological problems in themselves. However monomers and low molecular weight fractions that may be incorporated in certain commercial polymers can be a source of concern, as can be other low molecular weight chemicals purposely added to commercial polymers, in some instances, to modify their processing or functioning characteristics. Conditions of use must also be considered when employing polymeric films (with or w/o additives) as the food contact components of packages. A polymer may be completely non-toxic and an adequate barrier to other package constituents when used to contain foodstuffs if the resultant package is subsequently stored at room temperature, under refrigeration, or frozen. However when used as the inner ply of a boil-in pouch, a retortable pouch or an oven bag, it must be determined that it is not subject to some degree of thermal breakdown or allows permeation of adhesive or ink components not approved for direct contact. Finally, if there is a requirement to sterilize packages before filling, as in aseptic packaging, the effect of the sterilizing medium on the packaging material must be fully understood.

The Interstate Milk Shippers Conference—Present Status of the I.M.S. Program. Hubert H. Vaux, *Indiana State Board of Health, 1330 West Michigan Street, Indianapolis, Indiana 46206.*

Lack of reciprocity continues to blemish the image and record of the NCIMS. The 1973 Conference addressed the issue and took actions intended to correct this situation. Those dealing with defining reciprocity, non-reciprocal state identification, and delisting have only been partially effective. The possible loss of voting rights and office-holding privileges of non-reciprocal states will be decided in 1977 and may provide the necessary impetus. As a result of technical comments from the January, 1976 session, modifications in the Procedures Manual requested by FDA, and requests of NCIMS and other groups, we are now advised that the PMO and related documents will be prepared in their previous format. The Executive Board is actively engaged in discussions with FDA to resolve some remaining technical issues and provisions of a possible Memorandum-of-Understanding between NCIMS and FDA. It would seem that the most significant portion of our opposition to the suggested federal regulation was that the structure of the present program had no identifiable deficiencies. The best way to retain the program as we presently know it is to continue to provide as high a degree of public health protection as possible to make such a regulation unnecessary.

Present Status and Trends in the Aseptic Packaging of Milk Products and Juices. Harold Wainess, *Harold Wainess and Associates, 464 Central Ave., Northfield, Illinois 60093.*

Aseptic packaging is now a world-wide acceptable method of providing long shelf life food products with better organoleptic qualities, less damage to nutritional properties than with retort sterilized products, and little effect on the heat labile proteins and other ingredients. The process involves heating the product to ultra high temperatures (UHT) of 135-149 C and holding for 2-8 sec. The sterilized product is cooled (4-20 C) and filled into containers, including plastic coated cartons, cans, sachets, large plastic bags, drums, plastic cups, and bottles and glass. They are first presterilized by ethylene oxide, hydrogen peroxide, superheated steam, sterilized hot air, or radiation. Then they are filled and sealed in a sterile environment created by pressurized sterile air, resulting in a product where pathogenic organisms are killed and other undesirable organisms in the product eliminated to such an extent that product deterioration of a sensory nature does not take place in the normal commercial life of the product. Extended shelf life will vary dependent upon plant sanitation techniques, container integrity, and storage temperatures. Economically, the ideal container should require minimum storage space, be light weight, restrict the passage of light, have no flavor effect on the product over a long storage period, and contain a reclosable feature. A flexible package of metal foil, paper, plastic, or combination of the preceding meets these requirements.

Textured Vegetable Protein, New and Growing Food Category. Thomas L. Welsh, *Miles Laboratories, Inc., Grocery Products Division, 7123 West 65th Street, Chicago, Illinois 60638.*

Escalating cost of animal protein even in prosperous, fully developed countries, strongly indicates that vegetable protein will become an increasingly larger percentage of human diets in the future. Consumption of vegetable protein products is growing very rapidly on a worldwide basis. There are two basic categories: (a) *Extenders*-designed to be mixed with animal protein from meat, poultry, or seafood sources. The finished product is then 30-50% vegetable origin. (b) *Analogs*-designed to be consumed as alternatives to meat, poultry, or seafood and having the appearance and taste of animal protein products. In addition to the economic advantages, vegetable protein analogs using only vegetable oils and fats offer additional advantages to those wishing to modify their dietary intake of saturated fats and cholesterol. Nutritional equivalence of vegetable protein products is fundamental to product design. Protein and fat content must be standardized. Vegetable proteins are blended to reach desirable protein quality. Analogs currently marketed are primarily blends of soy and wheat protein containing lesser amounts of yeast and albumen. The products are fortified with vitamins and minerals to levels present in animal protein foods. In addition, new products based on other vegetable protein sources are currently under development throughout the world. These include rapeseed, cottonseed, sesame, sunflower, and leaf proteins. These protein sources are in abundance and offer the world's exploding population a virtually untapped resource for its burgeoning food requirements.

The Sixty-Third Annual Meeting of IAMFES

Arlington Park Hilton, Arlington Heights, Illinois, August 8-12, 1976



Figure 1. Registration desk is busy on Monday morning.

Although fireworks displays and "tall ships" were absent from the 63rd Annual Meeting of IAMFES, enthusiasm and interest were present in large quantities. Hosted by the Associated Illinois Milk, Food and Environmental Sanitarians and held at the Arlington Park Hilton Hotel, the "Star-Spangled" meeting was attended by more than 400 persons. Many attended the 1976 regional meeting of the National Mastitis Council, which was held on August 12, immediately following the IAMFES meeting. The meeting was highlighted by committee sessions, technical sessions, evening discussions, a wine and cheese reception beyond description, the annual business meeting, and a well-planned and well-executed awards banquet. As is its custom, the Executive Board of IAMFES met before, during and after the regular sessions to transact the Association's business.

MEETINGS OF THE EXECUTIVE BOARD

During its sessions, the Executive Board heard the following reports:

(a) *Financial report.* Executive Secretary E. O. Wright reported that the total income from July 1, 1975 to June 30, 1976 was approximately \$111,000, with expenses for the same period totaling approximately \$103,000. The *Journal of Milk and Food Technology* generated a net income of \$12,729, principally from income increases in advertising and subscriptions, which covered a net loss of \$4,778 incurred by the Association. An overall net income of \$7,950 was generated for the 1975-76 fiscal year.

(b) *Budget committee.* P. J. Skulborstad reviewed the budget for 1976-77, which projects a total income of \$61,885 for the Association and \$68,000 for the Journal.



Figure 2. 1976-77 Executive Board and Editors of IAMFES (back row, left to right): Dr. H. V. Atherton, President; H. Hutchings, First Vice-President; D. D. Fry, President-Elect; P. J. Skulborstad, Senior Past President; (Second row, left to right): E. O. Wright, Executive Secretary and Managing Editor; Prof. R. P. March, Second Vice-President; Dr. E. H. Marth, Editor, Journal of Milk and Food Technology/Journal of Food Protection; W. Kempa, Secretary-Treasurer; (Front row): H. E. Thompson, Jr., Junior Past President; B. Lee, Assistant Executive Secretary and Managing Editor.

(c) *Membership.* E. O. Wright reported that membership as of July, 1976 was as follows: affiliate members-1401; direct members-736; subscribers-1184; students-86; honorary life members-17; total membership-3424. This is a decrease of 56 from the 1975 total. The Illinois affiliate won the 1976 membership contest.

(d) *Election results.* President Thompson announced that William Kempa of Ontario will be the new Secretary-Treasurer.



Figure 3. Executive Board session prior to annual meeting.

(e) *Awards.* E. O. Wright, Chairperson of the Committee on Awards and Recognition, stated that the decisions of the committee were difficult because of the many outstanding candidates nominated. The committee

selected, with the Board's approval, the following award recipients: Citation-James Meany; Honorary Life-Ben Luce; Certificate of Recognition-Ferris Biggert; Shogren Affiliate Award-Wisconsin; Educator/Industry-Burdet Heinemann; Sanitarian's-Melvin W. Jefferson. The Samuel J. Crumbine Award was given this year at the IAMFES meeting to Region VI of the New Mexico Environmental Improvement Agency.

(f) *Editor, Journal of Milk and Food Technology/ Journal of Food Protection.* In his report, Dr. E. H. Marth stated that Volume 38 (1975) was the largest ever published. 136 papers were published, 74% of which were research papers, 19% papers of technical general interest and 7% papers of non-technical general interest. In keeping with the trend of the past two years, more papers considered non-dairy foods than dairy foods (56% vs. 44%). Volume 39 (1976) is currently running ahead of Volume 38 in terms of total pages and number of research papers. Dr. Marth noted the increased international character of the Journal articles, and reminded the Board that the name of the Journal will change to the *Journal of Food Protection* as of January, 1977.



Figure 4. *Farm Methods Committee at work.*

(g) *Journal Management Committee.* Dr. R. B. Read, Jr., Chairperson of the committee, presented the committee's six recommendations as follows: (1) publish announcements of new products/processes in the Journal, (2) appoint affiliate representatives to submit reports of affiliate activities to the Journal, (3) endeavor to have an Executive Board member in attendance at each affiliate annual meeting, (4) review material relevant to the practicing sanitarian in other publications for possible inclusion in the Journal, (5) develop a system for better identification of Journal issues, and (6) consider changing the name of International to one including the words "food protection."

(h) *Sanitarians Joint Council.* R. Belknap, IAMFES representative to the Council, reported on the last Council meeting in Nashville and indicated that the Council will meet during the International Annual Meeting for at least the next two years.

(i) *National Mastitis Council.* IAMFES representative to the Council, A. Parker, reported on his attendance at the NMC annual meeting and discussed ideas for

NMC-funded programs and activities for IAMFES.

(j) *Committee on Education and Professional Development.* Dr. R. Richter has been appointed chairperson of this committee, which will begin work on preparation of a new informative brochure about IAMFES.

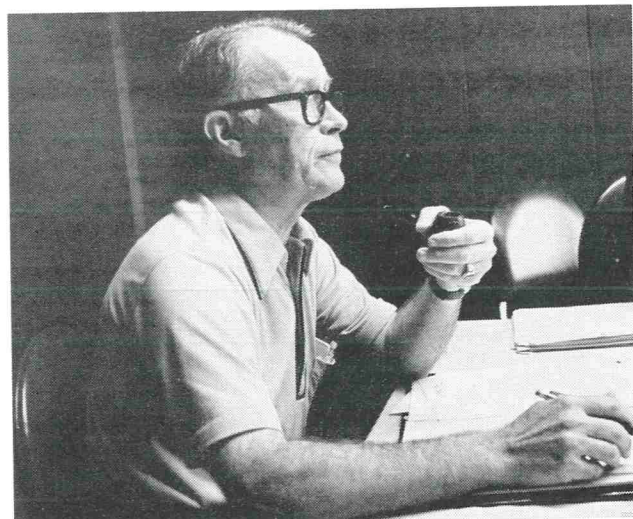


Figure 5. *President Thompson reflects on committee reports.*

(k) *Committee on Communicable Diseases Affecting Man.* Dr. F. Bryan, Chairperson, announced that the 3rd edition of *Procedures to Investigate Foodborne Illness* is off the press and available from the Executive Office. He discussed the possibility of IAMFES sponsoring workshops or shortcourses on the publication's content. The committee is considering the preparation of a similar publication on waterborne illness.

(l) *Committee on Applied Laboratory Methods.* Dr. A. R. Brazis, Chairperson, appealed for increased involvement of laboratory-oriented members in this committee. Members are especially needed for the subcommittee on Laboratory Methods for Examination of Water and Other Environmental Samples.

(m) *Committee on Food Equipment Sanitary Standards.* K. Jones distributed copies of the committee's report, which included an updated list of the committee's objectives. This report will appear in a future issue of the Journal.

(n) *Farm Methods Committee.* M. W. Jefferson and D. Termunde presented the committee's interim report. Mr. Jefferson is resigning as chairperson, and will be succeeded by Mr. Termunde.

(o) *International Dairy Federation.* H. Wainess, the unofficial IAMFES representative to IDF, reported on the Federation's activities. IDF will meet in Quebec City, Quebec, Canada, in 1976.

(p) *Membership Committee.* R. Belknap, newly appointed chairperson of this committee, outlined his plans for increasing affiliate membership.

The Executive Board took the following action in the course of its meetings: (a) appointed the following committee to prepare goals and guidelines for the

IAMFES Foundation: P. J. Skulborstad, Director, O. Osten; F. Uetz; E. O. Wright, Ex-officio; H. Barnum, Alternate; (b) appointed the following committee to prepare a suitable program to present to the National Mastitis Council regarding partial use of its funds for IAMFES educational activities: B. Dawson, Chairperson; R. Richter; B. Cook; J. Adams; P.J. Skulborstad, Coordinator; (c) gave full authority (with the Board's guidance) to Mr. Ken Harrington for administration of the IAMFES sustaining membership program; (d) gave Mr. Harold Wainess the authority to explore possibilities for liaison with the International Dairy Federation; (e) approved a 10% across-the-board advertising rate increase for the Journal effective January 1, 1977; (f) a letter of appreciation will be sent to Dr. K.G. Weckel for his service on the Journal Editorial Board; (g) approved disbanding the present Committee on Environmental Health Programs, and formulation of new committee objectives pertaining to food plant-related environmental problems; (h) approved Florida as the site for the 1979 annual meeting.

The fall meeting of the Executive Board will be held December 7-9, at the Sioux City Hilton, Sioux City, Iowa.

AFFILIATE COUNCIL

The 1976 Affiliate Council meeting gave affiliate representatives the opportunity to exchange ideas and renew old acquaintances. More than 30 persons representing 14 affiliates attended the council meeting on Monday afternoon, August 9.

E. O. Wright discussed facets of current International programs and projects. He stressed the need for increased affiliate involvement in all areas of the IAMFES.

After describing International's awards program, Mr. Wright solicited the Council's suggestions concerning the program. During discussion, it was decided that some type of student recognition might be appropriate. Various Council members described scholarships which are awarded by their affiliates to outstanding students. The Council appointed a committee to study award opportunities.

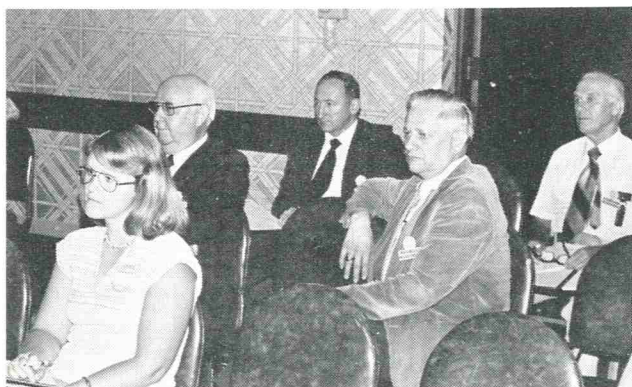


Figure 6. Shown attending the Affiliate Council meeting are (left to right): Ms. Diane Sampson, Harold Heiskell, Dr. Lloyd Luedecke, Dr. E. H. Marth and William Kempa.

Dr. E. H. Marth reported on the *Journal of Milk and Food Technology/Journal of Food Protection*. He introduced Ms. Barbara Lee, who has been appointed assistant editor. She will be in charge of the News and Events and Affiliate Affairs sections of the Journal. Ms. Lee spoke briefly to the group and asked for affiliate cooperation in sending affiliate news items to the Journal. Dr. Marth cited the need for non-technical and general interest papers for the Journal.

E. O. Wright reported that it has become necessary to increase affiliate membership rates. Because of increased costs of printing, paper and postage, affiliate dues to International will be \$14/year effective January, 1977.

The Wisconsin affiliate offered a tentative invitation to host the 1980 International Annual Meeting, which could be held jointly with the National Environmental Health Association (NEHA).

R. P. March introduced Dr. Frank Arnold, president of NEHA, who spoke briefly regarding cooperation in the unification efforts of IAMFES and NEHA.



Figure 7. Dr. Frank Arnold, (left) president of the National Environmental Health Association is shown with Dr. H. V. Atherton, president of IAMFES.

Erwin Gadd (Missouri) and John Zook (Kansas) were unanimously re-elected Chairperson and Secretary-Treasurer of the Council for 1976-77.

TECHNICAL SESSIONS

The number of research papers presented during the Annual Meeting continued to increase. Topics discussed at this year's meeting included: statistical summary of public health evaluation of milk quality, sporeformers in raw milk and their outgrowth in heated milk at 7 C, antibiotics in milk-current and future methodology, a collaborative study to determine the feasibility of using various-sized discs to measure sediment in milk, thermal inactivation of *Clostridium botulinum* type A toxin, microbiological studies on aging of intact and excised



Figure 8. George M. Burditt discussed the FDA and food regulation enforcement in his keynote address.

beef muscle, toxicological considerations in selection of flexible packaging for foods, bacteriology of ground beef and soy-extended ground beef, toxigenic potential of molds isolated from moldy cheese trimmings, prediction of fluid milk shelf-life by assessment of post-pasteurization contamination, enumeration and fate of enteropathogenic *Escherichia coli* during the manufacture of Camembert cheese, significance of somatic cells in milk, characterization of psychrotrophic bacteria from aged beef, freezing points and milk adulteration, testing for antibiotics in milk, present status and trends in tuberculosis and brucellosis in cattle, biodegradation of aflatoxin by toxigenic aspergilli, significance of mycotoxins to food safety and human health, developments in food virology, textured vegetable protein, and trends in the aseptic packaging of milk products and juices.



Figure 9. Tuesday's general session was highlighted by talks by Dr. Joyce Lashof (left) and C. K. Luchterhand.

Invited and general interest papers discussed such subjects as FDA and enforcement of food regulations, the interstate milk shippers program, dating of food products, sanitation training for food service managers,

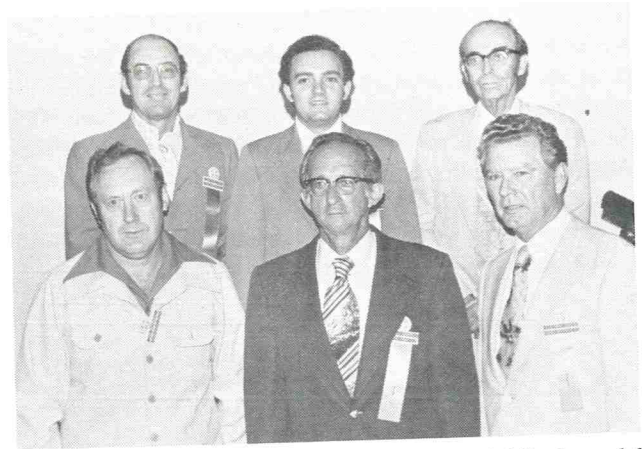


Figure 10. Speakers at the technical sessions included (back row, left to right): D. D. Fry, session chairperson, D. Glingman, F. B. Shaw; (front row, left to right): J. G. Bradshaw, Dr. A. A. Kraft, and A. S. Davis.



Figure 11. Papers were presented by (back row, left to right): L. A. Allen, M. W. Jefferson, H. H. Vaux; (front row, left to right): C. B. Lane, P. Schoech and J. W. Messer.

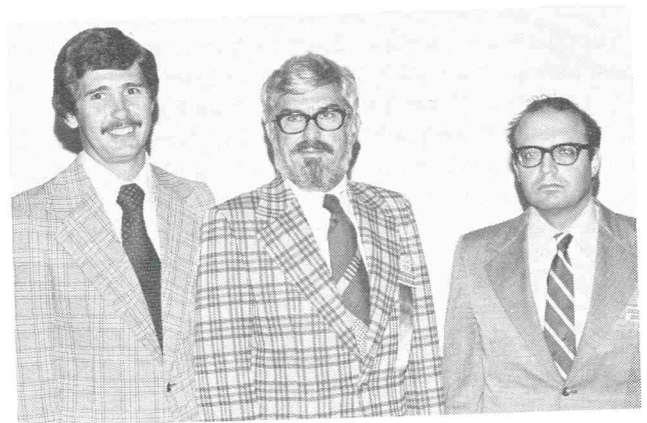


Figure 12. H. Hutchings (center), Milk Sanitation Section Chairperson, is shown with speakers R. Garrett (left), and N. T. Simon.

the NIFI foodservice certification, in defense of technology, the value of Association of Dairy Fieldmen affiliation, history and role of the IAMFES farm methods committee, the U.S. whey production industry, handling of perishable foods and evaluation of a fast food management training program.

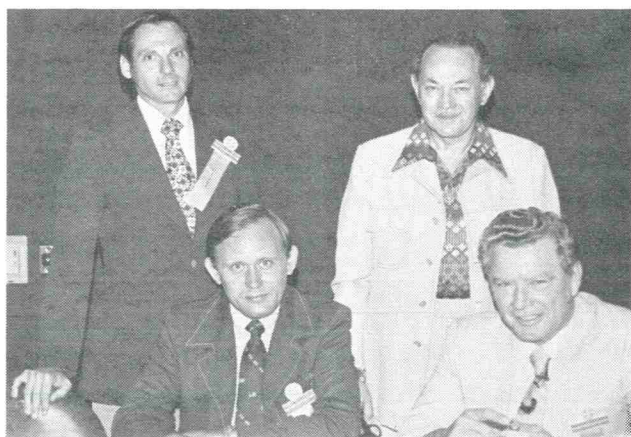


Figure 13. Papers were given by Dr. L. B. Bullerman and A. S. Davis, seated; W. S. Clark and H. Wainess are standing.

Abstracts of both research and invited papers appear on pages 705-710 of this issue. Most papers given at the Annual Meeting will or have appeared in the *Journal of Milk and Food Technology*/*Journal of Food Protection*.



Figure 14. Speakers at Wednesday's general session were Dr. Fergus M. Clydesdale (left) and Ms. Jane Byrne.

BUSINESS MEETING

President H. E. Thompson, Jr. called the business meeting to order at 10:30 a.m. on August 11, 1976, with about 140 persons in attendance. After the minutes of the 1975 meeting were approved, the following reports were given:

Report of the Executive Secretary (E. O. Wright), Budget Committee (P. J. Skulborstad), Editor, *Journal of Milk and Food Technology*/*Journal of Food Protection* (Dr. E. H. Marth), Committee on Applied Laboratory Methods (Dr. A. R. Brazis), Committee on Food Equipment Sanitary Standards (K. Jones), Farm Methods Committee (M. W. Jefferson), Committee on Communicable Diseases Affecting Man (Dr. F. Bryan), International Dairy Federation (H. Wainess), Affiliate Council (E. Gadd), Journal Management Committee (Dr. R. B. Read, Jr.). Highlights of these reports appear elsewhere in this issue and hence are not repeated here.

The work of the Committee on Food Protection was reported by its chairperson, C. Felix. The committee recommended that a merger of existing IAMFES committees dealing with various aspects of food

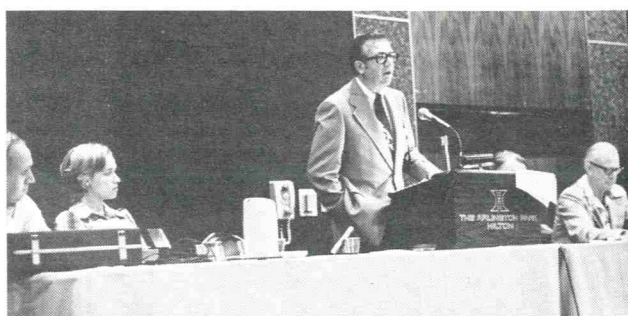


Figure 15. P. J. Skulborstad presents IAMFES budget during the business meeting.

protection take place to form a new, enlarged Food Protection Committee with specialized subcommittees.

H. Wainess reported on the activities of the Baking Industry Equipment Committee. Copies of the BISSC standards are available free of charge from Mr. Raymond J. Walter, Executive Secretary, BISSC, 521 Fifth Avenue, New York, NY 10017.

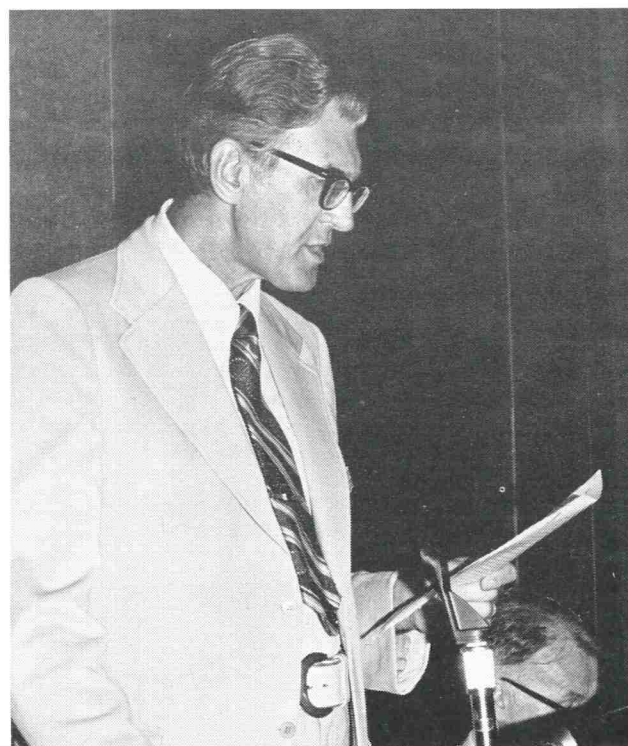


Figure 16. Dr. A. R. Brazis gives the report of the Committee on Applied Laboratory Methods.

President Thompson read the report of the Committee on Sanitary Procedures in the absence of D. B. Whitehead. The committee requested the attention of IAMFES members to Senate bill S-3555; the committee feels that this bill, if passed, will interfere with free determination of voluntary standards.

Dr. K. G. Weckel, Chairperson, gave the report of the 3-A Symbol Council. As of July 31, 1976 there were 158 3-A authorizations in effect.

The following resolutions were presented by C. Felix, Chairperson of the Resolutions Committee, and adopted by the membership:

RESOLUTION NO. 1**WHEREAS:**

The Associated Illinois Milk, Food and Environmental Sanitarians and Local Arrangements Committee labored long and hard and with exceptional success to host the sixty-third annual meeting of the International Association of Milk, Food and Environmental Sanitarians in Arlington Heights, Illinois, and

WHEREAS:

The facilities for both the technical sessions and the social occasions were anticipated and supplied with generosity and style by the Associated Illinois Milk, Food and Environmental Sanitarians and Local Arrangements Committee, and

WHEREAS:

These same hosts exercised the highest standards of the International Association of Milk, Food and Environmental Sanitarians in coordinating the efforts of their Industry, Educational and Regulatory members toward the success of the Association's Annual Meeting, and

WHEREAS:

The 1976 meeting was in every respect a "Star Spangled Meeting" that will long be remembered as a highlight of the Bicentennial Year,

THEREFORE, BE IT RESOLVED:

That the International Association of Milk, Food and Environmental Sanitarians adopt this resolution of appreciation and gratitude to the Associated Illinois Milk, Food and Environmental Sanitarians, and, further, that a copy of the resolution be sent to the Illinois Association and be published as well in the *Journal of Food Protection*.

RESOLUTION NO. 2**WHEREAS:**

The Arlington Park Hilton of Arlington Heights, Illinois, was the site of the 1976 International Association of Milk, Food and Environmental Sanitarians annual meeting, and

WHEREAS:

The personnel of the Arlington Park Hilton were most accomodating to the needs of the members of the International Association of Milk, Food and Environmental Sanitarians, and

WHEREAS:

The facilities for the program sessions and the members' personal comfort were outstanding,

THEREFORE, BE IT RESOLVED:

That an appropriate expression of gratitude be sent to the management and staff of the Arlington Park Hilton hotel.



Figure 17. H. V. Atherton (standing, right) receives the presidential gavel from Charles Felix, Editor of Environmental News Digest. H. E. Thompson, Jr. is seated in the foreground.



Figure 18. H. E. Thompson, Jr. (right) is given the Past-president's plaque by H. V. Atherton.



Figure 19. Robert Coe, secretary-treasurer of the Illinois affiliate, accepts the Membership Contest winner's check from Barbara Lee.

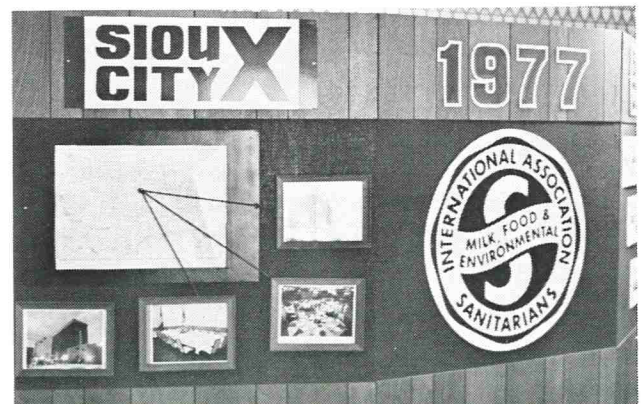


Figure 20. "X Marks the Spot" for the 1977 Annual Meeting in Sioux City, Iowa.

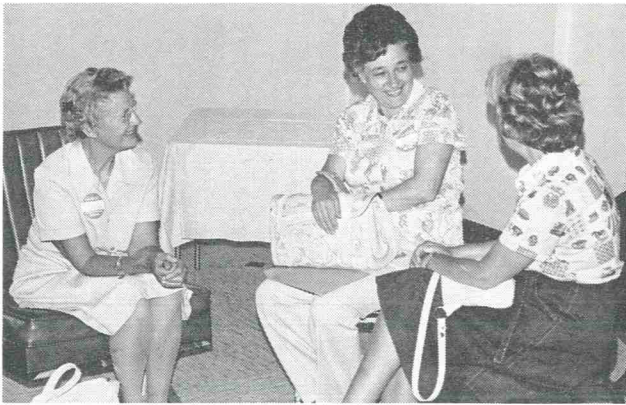


Figure 21. *Old and new friends meet in the Ladies' Hospitality Room.*

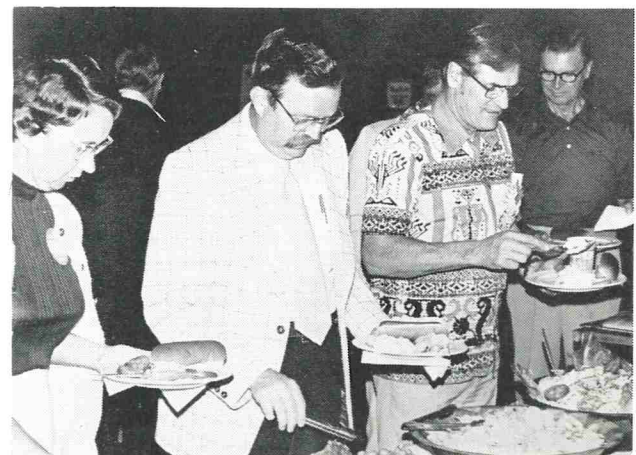


Figure 22. *"Early birds" enjoy Sunday's buffet supper.*

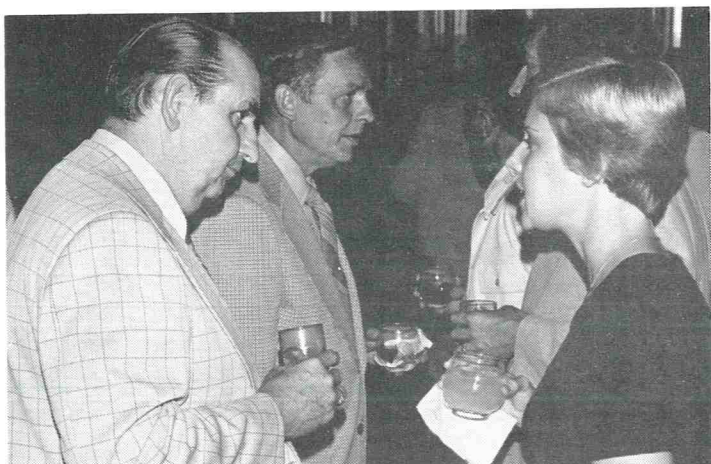


Figure 23. Scenes from the wine and cheese party.



Figure 24. Entertainment at the awards banquet was furnished by "Life!"

IAMFES Honors Jefferson, Heinemann, Meany, Luce and the Wisconsin Affiliate Crumbine Award Given at Annual Meeting

Each year, IAMFES honors several members and one affiliate organization for meritorious service. Honors given to individual members are in the form of four awards designated as the Sanitarian's Award, the Educator/Industry Award, the Citation Award and the Honorary Life Membership. The C. B. Shogren Award is given annually to the affiliate organization with the most outstanding program during the past year. In 1976, the committee on Awards and Recognition consisted of E. O. Wright, Chairperson; J. Boosinger, W. Kempa, C. K. Luchterhand and L. P. Duncan.

This year, for the first time, the Samuel J. Crumbine Award for outstanding achievement by a local government agency in food and beverage sanitation was awarded at the IAMFES meeting.



Figure 1. M. W. Jefferson (left) receives the Sanitarian's Award from representatives of the Pennwalt Corporation, Klenzade, and the Diversey Corporation.

SANITARIAN'S AWARD TO M. W. JEFFERSON

A great deal of the steady, pioneering leadership that gained national recognition for Virginia's dairy regulatory program was provided by Melvin W. Jefferson, the recipient of the 1976 Sanitarians' Award. This award, consisting of a plaque and a \$1000 honorarium jointly funded by the Pennwalt Corporation, Klenzade Products Division, Economics Laboratories, and the Diversey Corporation, is given annually to a member of IAMFES who has done outstanding work in public health during the preceding seven years.

A graduate of Virginia Tech with a B.S. in Dairy

Science, Jefferson has been with Virginia's Department of Agriculture for 24 years. During this time, he has worked to eliminate duplicity and promote reciprocity within the state's regulatory agencies. In 1969, his work on the Virginia Mastitis Prevention and Control Committee contributed to the addition of mastitic milk control to the state regulatory program. In that same year, under Jefferson's leadership, a state-wide program requiring all tank truck operators to be certified to collect and handle bacteriological samples became effective.

Since 1969, Jefferson's hard work and dedication have aided in the implementation of subsequent regulatory improvements, some of which have included: (1) the power to adopt regulations pertaining to fluid milk, milk products and ice cream was given to the Virginia Board of Agriculture, which, under Jefferson's guidance, developed regulations for fluid milk and milk products that paralleled those of the U.S. Public Health Service and made it possible for Virginia to participate fully in the National Conference of Interstate Milk Shippers; (2) development of regulations concerning ice cream and frozen desserts which followed federal standards; (3) establishment of reciprocal agreements with Virginia's neighboring states and with Pennsylvania; and (4) the reorganization of the Bureau of Dairy Services. Jefferson has recently been promoted to the position of Director of the Division of Markets in the Virginia Department of Agriculture (see page 503, volume 37, the *Journal of Milk and Food Technology*).

Jefferson is active in many food- and dairy-related organizations. He has chaired the IAMFES Farm Methods Committee, and is serving on the 3-A Sanitary Standards and Sanitary Procedures Committees. In addition to chairing the National Labeling Committee, he is a member of the Board of Directors and the Executive Committee of the National Mastitis Council, a member of Council I of the National Conference of Interstate Milk Shippers, the advisory board of the Department of Dairy Science, Virginia Polytechnic Institute, and the Virginia State Dairymen's Association Committee on Component Pricing of Milk. He has served as president of the dairy Division of the National Association of State Departments of Agriculture. He is twice past president of the Southern States Division of NASDA, and has served as president of the Virginia Association of Sanitarians.



Figure 2. Robert Dawson, representative of the Milking Machine Manufacturers' Council (right), presents the Educator/Industry Award to Burdet Heinemann.

BURDET HEINEMANN GIVEN EDUCATOR/INDUSTRY AWARD

Burdet H. Heinemann, Vice President for Research and Product Development of Mid-America Dairymen, Inc., is the 1976 recipient of the Educator/Industry Award. This award, funded by the Milking Machine Manufacturers' Council of the Farm and Industrial Equipment Institute, was instituted in 1973 to recognize major contributions to food safety and hygiene by an IAMFES member in industrial or academic work. It consists of a \$1000 honorarium and a plaque.

Heinemann was born in St. Louis and grew up in Kansas City, Missouri. He was graduated in 1937 from Iowa State College of Agriculture and Mechanic Arts (now Iowa State University) with a B.S. degree in bacteriology. In 1936, he joined the Producer Creamery Company, a predecessor of Mid-America Dairymen, as a laboratory specialist. He was subsequently appointed Technical Director of Research and Product Development of Mid-America Dairymen, and was promoted to Vice President for R & D in 1967.

Heinemann's research has encompassed a wide range of topics pertaining to the dairy and food industry. Packaging of butter, 80% cream and cottage cheese in polyethylene-lined containers, now universal in the industry, was developed under his supervision. Work done by Heinemann and coworkers, under grants from the U.S. Public Health Service, indicated that Strontium 90 and Iodine 130 could be safely removed from milk, and provided a much-needed commercial screening method. Other research projects have included the use of Nisin in milk, standardization of the Babcock test for milk, and the development of ultra pasteurization and packaging of milk and milk products. Heinemann has been a prolific author of technical research papers and commercial production monographs.

He is a member of numerous honorary and professional societies, including the American Dairy Science Association, the American Dry Milk Institute,

the American Public Health Association, the Milk Industry Foundation and the National Milk Producers Federation. He is listed in "Who's Who in the Midwest" and in "American Men of Science." He has served on important dairy and food industry committees, including the National Research Council and the Executive Board of the National Conference of Interstate Milk Shippers. He has been a long-time member of the National Mastitis Council, and served as that organization's president in 1975.



Figure 3. James Meany (left) receives the Citation Award from H. E. Thompson, Jr.

JAMES MEANY RECEIVES CITATION AWARD

The Citation Award, given annually to a member of IAMFES who has contributed substantially to the growth, advancement and status of the Association, has been awarded to James A. Meany, Chief Sanitary Officer, Chicago Department of Health. Meany, a lifetime resident of Chicago, graduated from Loyola University in 1933. In 1938, he became a dairy inspector for the Chicago Department of Health, and subsequently became supervising dairy inspector, county unit inspector and chief dairy inspector. In 1970, he was appointed Chief Sanitary Officer, a capacity in which he is responsible for all inspectional activities of the Chicago Department of Health.

A registered sanitarian, Meany was a leader in programs to assure safe water supplies for farms holding Board of Health permits. He also assumed leadership in a program to analyze the problem of "abnormal milk," which was a forerunner of the mastitis program. He was instrumental in achieving success for Chicago's milk inspection, rodent control and lead poisoning control programs. Under Meany's leadership, a group of city, state and federal health officials joined with representatives of the academic community and consumer, labor and food service representatives to formulate Chicago's modern and comprehensive restaurant code. Meany is currently engaged in coordinating an education-surveillance program to deal with the problem of St. Louis encephalitis in Chicago and surrounding areas.

Meany has been president of the Associated Illinois Milk, Food and Environmental Sanitarians, and served as secretary of that affiliate for 17 years. He has served on the 3-A Sanitary Standards Committee since 1953 and has also served as a member of the 3-A Symbol Council. He was a charter member of the Sanitarians Registration Committee of the Illinois Department of Registration and Education.

Meany was the 1965 recipient of the Illinois affiliate's "Pete Riley" Sanitarian of the Year Award, which was given in recognition of his work on the abnormal milk program as well as his contribution to the Council of Affiliates of IAMFES.



Figure 4. H. V. Atherton (right) presents Ben Luce with the Honorary Life Member plaque.

HONORARY LIFE MEMBERSHIP TO BEN LUCE

Forty years of experience in the dairy industry belong to A. Bender Luce, recipient of the 1976 Honorary Life Membership. Luce, a registered sanitarian and Chief of the Dairy Inspection Section of the Washington State Department of Agriculture, was born in Fort Benton, Montana. He graduated from the University of Idaho in 1936 with a B.S. in Agriculture. His experience in the dairy industry ranges from his early work on a family dairy in Idaho to his present position as Chief of Dairy Inspection.

He is a member of the National Labeling Committee, the National Association of Sanitarians, and the Interstate Milk Shippers Conference Task Committee. He has served as chairperson of the Registered Sanitarians Board of Washington, as secretary-treasurer of the Washington Association of Milk Sanitarians, and is past president of the Washington State Dairy Institute Alumni.

He has long been active in IAMFES activities, serving on the Education, Farm Methods and Bulk Milk Handling Committees, the Advisory Committee of the National Mastitis Council, and is past chairperson of the Council of Affiliates.

Luce was honored by IAMFES as the winner of the 1972 Citation Award.



Figure 5. Donald G. Raffel (left), representing the Wisconsin Affiliate, receives the Shogren Award from D. D. Fry.

WISCONSIN AFFILIATE WINS SHOGREN AWARD

The Committee on Recognition and Awards has named the Wisconsin Association of Milk and Food Sanitarians as the recipient of the C. B. Shogren Award. This citation was developed by the Affiliate Council of IAMFES to annually recognize the affiliate organization with the most outstanding program. Mr. Donald G. Raffel, Secretary, accepted the award for the affiliate.

The Wisconsin Affiliate entered the competition by completing a questionnaire providing information about the state organization's membership, service and activities. A point system was used to evaluate each affiliate's responses. Outstanding efforts of the Wisconsin Association of Milk and Food Sanitarians have included close cooperation with the University of Wisconsin at Eau Claire and the Wisconsin Environmental Health Association in developing an educational program for undergraduates, and work with the University of Wisconsin to establish continuing education courses for Association sanitarians.



Figure 6. P. J. Skulborstad (right) presents the Crumline Award to John Guinn, representing Region VI of the New Mexico Environmental Improvement Agency.

**COMBINE AWARD TO REGION VI OF
NEW MEXICO ENVIRONMENTAL IMPROVEMENT
AGENCY**

A regional unit of a statewide environmental agency, with combined responsibility for food service sanitation, pollution control, solid waste management and some aspects of occupational safety and health in a five-county area of Southeastern New Mexico, has been selected as the winner of the 1976 Samuel J. Crumline Consumer Protection Award.

Region VI of the New Mexico Environmental Improvement Agency, Roswell, New Mexico received the award, presented annually by the Single Service Institute to honor outstanding achievement by a local government agency in developing a public program of food and beverage sanitation. The award decision is made by a jury of consumer representatives and leading professionals in the public health and environmental fields. John E. Guinn, Regional Manager of the New Mexico Environmental Improvement Agency, accepted the award on behalf of the winning organization.

The award is named for the Kansas State Health Officer who, in 1909, first banned common drinking

cups from public facilities. The Single Service Institute, which established the award in 1954, is the national trade association of manufacturers of single-use food service and packaging products.

The New Mexico environmental organization won the award for an entry which best demonstrated "the use of effective planning and management techniques by officials of local government agencies in the development of comprehensive food protection programs," according to Charles W. Felix, Director, Environment, Health and Communications, of the Single Service Institute. Mr. Felix pointed out that this year was the first time that a unit of a state agency was eligible to compete for the Crumline Award, which formerly had been limited strictly to local government agencies.

Food service sanitation is a leading environmental health problem, but it is closely interrelated with other environmental issues, the Crumline Award Jury noted. Region IV of the New Mexico Environmental Improvement Agency impressed the jury with both its structure as an across-the-board environmental health institution and its success in establishing management and budgetary systems enabling it to fulfill its broad responsibilities.

Holders of 3-A Symbol Council Authorizations on August 20, 1976

Questions or statements concerning any of the holders of authorizations listed below, or the equipment fabricated, should be addressed to Earl O. Wright, Sec'y.-Treas., P.O. Box 701, Ames, Iowa 50010.

01-06 Storage Tanks for Milk and Milk Products

- | | | |
|-----|--|-------------|
| 28 | Cherry-Burrell Corporation
575 E. Mill St.
Little Falls, New York 13365 | (10/ 3/56) |
| 102 | Chester-Jensen Company, Inc.
5th & Tilgham Streets
Chester, Pennsylvania 19013 | (6/ 6/58) |
| 2 | CREPACO, Inc.
100 C.P. Avenue
Lake Mills, Wisconsin 53551 | (5/ 1/56) |
| 117 | Dairy Craft, Inc.
St. Cloud Industrial Park
St. Cloud, Minnesota 56301 | (10/28/59) |
| 76 | Damrow Company
196 Western Avenue
Fond du Lac, Wisconsin 54935 | (10/31/57) |
| 115 | DeLaval Company, Ltd.
350 Dutchess Turnpike
Poughkeepsie, New York 12602 | (9/28/59) |
| 109 | Girton Manufacturing Company
State Street
Millville, Pennsylvania 17846 | (9/30/58) |
| 114 | C. E. Howard Corporation
9001 Rayo Avenue
South Gate, California 90280 | (9/21/ 59) |
| 127 | Paul Mueller Company
P.O. Box 828
Springfield, Missouri 65801 | (6/29/60) |
| 31 | Walker Stainless Equipment Co.
Elroy, Wisconsin 53929 | (10/ 4/56) |

02-06 Pumps for Milk and Milk Products

- | | | |
|------|---|------------|
| 214R | Ben H. Anderson Manufacturers
Morrisonville, Wisconsin 53571 | (5/20/70) |
| 212R | Babson Bros. Co.
2100 S. York Rd.
Oak Brook, Illinois 60621 | (2/20/70) |
| 29R | Cherry-Burrell Corporation
2400 Sixth St., Southwest
Cedar Rapids, Iowa 52406 | (10/ 3/56) |
| 63R | CREPACO, Inc.
100 CP Avenue
Lake Mills, Wisconsin 53551 | (4/29/57) |
| 205R | Dairy Equipment Company
1919 South Stoughton Road
Madison, Wisconsin 53716 | (5/22/69) |
| 65R | G & H Products, Inc.
5718 52nd Street
Kenosha, Wisconsin 53140 | (5/22/69) |
| 145R | ITT Jabsco, Incorporated
1485 Dale Way
Costa Mesa, California 92626 | (11/20/63) |

- | | | |
|------|---|------------|
| 26R | Ladish Co., Tri-Clover Division
9201 Wilmot Road
Kenosha, Wisconsin 53140 | (9/29/56) |
| 236 | Megator Corporation
125 Gamma Drive
Pittsburgh, Pennsylvania 15238 | (5/ 2/72) |
| 241 | Puriti S. A.
Alfredo Noble #39, Industrial Pte. de Vigas
Tlalnepantla, Mexico | (9/12/72) |
| 148 | Robbins & Myers, Inc.
Moyno Pump Division
1345 Lagonda Avenue
Springfield, Ohio 45501 | (4/22/64) |
| 72R | L. C. Thomsen & Sons, Inc.
1303 43rd Street
Kenosha, Wisconsin 53140 | (8/15/57) |
| 219 | Tri-Canada Cherry-Burrell Ltd.
6500 Northwest Drive
Mississauga, Ontario, Canada | (2/15/71) |
| 175R | Universal Milking Machine Div.
National Cooperatives, Inc.
First Avenue at College
Albert Lea, Minnesota 56007 | (10/26/65) |
| 52R | Viking Pump Div.
Houdaille Industries, Inc.
406 State Street
Cedar Falls, Iowa 50613 | (12/31/56) |
| 5R | Waukesha Foundry Company
Waukesha, Wisconsin 53186 | (7/ 6/56) |

04-03 Homogenizers and High Pressure Pumps of the Plunger Type

- | | | |
|-----|--|------------|
| 247 | Bran and Lubbe, Inc.
2508 Gross Point Road
Evanston, Illinois 60201 | (4/14/73) |
| 87 | Cherry-Burrell Company
2400 Sixth Street, Southwest
Cedar Rapids, Iowa 52404 | (12/20/57) |
| 37 | CREPACO, Inc.
100 CP Avenue
Lake Mills, Wisconsin 53538 | (10/19/56) |
| 75 | Gaulin, Inc.
44 Garden Street
Everett, Massachusetts 02149 | (9/26/57) |
| 237 | Graco Inc.
P.O. Box 1441
Minneapolis, Minnesota 55440 | (6/ 3/72) |
| 256 | Hercules, Inc.
2285 University Avenue
St. Paul, Minnesota 55114 | (1/23/74) |

05-13 Stainless Steel Automotive Milk Transportation Tanks for Bulk Delivery and/or Farm Pick-up Service

- | | | |
|------|--|------------|
| 131R | Almont Welding Works, Inc.
4091 Van Dyke Road
Almont, Michigan 48003 | (9/ 3/60) |
|------|--|------------|

- | | | | | | |
|-----|---|------------|------|---|------------|
| 70R | Brenner Tank, Inc.
450 Arlington,
Fond du Lac, Wisconsin 54935 | (8/ 5/57) | 203R | ITT-Grinnell Company
260 W. Exchange St.
Providence, Rhode Island 02901 | (11/ 7/68) |
| 40 | Butler Manufacturing Co.
900 Sixth Ave., Southeast
Minneapolis, Minnesota 55114 | (10/20/56) | 218 | Highland Corporation
74-10 88th St.
Glendale, New York 11227 | (2/12/71) |
| 66 | Dairy Equipment Company
1919 South Stoughton Road
Madison, Wisconsin 53716 | (5/29/57) | 34R | Ladish Co., Tri-Clover Division
2809 60th St.
Kenosha, Wisconsin 53140 | (10/15/56) |
| 45 | The Heil Company
3000 W. Montana Street
Milwaukee, Wisconsin 53235 | (10/26/56) | 239 | LUMACO
Box 688,
Teaneck, New Jersey 07666 | (6/30/72) |
| 201 | Paul Krohnert Mfg., Ltd.
811 Steeles Avenue
Milton, Ontario, Canada L9T 2Y3 | (4/ 1/68) | 200R | Paul Mueller Co.
P.O. Box 828
Springfield, Missouri 65801 | (3/ 5/68) |
| 85 | Polar Manufacturing Company
Holdingford, Minnesota 56340 | (12/20/57) | 242 | Puriti, S. A.
Alfredo Nobel #39 Industrial Pte. de Vigas
Tlalnepantla, Mexico | (9/12/72) |
| 71 | Progress Industries, Inc.
400 E. Progress Street
Arthur, Illinois 61911 | (8/ 8/57) | 149R | Q Controls
Occidental, California 95465 | (5/18/64) |
| 121 | Technova Inc. Gosselin Division
1450 Hebert c.p. 758
Drummondville, Quebec, Canada | (12/ 9/59) | 73R | L. C. Thomsen & Sons, Inc.
1303 43rd Street
Kenosha, Wisconsin 53140 | (8/31/57) |
| 189 | A. & L. Tougas, Ltee
1 Tougas St.
Iberville, Quebec, Canada | (10/ 3/66) | 191R | Tri-Canada Cherry-Burrell, Ltd.
6500 Northwest Drive
Mississauga, Ontario, Canada L4V 1K4 | (11/23/66) |
| 47 | Trailmobile, Div. of Pullman, Inc.
701 East 16th Avenue
North Kansas City, Missouri 64116 | (11/ 2/56) | 250 | Universal Milking Machine Division
Universal Cooperatives, Inc.
408 First Ave. South
Albert Lea, Minnesota 56007 | (6/11/73) |
| 25 | Walker Stainless Equipment Co.
New Lisbon, Wisconsin 53950 | (9/28/56) | 86R | Waukesha Specialty Company, Inc.
Darien, Wisconsin 53114 | (12/20/57) |

**08-17 Fittings Used on Milk and Milk Products Equipment
and Used on Sanitary Lines Conducting Milk and
Milk Products**

- | | | |
|------|--|------------|
| 79R | Alloy Products Corporation
1045 Perkins Avenue
Waukesha, Wisconsin 53186 | (11/23/57) |
| 138R | APV-CREPACO of Canada Limited
1250 Ormont Dr.
Weston, Ontario, Canada M9L 2V4 | (12/17/62) |
| 245 | Babson Brothers Company
2100 South York Road
Oak Brook, Illinois 60521 | (2/12/73) |
| 82R | Cherry-Burrell Company
2400 Sixth Street, Southwest
Cedar Rapids, Iowa 52406 | (12/11/57) |
| 266 | Condor Manufacturing Company
418 West Magnolia Avenue
Glendale, California 91204 | (8/ 1/75) |
| 260 | CREPACO, Inc.
100 CP Avenue
Lake Mills, Wisconsin 53551 | (5/22/74) |
| 271 | The Foxboro Company
Neponset Street
Foxboro, Massachusetts 02035 | (3/ 8/76) |
| 67R | G & H Products, Inc.
5718 52nd Street,
Kenosha, Wisconsin 53140 | (6/10/57) |
| 199R | Graco, Inc.
P.O. Box 1441
Minneapolis, Minnesota 55440 | (12/ 8/67) |

**08-17 Inlet and Outlet Leak Protector Plug Valves
for Batch Pasteurizers**

- | | | |
|------|---|------------|
| 122R | Cherry-Burrell Company
2400 Sixth St., Southwest
Cedar Rapids, Iowa 52406 | (12/11/59) |
| 69 | G & H Products Corporation
5718 52nd Street
Kenosha, Wisconsin 53140 | (6/10/57) |
| 27 | Ladish Co., Tri-Clover Division
9201 Wilmot Rd.
Kenosha, Wisconsin 53140 | (9/29/56) |
| 78 | L. C. Thomsen & Sons, Inc.
1303 43rd Street
Kenosha, Wisconsin 53140 | (11/20/57) |

**09-07 Instrument Fittings and Connections Used on
Milk and Milk Products Equipment**

- | | | |
|-----|---|------------|
| 269 | Babson Bros. Company
2100 South York Road
Oak Brook, Illinois 60521 | (1/23/76) |
| 206 | The Foxboro Company
Neponset Avenue
Foxboro, Massachusetts 02035 | (8/11/69) |
| 32 | Taylor Instrument Process Control
Div. Sybron Corporation
95 Ames Street
Rochester, New York 14601 | (10/ 4/56) |
| 246 | United Electric Controls
85 School Street
Watertown, Massachusetts 02172 | (3/24/73) |

**10-00 Milk and Milk Products Filters Using Disposable
Filter Media, As Amended**

- 35 Ladish Co., Tri-Clover Division (10/15/56)
2809 60th Street
Kenosha, Wisconsin 53140

**11-03 Plate-type Heat Exchangers for Milk and
Milk Products**

- 20 A.P.V. Company, Inc. (9/ 4/56)
395 Fillmore Avenue
Tonawanda, New York 14150
- 30 Cherry-Burrell Corporation (10/ 1/56)
2400 Sixth Street, Southwest
Cedar Rapids, Iowa 52404
- 14 Chester-Jensen Co., Inc. (8/15/56)
5th & Tilgham Streets
Chester, Pennsylvania 19013
- 38 CREPACO, Inc. (10/19/56)
100 CP Avenue
Lake Mills, Wisconsin 53551
- 267 De Danske Mejeriers Maskinfabrik (10/15/75)
The Danish Dairies' Machine Factory
P.O. Box 66, 6000 Kolding, Denmark
- 120 DeLaval Company, Ltd. (12/ 3/59)
113 Park Street
South Peterborough, Ontario, Canada
- 17 The DeLaval Separator Company (8/30/56)
Dutchess Turnpike
Poughkeepsie, New York 12602
- 15 Kusel Dairy Equipment Company (8/15/56)
100 W. Milwaukee Street
Watertown, Wisconsin 53094

**12-04 Internal Return Tubular Heat Exchangers,
for Milk and Milk Products**

- 248 Allegheny Bradford Corporation (4/16/73)
P.O. Box 264
Bradford, Pennsylvania 16701
- 243 Babson Brothers Company (10/31/72)
2100 S. York Road
Oak Brook, Illinois 60521
- 103 Chester-Jensen Company, Inc. (6/ 6/58)
5th & Tilgham Street
Chester, Pennsylvania 19013
- 152 The DeLaval Separator Co. (11/18/69)
350 Dutchess Turnpike
Poughkeepsie, New York 12602
- 217 Girton Manufacturing Co. (1/23/71)
Millville, Pennsylvania 17846
- 252 Ernest Laffranchi (12/27/73)
P.O. Box 455
Ferndale, California 95536
- 238 Paul Mueller Company (6/28/72)
P.O. Box 828
Springfield, Missouri 65801
- 96 C. E. Rogers Company (3/31/64)
P.O. Box 188
Mora, Minnesota 55051

13-06 Farm Milk Cooling and Holding Tanks

- 240 Babson Brothers Company (9/ 5/72)
2100 S. York Road
Oak Brook, Illinois 60521

- 11R CREPACO, Inc. (7/25/56)
100 CP Ave.
Lake Mills, Wisconsin 53551
- 119R Dairy Craft, Inc. (10/28/59)
St. Cloud Industrial Park
St. Cloud, Minnesota 56301
- 4R Dairy Equipment Company (6/15/56)
1919 South Stoughton Road
Madison, Wisconsin 53716
- 92R DeLaval Company, Ltd. (12/27/57)
113 Park Street
South Peterborough, Ontario, Canada
- 49R The DeLaval Separator Company (12/ 5/56)
Dutchess Turnpike
Poughkeepsie, New York 12602
- 10R Girton Manufacturing Company (7/25/56)
Millville, Pennsylvania 17846
- 95R Globe Fabricators, Inc. (3/14/58)
3350 North Gilman Rd.
El Monte, California 91732
- 179R Heavy Duty Products (Preston), Ltd. (3/ 8/66)
1261 Industrial Road
Preston, Ontario, Canada
- 12R Paul Mueller Company (7/31/56)
P.O. Box 828
Springfield, Missouri 65801
- 249 Sunset Equipment Co. (4/16/73)
3765 North Dunlap Street
St. Paul, Minnesota 55112
- 42R VanVetter, Inc. (10/22/56)
2130 Harbor Avenue Southwest
Seattle, Washington 98126
- 16R Zero Manufacturing Company (8/27/56)
Washington, Missouri 63090

**16-04 Evaporators and Vacuum Pans for Milk and
Milk Products**

- 164R Anderson IBEC (4/25/65)
19609 Progress Drive
Strongsville, Ohio 44136
- 254 Anhydro, Inc. (1/ 7/74)
130 S. Washington St.
North Attleboro, Massachusetts 02760
- 132R A.P.V. Company, Inc. (10/26/60)
137 Arthur Street
Buffalo, New York 14207
- 263 C. E. Howard Corporation (12/21/74)
9001 Rayo Avenue
South Gate, California 90280
- 107R C. E. Rogers Company (8/ 1/58)
P.O. Box 118
Mora, Minnesota 55051
- 186R Marriott Walker Corporation (9/ 6/66)
925 East Maple Road
Birmingham, Michigan 48010
- 273 Niro Atomizer Inc. (5/20/76)
9165 Rumsey Road
Columbia, Maryland 21044

**17-04 Fillers and Sealers of Single Service Containers
For Milk and Milk Products**

- 192 Cherry-Burrell Corporation (1/ 3/67)
2400 Sixth St., Southwest
Cedar Rapids, Iowa 52404

- 137 Ex-Cell-O Corporation (10/17/62)
2855 Coolidge,
Troy, Michigan 48084
- 220 Hercules, Inc., Package Equipment Div. (4/24/71)
2285 University Ave.
St. Paul, Minnesota 55114
- 211 Twinpack, Inc. (2/4/70)
2225 Hymus Blvd.
Dorval 740 P.Q., Canada

**19-00 Batch and Continuous Freezers, For Ice Cream, Ices
and Similarly Frozen Dairy Foods, As Amended**

- 146 Cherry-Burrell Company (12/10/63)
2400 Sixth Street, Southwest
Cedar Rapids, Iowa 52404
- 141 CREPACO, Inc. (4/15/63)
100 CP Avenue
Lake Mills, Wisconsin 53551

22-03 Silo-Type Storage Tanks for Milk and Milk Products

- 168 Cherry-Burrell Corporation (6/16/65)
575 E. Mill St.
Little Falls, New York 13365
- 154 CREPACO, Inc. (2/10/65)
100 CP Avenue
Lake Mills, Wisconsin 53551
- 160 Dairy Craft, Inc. (4/5/65)
St. Cloud Industrial Park
St. Cloud, Minnesota 56301
- 181 Damrow Company, Division of DEC (5/18/66)
International, Inc., 196 Western Ave.
Fond du Lac, Wisconsin 54935
- 262 DeLaval Company Limited (11/11/74)
113 Park Street
South, Peterborough, Ontario, Canada
- 156 C. E. Howard Corporation (3/9/65)
9001 Rayo Avenue
South Gate, California 90280
- 276 Letsch Corporation (8/17/76)
501 N. Belcrest
Springfield, Missouri 65802
- 155 Paul Mueller Co. (2/10/65)
P.O. Box 828
Springfield, Missouri 65801
- 165 Walker Stainless Equipment Co. (4/26/65)
Elroy, Wisconsin 53929

**23-00 Equipment for Packaging Frozen Desserts,
Cottage Cheese and Milk Products Similar to
Cottage Cheese in Single Service Containers**

- 174 Anderson Bros. Mfg. Co. (9/28/65)
1303 Samuelson Road
Rockford, Illinois 61109
- 209 Dobby Packaging Machinery (7/23/69)
Domain Industries, Inc., 869 S. Knowles Ave.
New Richmond, Wisconsin 54017
- 258 Hercules, Inc. (2/8/74)
2285 University Ave.
St. Paul, Minnesota 55114
- 222 Maryland Cup Corporation (11/15/71)
Owings Mills, Maryland 21117
- 193 Triangle Package Machinery Co. (1/31/67)
6655 West Diversey Ave.
Chicago, Illinois 60635

24-00 Non-Coil Type Batch Pasteurizers

- 161 Cherry-Burrell Corporation (4/5/65)
575 E. Mill St.
Little Falls, New York 13365
- 158 CREPACO, Inc. (3/24/65)
100 CP Avenue
Lake Mills, Wisconsin 53551
- 187 Dairy Craft, Inc. (9/26/66)
St. Cloud Industrial Park
St. Cloud, Minnesota 56301
- 177 Girton Manufacturing Co. (2/18/66)
Millville, Pennsylvania 17846
- 166 Paul Mueller Co. (4/26/65)
P.O. Box 828
Springfield, Missouri 65601

**25-00 Non-Coil Type Batch Processors for Milk and
Milk Products**

- 275 Bepex Corporation (7/12/76)
150 Todd Road
Santa Rosa, California 95402
- 162 Cherry-Burrell Corporation (4/5/65)
575 E. Mill St.
Little Falls, New York 13365
- 159 CREPACO, Inc. (3/24/65)
100 CP Avenue
Lake Mills, Wisconsin 53551
- 188 Dairy Craft, Inc. (9/26/66)
St. Cloud Industrial Park
St. Cloud, Minnesota 56301
- 167 Paul Mueller Co. (4/26/65)
Box 828
Springfield, Missouri 65801
- 202 Walker Stainless Equipment Co. (9/24/68)
New Lisbon, Wisconsin 53950

26-00 Sifters for Dry Milk and Dry Milk Products

- 228 Day Mixing, Div. LeBlond, Inc. (2/28/72)
4932 Beech Street
Cincinnati, Ohio 45202
- 229 Russell Finex Inc. (3/15/72)
156 W. Sandford Boulevard
Mt. Vernon, New York 10550
- 173 B. F. Gump Division (9/20/65)
Blaw-Knox Food & Chem. Equip. Inc.
750 E. Ferry St., P.O. Box 1041
Buffalo, New York 14240
- 185 Rotex, Inc. (8/10/66)
1230 Knowlton St.
Cincinnati, Ohio 45223
- 176 Koppers Company, Inc. (1/4/66)
Metal Products Division
Sprout-Waldron Operation
Munsy, Pennsylvania 17756
- 172 SWECO, Inc. (9/1/65)
6111 E. Bandini Blvd.
Los Angeles, California 90022

28-00 Flow Meters for Milk and Liquid Milk Products

- 272 Accurate Metering Systems, Inc. (4/2/76)
1731 Carmen Drive
Elk Grove Village, Illinois 60007

- 253 Badger Meter, Inc. (1/ 2/74)
4545 W. Brown Deer Road
Milwaukee, Wisconsin 53223
- 223 C-E IN-VAL-CO, Division of Combustion (11/15/71)
Engineering, Inc.
P.O. Box 556, 3102 Charles Page Blvd.
Tulsa, Oklahoma 74101
- 265 Electronic Flo-Meters, Inc. (3/10/75)
12115 Self Plaza
Dallas, Texas 75218
- 226 Fischer & Porter Company (12/ 9/71)
County Line Road
Warminster, Pennsylvania 18974
- 261 Foss America, Inc. (11/ 5/74)
Route 82
Fishkill, New York 12524
- 224 The Foxboro Company (11/16/71)
Foxboro, Massachusetts 02035
- 270 Taylor Instrument Process Control (2/ 9/76)
Sybron Corporation, 95 Ames Street
Rochester, New York 14601

29-00 Air Eliminators for Milk and Fluid Milk Products**30-00 Farm Milk Storage Tanks**

- 257 Babson Bros. Co. (2/ 7/74)
2100 S. York Road
Oak Brook, Illinois 60521

31-00 Scraped Surface Heat Exchangers

- 274 Contherm Corporation (6/25/76)
P.O. Box 352
Newburyport, Massachusetts 01950

32-00 Uninsulated Tanks for Milk and Milk Products

- 264 Cherry-Burrell Company, Division (1/27/75)
of Paxall, Inc.
575 E. Mill St.
Little Falls, New York 13365
- 268 Dairy Craft, Inc. (11/21/75)
P.O. Box 1227
St. Cloud, Minnesota 56301

Financial Report IAMFES

Members of the Board of
 International Association of Milk, Food
 and Environmental Sanitarians, Inc.

We have examined the accompanying balance sheet of the International Association of Milk, Food and Environmental Sanitarians, Inc., at June 30, 1976, and the related statement of income for the year then ended. Our examination was made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying statements present fairly the financial position of International Association of Milk, Food and Environmental Sanitarians, Inc., at June 30, 1976, and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

Dougherty & Co

Certified Public Accountants

July 9, 1976

BALANCE SHEET As of June 30, 1976 and 1975

ASSETS

	Year Ended	
	June 30, 1976	June 30, 1975
Current Assets:		
Cash on hand, in bank and savings and loan assoc.	\$ 22,277.32	16,621.75
Accounts receivable-trade	4,006.16	3,820.49
Inventory-supplies	3,100.31	4,339.30
Prepaid expenses	79.92	78.05
Total current assets	<u>29,463.71</u>	<u>24,859.59</u>
Fixed Assets:		
Office equipment	2,092.94	3,768.12
Addressing and mailing equipment	2,573.23	3,214.36
	4,666.17	6,982.48
Less allowance for depreciation	1,864.06	6,144.02
Net fixed assets	<u>2,802.11</u>	<u>838.46</u>
Total assets	<u>\$ 32,265.82</u>	<u>25,698.05</u>

LIABILITIES AND NET EQUITY

Current Liabilities:		
Accounts payable-trade	\$ 676.29	812.22
Payroll taxes payable	716.08	557.51
Special purpose funds	1,835.25	2,735.27
Total current liabilities	<u>3,227.62</u>	<u>4,105.00</u>
Equity:		
Balance-beginning of period	21,593.05	14,577.52
Net increase, decrease (-) during period	7,445.15	7,015.53
Balance-end of period	<u>29,038.20</u>	<u>21,593.05</u>
Total liabilities and equity	<u>\$ 32,265.82</u>	<u>25,698.05</u>

See Notes To Financial Statements—June 30, 1976

INCOME STATEMENT
For the Years Ended June 30, 1976 and 1975

	Year Ended	
	June 30, 1976	June 30, 1975
Income:		
Affiliate dues	\$ 16,894.00	18,515.87
Direct dues	10,796.14	10,021.82
Total dues received	27,690.14	28,537.69
Contributions received for awards	1,710.42	2,700.00
Convention and meeting income	1,503.00	2,500.00
Publications and pamphlets	963.69	1,881.76
Sale of 3-A Standards	3,312.70	2,474.46
Decals, buttons, misc. and expense reimb.	965.97	1,208.19
Expense reimbursement—3-A	7,766.94	4,940.27
Sale of equipment	150.00	—
Interest income	265.21	334.76
Total income	<u>44,328.07</u>	<u>44,577.13</u>
Expense:		
Salaries	28,428.02	24,590.62
Payroll tax expense	1,696.86	1,653.39
Travel	3,479.92	3,095.31
Office supplies	3,025.83	1,954.37
Box rent and postage	2,215.82	1,876.83
Telephone	842.80	924.00
Office rent	2,250.00	2,625.00
Insurance	158.97	149.11
Legal and professional fees	1,175.52	1,058.00
Dues and subscriptions	200.00	—
Depreciation—office equipment	227.78	216.96
3-A Standards expense	332.55	256.61
Citations and awards	2,000.00	2,594.45
Buttons and decals	3.41	263.28
Convention and annual meeting expense	2,205.93	1,332.72
Cost of printing pamphlets	306.11	342.16
Miscellaneous	557.53	258.17
Total expense	<u>49,107.05</u>	<u>43,190.98</u>
Net income (loss) of Association	(4,778.98)	1,386.15
Add—net income (loss) of Journal—Exhibit B-1	<u>12,729.28</u>	<u>5,629.38</u>
Total net income (loss)	<u>\$ 7,950.30</u>	<u>7,015.53</u>

See Notes To Financial Statements—June 30, 1976

INCOME STATEMENT
For the Years Ended June 30, 1976 and 1975

	Year Ended	
	June 30, 1976	June 30, 1975
Income:		
Advertising	\$ 15,590.55	12,303.81
Subscriptions	32,626.58	16,865.67
Sale of journals	296.94	117.18
Sale of reprints	7,692.12	8,385.28
Page charges	<u>10,475.00</u>	<u>10,850.00</u>
Total income	<u>66,681.19</u>	<u>48,521.94</u>
Expense:		
Editorial salaries	—	3,350.00
Printing and publishing	37,500.71	29,499.29
Plates, cuts, etc.	846.00	297.50
Mailing and postage	4,215.00	2,843.08
Reprint expense	4,775.74	3,971.74
Advertising costs—commission and printing costs	1,678.85	626.60
Stationery and supplies	202.87	773.65
Travel expense	385.92	555.09
Depreciation—addressing equipment	149.21	41.11
Telephone	306.94	28.96
Consulting	3,600.00	525.00
Miscellaneous	<u>290.67</u>	<u>380.54</u>
Total expense	<u>53,951.91</u>	<u>42,892.56</u>
Net income of Journal	<u>\$ 12,729.28</u>	<u>5,629.38</u>

NET EQUITY
As of June 30, 1976

Balance June 30, 1975	\$ 21,593.05
Less transfer to Special Purpose Fund (Foundation Fund)	<u>505.15</u>
	21,087.90
Add net income for the year ended June 30, 1976	<u>7,950.30</u>
	<u>\$ 29,038.20</u>

Notes to Financial Statements—June 30, 1976

Inventory

Inventory of supplies is recorded at the lower of cost or market.

Fixed Assets

Office equipment, and addressing and mailing equipment are recorded at cost. Depreciation is computed on the straight-line method over the estimated useful life. At June 30, 1976, assets fully depreciated and the balance of accumulated depreciation were eliminated from the books.

Recognition of Revenues

Income from dues and subscriptions is recorded on the cash basis.
All other income is recorded on the accrual basis.

News and Events

Calendar of Events

October 29, 1976. **FOOD MICROBIOLOGY WORKSHOP.** Phillip Morris Research Center, Richmond, Virginia. Fee \$15.00. Sponsored by Carolina-Virginia Institute of Food Technology. For more information contact: Dr. Robert M. Ikeda, Phillip Morris Research Center, P.O. Box 26583, Richmond, VA 23261.

November 9-11, 1976. **RESEARCH AND DEVELOPMENT ASSOCIATES FOR MILITARY FOOD AND PACKAGING SYSTEMS, INC.** U.S. Army Natick Research and Development Command, Natick, Massachusetts. For information contact: Col. Merton Singer, USA (Ret), Executive Secretary, R & D Associates, 90 Church Street, Rm. 1315, New York, NY 10007. (212) 264-7612.

January 12-13, 1977. **DAIRY PROCESSORS CONFERENCE.** Quality Inn Motel, Madison, Wisconsin. Sponsored by the Food Science Department, University of Wisconsin-Madison.

February 9-10, 1977. **DAIRY INDUSTRY CONFERENCE.** Center for Tomorrow, Ohio State University, Columbus, Ohio. For information contact: John Lindamood, Dept. of Food Science and Nutrition, 2121 Fyffe Road, Ohio State University, Columbus, OH 43210.

February 13-16, 1977. **INTERNATIONAL EXPOSITION FOR FOOD PROCESSORS.** Superdome, New Orleans, Louisiana. Sponsored by the Food Processing Machiner and Supplies Association, 7758 Wisconsin Avenue, Washington, DC 20014.

March 21-25, 1977. **MID-WEST WORKSHOP IN MILK AND FOOD SANITATION.** Center for Tomorrow, Ohio State University, Columbus. For information contact: John Lindamood, Dept. of Food Science and Nutrition, 2121 Fyffe Road, Ohio State University, Columbus, OH 43210.

Notice to Membership

In accordance with the IAMFES Constitution and By-laws, which requires a Secretary-Treasurer to be elected by mail ballot, the membership is hereby notified that President Henry V. Atherton, at the annual meeting in Arlington Heights, Illinois appointed the following members to the nominating committee for 1977: James Burkett, Dudley Connor, Milford Juckett, Ben Luce, James Smathers, Glenn Ward, and Ray Belknap.

Nominations for the office of Secretary-Treasurer are now open and any member wishing to make a nomination should send a biographical sketch and picture of his nominee to the nominating committee no later than November 1, 1976. To maintain proper balance on the Executive Board, the nominee should be selected this year from industry.

R. A. Belknap
Chairman, Nominating
Committee
International Association of Milk,
Food & Environmental Sanitarians, Inc.
79 Locust Ave.
Ft. Mitchell, KY 41017

Notice-IAMFES Awards-1977

Each year IAMFES recognizes outstanding contributions and performance by its members.

The success of this program is dependent not only on those organizations who so generously support the monetary aspects of these awards, but it is equally dependent on your individual help in furnishing the Awards Committee with appropriate information and names of potential award winners.

Will you please give serious thought to the following Awards, which will be considered for presentation at our 1977 IAMFES Annual Meeting.

1. *The Sanitarians' Award* of \$1000 to a local or municipal sanitarian, who, during the past seven years, has made outstanding contributions to the health and welfare of his community.
2. *Educator/Industry Award* of \$1000 to a university or industry employee who has made outstanding contributions of food safety and sanitation. In 1977 the award will be made to a university worker.
3. *The Citation Award* to a member who has given outstanding service to IAMFES in filling its objectives.
4. *The Shogren Award* to the affiliate organization that has the best statewide or regional program.
5. *Honorary Life Membership* to that member who has given long and outstanding service to IAMFES.

Please contact P. J. Skulborstad, Chairperson of the IAMFES Recognition and Awards Committee, 2100 South York Road, Oakbrook, IL 60521.

Association Affairs

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International Assn. of Milk, Food and Environmental Sanitarians

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J. Raithby

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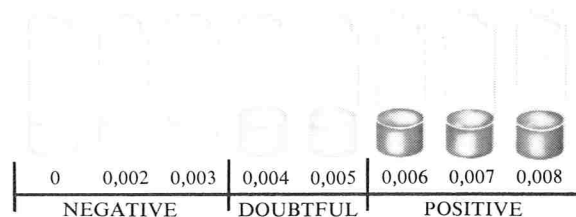
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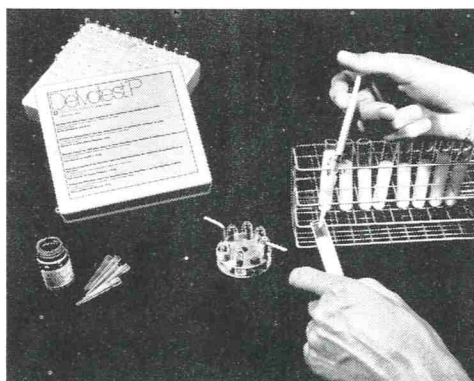


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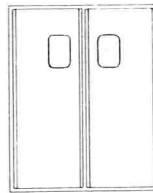
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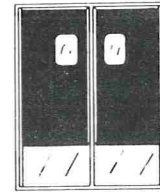
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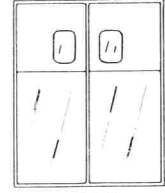
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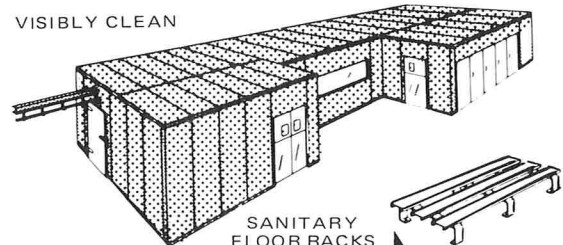
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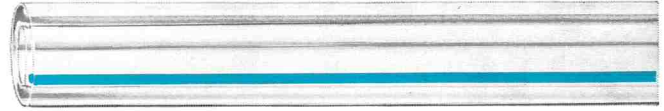
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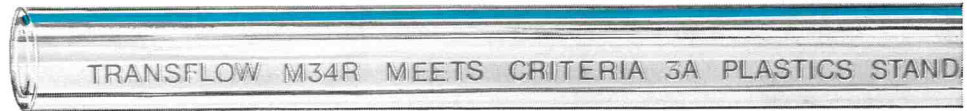
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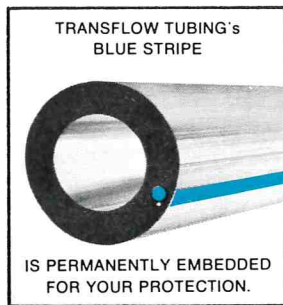
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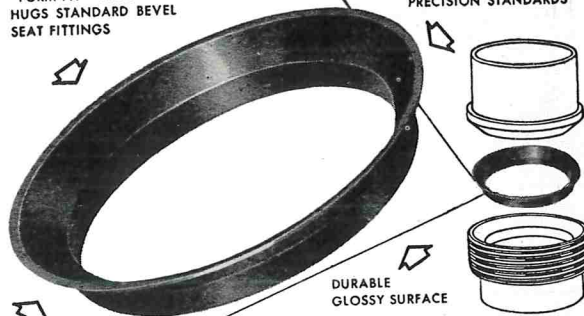
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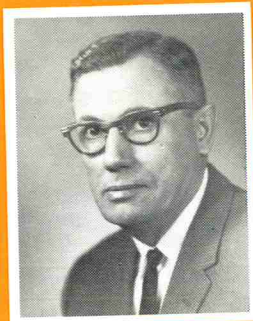
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Ralph Bonewitz, Extension Specialist
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What questions should a dairyman ask before expanding or modernizing?

Here are some of the most basic questions I believe dairymen should ask themselves before they begin a program of modernization or expansion:

What about my future in dairying? Will the changes I make be profitable in the long run? Will the changes be feasible in the short run?

Long run profitability refers to a period of eight to ten years or more. It is usually studied through the use of budgets. In the budgeting process, capital expenditures are prorated over the life of the assets by arbitrary depreciation methods.

Short run feasibility refers to the income-generating ability of a business in a short period of time. It is usually studied through the use of a projected cash flow.

Watch your cash flow

Projected cash inflow and outflow during the period are compared, reflecting payment requirements from credit agencies as well as all normal expenditures. Some business changes are capable of being profitable in the long run *but they are not capable of meeting short run demands for cash, particularly when payment requirements for capital expenditures are concentrated in the early years of an investment.*

Management must expand as herds get larger. More failures are due to lack of management than any other one thing. Hours spent thinking and getting facts will pay off and the manager or owner must assume this responsibility. A manager must have the ability to get the right things done at the right time.

Here are some more questions:

Will my expansion or modernization plan improve the chances and ease of producing a higher quality

product? Will it increase the ease of the key jobs associated with dairying? Will it increase the efficiency of labor, investment and/or equipment? Will the modernized set-up provide the minimum movement of men, animals and material? Can this modern dairy farm compete with nonfarm occupations for good labor or manpower?

Do you as a manager or owner have a concern for production, people, quality milk and a desire to make the dairy more profitable? Will you develop a good milking program? One that obtains high production per cow, controls mastitis, produces clean excellent-flavored milk and uses a minimum amount of labor?

Check this planning list

Tomorrow's profitable dairy farm can be expected to be a planned operation. Here are some of the things you will want to consider during the planning phase: 1) Size of herd to be accommodated; 2) Dairy breed; 3) Climate conditions; 4) Topography of farmstead, slope, drainage and exposure; 5) Size and productivity of the farm; 6) Feeding program as related to feed storage and equipment for feeding; 7) Existing buildings and equipment that will fit into long range plans; 8) Availability of labor; 9) Capital available for investment; 10) Sanitary regulations or codes or present and potential milk markets; 11) Personal preference of the owner; 12) Water and air pollution regulations.

Planning with pencil and paper prior to the start of construction permits you to analyze combinations of equipment and building arrangements without any expenditure. Visit as many farms as possible and incorporate the good points seen at these farms into your facilities. Use university people and private consulting people.

Unless a dairyman regularly tests production, a pipeline milker can be the best friend that a cull cow ever had. The cull cow strolls in with the good producers, gives only enough milk to color the line, eats almost as much feed as the best cows, and then goes her merry way. A dairyman needs profitable production from every cow. You will call the correct signals and build a profit-winning dairy team if you use production records.

Feeding practices important

Constant attention to feeding practices, breeding for production and herd health during expansion are very important. A well designed, properly installed milking system is essential to proper milking. You can't afford an inadequate or poorly maintained milking system.

Productivity must be the key

The productivity of a resource depends on the amount and kind of other resources with which it is combined. As an example, when capital is substituted for labor, it requires fewer hours of labor per cow. However, unless production increases or more cows can be handled, the machinery and equipment cost will offset the savings in labor. Productivity of a resource then depends on the kind and quality of the resource with which it is combined. Modern technology is closely related then to the substitution of capital for labor and land. It increases the demands on management, emphasizes financial management and increases technical requirements of hired labor.

Finally, all of this modernization should help make dairying more pleasant, as well as more productive for you and your family.

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