

DAIRY, FOOD AND ENVIRONMENTAL

# Sanitation

A PUBLICATION OF THE INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC.

DECEMBER 1999



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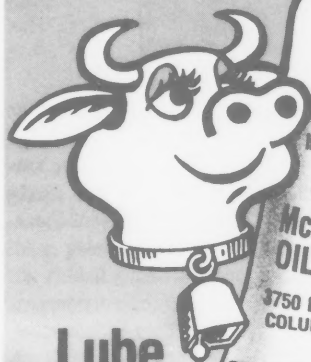
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**Seiberling Associates, Inc.**, 94 North High St., Suite 350, Dublin, OH 43017-1100; 614.764.2817

**Silliker Laboratories Group, Inc.**, 900 Maple Road, Homewood, IL 60430; 708.957.7878

**Universal Sanitizers & Supplies, Inc.**, P.O. Box 50305, Knoxville, TN 37950; 423.584.1936

**Warren Analytical Laboratory**, 650 'O' St., P.O. Box G, Greeley, CO 80632-0305; 800.945.6669

**Weber Scientific**, 2732 Kuser Road, Hamilton, NJ 08691-9430; 609.584.7677

**West Agro, Inc.**, 11100 North Congress Ave., Kansas City, MO 64153; 816.891.1528

**Zep Manufacturing Co.**, 1310 Seaboard Industrial Blvd., Atlanta, GA 30318; 404.352.1680

**Zylux Corporation**, 1742 Henry G. Lane St., Maryville, TN 37801; 423.379.6016

# QUOTATIONS

## FROM JACK



By JACK GUZEWICH  
IAMFES President

**“No matter how you cut it, Membership in IAMFES has a lot to offer the field sanitarian”**

One of the groups IAMFES serves is the field sanitarian. Field sanitarians include local dairy field staff and dairy plant quality assurance staff, quality assurance staff in other food processing industries and the retail food industry and state and local government inspectional staff. Field sanitarians have some special needs from our Association. They

are looking for practical information on how they can do their job better, information on what new things are happening that could affect them in the future and resource information on new products or information that they can use. IAMFES meets these needs in part through our journal *Dairy, Food and Environmental Sanitation* and symposia at our Annual Meeting that provide the kinds of information they are looking for. Our Annual Meeting also provides an excellent opportunity to network with many leaders in food safety from around the world. IAMFES publishes brochures and manuals targeted to field sanitarians including “Procedures to Investigate Foodborne Illness,” “Procedures to Investigate Waterborne Illness,” “Procedures to Investigate Arthropodborne and Rodentborne Illness,” “Before Disaster Strikes... a Guide to Food Safety in the Home,” and “Food Safety at Temporary Events.” Unfortunately, many field sanitarians do not belong to “International” as they feel that we are not meeting their needs.

We are always looking for additional ways to reach out to field sanitarians and demonstrate to them the value of belonging to our Association. To better accomplish this we need ideas from our current Members on how we can attract and retain more field sanitarians as members. Are there specific subjects you would like to see covered in *DFES* articles? Are there symposia topics we can include at future annual meetings?

We are looking to expand services on our web page; which ones can you suggest that would most appeal to the field sanitarian? We have been talking about sponsoring training courses in various parts of the country on topics of interest to field sanitarians. Would you be interested in attending such courses and what topics would you like to see us address? What course formats (e.g., length of course); registration cost, and size of class would appeal to sanitarians?

Another way field sanitarians can find IAMFES Membership valuable is by joining one of our committees or professional development groups. These groups are looking for new members and while they usually only meet at the Annual Meeting they have begun to take on projects during the year. They are an excellent way to make contacts with other individuals with similar interests. We have groups in dairy field and plant areas, meat and poultry, seafood, produce, viral and parasitic foodborne agents, retail food and HACCP just to mention a few of the subject areas.

No matter how you cut it, Membership in IAMFES has a lot to offer the field sanitarian, we just need to get the word out and tailor our services to ever-changing interests. To this end I ask your help in responding to this article by either contacting David Tharp in our Des Moines office or me with your suggestions on how we can increase our field sanitarian membership. Thanks for your help.

To Our Members Around the World

Didi Loynachan

Beth M Miller

Lisa K. Hovey

Pam Warringer

Dw Conroy



Wend Thomp

Lucia Collison

Julie Cottonack

Doana Bensus

Karla Jordan

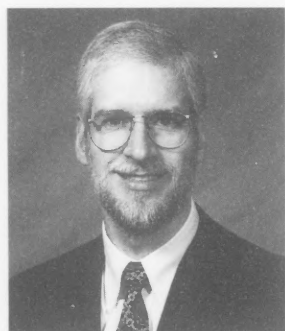
Kanya Wheeler

Frank Zuehlke

Best Wishes for a Prosperous  
and Happy New Year!

# COMMENTARY

## FROM THE EXECUTIVE DIRECTOR



By DAVID W. THARP  
IAMFES Executive Director

### “A review of high points of 1999 and a preview of 2000 and beyond”

Again, we find ourselves at the end of a year. This time though, it is a very special year for a number of reasons. Of course, we all know it is the end of a century, the twentieth century and we will roll over the annual calendar to the year 2000 in just a matter of days. What will the new century bring to your Association? I want to take a little time to give you a preview of future goals and to review our 1999 accomplishments.

Of the many accomplishments during 1999, Members voting to change the Association name to International Association for Food Protection has to rank at the top of the list. We received ballots from nearly 40% of the Membership, which is an astonishingly high response rate. Equally impressive is that of the ballots returned, 94% voted for the new name. We are excited by the opportunity created with the new name and look forward to your help in spreading the word to your colleagues.

Another piece of great news comes from our financial report for the fiscal year ending August 31. We completed the year with revenue exceeding expense by nearly \$32,000 which was about \$19,000 ahead of budget. This was accomplished in a year in which we kept dues steady by allowing an early payment discount for Members paying their dues timely. Although we had a great year financially, the Association is still carrying a deficit in our general fund of \$38,600. We have a plan in place to erase our deficit by the end of 2000, and I believe we are on track to accomplishing this goal.

During 1999, our Annual Meeting in Dearborn, Michigan was very successful with more than 1,130 attendees from around the globe. We were fortunate to have many excellent food safety topics presented during the program. Workshops were held on “Procedures to Investigate Foodborne Illness” and “An Insider’s Look at Microbial Risk Assessment.” The Risk Assessment Workshop was also presented in Washington, D.C. last April to a full house.

At the end of October, we traveled to Chicago to exhibit at the Worldwide Food Expo and had the opportunity to meet many interested individuals. Particularly gratifying was the number of people stopping at our booth from outside of North America! Some recognized our journals, but most were interested in becoming Members in the new International Association for Food Protection. Since returning, we have seen many membership application forms returned to our office. In addition, we drew for a registration to next year’s Annual Meeting and three Memberships. The winners are announced on page 847 of this issue of *DFES*.

We again made progress on reducing the processing time of manuscripts for publication in the *Journal of Food Protection* and saw increased submission rates for both *JFP* and *DFES*. The journals are the pride and joy of this Association and we must continue to do everything possible to present the professional image of the Association through our journals. We rely on both the *Journal of Food Protection* and

*Dairy, Food and Environmental Sanitation* to carry the Association message of "Advancing Food Safety Worldwide."

As we enter the New Year, efforts will be focused on attracting new Members and providing new services to our long-time Members. Some examples of improved, new services include the availability of submitting abstracts for presentation at Annual Meeting online at our Web site. We are also working towards a "Members Only" section of the Web site that will contain an up-to-date Membership directory. This will assist Members in contacting other Members. In today's mobile society, Members change jobs rather quickly. The "print version" of our Membership directory becomes outdated rapidly. The ability to look up current contact information for more than 3,000 colleagues will be a convenience for all Members.

Other online services being developed are e-commerce to include registration for Annual Meeting and workshops online,

and the ability to sign up for Membership, purchase publications, and renew your Membership at [foodprotection.org](http://foodprotection.org). We look forward to the increased versatility e-commerce offers to our Members and look forward to implementing this new technology during the next year.

Also in development at this time is a Student Professional Development Group. By this August at Annual Meeting, the Student PDG will have a full slate of meetings and activities planned. To date, it has been discussed to hold a luncheon with a featured speaker, to have a booth in the exhibit hall, to host a job-posting bulletin board, and to have other student social activities. Keep watching *DFES* for more information about the Student PDG as it develops.

A future project for 2001 or 2002 was discussed at the recent Executive Board meeting. As we enter the New Year, we will be investigating and working towards hosting international meetings outside of North America. It is not the intent to replace our Annual Meeting with these international

meetings, but to complement the Annual Meeting. We feel the time is right to pursue this activity with our new name and the increased ability to travel internationally. This will allow the International Association for Food Protection to position the Association as a world leader in providing information through journals and educational meetings on protecting the food supply. During the next year, we will conduct surveys and gather input from Members to consider and analyze when planning our plan of action.

There you have it, a review of high points of 1999 and a preview of 2000 and beyond. I hope that you'll agree that the affairs of the Association are in good hands of your Executive Board and that you agree that the Executive Board continually plans for future growth with your best interests in mind. With your support, we will continue to grow. We do have the opportunity to be the organization that brings together food safety professionals worldwide to protect the world's food supply. What could be more important?

# LOOK WHAT'S NEW

**A Student  
Professional  
Development  
Group  
is Forming**

If you are interested in joining this new PDG, please contact Scott Burnett:

University of Georgia  
Center for Food Safety & Quality Enhancement  
1109 Experiment St., Griffin, GA 30223-1797  
Phone: 770.228.7283 ext. 115; Fax: 770.229.3216  
E-mail: [sburnett@cfsqe.griffin.peachnet.edu](mailto:sburnett@cfsqe.griffin.peachnet.edu)

**Faculty: Please inform your students.**

# Evaluation of Sanitizers for Killing *Escherichia coli* O157:H7, *Salmonella*, and Naturally Occurring Microorganisms on Cantaloupes, Honeydew Melons, and Asparagus

C. M. Park and L. R. Beuchat\*

## SUMMARY

Chlorine (200 and 2000 ppm), acidified sodium chlorite (850 and 1200 ppm), hydrogen peroxide (0.2 and 1%), and Tsunami™ (40 and 80 ppm) were evaluated for their effectiveness in killing *Escherichia coli* O157:H7 and *Salmonella* inoculated onto the surface of cantaloupes, honeydew melons, and asparagus spears. Populations of naturally occurring aerobic microorganisms and yeasts and molds on untreated produce, and on produce treated with these chemicals and water (control), were determined. At the highest concentrations tested, chlorine, acidified sodium chlorite, and Tsunami™ killed 2.6 to 3.8 log<sub>10</sub> CFU *E. coli* O157:H7 and *Salmonella*, compared with water (control) treatment of cantaloupes and honeydew melons. Chlorine (2000 ppm) and acidified sodium chlorite (850 and 1200 ppm) were most effective in killing aerobic microorganisms and yeasts and molds naturally occurring on cantaloupes and honeydew melons. The lethal effectiveness of test chemicals was less pronounced on asparagus than on cantaloupes and honeydew melons.

## INTRODUCTION

Outbreaks of foodborne illness associated with consuming raw fruits and vegetables in the United States have occurred more frequently in recent years (3, 10). Factors contributing to these outbreaks include changes in consumers' dietary habits, insufficient knowledge of hygienic practices, and shifts in social demographics (6, 16). Changes in global trade and international travel patterns, in the frequency of eating meals in food service establishments, and in produce production, processing, and marketing practices have also undoubtedly contributed to an increased frequency of illness associated with consuming raw fruits and vegetables.

Pathogenic microorganisms have been isolated from a wide range of raw fruits and vegetables on an international scale (3), and several



outbreaks of illness linked to consuming watermelon or cantaloupe have been documented (7, 8, 12, 13, 17, 18). Pathogenic bacteria are known to grow on cut watermelon, cantaloupe, and honeydew melon (9, 11, 15). Outbreaks linked to asparagus have not been reported, although pathogenic bacteria have been shown to grow on asparagus held at refrigeration temperatures (2).

The increased frequency of outbreaks of illness associated with the consumption of raw fruits and vegetables in recent years has raised interest in evaluating the efficacy of sanitizers traditionally used in the food industry (4). Only a few reports have described the efficacy of sanitizers in reducing microbial populations on the surface of melons, and most of these studies have dealt with traditional washing with chlorinated water (4, 14). Exposure of whole cantaloupes to hydrogen peroxide vapor was suggested as an effective procedure to reduce numbers of microorganisms and prevent decay during storage at 36°F (2.2°C) for up to 4 weeks (19).

The effectiveness of chlorine, hydrogen peroxide, and ethanol in killing *Salmonella* inoculated onto the surface of cantaloupe cubes has been studied (6). Chlorine (2000 ppm) treatment reduced the population by less than 10-fold; the very high level of organic matter in the cantaloupe juice released from cut tissue apparently neutralizes the chlorine before its lethality can be manifested. Hydrogen peroxide (2 and 5%) and 70% ethanol were similar in their minimal effectiveness in killing *Salmonella* on cantaloupe cubes. A similar phenomenon would be expected for other cut melons.

This study was undertaken to compare several sanitizers for their effectiveness in killing *Escherichia coli* O157:H7, *Salmonella*, aerobic microorganisms, and yeasts and molds on the surface of whole cantaloupe and honeydew melons, and on asparagus spears.

## MATERIALS AND METHODS

### Test strains

Five strains of *E. coli* O157:H7 were used: 932, H1730, and F4546 (human isolates); E0018 (calf feces isolate); and 944 (salami isolate). Six serotypes of *Salmonella* were used: Agona (from alfalfa sprouts), Enteritidis E190-88 (from human feces), Gaminara F2712 (from orange juice), Michigan (cantaloupe), Montevideo G4639 (from a patient suffering from salmonellosis associated with consumption of tomatoes), and Typhimurium (bovine feces isolate). Strains were cultured at 37°C in 10 ml of tryptic soy broth (TSB, pH 7.3) (Difco, Detroit, MI) supplemented with 50 µg/ml nalidixic acid (TSBN). Cultures were transferred to TSBN at three successive 24-h intervals before cells were harvested by centrifugation (2,000 × g, 15 min, 21°C) and resuspending in 5 ml of sterile 0.1% peptone water. Volumes of cell suspensions of strains of *E. coli* O157:H7 or *Salmonella* were combined so that their populations were similar. The two mixed-strain suspensions of each pathogen were used as inocula for all test produce.

### Test produce

Cantaloupes (18 per box), honeydew melons (18 per box), and asparagus spears (11 1-lb bunches per box) were kindly supplied by Chestnut Hill Farms, Dodge Island, Miami, FL. Produce was kept at 5°C for up to 10 days before being used in various experiments.

### Procedure for inoculation

Cantaloupes, honeydew melons, and asparagus were adjusted to room temperature (23±2°C) over a 14- to 18-h period. Three cantaloupes, three honeydew melons, or three 100-g samples of asparagus spears were each inoculated with 100 µl of *E. coli* O157:H7 cell suspension and 100 µl of *Salmonella* cell suspension. The inoculum, which was applied in 8 to 10 spots by use of a 100-µl syringe, contained 8.65 to 8.76 log<sub>10</sub> CFU of either *E. coli*

O157:H7 or *Salmonella*. Produce was kept in a laminar flow biosafety hood with the fan on for 2 to 3 h to dry the inocula on the surface of produce. Each trial consisted of three melons or three 100-g samples of asparagus and was replicated three times.

### Treatment procedure

Four chemical treatments were evaluated for their effectiveness in killing *E. coli* O157:H7 and *Salmonella* inoculated onto the surface of produce, as well as total aerobic microorganisms and yeasts and molds naturally occurring on the produce. Chemicals tested were sodium hypochlorite (Aldrich, Milwaukee, WI) (200 and 2000 ppm free chlorine in 0.05 M potassium phosphate buffer, pH 6.8); acidified sodium chlorite (Alcide Corp., Redmond, WA) (850 and 1200 ppm); hydrogen peroxide (VWR, West Chester, PA) (0.2 and 1.0%); and Tsunami™ (Ecolab, Mendota Heights, MN) (40 and 80 ppm), which contains peracetic acid as an antimicrobial component. It should be noted that direct contact use of acidified sodium chlorite, hydrogen peroxide, and Tsunami™ to sanitize produce is not currently authorized by the U.S. Food and Drug Administration. An exceptionally high (2000 ppm) concentration of chlorine was evaluated because previous experiments showed that 200 ppm chlorine was largely ineffective in killing pathogenic bacteria on other types of produce (4, 5). Free chlorine in sodium hypochlorite solutions was determined with a chlorine test kit (Hach Co., Ames, IA) that has been approved by the U.S. Environmental Protection Agency.

Each cantaloupe, honeydew melon, or 100 g of asparagus was placed in a 1-gallon zip-lock freezer bag. To each bag containing one cantaloupe, one honeydew melon, or 100 g of asparagus, 200 ml of sterile water (control) or chemical treatment solution was added. Melons were washed by vigorously rubbing the bagged fruit by hand for 3 min; asparagus was washed by vigorously shaking the bagged sample for 3 min.

**TABLE 1. Effectiveness of chemical treatment in killing microorganisms on cantaloupes**

Treatment	Chemical concentration	Populations ( $\log_{10}$ CFU/ml of DE wash solution) <sup>1</sup>			
		<i>E. coli</i> O157:H7	<i>Salmonella</i>	Aerobic microorganisms	Yeasts and molds
Water		3.38 a	3.75 a	5.49 a	4.53 ab
Chlorine	200 ppm	0.60 cd	0.85 cd	4.73 a	3.53 bcd
	2000 ppm	0 <sup>2</sup> e	0.30 de	2.86 c	2.10 ef
Acidified sodium chlorite	850 ppm	0 e	ND <sup>3</sup> e	3.48 bc	1.82 f
	1200 ppm	0.30 de	ND e	3.35 c	2.48 def
Hydrogen peroxide	0.2%	2.30 b	2.94 b	4.53 ab	3.90 abc
	1.0%	1.00 c	1.04 c	5.15 a	4.82 a
Tsunami™	40 ppm	0.30 de	0.30 e	4.61 a	3.26 cde
	80 ppm	0.48 cde	0.48 de	4.87 a	3.23 cde

<sup>1</sup>Values in the same column that are followed by the same letter are not significantly different at the  $P \leq 0.05$  level.

<sup>2</sup>1 CFU/ml.

<sup>3</sup>None detected (lower limit of detection was 0.17 CFU/ml of DE wash broth); for the purpose of statistical analysis, 0 CFU/ml was used for samples in which no *Salmonella* were detected.

### Procedures for microbiological analysis

After being washed in water (control) or chemical treatment solution for 3 min, produce was transferred to a new bag to which 100 ml of Dey-Engley (DE) neutralizing broth (Difco) was added. Melons were again washed by hand rubbing for 3 min; asparagus was washed by vigorously shaking for 3 min. Quadruplicate 0.25-ml and duplicate 0.1-ml samples of DE wash broth were surface plated on sorbitol MacConkey agar supplemented with 50  $\mu\text{g/ml}$  nalidixic acid (SMAN, pH 7.1) (Unipath-Oxoid U.S., Columbia, MD), bismuth sulfite agar supplemented with 50  $\mu\text{g/ml}$  nalidixic acid (BSAN, pH 7.6) (Difco), plate count agar (PCA, pH 7.0) (Difco), and dichloran rose bengal chloramphenicol agar (DRBC agar, pH 5.6)

(Oxoid). Samples of DE wash broth serially diluted in sterile 0.1% peptone were also surface plated in duplicate (0.1 ml) on enumeration media. Inoculated SMAN and BSAN plates were incubated 24 h at 37°C, PCA plates were incubated 48 h at 30°C, and DRBC agar plates were incubated 5 days at 25°C before presumptive colonies of *E. coli* O157:H7 and *Salmonella*, total aerobic microorganisms, and yeasts and molds, respectively, were counted. Presumptive colonies of *E. coli* O157:H7 were confirmed by the API-20E miniaturized diagnostic kit (Biomérieux Vitek, Inc., Hazelwood, MO) and the O157 latex agglutination assay (Oxoid). Randomly selected presumptive colonies of *Salmonella* were analyzed using the *Salmonella* latex agglutination test (Oxoid).

Three replicate experiments were conducted. Data were subjected to analysis of variance and Duncan's multiple range test (SAS Inc., Cary, NC) to determine if mean values ( $P \leq 0.05$ ) of populations of pathogens differed significantly.

### RESULTS AND DISCUSSION

Mean populations of *E. coli* O157:H7 and *Salmonella* in 100  $\mu\text{l}$  of respective inocula applied to cantaloupes, honeydew melons, and asparagus ranged from 8.65 to 8.76  $\log_{10}$  CFU. A portion of these cells would be expected to die as a result of the drying process. Also, a portion of test cells may have been sublethally injured as a result of exposure to chemicals and thus not detected on selective media. Some of the surviving cells would be removed in the 200 ml of water or

**TABLE 2. Effectiveness of chemical treatment in killing microorganisms on honeydew melons**

Treatment	Chemical concentration	Populations ( $\log_{10}$ CFU/ml of DE wash solution) <sup>1</sup>			
		<i>E. coli</i> O157:H7	<i>Salmonella</i>	Aerobic microorganisms	Yeasts and molds
Water		2.60 a	3.14 a	3.81 a	2.39 a
Chlorine	200 ppm	ND <sup>2</sup> c	ND c	3.48 a	1.28 b
	2000 ppm	ND c	ND c	1.48 d	0 <sup>3</sup> c
Acidified sodium chlorite	850 ppm	ND c	ND c	2.14 cd	0.70 bc
	1200 ppm	ND c	ND c	1.32 d	0.85 bc
Hydrogen peroxide	0.2%	1.20 b	1.95 b	3.40 ab	2.47 a
	1.0%	1.00 b	1.72 b	2.89 abc	2.06 a
Tsunami <sup>™</sup>	40 ppm	ND c	0 c	2.44 bc	2.30 a
	80 ppm	ND c	ND c	3.13 abc	2.03 a

<sup>1</sup>Values in the same column that are followed by the same letter are not significantly different at the  $P \leq 0.05$  level.

<sup>2</sup>None detected (lower limit of detection was 0.17 CFU/ml of DE wash broth); for the purpose of statistical analysis, 0 CFU/ml was used for samples on which no *E. coli* O157:H7 or *Salmonella* were detected.

<sup>3</sup>1 CFU/ml.

chemical solution used to treat the produce. Data reported in Tables 1-3 are on a basis of  $\log_{10}$  CFU/ml of DE wash broth. Assessment of the relative efficacy of chemical treatments in killing microorganisms is best made by comparing numbers of CFU recovered in DE wash broth from produce washed with water to numbers recovered in DE wash broth from produce treated with chemical solutions, rather than comparing the number of CFU inoculated onto the produce to the number of CFU recovered per ml of DE broth.

### Cantaloupes

Shown in Table 1 are populations of *E. coli* O157:H7, *Salmonella*, aerobic microorganisms, and yeasts and molds recovered from cantaloupes treated with water (control) or various chemical solutions. Treatment of cantaloupes with all chemical solutions at all test concen-

trations significantly ( $P \leq 0.05$ ) reduced populations of *E. coli* O157:H7 and *Salmonella*, compared with populations detected on respective control (water treated) samples. Chlorine (2000 ppm), acidified sodium chlorite (850 and 1200 ppm), and Tsunami<sup>™</sup> (40 and 80 ppm) were more effective than hydrogen peroxide. Chlorine (2000 ppm) and acidified sodium chlorite (850 and 1200 ppm) were the most effective in reducing the aerobic microorganisms and yeasts and molds.

### Honeydew melons

Table 2 shows populations of *E. coli* O157:H7, *Salmonella*, and natural microflora recovered from honeydew melons treated with water or chemical solutions. Trends in reduction of numbers are similar to those observed for cantaloupes. However, the lower number of pathogens recovered from honey-

dew melons than from cantaloupes treated with water or chemical solutions indicate that larger numbers of cells were removed and/or killed on honeydew melons than on cantaloupes during the 3-min rubbing process. The smoother surface of honeydew melons, compared with cantaloupes, undoubtedly influenced the ease of cell attachment and removal of microbial cells.

### Asparagus

Shown in Table 3 are numbers of *E. coli* O157:H7, *Salmonella*, and natural microflora recovered from water- and chemically-treated asparagus. Higher numbers of cells from inocula of *E. coli* O157:H7 and *Salmonella* were recovered, compared with numbers recovered from cantaloupe and honeydew melon. As was the case for cantaloupes, chlorine (2000 ppm), acidified sodium chlorite (850 and 1200 ppm), and

**TABLE 3. Effectiveness of chemical treatment in killing microorganisms on asparagus**

Treatment	Chemical concentration	Populations ( $\log_{10}$ CFU/ml of DE wash solution) <sup>1</sup>			
		<i>E. coli</i> O157:H7	<i>Salmonella</i>	Aerobic microorganisms	Yeasts and molds
Water		4.00 a	4.27 a	6.71 a	6.07 a
Chlorine	200 ppm	3.03 ab	3.20 b	6.35 abc	5.79 a
	2000 ppm	1.86 c	1.54 c	6.05 c	5.21 b
Acidified sodium chlorite	850 ppm	2.46 bc	2.78 b	6.14 bc	5.56 ab
	1200 ppm	2.28 bc	1.62 c	6.19 bc	5.67 ab
Hydrogen peroxide	0.2%	3.67 a	3.83 ab	6.58 ab	6.04 a
	1.0%	3.31 ab	3.49 ab	6.31 abc	5.62 ab
Tsunami™	40 ppm	2.91 ab	3.23 b	6.51 abc	6.00 a
	80 ppm	3.21 ab	2.91 b	6.49 abc	6.00 a

<sup>1</sup>Values in the same column that are followed by the same letter are not significantly different at the  $P \leq 0.05$  level.

Tsunami™ (40 and 80 ppm) were more effective than hydrogen peroxide in killing *Salmonella*. Treatment with chlorine (2000 ppm) or acidified sodium chlorite (850 and 1200 ppm) resulted in the largest reductions of *E. coli* O157:H7 and aerobic microorganisms. With the exception of treatment with 2000 ppm chlorine, chemical treatments were essentially without effect in killing yeasts and molds on asparagus.

## CONCLUSION

The effectiveness of 200 ppm chlorine in killing test pathogens on cantaloupes and honeydew melons was greater than that observed for pathogens on other produce (1, 4, 5, 20-22). Factors influencing these observations include differences in surface morphology of produce, method of applying inoculum, procedures for preparing and applying inoculum, and methods for removal and enumeration of surviving cells. A standard method for testing the

efficacy of produce sanitizers would be extremely useful when comparing results obtained in different laboratories.

Results of our study clearly indicate that populations of *E. coli* O157:H7 and *Salmonella* can be reduced significantly by treatment with chemical solutions. Chlorine, acidified sodium chlorite, and Tsunami™ killed 2.6 – 3.8  $\log_{10}$  CFU of these pathogens, compared with the effect of water treatment of cantaloupes and honeydew melons. Considering the concentrations of chemicals evaluated and all three types of produce examined in this study, the general order of effectiveness in killing the selected pathogens was chlorine (200 or 2000 ppm)  $\geq$  acidified sodium chlorite (850 ppm) = Tsunami™ (40 or 80 ppm)  $\geq$  hydrogen peroxide (1%). Exceptions to this order within a specific produce type, however, necessitate that judgments be made in selection of treatment for each type of produce.

## ABOUT THE AUTHORS

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# ★ Congratulations! ★



Julie Cattanaach, David Sharp and Bev Corron staffed the Association booth at the Worldwide Food Expo, October 28-31, 1999

In October of 1999, the International Association for Food Protection (formerly IAMFES) participated at the Worldwide Food Expo in Chicago, Illinois. While exhibiting, we offered a drawing for a one-year Membership with our Association. We are pleased to announce the following winners of the drawing:

**Joseph Iwan, Chicago, Illinois**

**N. Sivakumaran, Ambattur, Chennai, India**

**Emily Goodvin Villanueva, Austin, Texas**

We hope these new Members  
find their memberships rewarding.

# The Presence of *Salmonella* in Local Food and Beverage Items in Singapore

Doris L. K. Ng,\* Bee Bee Koh, Leng Tay, and Mavis Yeo

## SUMMARY

During the period January 1998 to July 1998, a total of 2617 samples, mostly food and beverage items for direct consumption, were examined for *Salmonella*. Of these, 37 (1.4%) were found to be positive for *Salmonella*. Twenty-one *Salmonella* serotypes belonging to 7 different groups were isolated. The predominant group was *Salmonella* Group B (45.9%) while the predominant serotype was *Salmonella typhimurium* (13.5%).

## INTRODUCTION

More than 2300 serotypes of salmonellae are currently recognized, with all considered pathogenic for humans (5). Salmonellae are found in the intestinal tracts of animals and humans. Animal food products may contain the bacteria. Humans can, directly or indirectly, be sources of contamination, with poor personal hygiene playing a vital role in transmission from one person to another.

Salmonellosis in man most commonly results from ingestion of contaminated food. The most vulnerable foods are those that are rich in proteins and carbohydrates and that have been extensively handled or left unrefrigerated for considerable lengths of time and then lightly cooked or served without further

cooking (5). In view of this, a survey investigated the presence of *Salmonella* in different types of food and beverage items sold locally in Singapore for direct consumption. Swabs used to detect contamination of surfaces, as well as raw meats, processed meats, and processed seafood items that need further cooking, were tested.

## MATERIALS AND METHODS

Media used were purchased either from Oxoid Ltd, Basingstoke, UK or BBL, Becton Dickinson and Company, Cockeysville, USA. Serological tests were performed using the Murex Agglutinating Sera (Rabbit) for slide agglutination.

A 25 g sample of each food was homogenized in 225 ml of pre-en-

richment broth (1, 3, 4). After incubation at 37°C for 24 h, 1 ml and 10 ml portions of the enriched sample were transferred separately into 100 ml of Rappaport-Vasiliadis broth and 100 ml of Tetrathionate broth containing 0.001% Brilliant Green, respectively. The former was incubated at 42°C and the latter at 37°C.

After 24 h and 48 h of incubation, 3 mm loopfuls of the broths were inoculated onto Xylose Lysine Desoxycholate Agar and Hektoen Enteric Agar. The agar plates were incubated at 37°C for 24 h. Suspect colonies were picked and identity of the purified colonies confirmed by biochemical and serological procedures.

## RESULTS AND DISCUSSION

*Salmonella* was isolated from 37 (1.4%) of 2617 samples examined. Table 1 gives the different categories and number of samples examined and samples found to be positive for *Salmonella*.

*Salmonella* was isolated from both raw and cooked food as well as from beverages. The raw foods positive for *Salmonella* were all meant for direct consumption. The cooked foods positive for *Salmonella* included meat and seafood items and other carbohydrate/protein-rich food items. A detailed breakdown of the *Salmonella* posi-

**TABLE 1. *Salmonella* isolations from various types of samples**

Categories of samples	Na. of samples tested	No. of <i>Salmonella</i> positive samples (% of total)
<b>RAW FOODS</b>		
Meat (beef)	2	0
Processed meat (sausages, frankfurters, etc.)	10	0
Seafaad (fish, prawns, cuttlefish, etc.)	38	0
Salads	165	0
Raw fish and raw fish salad (Yu sheng)	44	2 (4.5%)
Chinese rajak and prawn paste	37	0
Cucumber/Tamata	16	1 (6.3%)
Egg	1	0
<b>COOKED FOODS</b>		
Meat and meat products (beef, mutton, pork, chicken)	403	7 (1.7%)
Egg and egg products	71	0
Rice with meat or vegetables (char siew rice, chicken rice, chye png, etc.)	223	5 (2.2%)
Malay and Indian food (nasi lemak, mee siam, lantang, begedil, Indian rojak, rati prata, etc.)	194	4 (2.1%)
Seafood (fish, fishcake and fishball, sotong, etc.)	430	12 (2.8%)
Chinese pasta (kway teow, mee, bee haan, etc.)	198	1 (0.5%)
Dairy products (ice cream, milk, etc.)	104	0
Hamburgers	14	0
Vegetables	28	0
Snacks and desserts (sandwiches, cakes, cheng tng, etc.)	134	0
Others (laksa, yang tau fu, porridge, etc.)	206	2 (1.0%)
<b>MISCELLANEOUS</b>		
Sushi	35	0
Cut fruits	45	0
Fruit juice and fruit puree	30	2 (6.7%)
Chilli sauce	32	0
Ice cube	1	0
Drinks (saya bean milk, mila drink, etc.)	140	1 (0.7%)
Swabs (from cooking utensils, chopping boards, etc.)	16	0
<b>TOTAL</b>	<b>2617</b>	<b>37 (1.4%)</b>

tive samples and the serotypes isolated is given in Table 2.

The predominance of the different *Salmonella* groups and serotypes isolated are given in Tables 3 and 4, respectively.

Of the 7 *Salmonella* groups isolated, the predominant one was *Salmonella* Group B (45.9%), fol-

lowed by *Salmonella* Group E<sub>1</sub> (18.9%).

A total of 21 *Salmonella* serotypes were isolated. The predominant one was *Salmonella typhimurium* (13.5%), followed by *Salmonella agona* (10.8%). Both serotypes belong to *Salmonella* Group B.

The low percentage (1.4%) of contaminated samples indicates that hygienic practices are generally good. All 37 contaminated samples were meant for direct consumption. Out of these, 31 were cooked foods. Contamination of these samples could have occurred if the raw product was not from a safe source and

**TABLE 2. Breakdown of types of *Salmonella* positive samples**

Categories of samples	Types of positive sample	No. of positive samples	<i>Salmonella</i> ; serotype/s isolated	
<b>RAW FOODS</b>				
Raw fish and raw fish salad (Yu sheng)	Raw fish	1	<i>S. wandsworth</i>	
	Raw fish salad	1	<i>S. wandsworth</i>	
Cucumber/Tomato	Cucumber	1	<i>S. kingston</i>	
<b>COOKED FOODS</b>				
Meat and meat products	Curry mutton	1	<i>S. zerifin</i>	
	Lemon chicken	1	<i>S. anatum</i>	
	Chicken meat		2	<i>S. enteritidis</i> , <i>S. kingston</i>
		Chicken drumstick	1	<i>S. agona</i>
	Char siew meat	2	<i>S. agona</i> , <i>S. typhimurium</i>	
Rice with meat or vegetables	Chicken rice	4	<i>S. agona</i> , <i>S. hadar</i> , <i>S. infantis</i> , <i>S. typhimurium</i>	
			Duck rice	1
	Malay and Indian food	Nasi ayam	2	<i>S. agona</i> , <i>S. kisii</i>
Lontong		1	<i>S. pramiso</i>	
Begedil		1	<i>S. lagos</i>	
Seafood	Cooked mussel meat	1	<i>S. weltevreden</i>	
	Sardine	1	<i>S. typhimurium</i>	
	Fried fish	1	<i>S. typhimurium</i>	
	Cooked squid	1	<i>S. dumfries</i>	
	Fishcake		7	<i>S. derby</i> , <i>S. enteritidis</i> , <i>S. oranienburg</i> , <i>S. senftenberg</i> , <i>S. singapore</i> , <i>S. stanley</i> , <i>S. typhimurium</i>



**Table 2. continued**

	Fish ball	1	<i>S. oranienburg</i>
Chinese pasta	Fried bee hoon	1	<i>S. saint-paul</i>
Others	Laksa	2	<i>S. duisburg,</i> <i>S. lagos</i>
<b>MISCELLANEOUS</b>			
Fruit juice and fruit puree	Guava puree	1	<i>S. dumfries</i>
	Durian puree	1	<i>S. dumfries</i>
Drinks	Sugar-cane juice	1	<i>S. weltevreden</i>
	<b>TOTAL</b>	<b>37</b>	

**TABLE 3. Predominance of different groups of *Salmonella* isolated**

Group isolated	Total no. of positive samples	% of positive samples
B	17	45.9
C <sub>1</sub>	5	13.5
C <sub>2</sub>	2	5.4
D	3	8.1
E <sub>1</sub>	7	18.9
E <sub>4</sub>	1	2.7
Q	2	5.4

processing was not sufficient to destroy the pathogen/s present. However, it could also have occurred through recontamination of the cooked food either by direct or indirect contact with raw products, by improper handling, or from the environment.

To reduce the incidence of Salmonellosis, education and training of food preparation personnel on the causes and prevention of foodborne illnesses are important, as many foodborne diseases result from ignorance (4). Raw food should always be obtained from safe sources. Cooking and reheating of food should be thorough, and a temperature of at least 70°C should be

achieved throughout the food (2). Recontamination of cooked foods can be avoided by proper food handling, observing good personal hygiene, and using properly sanitized equipment and utensils. If foods are prepared ahead of time, they should be cooled promptly to retard multiplication of bacteria (5).

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**TABLE 4. Predominance of different serotypes of *Salmonella* isolated**

Group isolated	Serotypes isolated	No. of isolates	% of total isolates
B	<i>S. agona</i>	4	10.8
	<i>S. derby</i>	1	2.7
	<i>S. duisburg</i>	1	2.7
	<i>S. kingston</i>	2	5.4
	<i>S. lagos</i>	2	5.4
	<i>S. saint-paul</i>	1	2.7
	<i>S. stanley</i>	1	2.7
	<i>S. typhimurium</i>	5	13.5
C <sub>1</sub>	<i>S. infantis</i>	1	2.7
	<i>S. kisi</i>	1	2.7
	<i>S. oranienburg</i>	2	5.4
	<i>S. singapore</i>	1	2.7
C <sub>2</sub>	<i>S. hadar</i>	1	2.7
	<i>S. zerifin</i>	1	2.7
D	<i>S. enteritidis</i>	3	8.1
E <sub>1</sub>	<i>S. anatum</i>	1	2.7
	<i>S. dumfries</i>	3	8.1
	<i>S. pramiso</i>	1	2.7
	<i>S. weltevreden</i>	2	5.4
E <sub>4</sub>	<i>S. senftenberg</i>	1	2.7
Q	<i>S. wandswoth</i>	2	5.4

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# Washing Fresh Fruits and Vegetables: Lessons from Treatment of Tomatoes and Potatoes with Water

Jerry A. Bartz

## SUMMARY

Bacterial soft rot development in storage can be used to measure the effect of prior contact of potatoes or tomatoes with water containing *Erwinia carotovora* subsp. *carotovora*. Because this bacterium is a strict wound invader that cannot penetrate an unbroken epidermis, the potato or tomato soft rot system can be used as a model for certain microbial problems associated with the washing/handling of fresh fruits and vegetables in water. Immersion of either tomato fruit or potato tubers in water containing  $\log_{10}$  4.0 CFU/ml or more of *E. c. carotovora* led to increased incidence and severity of soft rot above the base level for the test lot (amount occurring with no postharvest treatment). Decay increased as populations of pathogens in the water increased. Wash water can infiltrate intercellular spaces in tomato or potato tissues by temperature-, time-, and pressure-dependent processes. Infiltration occurs only when the water pressure on the product surface overcomes internal gas pressures and the hydrophobic nature of the product surface. When infiltration occurs, the spores or cells of pathogens suspended in the water become internalized in the product. Addition of detergents (surfactants) to water promotes infiltration, apparently by reducing the surface tension of the water at the air-water interface at pores leading into the fruit or tuber. The incidental accumulation of surfactants in packinghouse water systems associated with washing spray residues from product surfaces may also increase the potential for infiltration. Addition of chlorine to water prior to adding products can prevent transfer of pathogens from the water to infection courts on the product. However, once the product is inoculated, chlorinated water will reduce but not prevent the subsequent development of decay. Washing freshly inoculated potatoes in clean tap water did not eliminate the effect of the inoculation. The addition of chlorine to the water used to infiltrate surface contaminated tomatoes reduced but did not prevent the subsequent development of decay. Thorough air-drying (up to 3 h) of potatoes that had been washed in contaminated water reduced, to nearly the preexisting level, the increased soft rot potential associated with washing in contaminated water.

## INTRODUCTION

Water has several essential uses in the postharvest handling of many fresh fruits and vegetables. It is used to cushion the unloading of field or storage containers of fruits and vegetables, to disperse bulk loads or piles of fruits and vegetables, and to move fruits and vegetables in a single layer to packingline machinery. Water is also used to clean harvested products. Certain fruits and vegetables are cooled by showers of cold water or submersion in cold water. However, a few fruits and vegetables (strawberries, raspberries, crisp-head lettuce, etc.) are not handled in water or exposed to spray washes because of concerns that wetting the product promotes postharvest decays.

Accumulation of microorganisms in water systems is a major concern for packinghouses. Microbes, plant debris, soil, spray residues, and other material on the surface of the fruit or vegetable are washed into the water as the product moves through the system. Water in the dump tank/flume system for most fruits and vegetables is recirculated continuously during a work day, and materials washed from the products accumulate in the water. "Trash eliminators" remove larger plant debris. Matter that settles out, such as soil particles, must be continuously or periodically removed, particularly when freshly harvested root crops are handled. However, small particulate matter, microorganisms, and dissolved substances accumulate. Because this matter soils the surface of all fruits and vegetables in the system, spray-washers are used to clean products as they leave the dump tank/flume system. Washing fruits and vegetables with clean water can reduce the microbial load by 10 to 100-fold, according to several published reports (26, 33), but may not reliably remove pathogens from product surfaces (33).

An accumulation of certain plant pathogens in dump tanks and flumes has been associated with excessive losses to decay, particu-

larly with tomatoes (2, 9). A primary postharvest pathogen of both tomatoes and potatoes is *Erwinia carotovora* subsp. *carotovora*, which causes bacterial soft rot (6, 33). Additional pathogens of tomatoes include *Geotrichum candidum* (sour rot), *Botrytis cinerea* (gray mold), *Rhizopus stolonifer* (Rhizopus rot), and certain lactic acid bacteria (10, 21). By contrast, major postharvest potato pathogens that can be found in dump tanks and flumes include *E. c. carotovora* as well as species of *Fusarium* (dry rot) and *Helminthosporium solani* (silver scurf) (40). The most common way for these pathogens to infect their hosts is through wounds. Most fruits and vegetables arriving at the packinghouse have some type of fresh, harvest-related wound, and a contaminated water system therefore almost always assures that the products will become inoculated. For most fresh fruits and vegetables, inoculation in the water handling system leads to excessive post-harvest decay.

Potatoes and tomatoes differ in susceptibility to bacterial soft rot. Potatoes stored in air at moderate temperatures are highly resistant unless previously damaged, as by heat, shatter bruises, or infection by another pathogen (40). Potatoes stored under anaerobic conditions, however, are highly susceptible to soft rot (32, 34, 35). Internal tissues of wet tubers can become anaerobic within 2.5 h at 21°C (19), allowing certain species of the obligate anaerobe *Clostridium* to grow (32). Potatoes also can become anaerobic if air movement is restricted and temperatures are high.

Because aerobically stored tubers are highly resistant to soft rot, the efficacy of treatments for controlling the disease is evaluated by their effect on the "potential" for development of soft rot. Soft rot potentials are converted to decay when tubers are wet, or become wet, or are in an anaerobic environment for 24 h or longer. By contrast, tomatoes decay readily in aerobic environments, although high relative humid-

ity and free moisture on fruit surfaces greatly favor decay development. With either potatoes or tomatoes, removing residual moisture from product surfaces after wash/handling operations is essential to minimizing postharvest decay.

The status of clinical pathogens on or in fresh market tomatoes and potatoes is unknown. Certain bacteria that are pathogenic to humans have been shown to multiply in fresh tomatoes (1, 17, 41, 44). The apparently acidic pH of exposed or injured tomato cells does not prevent growth of various *Salmonella* spp. or *Listeria monocytogenes*. Therefore, if tomatoes entering a packinghouse water system are contaminated with these bacteria or the water system itself is contaminated, the packaged tomatoes will likely be contaminated. Moreover, several survival studies (1, 17, 41, 44) show that tomatoes contaminated in the field, during harvest, or at the packinghouse are likely to remain contaminated throughout the marketing system. Additionally, free moisture on tomato surfaces and warm temperatures during handling, storage, or preparation of fresh tomato products would allow certain clinical pathogens to multiply. Outbreaks of foodborne illnesses have been associated with consumption of fresh tomatoes on two recent occasions (28, 42). However, whether the implicated tomatoes were contaminated before, in, or after the packinghouse is not clear.

Potatoes develop in a soil environment where certain clinical pathogens, e.g., *Listeria monocytogenes*, occur naturally. Indeed, Heisick et al. (29) found this pathogen more frequently in potatoes (nearly 26% positive) and radishes than in several other vegetables sampled from supermarkets in Minneapolis, MN. Fortunately, potatoes are seldom consumed raw. Nevertheless, the risk of cross contamination from fresh potatoes to cutting boards and knives to lettuce and other salad vegetables in the home remains a real possibility.

The most frequently used method to control microbial populations in water wash/handling systems in fresh fruit and vegetable packinghouses is the continuous or sporadic addition of chlorine products that produce hypochlorous acid and hypochlorite ion in the water. Hypochlorous acid at relatively low concentrations (0.5 to 10 mg/l) is rapidly lethal to the suspended vegetative cells of bacteria (23). Somewhat higher concentrations are required to kill bacterial or fungal spores (23, 25, 36). For several reasons, however, recommendations for water chlorination in commercial packinghouses feature free chlorine concentrations of 100-300 mg/l, well above the minimum lethal dose for spores. First, because of its reactivity with many chemicals, microbes, and plant debris, chlorine is highly unstable in water receiving raw fruits and vegetables. Frequent or continuous addition of chlorine products are required to maintain a free chlorine residual in the water. Maintenance of concentrations above the minimum provides a margin of safety in case the chlorine demand (sum of all material that reacts with chlorine) entering the system exceeds anticipated levels. Second, many microbes entering packinghouse water systems are in clumps or embedded in or attached to organic matter and, as a result, are not as sensitive to free chlorine as are the aqueous suspensions of individual bacterial cells or fungal spores commonly examined in the laboratory. Third, microbes released into the water must be destroyed quickly before they contaminate product surfaces, because reliable means of decontaminating fresh produce do not exist.

Whether water wash/handling systems for potato tubers should be treated with chlorine is controversial because of the difficulty of maintaining a free-chlorine residual in the water as soil and tuber periderm particles accumulate. The free chlorine added to a potato washer or dump tank is usually quickly inactivated. However, as will be demon-

strated, the potential for bacterial soft rot in potato tubers increases as the inoculum concentration in the handling water increases. Washing contaminated tubers in clean water did not eliminate this increase in potential. Additional factors in washing of tomatoes and potatoes examined herein include ways that water containing suspended microbes could enter the product during washing/handling operations. The interaction of water chlorination and drying with factors leading to inoculation/contamination were also explored. Factors leading to increased decay may also increase the chance of contamination by clinical pathogens.

## MATERIALS AND METHODS

### General methods

Plant material (potato tubers and tomato fruit) obtained from various sources was either used immediately or stored at appropriate temperatures. Prior to tests, the material was sorted to eliminate decay, severe injury, or growth defects and warmed to desired temperatures. Cultures of *E. c. carotovora* used (SR1, SR12, or SR38) were maintained and harvested as described (5, 8). After treatment, tomatoes were stored for 7-14 days at 20-30°C under a R.H. above 90%, whereas potatoes were stored for at least 72 h at 20°C under a mist or fog of water that kept surfaces wet (34). Disease in tomatoes was recorded as the incidence of decay (percentage of fruit with at least one lesion) or as severity of decay at a wounded area. With potatoes, disease was tabulated as incidence or severity of decay. Severity was rated as the percentage of surface area decayed (SAD) by the Horsfall-Barratt (30) system.

### Pathogen populations and postharvest decay

The decay hazard associated with accumulation of *E. c. carotovora* in wash/handling water was examined by wound inoculating tomato fruit with straight pins (16 punctures, 2-mm deep, per fruit)

that had been dipped into a suspension containing  $\log_{10}$  2.0 to 8.0 CFU/ml of the organism and then storing the fruit at 21°C for 8 days (8). For accumulation of soft rot bacteria in potato handling water, Russet Burbank potatoes at ambient temperatures were submerged for 2 min in aqueous cell suspensions containing  $\log_{10}$  3.7 to 6.7 CFU/ml of *E. c. carotovora*. The inoculated tubers were immediately placed in the mist chamber.

### Inoculation of products by infiltration

The possible infiltration of tomatoes by water during wash/handling procedures was explored initially by submerging tomatoes at 37 or 40°C in aqueous cell suspensions of *E. c. carotovora* or diluted suspensions of India ink (ca. 1:10) at 20°C (15). Tomatoes were individually labeled, weighed, and then held just under the surface of the water for the designated time interval. After treatment, fruits were dried with a cotton towel, weighed, and then examined for ink penetration or stored to observe decay development. Development of lesions beneath or beside the stem scar or in association with the blossom scar confirmed the internalization of *E. c. carotovora*, because such lesions rarely or never developed after fruit had been rinsed in inoculum.

Infiltration due to water pressure on product surfaces was examined by air-pressure treatment of potatoes or tomatoes that had been submerged in water or cell suspensions of *E. c. carotovora* in a 19-l pressure cooker (3, 4, 12). The pressure of the air entering the closed chamber was measured directly with a mercury manometer.

The nonionic surfactants Triton X-100 (Rohm and Haas, Philadelphia, PA) and Tergitol-NPX (Union Carbide Corp., Danbury, CT) were added to water or to suspensions of *E. c. carotovora* at concentrations of 0.001 to 1.0% w/v to determine the effect of the surface tension of the wash water on infiltration, as quantified by weight and/or decay increase. Tomatoes or potato tubers

**TABLE 1. Decay in wound-inoculated\* tomatoes as affected by inoculum concentration**

Concentration (log CFU/ml)	Incidence (%) of decay after inoculation		
	3 days	7 days	14 days
0	2 <sup>†</sup>	4	11
2.0	0	4	11
4.0	0	29	69
6.0	12	65	86
8.0	23	72	93

\*Straight pins dipped into aqueous cell-suspension of bacteria at indicated concentration were pressed to side of tomato to create wounds ca. 2 mm deep. Inoculated tomatoes were stored at 21°C.

<sup>†</sup>Each value is the average of three 15-fruit replicates.

**TABLE 2. Decay in potatoes as affected by concentration of *E. c. carotovora* in wash water**

Concentration (log <sub>10</sub> CFU/ml)	Severity (% surface area)	Incidence
3.7	4 <sup>*</sup>	80
4.7	22	90
5.7	29	100
6.7	36	100

\*Average of 10 tubers that had been immersed in an aqueous cell-suspension of *E. c. carotovora* for 4 min and then stored under mist of water at 20°C for 4 days.

submerged in the various solutions were treated and then incubated.

#### **Efficacy of methods to reduce *E. c. carotovora* populations on potatoes or tomatoes during or after washing procedures**

Populations of *E. c. carotovora* on potatoes or tomatoes were reduced by post-wash rinses with clean or chlorinated water, maintenance

of a free chlorine residual in the water during washing, or drying of washed products prior to incubation. Chlorine solutions were prepared from sodium hypochlorite-based laundry bleach. Free chlorine concentrations in the treatments were determined by the DPD-test (Hellige, Inc., Garden City, NY) or were based on dilution after initial bleach strength was deter-

mined by titration with standard sodium thiosulfate (Hach Co., Loveland, CO). The pH of solutions was adjusted by addition of 1 N HCl or NaOH. In certain tests, naturally occurring NaHCO<sub>3</sub> in the tap water was the buffer, whereas in others a 0.05-M phosphate buffer was used. In certain treatments tuber surfaces were fan dried in the laboratory for up to 3 h.

#### **Effect of a clean water rinse**

Tubers were washed in log<sub>10</sub> 4.7 or 6.7 CFU of *E. c. carotovora*/ml for 5 s or 2 min and then rinsed under running tap water for 10 s prior to incubation (11).

#### **Effect of removing residual wash water by fan drying**

Tubers were exposed to inoculum with or without a hydrostatic pressure of 350 cm and then dried with a fan in the laboratory for up to 3 h. A sample of the dried tubers was enclosed in a polyethylene bag and stored at 20°C for 69 h. All tubers were moistened and incubated in the mist chamber for 96 h.

#### **Water chlorination to prevent transfer of pathogens from water**

Wounded tomato fruits were added to chlorinated water of different pH levels and different temperatures. The water was agitated with an aquarium pump, and an aquarium heater provided heat. A spore-suspension of *G. candidum* or *R. stolonifer* was added to the water, and fruits were removed 2 min later and then stored at 20°C to determine if lesions developed at the wounds. Control fruits were treated in chlorinated water alone.

In two separate visits to a commercial tomato packinghouse, chlorine concentrations in a dump tank-flume system were 50 or 85 (first visit) and 50 or 100 (second visit) mg of free chlorine/l at pH 7.0. The water temperature was 38°C. Four 55-kg (25-lb) cartons each of extra-large US Grades, No. 1 Combination, No. 2, and No. 3 were sampled after the packing line had been operating

**TABLE 3. Decay incidence and weight increase in washed tomatoes as affected by temperature of fruit and wash water containing *E. c. carotovora***

Fruit Temp. (°C)	Water Temp. (°C)	Weight Increase (%)	Decay incidence
20	20	0.00 <sup>x</sup>	0 <sup>y</sup>
40	20	0.44	100
40	40	0.02	0
20	40	0.01	0

<sup>x</sup>Average of 10 fruit that had been submerged in an aqueous cell suspension containing  $\log_{10}$  7.0 CFU/ml of *E. c. carotovora* for 10 min.

<sup>y</sup>Incidence of decay after 2-day storage at 26°C.

with the indicated chlorine concentration for about 20 min, treated with ethylene in the laboratory per commercial practice, and stored at 20°C for 2 wks. Periodic observations of fruit decays were made.

#### Effect of water chlorination on postharvest hazard

Tomatoes were submerged in water containing 0, 50, or 150 mg of free chlorine/l, a suspension of *E. c. carotovora* was added, the mixture was stirred for 2 to 3 s, and then the fruits were subjected to either a 91-cm hydrostatic pressure for 10 min or a 150-cm pressure for 2 min. The chlorine solutions were used at pH 6.8 or 9.6. The lower pH was created by adding a commercial chlorine buffer to the diluted laundry bleach. The corresponding "water alone" solution was composed of the amount of buffer used in the 50-mg/l treatment plus 0.1 M NaOH. The higher pH was that of the laundry bleach diluted with tap water to 150 mg of free chlorine/l, whereas the pH of the 0 and 50-mg/l solutions was adjusted adding 0.1 M NaOH to the solutions. The experiment was factorial, with three 10-fruit replicates for each treatment.

#### Bacterial soft rot development on inoculated tomatoes treated with chlorinated water

A section of epidermis, 1 cm<sup>2</sup> was removed from three areas on each fruit surface, and 10  $\mu$ l of inoculum containing  $\log_{10}$  4.7 CFU of *E. c. carotovora* was placed on each wound. After the inoculated wounds had dried for about 30 min, fruits were individually washed for 2 min in solutions of chlorinated water and then washed for 1 min in tap water, or washed for 1 min in 0.5 M sodium thiosulfate solution, or not washed. They were then stored at 25°C for 48 h. The severity of decay at each wound was rated as 1= no soft rot, 2= single small lesion, 3= multiple lesions in wound, 4= entire wounded surface decayed, and 5= soft rot invasive horizontally and vertically beyond margins of wound. There were five single fruit replicates in each combination of treatments.

#### Statistical analyses

The effect of the independent variables and potential interactions of independent variables on disease or weight increase was determined by appropriate analyses with Statis-

tical Analysis System software (SAS, Cary, NC).

## RESULTS AND DISCUSSION

### Pathogen populations and postharvest decay

With both tomatoes and potatoes, the incidence of bacterial soft rot in storage increased as the amount of inoculum applied to potential courts was increased (Tables 1 and 2) (8, 11). Moreover, disease onset was earlier on fruit that had been inoculated with high inoculum concentrations. Early disease onset allowed the decay to become more severe during storage. Severe bacterial soft rot in packaged or stored vegetables leads to secondary spread. Thus, accumulation of *E. c. carotovora* in the handling or wash water increases the chances for decay and the spread of decay. By contrast, small populations of pathogens in wash/handling water may not increase the decay potential above that in the freshly harvested vegetable. For example, with carefully sorted tomatoes, the availability of infection courts is limited to wounds that escaped detection during the sorting steps. A high concentration of decay pathogens in the water increases the chance that such wounds are inoculated and that disease onset occurs quickly after the vegetable is packaged.

### The infiltration of tomatoes or potatoes by handling/wash water

Fruits and vegetables are permeated with air spaces that connect interior cells to the external environment (33). Certain physical phenomena associated with the washing or handling of produce with water can cause water to infiltrate the air spaces. Haines and Moran (27) demonstrated more than 50 years ago that the washing of warm hen's eggs in cool water containing bacteria caused the water to infiltrate the egg shell, which led to a high incidence of rotten eggs. If the water temperature was higher than that of the eggs, the decay rate was

**TABLE 4. Effect of temperature on weight increase of fruit immersed 152 cm deep in water for 5 min\***

Water temp. (°C)	Fruit temp. (°C)			Avg.
	20	30	40	
% Weight Increase				
20	0.6 <sup>y</sup>	1.5	1.5	1.2
30	0.3	0.9	1.8	1.0
40	0.1	0.3	1.1	0.5
Avg.	0.3	0.9	1.5	-

\*Fruits stored 18 h at 40°C were adjusted to indicated temperature just prior to the test.

Five fruits of each temperature were added to water in the pressure chamber for the immersion treatment.

<sup>y</sup>Each value is the average of 10 fruits.

**TABLE 5. Weight increase and natural decay in tomatoes submerged to 122 cm in tap water containing Tergitol-NPX and then stored at 26°C for 72 h\***

Surfactant concentration	Weight increase (%)	Decay (%)
0.000	0.23	0
0.001	0.35	7
0.010	0.38	11
0.100	1.02	60
1.000	0.68	100

\*Average of two separate tests with immersion-treatment intervals of 5 min or 10 min, respectively. Each value is the average of 34 fruits.

significantly lower. Kasmire (31) noted that submersion of tomatoes at 29°C in water at 2°C for 10 min caused the fruit to increase in weight. No weight increase oc-

curred if the water temperature was 29 or 41°C. Bartz and Showalter (15) observed an abrupt and massive outbreak of bacterial soft rot among stored tomatoes that had been

cooled in water containing *E. c. carotovora* (Table 3). These tomatoes increased in weight by an average of 0.9 g/fruit. Lesions formed beside or beneath the stem scar instead of at wounds. Occasional lesions developed beneath the blossom scar. Fruit submerged for 10 min without the negative temperature differential (i.e., without the water cooler than the fruit) did not gain weight and did not decay within a 48-h incubation period. At the end of incubation, all apparently healthy fruits were sliced open. The internal tissues of fruits treated with a positive temperature differential or no temperature differential did not show stains, discoloration, or other evidence of bacterial activity.

Decay development and weight increases were also observed among tomatoes submerged to various depths in an aqueous cell suspension of *E. c. carotovora* (simulated by application of air pressure to the sealed chamber containing submerged fruit) (4). Decay incidence among the treatments was usually highly correlated with water uptake. However, tomatoes treated with a hydrostatic pressure of 61 cm for 2 min showed no detectable weight increase but developed a decay incidence of 20%. Fruit immersed in the same suspension but without the hydrostatic pressure had no weight increase or decay. This was considered evidence that even a slight movement of water into fruit could internalize the bacterium. When the pressure treatment was extended to 10 min, the average weight gain was 0.1 g/fruit, whereas decay averaged 40%. By contrast, submersion to 122 cm for ca. 1 s led to 70% decay but no detectable weight increase (i.e., a gain of less than 0.1g/fruit). Thus, internalization appears to begin the instant of application of pressure on the fruit surfaces.

The location and the appearance of the lesions that developed on infiltrated fruit were consistent with decay observed in a box of fruit sampled from a rejected shipment of tomato fruit (2), nearly 60% of



**TABLE 6. Severity and incidence of bacterial soft rot in potato tubers that had been immersed to two depths in clean water or an aqueous cell suspension of *E. c. carotovora* for different lengths of time**

Depth (cm)	<i>E. c.</i> <i>carotovora</i>	0.1 min		32 min	
		Severity	Incidence	Severity	Incidence
5	-	1*	13	3	80
	+	11	80	66	100
230	-	4	93	4	80
	+	64	100	68	100

\*Each value is the average of 15 tubers that had been stored under a mist of water for 4 days at 20°C. The suspension of *E. c. carotovora* contained log<sub>10</sub> 6.7 CFU/ml. The effects of depth, inoculum, and length of exposure on disease severity were significantly different ( $P < 0.0001$ ).

which had lesions within 5 days of harvest. Reports from the responsible packinghouse indicated that the dump tank did not appear to have enough capacity, and the packinghouse manager was consequently overfilling the tank with tomatoes in an attempt to keep the packing line operating efficiently. The tank overflow caused certain fruits to be submerged under several layers of fruit, whereas others were in the water for prolonged periods of time. These are natural situations likely to lead to infiltration.

Why the tomato fruit in the above tests did not simply absorb water through stem scar tissues when submerged was not initially clear. Brooks (18) and, subsequently, Clendenning (20) established that gas exchange between internal tissues of tomato fruit and the external atmosphere occurred primarily through the stem attachment and associated corky ring region of the fruit. Mature green tomatoes float in water, and, consequently must have extensive internal air spaces. The pores involved in gas exchange would likely be connected with the air spaces. However, water does not readily enter these pores. The surface of tomatoes is known to be covered by wax; clean water forms beads when applied to fruit surfaces. If the wax extended into the pores, then the hydropho-

bic nature of the pore surfaces would not allow water to enter by capillary action. Penetration of water into tomato fruit should be predictable by the Ideal Gas Law (15). When warm tomatoes cool while submerged, gases in intercellular spaces contract. Once a sufficient vacuum has formed in the fruit, water would enter the pores. Similarly, hydrostatic pressure alone might be sufficient to force water into the pores.

Three lines of evidence supported the theory that the surfaces through which gas exchange occurs in tomatoes are hydrophobic and consequently not subject to capillary movement of water. First, as already noted, a known or presumed pressure imbalance between the atmosphere inside and outside the tomato fruit usually preceded increases of weight or decay (3, 4, 15). Fruits gained weight or decayed only if they had been cooled in water (presumed pressure difference) or subjected to a significant hydrostatic pressure (known pressure difference) while submerged. Second, an oil-based wax formulated for application to tomato surfaces (WT-3, Decco Div., Pennwalt Corp., Monrovia, CA) readily penetrated into stem scar tissues and outward beyond the edge of the stem scar in the absence of pressure differences, whereas water did not (4). Fruit

tissues around wax-treated stem scars had an "oil-soaked" appearance. Third, the addition of surfactants to water, which helps water to spread over hydrophobic surfaces, increased the extent of infiltration (see following).

Washing tomatoes with India ink (a stable suspension of carbon particles) instead of aqueous cell suspensions of *E. c. carotovora* allowed visualization of the movement of water into fruit. The tissues in the stem scar were blackened, as were portions of the white tissue in the center of the fruit. The ink particles also spread laterally in the locules near the stem scar.

The pulp temperature of tomato fruit at the time of exposure to water affected how readily infiltration occurred (3). When fruit and water temperatures were equal, warm fruit absorbed more water during a 5-min pressure treatment than did cool ones (Table 4). Green tomatoes stored at 40°C overnight (18 h) and then adjusted to 20°C or 30°C, or left at 40°C, and then subjected to pressure treatment in water at 20°, 30°, or 40°C, respectively, increased in weight by 0.6, 0.9 or 1.1 g/fruit, respectively. Similarly, tomatoes stored overnight at 20°C prior to temperature adjustment and pressure treatment gained 0.3, 0.8, or 1.3 g/fruit, respectively. Thus, the overnight storage temperature did

**TABLE 7. Severity of bacterial soft rot in potato submerged to two depths in water containing Triton X-100 or *E. c. carotovora*\***

Triton X-100 conc. (%)	Water		<i>E. c. carotovora</i>	
	5 cm	180 cm	5 cm	180 cm
	% Surface area decayed			
0.00	2	4	19	30
0.01	10	5	21	38
0.10	18	23	38	47

\*Tubers were treated in water or  $\log_{10}$  5.7 CFU/ml for 4 min and then stored under continuous mist of water for 4 days at 20°C. Each value is the average of 10 tubers.

not alter the effect of initial fruit temperature on water uptake. Tomatoes that are warm at the time of washing/handling with water are more likely to be infiltrated than those that are cool.

The addition of surfactants to wash water should reduce the infiltration value (pressure  $\times$  time) leading to water intake. When the surfactant Tergitol-NPX was added to water prior to a hydrostatic-pressure treatment of tomatoes, the weight increase was highly correlated with the surfactant concentration of 0 to 0.1% w/v in two separate tests,  $r=0.96$  and  $0.99$ , respectively (Table 5) (4). Decay increased as the water intake increased. However, less infiltration occurred with a 1.0% surfactant concentration than with a 0.1% concentration, whereas decay increased. Water was observed to ooze out of the stem scars of the 1%-fruit after they were removed the water, perhaps accounting for the reduction in water uptake.

In the surfactant tests, decay developed from naturally occurring inoculum on the fruit surface. The fruit used in the fruit-temperature tests also decayed after being infiltrated with water alone, which illustrates the decay hazard posed by the infiltration of fruit with water. In each of the tests, city tap water containing a trace amount of chlorine

was used for infiltrating the fruit. The fruit appeared to be clean when treated, although populations of decay/spoilage microorganisms were clearly present. Harvest-related wounds on the fruit surfaces remained free of lesions during storage, although the storage interval was relatively short because of the rapid development of lesions associated with the infiltration. Water congestion in the infiltrated tissues would have provided ideal conditions for microbial development. Young (43) reported that even saprophytic bacteria can grow in water-congested leaf tissue.

The decay observed among tomatoes (Tables 5 and 6) was originally identified, based on odor and general appearance, as sour rot caused by *G. candidum*. However, in a subsequent test, a naturally occurring decay found among tomatoes that had been infiltrated with tap water was identified as being caused by two different Gram positive bacteria, *Lactobacillus* spp. and *Leuconostoc* spp. (10).

The infiltration values that produced water movement into tomatoes failed to do so with potato tubers (11). However, application of much higher hydrostatic pressure on potatoes submerged in India ink led to penetration of lenticels and wounds with ink particles. The par-

ticles were observed beneath lenticels and wounds on the underside of the peel as well as occasionally in the flesh of the peeled tuber. Thus, potato tubers, which sink in water, can become infiltrated by water if the pressure imbalance is large enough. Subjecting tubers to pressures up to and including infiltration values associated with the visible movement of ink particles into lenticels did not lead directly to development of decay even when heavy aqueous cell suspensions ( $\log_{10}$  7.7 CFU/ml) of *E. c. carotovora* were used instead of ink. Instead, increased decay developed when infiltrated tubers were stressed by continuous wetness. When the surfactant Triton X-100 was added to the water or aqueous cell-suspension of *E. c. carotovora* used to treat potato tubers, the soft rot potential increased as the concentration of surfactant increased (Table 7) (11). The effects of the surfactant concentration, inoculum treatment (with vs. without bacteria suspended in water), and hydrostatic pressure were significant,  $P > F = 0.0001$ ,  $0.0001$ , and  $0.04$ , respectively. None of the potential interactions were significant. The presence of the surfactant increased decay severity even in the absence of added inocula and a substantial hydrostatic pressure. Addition of the surfactant to India ink suspensions did not lead to a visible penetration of lenticels in treated fruit unless substantial hydrostatic pressure was applied. However, tubers submerged in surfactant solutions in the absence of time/pressure treatments leaked more electrolytes than those similarly treated in water (11). Therefore, the surfactant appeared to have increased the nutrients available for bacterial growth.

#### **Methods to reduce bacterial populations during or after washing procedures**

In several different tests, the contact of potato tubers with fresh inoculum increased the potential for bacterial soft rot. Therefore, possible ways to moderate the increased decay potential were examined. Tubers washed in inoculum for 5 s developed as much decay as did

**TABLE 8. Severity of bacterial soft rot (% surface area decayed) in potatoes after a wash in *E. c. carotovora* and tap water rinse\***

Duration of wash (sec)	Conc. ( $\log_{10}$ CFU/ml)	% Surface Area Decayed	
		Rinsed	Not Rinsed
5	4.7	8	5
	6.7	33	17
120	4.7	9	9
	6.7	29	19

\*Tubers were washed for 10 s in an aqueous cell suspension, rinsed or not under running tap water for 15 s, and incubated in mist chamber for 4 days. Each value is the average of seven tubers. The effects of wash and rinse treatments and all interactions were not significant. The effect of inoculum concentration was significant ( $P < F=0.0001$ ).

those exposed for 2 min (Table 8) (11), evidence that tuber contact with fresh inoculum rapidly increases the potential for decay. This increased potential was not reduced by a 10 s wash of the inoculated tubers under running tap water. Although the tap-water treatment removed ca. 99% of the population of *E. c. carotovora* that could be subsequently washed from the tuber surface, the total population fell by only 50%. In other tests, tubers rinsed with tap water after being exposed to contaminated water developed more decay than those not rinsed (Bartz, unpublished). Thus, a wash of contaminated tubers with clean tap water does not eliminate the contamination and may, in certain circumstances, increase the decay potential. Ruehle (37) noted more than 45 years ago that consumer preference for washed potatoes was increasing grower losses to postharvest decay. Two factors identified as responsible for the increased decay were contact with fresh inoculum and the residual water left on freshly washed tubers. Whether movement of inoculum into infection courts or creation of new infection courts also occurred was not determined.

Treatment of freshly contaminated tubers with chlorinated water reduced the soft rot potential associated with fresh inoculum, but had no effect on the potential existing prior to inoculation (base level) unless an extreme concentration was used. A 5-min treatment in 5000 mg of free chlorine/l (pH 10-11) (1:10 dilution of laundry bleach) eliminated the soft rot potential associated with a rinse of tubers in water containing  $\log_{10}$  6.7 CFU/ml *E. c. carotovora* and reduced the background level from 20% to 3%. Fruit immersed in the same suspension but without the hydrostatic pressure had no weight increase or decay. However, the skin of these tubers was bleached (14). Washing tubers in 0, 50, or 500 mg of free chlorine/l led to SADs of 69, 46, or 30%, respectively. In a subsequent test, tubers were washed in water or in 1000 or 5000 mg of free chlorine /l, air-dried, and then stored at high humidity at 20°C for 96 h before incubation in the mist chamber. The SAD for these three treatments was 1.6, 1.1 and 23%, respectively. Thus, the highest chlorine concentration failed to eradicate all *E. c. carotovora* and, apparently, damaged the tubers. This observ-

ation was consistent with a report by Scholey et al. (38) that treatment of tubers with high chlorine levels decreased the decay incidence in packaged tubers, initially but later led to more severe decay.

Drying freshly washed tubers can reduce the increase in soft rot potential associated with the washing procedure. Ruehle (37) demonstrated the commercial value of drying freshly harvested red potatoes with heated air in 1940. Removing films of water from tuber surfaces eliminates a major predisposition to bacterial soft rot. Additionally, a portion of the population of *E. c. carotovora* on tuber surfaces may be sensitive to desiccation. Bartz and Kelman (13) reported that air-drying surface contaminated tubers for 2 h reduced the number of bacteria that could be rinsed from tuber surfaces by 2  $\log_{10}$  units (the same reduction as with the tap water rinse). By contrast, the fraction of the population of *E. c. carotovora* apparently bound to the peel was reduced less than three fold, if at all. However, fan-drying freshly inoculated tubers for at least 1 to 3 h reduced the soft rot potential of surface-contaminated tubers significantly (Table 9). The 3-h drying treatment reduced the potential to nearly the 20% base level for the tubers used. Keeping the tuber surfaces dry for an additional 69 h reduced the SAD below the original base level. Tubers subjected to a 350-cm hydrostatic pressure while submerged were likely to have been infiltrated with inoculum. The pressure treatment nearly doubled the soft rot potential among the non-dried tubers. Fan-drying for 1 h eliminated the large difference in soft rot potential between pressure-and nonpressure-inoculated tubers. However, the potential remained somewhat higher among the pressure-inoculated tubers than among tubers in the non-pressure treatments. The infiltration effect was much larger on cured tubers with fresh wounds or on freshly harvested tubers than on cured tubers without fresh wounds. When tubers with fresh wounds were infiltrated with inoculum, air-drying was much less effective for reduction in the potential for decay.

**TABLE 9. Percentage of surface area decayed on tubers immersed in inoculum, treated with hydrostatic pressure, dried in air, and then incubated\***

Drying period (h)	Pressure treatment	
	5 cm	350 cm
0	44	84
1	31	38
3	22	29
72	2	13

\*Tubers were submerged in  $\log_{10}$  6.7 CFU/ml, exposed to pressure for 5 min, dried in ambient air or not, and incubated in mist chamber at 20°C for 96 h. A sample of tubers dried in air for 3 h was placed in polyethylene bags, held in mist room for 69 h, and then incubated. Prior to incubation, all tubers were moistened with tap water. Each value is the average of five tubers.

**TABLE 10. Bacterial soft rot development and weight increase of tomatoes washed in chlorinated water treated with *E. c. carotovora***

Treatments		Disease	Weight increase
		incidence (%)	(%)
water chlorination (mg/l)	0	64	0.13
	50	29	0.14
	150	19	0.18
immersion treatment	91 cm/10 min	30	0.13
	152 cm/2 min	44	0.17
solution pH	6.8	42	0.14
	9.6	32	0.16

<sup>a</sup> $\log_{10}$  6.0 CFU/ml was added to tomatoes in chlorinated water, the mixture was stirred 4 s, pressure was applied, and then fruits were stored at 24°C for 12 days. Each value is the average of three 10-fruit replicates.

Modern packinghouses utilize different ways to dry freshly washed fruits and vegetables. Many use a bed of sponge rolls positioned in the packing line to break up the film of water on product surfaces. How-

ever, the sponges may accumulate a biofilm (microorganisms embedded in slimes produced by certain bacteria) that can contaminate washed produce. Sponge beds are likely to develop a biofilm because they re-

main wet during the workday and perhaps between workdays. Continuous wetness and organic material from contact with fruit or vegetable surfaces are ideal for formation of a biofilm. In an initial examination of a tomato packinghouse sponge bed, large bacterial populations (including strains of soft rot erwinias) were isolated from the sponge rolls (Bartz, unpublished). The dump tank/flume system preceding the sponge bed contained up to 200 mg of free chlorine/l at pH 6.0. How bacteria survived the chlorine to be able to coat the rollers is not clear, unless the bacteria were embedded in aggregates of small leaf litter, etc. Small green particles were observed on brush rolls that were alternated with the sponge rolls. In tests at a commercial packinghouse, Senter et al. (39) associated an increase in bacterial populations on whole tomatoes with movement of the fruit through a dump tank/spray wash system that contained 90 to 140 mg/l of total chlorine. Whether the population increases were due to contamination of the fruits in the tank or by the packing line equipment is not clear.

Approximately 120 mg/l free chlorine at pH 6.0, 7.0, or 8.0 in water at 40°C containing wounded tomatoes (wound the size of small stem puncture) prevented the transfer of freshly released spores of *G. candidum* or *Rhizopus stolonifer* from the water to the wounds (7). When the water temperature was reduced to 25°C, however, only solutions at pH 6.0 or 7.0 prevented the transfer. Excessive decay developed after treatment at a water temperature of 25°C and a pH of 8.0. In two separate tests at a commercial packinghouse, maintenance of 50 versus 85 or 100 mg free chlorine/l at a pH of 7.0 and a temperature of 40°C did not affect the incidence of decay in packed tomatoes (16). All U.S. Grade 1 and 2 fruit remained below the 5% decay allowed by grade standards during a 14-day storage period. However, significantly more decay was found among commercially packed Grade-3 tomatoes than among Grades 1 and 2. A larger number of wounds and larger stem or blossom-end scars were

**TABLE 11. Severity of bacterial soft rot at wounds on tomato fruit that had been inoculated, washed in chlorinated water and then rinsed or not in water or 0.5 M sodium thiosulfate<sup>x,y</sup>**

Rinse	Cl <sub>2</sub> conc.	Chlorine pH		
		6.0	9.0	11.0
None	63	2.5 <sup>z</sup>	2.9	3.6
	500	1.6	2.3	2.8
Water	63	2.1	2.8	3.4
	500	1.9	2.2	3.1
Sodium thiosulfate	63	4.0	3.9	4.5
	500	1.9	3.5	4.3

<sup>x</sup>Fruit were wounded, log<sub>10</sub> 4.7 CFU of *E. c. carotovora* was applied to each wound, the wounds were allowed to air-dry for 30 min, and the entire fruit was submerged in chlorinated water in 0.05M sodium phosphate buffer. After 2 min, fruits were removed and rinsed or not for 1 min and then stored at 25°C for 48 h.

<sup>y</sup>Severity was rated based on 1 = no disease to 5 = lesions expanded beyond wound.

<sup>z</sup>Each value is the average of 15 wounds from three wounds on each of five single fruit replicates.

cited as the reasons for the increased decay in the Grade-3 fruit.

A 3-way factorial test on tomatoes contaminated with *E. c. carotovora* illustrated the efficacy of chlorinated water when tomatoes were subjected to infiltration while handled in water (5) (Table 10). The presence of free chlorine in the water did not prevent the development of unacceptable levels of decay among the infiltrated fruit. Use of a lower pH level to enhance the concentration of HOCl in the solution did not improve the efficacy of the chlorine treatment. However, more water entered the fruit as the chlorine concentration increased (linear effect of concentration on weight increase significant at  $P < 0.0001$ ) although decay decreased as the concentration increased (both linear and quadratic effects of concentration on disease incidence significant at  $P < 0.0001$ ). Significantly more dis-

ease developed when the pH of the solution was 6.8 or when fruits were exposed to the higher pressure/shorter contact interval treatment as compared with the respective alternative treatments ( $P < 0.0001$  for both).

Washes with chlorinated water are not considered effective in preventing decay if fruits and vegetables have already been inoculated (24). In two separate tests with shaved and then inoculated tomatoes, however, washing such fruit in 250 mg/l of free chlorine in water at pH 6.0 led to significant reductions in the development of decay (Bartz, unpublished). Less decay developed as the length of exposure to the chlorine increased from 15 s to 4.0 min. However, little change occurred with exposures longer than 2.0 min (both the linear and quadratic effects of exposure period on decay severity were significant). In a sub-

sequent test, washing wound-inoculated tomatoes for 2 min in a solution containing 500 mg/l of free chlorine led to less disease than washes with 62.5 mg/l (Table 11). Lesions developed on 33% of the wounds washed with a solution containing 500 ppm free chlorine, versus 89% of wounds on control fruit that had been inoculated and then washed in tap water. In this test and one preceding it (data not shown), a tap water rinse of the chlorine-treated fruit had little effect on the efficacy of the chlorine treatment, whereas rinsing such fruit in a thiosulfate solution greatly reduced the efficacy of the chlorine. Thus, either a chlorine residual persisted in the wounded tissues through the water rinse or the thiosulfate promoted the recovery of injured cells (22). Allowing the residual chlorine to dry on wounds, as compared with using a water rinse, did not improve the performance of the chlorine solution. Adjusting the pH level of the chlorine solution to enhance the HOCl concentration in the solution (pH 6.0 = 97% HOCl vs pH 11.0 = 99% OCl) significantly decreased decay severity.

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# FOOD MICRO '99:

## REPORT OF A SUCCESSFUL CONGRESS

Co-sponsored by the International Association for Food Protection

**F**ood Micro '99, the 17th International Congress of the International Committee on Food Microbiology and Hygiene (ICFMH), was held at Veldhoven, The Netherlands from 13-17 September, 1999.

The congress was especially designed to be a meeting place for those working in food microbiological research and professionals responsible for the production of safe food. A total of 673 persons from 57 countries participated in the congress. Food Micro'99 was advertised as the congress that concluded the second millennium. It was certainly also a milestone that marks a great number of important developments in the area of food microbiology.

Worldwide there are concerns about microbiological food safety and food quality. These are caused by the enormous changes in food production and food preferences. Rapidly increasing global trade and transport of food is one example. The rise of the food service industry is another. Consumers' food preferences have dramatically changed into the direction of ready-prepared foods which are mildly preserved and which retain as much as possible the characteristics of fresh foods. There is a demand for healthy foods, containing less sugar, less salt, less fat and less preservatives. These developments have required fundamental changes in the concepts used by food microbiologists and food technologists to control food safety. All these developments have set the general themes of Food Micro '99.

The plenary morning sessions were devoted to keynote lectures covering various relevant topics in food microbiology, with special emphasis on ecology and physiology of food related organisms and on risk

assessment. These two topics were chosen as the main themes of the congress and were covered by excellent speakers from various parts of the world. A total of 400 contributions covering fourteen themes were presented in plenary and parallel sessions as well as poster sessions, providing a detailed view on food microbiology at the turn of the millennium.

**Session on food safety:** emerging pathogens including amongst others viruses, parasites including *Trichinella* and *Cyclospora*, *E. coli* O157 and related serotypes, *Mycobacterium avium* spp. *paratuberculosis* were discussed in detail. In addition, quality control of raw materials, production and packaging facilities and the distribution chain were important issues at this congress as well.

**Session on mycology:** various contributions dealt with mycological methods and taxonomy as well as the inhibition of spore germination, mycelial growth and toxin production in food products.

**Session on physiology:** In addition to a number of excellent keynote lectures there was a series of contributions covering such topics as physiological aspects of microbial food spoilage and mechanisms of action of antimicrobials.

**Sessions on preservative agents and techniques and fermentation:** From the presentations it appeared that mild preservation technologies can in principle meet most of the current desired product requirements. Research activities on non-thermal physical preservation methods and the use of biological preservation agents, including fermentation were presented. The aim of these methods is usually extension of shelf life without necessarily killing most of the adverse microorganism.

**Session on ecosystems:** Changes in primary production and processing methods cause different microorganisms to become a problem and these are some of the reasons for the phenomenon of "emerging pathogens," highlighted at the congress. It appeared that there is an increasing interest in modern molecular ecology among food microbiologists.

**Session on risk assessment:** Risk assessment will make it possible to develop food safety objectives, standards which internationally have to be met to ensure food safety. Obviously these standards have to be based on sound research carried out in the format of a risk assessment, for which in many cases a great deal of research data are being and still have to be generated in the near future. Increasingly, exposure assessment and control measures are being based on predictions made possible through the development of predictive microbiology.

**Session on methods:** The largest session of this congress was the session on microbiological methods. Rapid progress is being made in both conventional and molecular-biological methods, particularly with respect to speed, sensitivity and specificity.

**Sessions on stress response and virulence and probiotics:** Various stress factors applied in these mild preservation techniques induce stress responses in microorganisms, phenomena which should be well understood in safe application of mild preservation methods. One specific area is the understanding of pathogenicity and virulence of foodborne pathogens, in terms of general dose-response relationships, but also in relation to pre-disposing factors and the use of pre- and probiotics.

**Session on cleaning and decontamination:** Hygienic design and cleaning and disinfection are very important issues in the production of safe food.

Integrated hygiene and food safety management systems in food production can give rise to exceptional improvements in food safety performance only if a high level of commitment and full functional involvement are realized.

**Session on predictive modelling:** Predictive microbiology is becoming a corner stone in the development of microbiological risk assessment, an important relatively new development in food microbiology, which was well represented at the congress. Increasingly, control measures are being based on predictions made possible through the development of predictive microbiology.

From the contributions it can be summarized that food microbiology and especially microbiological food safety will increasingly draw on basic research comprising modern molecular ecology, microbial (stress) physiology and molecular genetics. The basic scientific results will be increasingly used for the development of the information technology comprising predictive models, data for proper risk assessments, etc. This last will enable professionals, active in microbiological food safety, to use the information in a practical and sophisticated way.

The keynote lectures have been published in a special issue of the *International Journal of Food Microbiology*. Extended abstracts (2-4 pages) of the oral and poster presentations have been published in the congress proceedings. These hard cover printed proceedings, counting 942 pages, comprise the 380 reviewed scientific contributions. The proceedings can be ordered at the Foundation Food Micro '99, c/o TNO Voeding, P.O. Box 370, 3700 AJ Zeist, The Netherlands (E-mail: foodmicro@voeding.tno.nl).

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# Reflections from the Past

## Status of Our Association Past, Present, Future

H. L. "Red" Thomasson

1952 Annual Meeting  
International Association of Milk and Food Sanitarians, Inc.  
Minneapolis, Minnesota  
September 18-20, 1952

**F**orty years, nine months, and two days ago our thirty-five founders met in Milwaukee, Wisconsin, representing the United States, Canada, and Australia. At this meeting an organization was formed which was called the International Association of Milk Inspectors. The name was changed later to the International Association of Milk Sanitarians, and in 1947 this was changed again to the International Association of Milk and Food Sanitarians, Inc.

The high ideals and noble purpose of these men has continued to be our guiding light down through the years. Our steady growth and the recognition we have attained throughout the world is indisputable evidence of the value of our beginning. We have never forsaken those principles.

In 1937 the *Journal of Milk and Food Technology* was born and became our official publication. It is now world wide in circulation and second to none in the field of milk and food sanitation - a publication which is a living monument to the foresight and devotion of Bill Palmer, Dr. Schrader, Paul Brooks, and many others who worked so hard to establish the answer to a great need.

Today we have over three thousand, two hundred members who represent every state in the United States and fifty-six foreign countries, and nineteen Affiliate associations representing twenty-three states. Our Journal has an average circulation of over 4500 copies per issue.

In July a central office was established in Shelbyville, Indiana, with a full time Executive

Secretary, Managing Editor, and clerical help. It is my great privilege to be your first full time executive. The record of the first year of this operation, which will be reported to you at this meeting, is one that I can point to with justifiable pride. Let me hasten to add however, that it is a record which could never have been attained without the phenomenal support of your officers, Executive Board, and all of our members. It is your record.

Today the world waits upon the findings of our committees with regard to all the various problems in sanitation. Nowhere are there better, harder working committees than ours. With this position in the field of milk and food sanitation comes a great responsibility to maintain, to improve, to continue to grow.

Let us not rest on our laurels, let us not believe that we are perfect, let us not delude ourselves into believing that we have all the answers. Rather let us plan and work always toward the future. Many milestones have been passed, but many, many more beckon to us in the distance. Allow me to enumerate some future objectives toward which we should bend our efforts.

1. Unquestioned recognition of the milk and food sanitarian as a professional public health worker. This can only be accomplished through merit, public acceptance, and a job done better than anyone else can do it. Make no mistake, that you can legislate yourself into professionalism.

Such an approach will retard acceptance, on a professional level, many years.

2. Continued growth in membership both in number and quality.
3. An organized effort to bring about education in milk and food sanitation on the secondary and elementary level. The lack of education on these levels, concerning a matter so vital to the public health, is criminal negligence. We must inform the public who we are and what we do. So far, we have done this job poorly. Secondary and elementary education is the place to begin.
4. Monthly publication of the Journal. This can only be brought about by increases in membership, subscriptions, and advertising. Each of you can help, each of you will gain by this.
5. A travel expense budget for each of our committees. Committee work could be improved a thousand percent if we could become somewhat independent of requests for out of state travel. The objectives enumerated are by no means all, but certainly you will agree that they are worthwhile. So long as I have anything to do with this Association I pledge myself to support all well established endeavors and work toward the accomplishment of all others that you may deem worthy of our labors.

# **ANNOUNCING...**

## **Online Abstract Submission**

**at [www.foodprotection.org](http://www.foodprotection.org)**

**Abstracts must be received by January 10, 2000.**

Any questions regarding abstract submission can be directed to:

Bev Corron

515.276.3344 or 800.369.6337;

E-mail: [bcorron@foodprotection.org](mailto:bcorron@foodprotection.org).

# Presidential Address

Harold S. Adams

1956 Annual Meeting  
International Association of Milk and Food Sanitarians, Inc.  
Seattle, Washington  
September 5-7, 1956

Once during the term of an officer of this Association, when he advances to the honored position of President, he has the rare opportunity of formally addressing an annual meeting. This is both a responsibility and a distinct privilege. During his tenure from Second Vice President to President, normally a lapse of four years, the officer, in moving up, becomes intimately acquainted with an imposing amount of detail and with the many administrative and functional matters which must be handled on a day to day basis to keep International on a sound and strong footing.

When his time comes to present the annual presidential message he must decide the main theme of that address; he must try to determine what subject or subjects seem most pertinent and timely. His subject should have a direct bearing upon the future development and welfare of our Association. In addition, his message has a definite time limitation. This is not a simple task for there are many subjects of real interest to an Association such as this, numbering as it does among its membership men whose work involves industrial, regulatory, research and academic interests. But even amid this rather broad spectrum of diverse interest there is one theme which is of constant and enduring value, and that is professional growth and development.

I have chosen therefore as my main theme this subject of professional growth and development. I shall attempt to show where our Association has made progress and where more progress needs to be made.

It is trite to say that we either progress or retrogress, but trite as this truism may be it cannot be ignored. Either we progress or retrogress individually and as a whole. There is no standing still! The individual either advances

professionally or he slips backward. And so it is with an Association. Either it moves forward with new plans, projects and developments or it begins to show signs of inactivity and decadence. It must be alive, vital and progressive.

With this theme in mind, I would review with you some of the indications of growth and development that have taken place in International within the past few years.

One of the most significant developments contributing to the strength and prominence of this Association with the appointment six years ago of a full time executive secretary for the Association, and, in dual capacity managing editor of the Journal. Through such office there was established a sound system of business management and a centralization of managerial responsibility. Less than ten years ago this Association was in dire financial distress, membership was declining and affairs were in a most unstable and critical condition. Now, in 1956 we are in a strong financial position with a good balance and our business affairs are in order. In our Executive Secretary we have a man who is ready and willing at all times to assist and serve our 4200 members and the twenty-eight affiliates which make up the International.

In 1947 another progressive step toward growth and development was taken. In that year the name of this Association was changed to broaden its base and interest. In that year, by vote of the membership, the word, "Food" was added and we then became the International Association of Milk and Food Sanitarians, Inc.

In 1952, there was appointed a Committee on Education and Professional Department. This Committee, through its deliberations and program placed renewed emphasis on the professional advancement and status of the Sanitarian. It examined some of the avenues through which

professional advancement could be attained. As a result, at the 41st annual meeting in 1954, the membership took cognizance of the fact that sound and carefully conceived legislation for the certification or registration of sanitarians was one of several methods by which professional status might be enhanced. At the same time however, the Association was quick to recognize that registration and legislation directed toward it, must not be a false crutch upon which to lean, nor should it be used to protect mediocrity nor to perpetuate sub-professional performance. At the 41st annual meeting this Association acknowledged, during public assembly and by vote, what must be and is one of our primary and fundamental objectives, namely the raising of milk and food sanitarians to a professional level comparable to others with whom they work in the regulatory field.

Quite in line with professional advancement is another development that has reached fruition during the current year. Without going into developmental and other detail it is heartening to report the establishment of an undergraduate scholarship which is to be awarded annually in the amount of \$300.00 to a deserving student with acceptable academic standing who is taking major work in the field of sanitary science and public health. International through the Executive Board has appropriated \$300.00 for the 1956-57 college year and a recipient of this first scholarship has been selected. The name of this student and his university will be announced at the annual banquet. Several affiliates have endorsed the plan and made contributions. Should the amount thus contributed be sufficient, it is possible that two \$300.00 scholarships may be awarded in a given year. Since we have taken the firm position that adequate academic background is an essential stepping stone along the path of professional advancement the establishment of this scholarship is tangible evidence of our desire to promote it.

Still another development is of noteworthy interest and pertains directly to the immediate theme. It has been the feeling of several of our dedicated members that there exists a rather wide gap between technical information and its availability for use in the field. New developments, better ways of doing things, and technological advances do not become readily available to the man who most needs them because our lines of communication from the research laboratory to the field are often not as direct and clear cut as is

desirable. Frequently a satisfactory solution to a problem worked out successfully in one section may not filter through to another area faced with a quite similar problem. This is unfortunate. However, in recognition of this situation your Association has created a new committee to be called, "This Committee on Research Needs and Applications." We are not so naïve as to believe that the creation of this or any other committee will solve as vexing a problem as this, yet appointment of such a committee does indicate an awareness of a problem toward which this Association must work to develop the best possible solution. It must be said however, that this Committee will only be as useful as you members make it. If the committee learns, through you, the kinds of problems for which a solution is needed the technical competence of this Committee is such that a solution will be found. I know you will hear more of this committee as its program gains momentum.

I could mention many other matters which contribute immeasurably to the total stature of this Association, but I must pass on to other points. I want, however, to pay tribute to the fine and productive work of our numerous committees. In an Association as large as ours we must work under the committee plan and I particularly call to your attention the fine reports which will be presented here and which you will be able to read and study more carefully as they appear in the Journal.

As stated earlier, I wish to mention some areas of possible weakness in our Association. Perhaps these are not areas of weakness as much as areas where more critical evaluation is needed.

I believe we are at a point in this Association where we must ask the question, "Is a base built upon milk and food sanitation activities alone one that is sufficiently broad?" There are a number of factors which prompt this inquiry. We see around us other groups organizing with interests which, in several respects, are similar to ours. In the Midwest we learn of an organization formed to solicit the membership of dairy plant field men and build them into a national organization. A large group of men in this work are devoted members of this Association. In the southwest an organization is being formed and promoted which is directed toward the "registered" professional sanitarian and aims to create a society by that name. In a substantial number of states, and in several instances in states where there are affiliates of International, the National Association

of Sanitarians is active in soliciting membership from men engaged in the field of sanitation. And then, there are state associations in a number of states which are unaffiliated nationally. For reasons best known to themselves they prefer to remain alone or perhaps National Associations with whom they might affiliate do not appear to offer a program sufficiently appealing to them.

I point to these developments as indicative of the need for this Association to continuously take stock of its purpose and to constantly evaluate both its objectives and program.

Today we are a strong Association with some 4,200 members, but are we close to the end of the line? There are over 9,000 men and women in public health sanitation work in this country and perhaps half again as many in other phases of regulatory work, yet the combined membership of the two leading sanitarian organizations is about 6,000. To what organization does the balance belong? If they belong at all, it is safe to say, that they are not in affiliates of our Association, yet they are there and they are potential members.

It seems to me we must recognize this need for expansion. How best to accomplish it is a problem needing our careful scrutiny and attention. Yes, we have shown remarkable growth in less than a decade, but what about the next ten years, the decade ahead? I am convinced that a careful study of areas of broadened interest, an exploration of new services which this Association might render, and a careful appraisal of trends would return excellent dividends and a membership of half again the number currently enjoyed. We should seriously question whether we should remain a specialist group. We should weigh the arguments pro and con for there are those who argue as vehemently for the generalist as for the specialist.

In addition, we must continue to give serious study and consideration to this whole area of professional qualification and development. The Sanitarian today, more than ever before, is seeking and striving for professional status. There is more current interest in legislation for legal registrations of sanitarians than ever before. Even in states where acts have been introduced without success, new plans are being laid for re-introduction. So active is the interest in some states that one defeat becomes a challenge to prepare new supporting evidence and to try again.

Trends such as these not only must be watched they must be anticipated. If study shows that this Association needs to broaden its base, enlarge its scope and objectives, or otherwise change its emphasis, then, this must be courageously done. We must not be caught in the unfortunate situation of, "too little and too late."

As your President, I can only point out in this brief message some of the factors and some of the potentials as I see them. Alert as your officers, past and present have been, and are, they alone cannot carry the entire responsibility. It is you, the members, you on the firing line who carry out the important daily tasks, who must watch and listen and then raise your voices to be heard when a change of course is indicated.

My closing admonition then is this. Within the sphere of future growth and professional development of this Association must be all those things which continue to give it dignity, respect and stature. It is not an exclusive prerogative of your elected officers to carry this whole responsibility. Each member must share this equally. Each must be alert to new developments, new projects and growth potentials that will continue to make International the strong vital Association it is today.

# NewMembers

## AUSTRALIA

**Eko Sanjoyo**  
Maroubra

## CANADA

**Dubuc Martine**  
Ministry Agriculture,  
Fisheries, Food  
Quebec

## FINLAND

**Gun Wirtanen**  
VTT Biotechnology  
and Food Research  
Espoo

## INDIA

**Raja Ganesan Chandramogan**  
Hatsuor Agro Product Ltd.  
Madras, Tamilnadu

## UNITED STATES

### Colorado

**Emily A. Pertzsch**  
Dreyers Grand Ice Cream  
Lakewood

### Connecticut

**Larry Michaels**  
Amtrade International, Inc.  
Watertown

### Delaware

**Sharen Nowak**  
Harrington

### Florida

**Lourdes Tamborello**  
LMG, Inc.  
Plant City

## Georgia

**Jennifer Bailey**  
Seaboard Farms of Elberton  
Elberton

**Veneranda Gapud**  
Popeyes Chicken  
Snellville

**Nathanon Trachoo**  
University of Georgia  
Athens

**Yue Li**  
University of Georgia  
Griffin

## Illinois

**V. M. Balasubramaniam**  
The National Center for Food  
Safety and Technology  
Summit-Argo

**Bob Sperber**  
VerticalNet  
Chicago

## Louisiana

**John L. McKillip**  
Louisiana Tech University  
Ruston

## Massachusetts

**R. Labbe**  
University of Massachusetts  
Amherst

## Michigan

**Rejeetha M. Charoth**  
Request Foods Inc.  
Holland

**Bruce DuHamel**  
Mid-Michigan District Health Dept.  
Stanton

**Robert E. Hause**  
Van Buren/Cass District  
Health Dept., Hartford

## Minnesota

**David Jobe**  
Land O'Lakes, Inc.  
Thief River Falls

**Elaine Santi**  
Minnesota Dept. of Agriculture  
Iron

## Nebraska

**Alan Paul**  
ConAgra Frozen Foods  
Omaha

## New Jersey

**Eugene N. Bilenker**  
Crown Food Consultants  
Elizabeth

**James V. Giranda**  
International Flavors & Fragrances  
Howell

## North Carolina

**Denise C. Crowell**  
NC Dept. of Agriculture  
Cary

## Ohio

**John Buchanan**  
The Kroger Co.  
Cincinnati

**John P. Kolenski**  
The Kroger Co.  
Cincinnati

**Ruth K. Yong**  
The Kroger Co.  
Cincinnati

## **Oregon**

**Mark A. Daeschel**  
Oregon State University  
Corvallis

## **Pennsylvania**

**Christopher H. Sommers**  
USDA-ARS-NAA-ERRC  
Wyndmoor

## **Puerto Rico**

**Victoria Cerase**  
P. Campofresco, Inc.  
Santa Isabel

## **South Carolina**

**Mark Housley**  
Milliken, Spartanburg

## **Tennessee**

**Cindy Ayers**  
Shoney's, Nashville

## **Texas**

**Sharon Edlund**  
IDEXX Food Safety Net Services,  
Inc., San Antonio

**James E. McFarland**  
Corpus Christi-Nueces Co.  
Public Health  
Corpus Christi

**Jerry Reed**  
IDEXX Food Safety Net Services,  
Inc., Richardson

## **Virginia**

**Dan-My T. Chu**  
VA Commonwealth University  
Richmond

**Denise M. Toney**  
Div. Consolidated Labs  
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## **Washington**

**Charles D. Leaf**  
Leaf Environmental Health  
Consultants  
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**Loyce C. Robinson**  
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Milwaukee

**Scott J. Stieber**  
Marathon Cheese Corporation  
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**Lourdes Tamborello**  
LMG, Inc.  
Plant City

## Georgia

**Jennifer Bailey**  
Seaboard Farms of Elberton  
Elberton

**Veneranda Gapud**  
Popeyes Chicken  
Snellville

**Nathanon Trachoo**  
University of Georgia  
Athens

**Yue Li**  
University of Georgia  
Griffin

## Illinois

**V. M. Balasubramaniam**  
The National Center for Food  
Safety and Technology  
Summit-Argo

**Bob Sperber**  
VerticalNet  
Chicago

## Louisiana

**John L. McKillip**  
Louisiana Tech University  
Ruston

## Massachusetts

**R. Labbe**  
University of Massachusetts  
Amherst

## Michigan

**Rejeetha M. Charoth**  
Request Foods Inc.  
Holland

**Bruce DuHamel**  
Mid-Michigan District Health Dept.  
Stanton

**Robert E. Hause**  
Van Buren/Cass District  
Health Dept., Hartford

## Minnesota

**David Jobe**  
Land O'Lakes, Inc.  
Thief River Falls

**Elaine Santi**  
Minnesota Dept. of Agriculture  
Iron

## Nebraska

**Alan Paul**  
ConAgra Frozen Foods  
Omaha

## New Jersey

**Eugene N. Bilenker**  
Crown Food Consultants  
Elizabeth

**James V. Giranda**  
International Flavors & Fragrances  
Howell

## North Carolina

**Denise C. Crowell**  
NC Dept. of Agriculture  
Cary

## Ohio

**John Buchanan**  
The Kroger Co.  
Cincinnati

**John P. Kolenski**  
The Kroger Co.  
Cincinnati

**Ruth K. Yong**  
The Kroger Co.  
Cincinnati



## **Oregon**

**Mark A. Daeschel**  
Oregon State University  
Corvallis

## **Pennsylvania**

**Christopher H. Sommers**  
USDA-ARS-NAA-ERRC  
Wyndmoor

## **Puerto Rico**

**Victoria Cerame**  
P. Campofresco, Inc.  
Santa Isabel

## **South Carolina**

**Mark Housley**  
Milliken, Spartanburg

## **Tennessee**

**Cindy Ayers**  
Shoney's, Nashville

## **Texas**

**Sharon Edlund**  
IDEXX Food Safety Net Services,  
Inc., San Antonio

**James E. McFarland**  
Corpus Christi-Nueces Co.  
Public Health  
Corpus Christi

**Jerry Reed**  
IDEXX Food Safety Net Services,  
Inc., Richardson

## **Virginia**

**Dan-My T. Chu**  
VA Commonwealth University  
Richmond

**Denise M. Toney**  
Div. Consolidated Labs  
Richmond

## **Washington**

**Charles D. Leaf**  
Leaf Environmental Health  
Consultants  
Tumwater

## **Wisconsin**

**Bob Bladl**  
Grande Cheese Co.  
Waupun

**Jeffrey M. Crangle**  
Multipond America Inc.  
Green Bay

**Loyce C. Robinson**  
Milwaukee Health Dept.  
Milwaukee

**Scott J. Stieber**  
Marathon Cheese Corporation  
Marathon

# UpDates

## FPM&SA Elects New Officers, Directors at Annual Meeting

At the 114th Annual Meeting of the Food Processing Machinery & Supplies Association, new chairman and vice chairman (serving two-year terms) as well as three new Board members were elected to serve three-year terms on the Board of Directors.

Larry S. Hagopian, FPM&SA's new chairman, started his career in the food processing machinery industry in 1962 at Commercial Manufacturing, in Fresno, CA. Through the years he worked in all phases and departments of the company.

G. Joseph Olney, FPM&SA's new vice chairman, started out with the sales department of the G. J. Olney company in 1976 after graduating from Norwich University with a BS degree in Business Administration. Olney became vice president of sales in 1995, with duties focusing on sales and development of the company's food machinery products and became president in 1999. Olney also holds an MBA degree from Rensselaer Polytechnic Institute.

Jerry Houglund, FranRica (a business of FMC FoodTech) will continue on the Board as past chairman for a two-year term.

Leonard Byrne, president, Cryovac, Sealed Air Corporation, Duncan, SC, joined the company in 1966 assuming various positions in finance an administration in the W. R. Grace Division.

Byrne's education includes a BS degree in accounting from Providence College in Rhode Island and an MBA in economics

from St. John's University in New York.

Cal Gray, senior vice president, Vision Systems Operation, Satake USA, Houston, TX, joined the company six years ago and is responsible for engineering and production. Gray, a registered professional engineer has 25 years of plant, project and design engineering experience in the pharmaceutical and food industries.

Gray received his BS and MS degrees in mechanical engineering as well as his MBA from Virginia Tech.

Ashley Hunter, vice president/general manager of Odenberg Engineering, West Sacramento, CA, joined the company in 1994. Odenberg operates three business units which include: peeling equipment, freezing and chilling equipment and sorting equipment. These units are located in the US, Ireland, Holland and Italy. Reporting to Odenberg's president located in Ireland, Hunter is responsible for these three units' activities in the Americas.

Hunter received his B.Sc. (1st class honors) in 1982.

## Edward J. Fierko Named Osmonics President and Chief Operating Officer

Osmonics, Inc. announced that Edward J. Fierko has been appointed president and chief operating officer of the company, effective immediately. Fierko assumes responsibility for all of the company's operations.

Fierko joined Osmonics in October 1998 as vice president and general manager of the

company's fluid controls & valves and standard equipment & pumps global business units. Prior to joining Osmonics, Fierko served five years as president and chief executive officer of EcoWater International Inc., Glasgow, DE. In this role, Fierko oversaw 15 individual manufacturing companies which designed, developed, produced, and marketed water and wastewater treatment products to worldwide residential, commercial, industrial, and utility customers.

In 1987, Fierko joined the Marmon Group, Chicago, IL, as president and CEO of EcoWater Systems, St. Paul, MN.

Before joining EcoWater Systems, Fierko was with General Electric Company for 23 years in various management positions in finance, strategic planning, marketing, and general management. In his last seven years at GE, Fierko was division general manager of the Power Systems Management Division, headquartered in Malvern, PA.

Fierko is a former president of the Water Quality Association. He received his bachelor's degree in accounting from LaSalle University in Philadelphia, PA, and has completed management programs at several recognized MBA schools.

## Shank to Join IFT as Vice President of Science, Communications and Government Relations

Effective Jan. 1, 2000, Fred R. Shank, Ph.D., will be the new vice president of science, communications and government relations for the Institute of Food Technolo-

gists (IFT) in its soon-to-be satellite office in Washington, D.C. He will oversee four primary areas: government affairs, science communications, food research, and science and technology projects.

Most recently, Shank served as senior vice president of science and regulatory affairs for the Chocolate Manufacturers Association. Prior to that, he was senior advisor to the commissioner of the Food and Drug Administration (FDA). From 1989 to 1998, he served as director of FDA's Center for Food Safety and Applied Nutrition (CFSAN), leading the most comprehensive revision of food labeling in US history. He also oversaw the research and implementation of effective controls for foodborne pathogens and chemical contaminants as well as developed policies for foods produced by recombinant DNA technology among many accomplishments as CFSAN director.

Shank's career at the FDA began in 1978 in the Division of Nutrition. Previously, he worked for the U.S. Department of Agriculture for eight years in its Food and Nutrition Service and for the U.S. Air Force School of Aerospace Medicine for four years. Shank received numerous awards for his work in public service, including the Senior Executive Service Presidential Rank Award in 1993 and Presidential Award for Design Excellence in 1997.

## **Society for Industrial Microbiology Elects Officers**

New officers and directors have been elected by the Society for Industrial Microbiology (SIM). Vincent Gullo, Ph.D., director of microbial products, Schering-Plough Research Institute (Kenilworth, NJ) will serve as SIM president for the 1999-2000 term. president elect, for the term

commencing in August 2000, is Kristien Mortelmans, Ph.D., senior microbiologist, biopharmaceutical development division, SRI International (Menlo Park, CA). LaVerne Boeck, Eli Lilly & Company, Retired (Indianapolis, IN) is past president.

Steve Nelson begins his three-year term as treasurer which ends August 2002. Mr. Nelson is manager, Traders Protein (Memphis, TN). Ann Horan, associate director, microbial products, Schering-Plough Research Institute (Kenilworth, NJ) will continue to serve as secretary through her three-year term ending in August 2000.

Richard Baltz, Ph.D. was elected to SIM's Board of Directors. Dr. Baltz is president of CognoGen Biotechnology Consulting (Indianapolis, IN). Other SIM directors currently serving three-year terms are Anne Dombrowski, Ph.D., senior research fellow in Natural Products Drug Discovery at Merck Research Laboratories (Rahway, NJ); Brendlyn Faison, Ph.D., associate professor of biological sciences, Hampton University (Hampton, VA); and Douglas Jaeger, manager of custom fermentation for Abbott Laboratories (N. Chicago, IL).

## **Dennis A. Thayer Named Director of Operations Quality Assurance**

Luby's, Inc. announced the appointment of Dennis A. Thayer as director of operations quality assurance.

"Dennis will be responsible for implementing the ServSafe program and ensuring that Luby's 225 restaurants continue to maintain the standards in food health and safety," said Barry J. C. Parker. "His experience developing and implementing food safety and quality programs and training at both the corporate and regulatory

levels will provide the focus we need to maintain our standards as we grow and expand our business."

Thayer was formerly the manager for public health and safety for the National Restaurant Association in Washington, D.C. His 20 years of experience in public health include service as an active member of several Conference for Food Protection committees, the President's Council on Food Safety Initiative working groups and other food safety standards groups. He is one of the few National Environmental Health Association Certified Food Safety Professionals in the United States and is a frequent food safety and quality issues speaker for industry, professional, and regulatory educational conferences.

Thayer received a bachelor of science degree in resource management economics and engineering at the University of Maryland and took post-graduate courses in public health issues at Cornell, Penn State, the U.S. Public Health Service, the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), and the Environmental Protection Agency (EPA).

## **Meritech Announces New President and Chief Executive Officer**

Meritech, Inc. has announced the appointment of Christopher Drummond as the company's new president and chief executive officer. A native of Colorado, Drummond is a member of the Colorado Bar Association. He brings an extensive legal and management consulting background with him to the Meritech organization, and looks forward to furthering Meritech's commitment to innovation in hand/glove sanitizing equipment.

## John G. Cerveny, Recipient of 1999 WAMFS Sanitarian of the Year Award

**O**n September 23, 1999, John G. Cerveny was presented the Sanitarian of the Year Award at the Wisconsin Association of Milk and Food Sanitarians (WAMFS) Annual Meeting in Wausau, Wisconsin by President John Christy.

John Cerveny has been a food safety consultant since retiring from Oscar Mayer Foods in March 1996. During his thirty-seven-year tenure at Oscar Mayer he served as a microbiologist, senior research scientist, and most recently, as section manager of research and development microbiology. His career was directed toward the safety and quality of ready-to-eat meat and poultry products. Among his contributions was directing research that led to the use of sodium lactate as an antibotulinal agent in cooked poultry and fish. This preservative is now commonly used in precooked poultry products to inhibit botulinal toxin production.

John served on many advisory committees for the meat industry and for the International Life Sciences Institute (ILSI) on microbiological food safety issues. His participation and leadership were instrumental in addressing critical issues of the safety of sodium nitrite in the 1970s, *Listeria monocytogenes* and *Escherichia coli* O157:H7 in the 1980s and 1990s. The University of Wisconsin-Madison uses his expertise in meat safety as a lecturer and in extension workshops. He assists the American Meat Institute (AMI) and Oscar Mayer Foods in a variety of training programs in HACCP, sanitation, and microbiology.

As member of WAMFS and IAMFES since 1969, John has been active on the IAMFES Program Committee from 1992 to 1997 and served as chairperson for two



# NEWS

years. John served as the first chairperson of the IAMFES Meat Safety and Quality Professional Development Group, chairperson of the Developing Scientist Awards Committee, and was a member of the Long Range Planning Committee. He also has organized several symposia for recent annual meetings. He was honored by IAMFES for his contributions in the food industry by being awarded the Harold Barnum Industry Award in 1997. John has been active in WAMFS as a speaker at the Joint Educational Conference. In addition to WAMFS and IAMFES, John has been a member of American Society of Microbiology (ASM), Institute of Food Technologists (IFT), and the AMI.

## Silliker Adds Leading Canadian Lab to Its International Network

**S**illiker Laboratories Group, Inc. has acquired a Canada food testing and consulting organization, Diversified Research Laboratories Inc. (DRL). By combining Diversified with its own Canadian subsidiary, Silliker now offers Canadian food manufacturers, distributors and retailers comprehensive services to ensure the safety, nutritional value and quality of their products.

"Diversified has a strong technical staff with excellent chemistry expertise and extensive knowledge of food manufacturing, retailing and distribution gained over 25 years. This expands the range of services and technological resources available to our clients," said Russell Flowers, Ph.D., CEO/president of Silliker's North American network since 1990.

A full-service facility, Diversified is in contract research, routine testing, process monitoring and improvement. Experienced in all segments of the food industry, DRL also serves the pharmaceutical, cosmetic and consumer goods industries.

"Now more than ever, we are living in the global marketplace. By joining a growing international network of accredited laboratories, Diversified will be in a much stronger position to satisfy our clients' global technical and regulatory requirements," said Hugh Black, president of Diversified.

Diversified is the latest acquisition in the aggressive Silliker global expansion program. Silliker Laboratories Group, Inc., (USA) and bioMérieux Alliance, (France) announced the formation of a global Silliker laboratory network on July 26, 1999. With 23 facilities and more than 1,000 employees, the new international Silliker network now includes: 12 Silliker labs in the US; two in Canada; six in France (formerly Ercem and Fimebio); Silliker Ltd. (formerly British Analytical Control) in England; and new Silliker facilities in Italy and Belgium.

"Through the network, we can provide our clients with the individual attention they expect from a local lab, and they also gain scientific expertise and consistency only an international organization can offer," said Flowers. "All Silliker clients now have access to a wealth of internal resources and an internationally-recognized staff of food scientists."

## New Food Safety Video Available from SIUC

**A** low-cost, easily mastered training program developed at Southern Illinois University aims to help food service staff keep bacteria at bay.

"Foodborne illness is one of the nation's main food safety concerns—especially with all the recent publicity about *E. coli* contamination," said Hea-Ran "Helen" Ashraf, a food and nutrition expert from the Carbondale campus.

"Contamination can occur at any point, but food service operations are most often implicated. Most of the food safety training guides are written for managers, not for food handlers. We think this makes our program unique."

Ashraf, SIUC colleagues John W. Corker, T.C. Girard and Patricia K. Welch and public health officials David Blaise and James W. Bloom have put together a video and workbook to teach workers which steps in the handling process are most likely to contaminate food and what to do to beat the bugs.

The process, is called HACCP (pronounced HASS-up), an acronym for Hazard Analysis/Critical Control Points. The U.S. Department of Agriculture has required meat and poultry plants to use HACCP programs to ensure food safety since 1996. Many observers expect the Food and Drug Administration to place similar demands on the food service industry.

"HACCP has seven principles, but we have incorporated them all into two basic steps, and we've made these as simple and practical as possible so that anyone who handles food can put them into daily practice," Ashraf said.

"Because the team that designed the training program included public health department officials, food service managers should find the material both relevant and easy to use," Ashraf said.

## Leon Townsend Resigns from the Conference for Food Protection

**E**ffective October 31, 1999, Leon Townsend resigned from his duties as executive secretary of the Conference for Food Protection. Leon has served in that capacity for the last nine years and has witnessed considerable growth of the organization throughout his tenure. In accepting his resignation, the Conference Executive Board thanked him for his dedicated service – and for that of his wife Elsie – and extends to them their warmest wishes for the future.

Assuming the duties in Leon's absence is Trevor Hayes who recently retired as director, consumer protection, Santa Clara County Department of Environmental Health in California where he had served for almost thirty years. Trevor has been a member of the Conference's Executive Board for approximately nine years and served as the conference chair during the period 1992 - 1994.

Information concerning the Conference can now be obtained by contacting Trevor at his E-mail address - TWHgilroy@aol.com – by phone/fax at 408.848.2255, or by writing him at 1085 Denio Ave., Gilroy, CA 95020-9206.

## Home Cooking Getting More Dangerous; Foodborne Illnesses Up 25% in Five Years

**I**f you think your home is the safest place to eat, here's something you might want to chew on. The American Dietetic Association (ADA) says the home is one of the most common locations to get foodborne illnesses. In-home cases have gone up 25 percent in the last five years, the ADA says. "We're very much aware that it is a significant problem, and we're also aware that

a lot of individuals don't realize that they can do something to reduce their chance of foodborne illness in the home," says Cindy Moore, director of nutrition therapy at the Cleveland Clinic Foundation and spokesperson for the ADA. "There are many people who may not realize the importance of such simple things as washing their hands before they start meal preparation," Moore says.

The ADA says 33 million Americans contract foodborne illnesses each year, and about 9,000 of them die. That costs \$5 billion to \$6 billion a year in medical care and lost productivity, says the National Institute of Allergy and Infectious Diseases.

The main culprits are *Escherichia coli*, *Salmonella* and *Campylobacter*, all of which can cause symptoms that range from mild intestinal discomfort to severe dehydration or bloody diarrhea.

The ADA and the ConAgra Foundation commissioned a survey of 1,000 people who prepared the main meal in their households. The results, released at the annual ADA meeting in Atlanta, showed that 45 percent of people knew about the dangers of handling food without washing their hands, but still didn't wash properly. Ten percent of people who gave themselves an "A" in food handling don't wash their hands with soap and water after handling raw meat, the survey found.

Most people are unaware of food safety because of changes in modern society, says Kathryn Boor, a microbiologist in the department of food science at Cornell University in Ithaca, NY. She says in previous decades much more food was prepared and stored in the home. Knowledge about proper handling and precautions was passed from generation to generation, which doesn't happen as much now.

Boor says because of a drastic separation between people and food production, people now tend to view food as a manufactured product. "People lose the sense that foods are biological materials that are subject to bacteriological

alterations. They get home and they treat food the same way they treat socks or whatever," Boor says.

To increase awareness, the ADA and the ConAgra Foundation have mounted a national campaign to ensure home food safety. Here are some of their recommendations: make sure you wash your hands frequently when preparing food; keep raw meats separate from cooked foods; cook food thoroughly, and refrigerate foods promptly.

For more information on food-borne illness and steps you can take to avoid it, go to the ADA or Gateway to Government Food Safety Information.

Reprinted from *HealthScout*, Oct. 99.

## CADMS Honors Richard Reed as Sanitarian of the Year

**R**ichard Reed is a soon-to-be retired regional administrator for the California Department of Food and Agriculture, Milk and Dairy Foods Control Branch. He works out of Southern California and is responsible to see that the milk that is produced and processed there is of the higher safety and quality possible and that it conforms to state and federal regulatory guidelines. Richard and his staff inspect 40 percent of the state's dairy herds representing production of over 11.2 billion pounds of milk annually. His leadership has allowed the industry to progress both at the dairy farm and in the processing plant. He is known as a national leader in innovation in dairy production and processing. Many of the advances have resulted from Richard's willingness to give the industry encouragement to innovate and thus improve the product and processes.

Because of his long dedication and excellence of leadership throughout his career, the California Association of Dairy and Milk Sanitarians was pleased to honor him this year.

Jenny Scott was the affiliate's guest speaker and CADMS and members of CDIA were most pleased with her presentation and with the support that IAMFES provides to the affiliates. Jenny presented two IAMFES Certificates of Merit to CADMS-IAMFES Members Jena Roberts and Bill Huntley for their continued service to the dairy foods industry. Both Jena and Bill have given their time without hesitation to the industry's educational programs and to IAMFES. CADMS was very pleased that the IAMFES Board concurred in this important and significant recognition of people who work hard for the industry outside of their usual tasks of their employers.

## Weapon Against *E. coli*; E-Beam Technology

**I**n 1865, French chemist Louis Pasteur introduced the world to the process now known as pasteurization. By heating milk at 145° for 30 minutes, rapidly cooling it and then storing it below 50°, Pasteur discovered that harmful bacteria were destroyed without significantly changing the milk's composition, flavor or nutritional value.

In 2000, US consumers will be introduced to a new kind of pasteurization being developed by an interdisciplinary team of researchers at the University of Missouri-Columbia, Iowa State University, and Natick Army Laboratory. Like its 19th century forerunner, it destroys bacteria without significantly changing product composition, flavor or nutritional value. However, this 21st century process, termed cold pasteurization, is much different. Using electron beam technology it is fast, does not require heat and is designed to destroy one of the most feared bacterium in recent history—*E. coli* O157:H7.

"Today, you wouldn't even think of drinking milk that wasn't pasteurized," said Nan Unklesbay, MU food science professor. "So we asked ourselves, 'why aren't other foods, such as ground beef, pasteurized against dangerous bacteria like *E. coli* O157:H7?'"

Unklesbay has been the principal food scientist for the development of electron beam, or "E-beam," technology since 1995. That is when electrical engineering professor Randy Curry came to MU, bringing with him an accelerator. The high-powered accelerator is a type of cathode ray tube, similar to that found in a conventional television set.

In the 1980s, Curry developed similar devices for President Reagan's Strategic Defense Initiative, popularly known as "Star Wars." After "Star Wars" lost funding, he continued to develop accelerator technologies for national defense, but on a different level. Instead of defending against missile attacks, the accelerator defends against harmful microbes in food.

Working together, Curry and engineering professors Kenneth Unklesbay and Tom Clevenger developed and refined the process. Their research was funded by a \$250,000 grant from the Electrical Power Research Institute.

"We focused on *E. coli* O157:H7 contamination of ground beef for two reasons," Nan Unklesbay said. "First, meat is the most common source of *E. coli* O157:H7 poisoning. Second, *E. coli* O157:H7 is the nastiest bacteria we know about. It can survive temperatures and acidic conditions that others cannot. Because of its resilience, it is considered to be an indicator organism. We know that if we can kill *E. coli* O157:H7, we can kill everything else too."

In essence, the process of cold pasteurization is relatively simple. Once the linear accelerator is activated, electrons are accelerated down a tube. With a flip of a switch, the accelerator then propels the electrons at high

speeds, creating an "E-beam." When this invisible beam hits the *E. coli*, it interacts with the microbe's DNA, deactivating it.

"The whole process takes only a few seconds," Unklesbay said. "Though a number of variables, including fat content, thickness and state (fresh or frozen) of the meat, affect the duration and intensity of the process, the cold pasteurization occurs in the same way."

Consumers will see evidence of cold pasteurization as early as February. Two US meat processors plan to offer frozen hamburger patties treated with "E-beams" to grocers and fast-food restaurants. Processing will be at a new, \$6 million plant in Iowa City, IA, built by The Titan Corporation, a manufacturer of the accelerators. Patties will be frozen, processed, packaged and then treated. A cost increase of three to seven cents per pound is expected.

"At first, cold pasteurized products at the grocery store will be labeled as 'irradiated,' but the term should not worry consumers. It is simply the term that the USDA requires," Unklesbay said. "The process is non-nuclear, and we're working to have cold pasteurized products labeled as such to avoid confusion." Curry believes new accelerators will make the process less expensive to commercialize.

## Evaluation of Risks Related to Microbiological Contamination of Ready-to-Eat Foods by Food Preparation Workers

**T**he Food and Drug Administration (FDA) publishes the Food Code which provides guidance on food safety, sanitation and fair dealing that can be uniformly adopted by jurisdictions for regulating the retail segment of the food industry. The model Food Code is the cumulative result of the efforts and recommendations

of many contributing individuals, agencies, and organizations. Section 3-301.11 of the 1999 Food Code, entitled "Preventing Contamination from Hands" was added to the code in response to outbreaks of foodborne illness caused by food that had been contaminated with pathogens transmitted by food preparation workers. FDA believes that the considerable number of illnesses transmitted by food worker contamination of food demands rigorous intervention measures.

A summary of current information from scientific literature or provided to FDA that evaluates the factors related to contamination of foods by food workers and the effectiveness of interventions to prevent or minimize contamination of ready-to-eat food by food workers is available at: [vm.cfsan.fda.gov/~ear/rterisk.html](http://vm.cfsan.fda.gov/~ear/rterisk.html).

Three major intervention areas are addressed: exclusion of ill food workers from the workplace, removal of pathogens from the hands of food workers, and the use of barriers to prevent bare-hand contact with ready-to-eat foods.

Information provided in this review includes all applicable submissions that were received in response to Federal Register Notice, Vol. 64, No. 63, Friday, April 2, 1999. On September 16, 1999, Center for Disease Control (CDC) released data on the incidence of foodborne disease in the United States.

## Lab Test for Prions May Yield Diagnostic Tool for TSE Diseases

**A**n Agricultural Research Service (ARS) scientist in Ames, IA, has developed a laboratory assay that might lead to the development of a diagnostic test for transmissible spongiform encephalopathies (TSEs).

The laboratory assay, developed by ARS chemist Mary Jo Schmerr, detects the presence of

abnormal proteins called prions in the blood of animals and humans. Prions cause a group of TSE diseases.

The most well-known example of these diseases is bovine spongiform encephalopathy or "mad cow disease," which occurred in Great Britain in 1986. There are no documented cases of BSE in the United States. But all sheep are susceptible to another type of TSE known as scrapie. Elk and mule deer get chronic wasting disease, and mink are susceptible to yet another form of transmissible encephalopathy. Human forms of TSE that affect the brain include Creutzfeldt-Jakob disease and kuru. Creutzfeldt-Jakob disease is rare in the United States, and kuru has never been seen outside New Guinea.

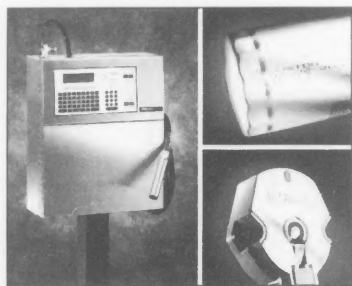
"Further development of this assay may lead to a diagnostic test for this fatal disease agent in animals and humans. Such a diagnostic test would be an important tool for the control of these diseases," said ARS administrator Floyd Horn.

The presence of BSE in cows has already dealt a severe economic blow to the British beef industry and would have a devastating impact on American agriculture if a case of BSE were identified in the United States.

"Schmerr's accomplishment is an excellent example of how long-term investment in research can benefit American agriculture," Horn said.

Schmerr, who works at ARS' National Animal Disease Center in Ames, and Andrew Alpert of PolyLC, Inc. in Columbia, MD, are co-inventors of the assay. ARS and Fort Dodge Animal Health of Fort Dodge, IA, have signed a Cooperative Research and Development Agreement (CRADA) to develop a test kit for use in diagnosing TSEs in animals. ARS, the USDA's chief scientific agency, is in the process of applying for a patent.

# IndustryProducts



Videojet Systems International, Inc.

## New Videojet Excel® 2D Series Printers Provide 2D Snowflake Code Capability

Videojet Systems International, Inc., has released the VIDEOJET EXCEL 2D Series non-contact, small character ink jet printers. These printers are specifically designed to print the Marconi Snowflake code, meeting the needs of applications that require product identification, time, date, contents and other variable/fixed information using an automated process.

The EXCEL 2D Series printers offer the versatility of imaging from one to four lines of print, or incorporating Videojet's two dimensional, Auto-ID code named the Marconi Snowflake Code. Characters ranging from 1/8 inch (3.2mm) to 1/3 inch (8.4mm) can be printed at line speeds of up to 1,111 feet/min (338 m/min). The message storage capability of the 2D Series allows for up to 56 stored messages, that can be recalled with a few simple key-strokes.

The Marconi Snowflake code is very compact, with a high data density capability. It is also a very robust code, with the capability of using error correction technology to maintain readability, even if up to 40% of the code has been damaged by debris, clutter or distortion. The Snowflake code is comprised of dots, and is superior in its ability to be printed by many different printing technologies. Because of the dot matrix format, it is one of very few 2-D codes that can be easily applied to virtually any substrate using ink jet and laser printing technology.

Dynamic-Environmental-Compensation is standard in the EXCEL 2D Series printers, to compensate for changing environmental conditions. This ensures that the EXCEL 2D Series printers will consistently provide the highest print quality and reliability. The rugged durability of these ink jet printers includes a stainless steel IP65 washdown resistant cabinet, and vinyl-covered armored print-head cable, allowing for top performance—even on high-output, high-speed, three-shift production lines in harsh environments.

Lower make-up fluid consumption and 66% less air usage than that of other models reduce operating costs, lower emissions, and make the EXCEL Series 2D printers highly efficient. Users have the option of using their own factory air supply or a portable air compressor.

Videojet Systems International, Inc., Wood Dale, IL

Reader Service No. 320

## Monitor 12 Sensors at Once from Sensotec

The microprocessor-based Model SC features the unique Signature Calibration option which enables the unit to automatically calibrate itself to the proper span, decimal point, and engineering units for each individual Signature Calibrated transducer. This time-saving feature eliminates manual set-up and the potential errors associated with this tedious chore. Simply attach the sensor and turn the unit on. That's all there is to it. All calibration data, engineering units and set up information are contained within the sensor itself, assuring flawless set-up every time, in seconds.

Sensor information and calibration data can be retrieved through the Model SC itself, or via direct PC interface. This facilitates record keeping associated with ISO certification.

The SC Series provides auto-zero, and a choice of calibration methods including MV/N shunt calibration, and 2-, 3-, or 5-point known load calibration. Standard outputs of  $\pm 5V$ , 0-10V, or 4-20mA are offered.

Other features include a menu-driven setup interface via front panel controls, 16-character vacuum fluorescent displays, and a full-feature RS-232/485 interface. The Model SC200 and SC300 provide complete mathematics capability, analog and digital peak detection and up to eight limits.

Sensotec, Inc., Columbus, OH

Reader Service No. 321

*The publishers do not warrant, either expressly or by implication, the factual accuracy of the products or descriptions herein, nor do they so warrant any views or opinions offered by the manufacturer of said articles and products.*



## RIDASCREEN®FAST T-2 Toxin Assay Granted Performance Tested Methods<sup>SM</sup> Status

The AOAC Research Institute granted Performance Tested Methods<sup>SM</sup> status to the RIDASCREEN®FAST T-2 Toxin Assay for the rapid detection of T-2 toxins in corn, wheat, and mixed feeds in October 1999. Independent testing at the Laboratory Services Division of the Canadian Food Inspection Agency under the direction of the AOAC Research Institute verified performance claims to quantitate T-2 toxin in corn at or above 150 ppb and in mixed feed at or above 300 ppb.

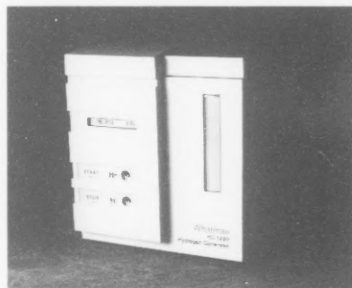
The RIDASCREEN®FAST T-2 Toxin Assay employs a standard competitive immunoassay technique using monoclonal antibodies specific to the T-2 toxin. Samples are extracted using aqueous methanol (70%) and then filtered, and diluted with distilled water. Extracted, filtered, and diluted samples are added to reaction wells in the RIDASCREEN®FAST T-2 Toxin Assay microtiter plate along with a T-2 toxin-enzyme conjugate, and allowed to incubate for 10 minutes. T-2 toxin in the sample and the T-2 toxin-enzyme conjugates compete for binding sites in the reaction wells. Excess T-2 toxins and T-2 toxin-enzyme conjugates are then rinsed from the reaction well leaving only bound molecules; A chromogen is added to the reaction well and incubated for five minutes producing a blue color that is inversely proportional to the amount of T-2 toxin in the original sample. The blue chromogen is converted to yellow by a reagent that stops the enzymatic reaction. A measurement is performed photometrically at 450nm. Quantitation is performed using a standard calibration curve, consisting of five T-2 toxin standards (0-400 ppb).

Independent testing performed at the Canadian Food Insp-

ection Agency compared the RIDASCREEN®FAST T-2 Toxin Assay with the standard chromatographic reference method (GC/MS) in feed, corn, and wheat samples. Both methods correlated very well. The RIDASCREEN®FAST T-2 Toxin Assay was found to slightly overestimate the concentrations of T-2 toxin at lower concentrations (< 150 ppb); however the assay performed well giving accurate results with blank samples spiked at 150 and 300 ppb T-2 toxin and with naturally contaminated samples containing 285 and 360 ppb T-2 toxin.

AOAC Research Institute,  
Gaithersburg, MD

Reader Service No. 322



Whatman Inc.

## Whatman Model H2-1200 UHP Hydrogen Generator Produces Flows of Up to 1.2 Liters Per Minute at Pressures Up to 100 PSIG

Whatman, recently released the model H2-1200 Hydrogen generator. This generator is the only hydrogen generator on the market that combines Solid Polymer Electrolyte (SPE) technology with palladium to produce 99.99999% hydrogen for fuel and carrier gas applications on gas chromatographs.

Deionized water is all that is required to generate hydrogen for months of continuous operation. The generator comes standard with an automatic feedwater

device which can be attached to an existing DI water supply for hands-off operation. With an output capacity of 1.2 liters per minute, one generator can supply 99.99999% pure carrier gas to four to six GCs, and fuel gas to ten to twelve FIDs. Based on cylinder gas savings alone, the Whatman hydrogen generator pays for itself in less than a year. The model H2-1200 also meets the strict safety guidelines of the National Fire Protection Agency (NFPA) and regulations of the Occupational Safety and Health Association (OSHA-1910.103). Most importantly, it is certified for laboratory use by CSA, UL, CE, and IEC 1010.

Whatman Inc., Tewksbury, MA

Reader Service No. 323

## New Simple, Inexpensive Test Accurately Detects *E. coli* O157

Using technology developed by a private company, a USDA biochemist has developed a rapid, easy-to-use test that detects *E. coli* in food products. The test uses magnetic beads coated with anti-*E. coli* O157 antibodies and ruthenium-labeled antibodies. Ruthenium is a metal that, through a chemical reaction, emits light that helps detect the presence of *E. coli*.

C. Gerald Crawford, with USDA's Agricultural Research Service, used equipment and technology patented by IGEN International Inc. of Gaithersburg, MD, to perfect this test. The test, which works on hamburger meat, is from 10 to 100 times more sensitive than other tests for *E. coli*. Crawford developed the assay at the ARS Eastern Regional Research Center in Wyndmoor, PA.

No special training is necessary to conduct the inexpensive test and the equipment, including a computer, can fit on a small

table. Samples can be loaded onto a tray similar to a carousel for a slide projector, and 50 samples can be tested in an hour. Total time from sample to answer: only 6 to 8 hours.

A large commercial meat supplier is evaluating the test. From the new assay, IGEN hopes to develop a line of fast, highly sensitive tests that will help food producers detect contaminants.

IGEN International, Inc.,  
Gaithersburg, MD

Reader Service No. 324

### The New E-Z<sup>®</sup> Tec<sup>®</sup> Model V Metal Detectors from Eriez Offer Major Advancements

The new Model V E-Z Tec<sup>®</sup> Metal Detector from Eriez is an advancement in metal detection, and provides efficient detection of ferrous, non-ferrous and stainless steel metals in various products. The new E-Z Tec, ensures product purity and protects downstream equipment with two new features:

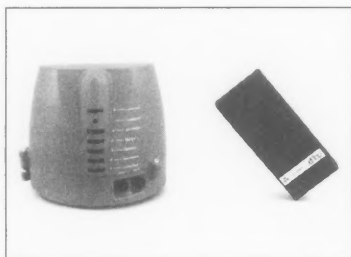
- **Rapid Recovery Function** – A metal detector must recover quickly after it detects contamination or it may miss the next piece of metal before it has time to reset. The E-Z Tec's advanced electronics can detect minute pieces of metal and recover even after large pieces of metal have been detected – in just seconds – reducing the loss of product and eliminating the possibility of missed metal.
- **MPC Term Communications Software** – With improved communications and interface capabilities, MPC Term allows one or more Window<sup>™</sup> or DOS-based PCs to monitor and control multiple systems of meal

detectors. Unique self-checking and real-time diagnostic functions have been added to allow Eriez technicians to troubleshoot the metal detector from anywhere in the world.

The E-Z Tec Model V has a compact cabinet design, allowing the metal detector to be installed where space is at a premium and easily accommodating shorter conveyor lengths.

Eriez Magnetics, Erie, PA

Reader Service No. 325



Tri-Clover, Inc.

### Pump and Valve Innovations by Tri-Clover

Innovative additions to its lines of pumps and valves have been planned by Tri-Clover, Inc.

Introduced is Tri-Clover's new e:Top<sup>™</sup> Control and Indication Unit for automated systems control with the company's 700 Series valves and B52 butterfly valves. The unit can be set without dismantling or adjusting the valve. It features indication signals, including maintenance notification.

The manufacturer of stainless steel processing equipment unveiled a new T-Series positive rotary lobe pump, specially designed for ultra-clean processing applications. The new TCIP pump, available in 14 models, offers smooth transfers and protects the integrity of delicate products.

Tri-Clover, Inc., Kenosha, WI

Reader Service No. 326

### New and Improved LIGHTNING<sup>®</sup> Swab from IDEXX

IDEXX Laboratories, Inc. announces the new and improved LIGHTNING<sup>®</sup> swab device to be used with the LIGHTNING<sup>®</sup> Cleaning Validation System. The new swab eliminates the glass formerly incorporated into the design and also eliminates the need for crimpers, meaning there is one less tool to carry.

To use the new swab, remove the top portion of the swab device and swab the area of interest, then reinsert the swab into the device. To activate the new swab device, press the bottom of the device firmly upward as far as possible, forcing the swab through the foil. Next, bend the bulb sideways to break the internal valve and squeeze the bulb chamber several times to empty the bulb chamber of all visible buffer. These new steps eliminate the glass ampoule and the need for crimpers. The swab device is then inserted into the luminometer and results can be read in 11 seconds.

The LIGHTNING Cleaning Validation System is an ATP-bioluminescence system consisting of a luminometer and swab devices. The system detects food residues in just one minute by measuring any adenosine triphosphate (ATP) left on a previously cleaned surface. The test uses the enzyme luciferase, which is highly sensitive to ATP. ATP is found in most food residues and all bacteria, yeast and mold cells, and provides a highly sensitive indicator of cleaning effectiveness. The LIGHTNING System can be used to monitor and optimize the effectiveness of cleaning procedures in food processing environments.

IDEXX Laboratories, Inc.,  
Westbrook, ME

Reader Service No. 327



International Association for  
Food Protection

The International Association for Food Protection welcomes your nominations for our Association Awards. Nominate your colleagues for one of the Awards listed below. Only Members are eligible to be nominated (does not apply to the NFPA Food Safety Award). You do not have to be a Member of the Association to nominate a deserving professional.

To request nomination criteria, contact:

International Association for Food Protection  
6200 Aurora Avenue, Suite 200W  
Des Moines, Iowa 50322-2863, USA  
By telephone: 800.369.6337; 515.276.3344  
Fax: 515.276.8655  
Web site: [www.foodprotection.org](http://www.foodprotection.org)  
E-mail: [info@foodprotection.org](mailto:info@foodprotection.org)

**Nominations deadline is February 18, 2000.** You may make multiple nominations. All nominations must be received at the International Association for Food Protection's office by February 18, 2000.

- ◆ Persons nominated for individual awards must be current Members of the Association. Black Pearl Award nominees must be a company employing current Members. NFPA Food Safety Award nominees do not have to be Members of the Association.
- ◆ Previous award winners are not eligible for the same award.
- ◆ Executive Board Members and Awards Committee Members are not eligible for nomination.
- ◆ Presentation of awards will be during the Awards Banquet at the Annual Meeting in Atlanta, Georgia on August 9, 2000.

Nominations will be accepted for the following Awards:

**Black Pearl Award** – Award Showcasing the Black Pearl

Presented in recognition of a company's outstanding achievement in corporate excellence in food safety and quality.

*Sponsored by Wilbur Feagan and F&H Food Equipment Company.*

## Award Nominations

**Fellows Award** – Distinguished Plaque

Presented to individuals for their contribution to the Association and its Affiliates with quiet distinction over a prolonged period of time.

*Sponsored by the International Association for Food Protection.*

**Honorary Life Membership Award** – Plaque and Lifetime Membership in the Association

Presented to Members for their devotion to the high ideals and objectives of the Association and for their service to the Association.

*Sponsored by the International Association for Food Protection.*

**Harry Haverland Citation Award** – Plaque and \$1,000 Honorarium

Presented to an individual for years of devotion to the ideals and objectives of the Association.

*Sponsored by DiverseyLever/U.S. Food Group.*

**Harold Barnum Industry Award** – Plaque and \$1,000 Honorarium

Presented to an individual for outstanding service to the public, the Association and the food industry.

*Sponsored by NASCO International, Inc.*

**Educator Award** – Plaque and \$1,000 Honorarium

Presented to an individual for outstanding service to the public, the Association and the arena of education in food safety and food protection.

*Sponsored by Nelson-Jameson, Inc.*

**Sanitarian Award** – Plaque and \$1,000 Honorarium

Presented to an individual for outstanding service to the public, the Association and the profession of the Sanitarian.

*Sponsored by Ecolab, Inc., Food and Beverage Division.*

**NFPA Food Safety Award** – Plaque and \$3,000 Honorarium

Presented to an individual, group, or organization in recognition of a long history of outstanding contribution to food safety research and education.

*Sponsored by National Food Processors Association.*

# Call for Abstracts



International Association for  
**Food Protection**

**87th Annual Meeting**  
**August 6-9, 2000**  
**Atlanta, Georgia**

## General Information

1. Complete the Abstract Submission Form.
2. All presenters must register for the Annual Meeting and assume responsibility for their own transportation, lodging, and registration fees.
3. There is no limit on the number of abstracts registrants may submit. However, the presenter must present their presentations.
4. Accepted abstracts will be published in the Program and Abstract Book. Editorial changes will be made to accepted abstracts at the discretion of the Program Committee.
5. Photocopies of the abstract form may be used.
6. Membership in the Association is not required for presenting a paper at the International Association for Food Protection Annual Meeting.

## Presentation Format

1. Technical – Oral presentations will be scheduled with a maximum of 15 minutes, including a two to four minute discussion. Projectors for 35-mm slides will be available. Other equipment may be used at the presenter's expense. Prior authorization from the office must be obtained. Overhead projectors will not be allowed.
2. Poster – Freestanding boards will be provided for presenting posters. Handouts may be used, but audiovisual equipment will not be available. The presenter will be responsible for bringing pins and velcro.

## Instructions for Preparing Abstracts

1. Title – The title should be short but descriptive. The first letter in each word in the title and proper nouns should be capitalized.
2. Authors – List all authors using the following style: surname followed by a comma then the first name.
3. Presenter Name & Title – List the full name and title of the person who will present the paper.
4. Presenter Address – List the name of the department, institution and full postal address (including zip/postal code and country).
5. Phone Number – List the phone number, including area code, country, and city of the presenter.
6. Fax Number – List the fax number, including area code, country, and city of the presenter.
7. E-mail – List the E-mail address for the presenter.
8. Format preferred – Check the box to indicate oral or poster format. The Program Committee makes the final decision on the format of the abstract.
9. Developing Scientist Awards Competitions – Check the box to indicate if the paper is to be presented by a student in this competition. A signature and date is required from the major professor or department head. See "Call for Entrants in the Developing Scientist Awards Competitions."
10. Abstract – Type abstract, Double-spaced in the space provided or on a separate sheet of paper using a 12-point font size. No more than 250 words.

## Abstract Submission

Abstracts submitted for the International Association for Food Protection 87th Annual Meeting in Atlanta, Georgia August 6-9, 2000 will be evaluated for acceptance by the Program Committee. Please be sure to follow format instructions above carefully; failure to do so may result in rejection. Information in the abstract data must not have been previously published in a copyrighted journal.

Submit your abstract to the office. Abstracts must be received no later than January 10, 2000.

Return the completed abstract form through one of the following methods:

1. Regular mail: Abstracts may be sent by post or express courier along with a disk copy (text or MS Word™ format) to the following address:  
Abstract Submission  
International Association for Food Protection  
6200 Aurora Avenue, Suite 200W  
Des Moines, Iowa 50322-2863, USA
2. E-mail: Submit via E-mail as an attached text or MS Word™ document to [abstracts@foodprotection.org](mailto:abstracts@foodprotection.org).
3. Online: Use the online abstract submission form located at [www.foodprotection.org](http://www.foodprotection.org).

## Selection Criteria

1. Abstracts must accurately and briefly describe:
  - (a) the problem studied and/or objectives;
  - (b) methodology;
  - (c) essential results; and
  - (d) conclusions and/or significant implications.
2. Abstracts must report the results of original research pertinent to the subject matter. Papers should report the results of applied research on: food, dairy and environmental sanitation; foodborne pathogens; food and dairy microbiology; food and dairy engineering; food and dairy chemistry; food additives and residues; food and dairy technology; food service and food administration; quality assurance/control; mastitis; environmental health; waste management and water quality. Papers may also report subject matter of an educational and or nontechnical nature.
3. Research must be based on accepted scientific practices.

4. Research should not have been previously presented nor intended for presentation at another scientific meeting. Papers should not appear in print prior to the Annual Meeting.
5. Results should be summarized. Do not use tables or graphs.

## Rejection Reasons

1. Abstract was not prepared according to the "Instruction for Preparing Abstracts."
2. Abstract does not contain essential elements as described in "Selection Criteria."
3. Abstract reports inappropriate or unacceptable subject matter, is not based on accepted scientific practices, or the quality of the research or scientific approach is inadequate.
4. Work reported appears to be incomplete and/or data are not presented. Indication that data will be presented is not acceptable.
5. The abstract was poorly written or prepared including spelling and grammatical errors.
6. Results have been presented/published previously.
7. The abstract was received after the deadline for submission.
8. Abstract contains information that is in violation of the International Association for Food Protection Policy on Commercialism.

## Projected Deadlines/Notification

Abstract Submission Deadline: January 10, 2000.

Acceptance/Rejection Notification: March 1, 2000.

## Contact Information

Questions regarding abstract submission can be directed to Bev Corron, 515.276.3344 or 800.369.6337; E-mail: [bcorron@foodprotection.org](mailto:bcorron@foodprotection.org).

## Program Chairperson:

David Golden  
University of Tennessee  
Dept. of Food Science and Technology  
Knoxville, TN 37901-1071, USA  
Phone: 423.974.7247  
Fax: 423.974.7332  
E-mail: [dgolden@utk.edu](mailto:dgolden@utk.edu)

# Abstract Form

**DEADLINE: Must be Received by January 10, 2000**

Follow instructions on page 884

(1) Title of Paper \_\_\_\_\_

(2) Authors \_\_\_\_\_

(3) Full Name and Title of Presenter \_\_\_\_\_

(4) Institution and Address of Presenter \_\_\_\_\_

(5) Phone Number: \_\_\_\_\_

(6) Fax Number: \_\_\_\_\_

(7) E-mail: \_\_\_\_\_

(8) Format preferred:     Oral     Poster     No Preference

NOTE: Selected presentations may be recorded (audio or visual). The Program Committee will make the final decision on presentation format.

(9) Developing Scientist Awards Competitions  Yes      Graduation date: \_\_\_\_\_

Major Professor/Department Head approval (signature and date): \_\_\_\_\_

(10) TYPE abstract, DOUBLE-SPACED, in the space provided or on a separate sheet of paper using a 12-point font size. No more than 250 words.

# Call for Entrants in the Developing Scientist Awards Competitions

Supported by the International Association for Food Protection Foundation

The International Association for Food Protection is pleased to announce the continuation of its program to encourage and recognize the work of students and recent graduates in the field of food safety research. Qualified individuals may enter either the oral or poster competition.

## Purpose

1. To encourage students and recent graduates to present their original research at the Annual Meeting.
2. To foster professionalism in students and recent graduates through contact with peers and professional Members of the Association.
3. To encourage participation by students and recent graduates in the Association and the Annual Meeting.

## Presentation Format

**Oral Competition** – The Developing Scientist Oral Awards Competition is open to graduate students enrolled or recent graduates from M.S. or Ph.D. programs or undergraduate students at accredited universities or colleges. Presentations are limited to 15 minutes, which includes two to four minutes for discussion.

**Poster Competition** – The Developing Scientist Poster Awards Competition is open to students enrolled or recent graduates from undergraduate or graduate programs at accredited universities or colleges. The presenter must be present to answer questions for a specified time (approximately two hours) during the assigned session. Specific requirements for presentations will be provided at a later date.

## General Information

1. Competition entrants cannot have graduated more than a year prior to the deadline for submitting abstracts.
2. Accredited universities or colleges must deal with environmental, food or dairy sanitation, protection or safety research.
3. The work must represent original research completed and presented by the entrant.
4. Entrants may enter only one paper in either the oral or poster competition.
5. All entrants must register for the Annual Meeting and assume responsibility for their own transportation, lodging, and registration fees.
6. Acceptance of your abstract for presentation is independent of acceptance as a competition finalist. Competition entrants who are chosen as finalists will be notified of their status by the chairperson by June 1, 2000.
7. All entrants with accepted abstracts will receive complimentary, one-year Association Membership, which includes their choice of *Dairy, Food and Environmental Sanitation* or *Journal of Food Protection*.
8. In addition to adhering to the instruction in the "Call for Abstracts," competition entrants must check the box to indicate if the paper is to be presented by a student in this competition. A signature and date is required from the major professor or department head.

## Judging Criteria

A panel of judges will evaluate abstracts and presentations. Selection of up to ten finalists for each competition will be based on evaluations of the abstracts and the scientific quality of the work. All entrants will be advised of the results by June 1, 2000.

Only competition finalists will be judged at the Annual Meeting and will be eligible for the awards. All other entrants with accepted abstracts will be expected to be present as part of the regular Annual Meeting. The presentations will not be judged and they will not be eligible for the awards.

Judging criteria will be based on the following:

1. Abstract – clarity, comprehensiveness and conciseness.
2. Scientific Quality – Adequacy of experimental design (methodology, replication, controls), extent to which objectives were met, difficulty and thoroughness of research, validity of conclusions based upon data, technical merit and contribution to science.
3. Presentation – Organization (clarity of introduction, objectives, methods, results and conclusions), quality of visuals, quality and poise of presentation, answering questions, and knowledge of subject.

## Finalists

Awards will be presented at the International Association for Food Protection Annual Meeting Awards Banquet to the top three presenters (first, second and third places) in both the oral and poster competitions. All finalists will receive a complimentary Awards Banquet ticket and are expected to be present at the banquet where the awards winners will be announced and recognized.

## Awards

- First Place – \$500 and an engraved plaque
- Second Place – \$300 and a framed certificate
- Third Place – \$100 and a framed certificate

Award winners will also receive a complimentary, one-year Membership including *Dairy, Food and Environmental Sanitation* and *Journal of Food Protection*.

# Policy on Commercialism

## 1. INTRODUCTION

No printed media, technical sessions, symposia, posters, seminars, short courses, and/or all related type forums and discussions offered under the auspices of the International Association for Food Protection (hereafter referred to as to Association forums) are to be used as platforms for commercial sales or presentations by authors and/or presenters (hereafter referred to as authors) without the expressed permission of the staff or Executive Board. The Association enforces this policy in order to restrict commercialism in technical manuscripts, graphics, oral presentations, poster presentations, panel discussions, symposia papers, and all other type submissions and presentations (hereafter referred to as submissions and presentations), so that scientific merit is not diluted by proprietary secrecy.

Excessive use of brand names, product names or logos, failure to substantiate performance claims, and failure to objectively discuss alternative methods, processes, and equipment are indicators of sales pitches. Restricting commercialism benefits both the authors and recipients of submissions and presentations.

This policy has been written to serve as the basis for identifying commercialism in submissions and presentations prepared for the Association forums.

## 2. TECHNICAL CONTENT OF SUBMISSIONS AND PRESENTATIONS

### 2.1 Original Work

The presentation of new technical information is to be encouraged. In addition to the commercialism evaluation, all submissions and presentations will be individually evaluated by the Program Committee chairperson, technical reviewers selected by the Program Committee chairperson, session convener, and/or staff on the basis of originality before inclusion in the program.

### 2.2 Substantiating Data

Submissions and presentations should present technical conclusions derived from technical data. If products or services are described, all reported capabilities, features or benefits, and performance parameters must be substantiated by data or by an acceptable expla-

nation as to why the data are unavailable (e.g., incomplete, not collected, etc.) and, if it will become available, when. The explanation for unavailable data will be considered by the Program Committee chairperson and/or technical reviewers selected by the Program Committee chairperson in order to ascertain if the presentation is acceptable without the data. Serious consideration should be given to withholding submissions and presentations until the data are available as only those conclusions that might be reasonably drawn from the data may be presented. Claims of benefit and/or technical conclusions not supported by the presented data are prohibited.

### 2.3 Trade Names

Excessive use of brand names, product names, trade names, and/or trademarks is forbidden. A general guideline is to use proprietary names once and thereafter to use generic descriptors or neutral designations. Where this would make the submission or presentation significantly more difficult to understand, the Program Committee chairperson, technical reviewers selected by the Program Committee chairperson, session convener, and/or staff will judge whether the use of trade names, etc., is necessary and acceptable.

### 2.4 "Industry Practice" Statements

It may be useful to report the extent of application of technologies, products, or services, however, such statements should review the extent of application of all generically similar technologies, products, or services in the field. Specific commercial installations may be cited to the extent that their data are discussed in the submission or presentation.

### 2.5 Ranking

Although general comparisons of products and services are prohibited, specific generic comparisons that are substantiated by the reported data are allowed.

### 2.6 Proprietary Information (See also 2.2.)

Some information about products or services may be proprietary to the author's agency or company, or to the user and may not be publishable. However, their scientific principles and validation of performance parameters must be described. Conclusions and/or comparisons may only be made on the basis of reported data.



## **2.7 Capabilities**

Discussion of corporate capabilities or experiences are prohibited unless they pertain to the specific presented data.

## **3. GRAPHICS**

### **3.1 Purpose**

Slides, photographs, videos, illustrations, art work, and any other type visual aids appearing with the printed text in submissions or used in presentations (hereafter referred to as graphics) should be included only to clarify technical points. Graphics which primarily promote a product or service will not be allowed. (See also 4.6.)

### **3.2 Source**

Graphics should relate specifically to the technical presentation. General graphics regularly shown in, or intended for, sales presentations cannot be used.

### **3.3 Company Identification**

Names or logos of agencies or companies supplying the goods or services must not appear on the graphics, except on the first slide of the presentation. Slides showing products may not include predominant nameplates. Graphics with commercial names or logos added as background borders or corners are specifically forbidden.

### **3.4 Copies**

Graphics that are not included in the preprint may be shown during the presentation only if they have been reviewed in advance by the Program Committee chairperson, session convener, and/or staff, and have been determined to comply with this policy. Copies of these additional graphics must be available from the author on request by individual attendees. It is the responsibility of the session convener to verify that all graphics to be shown have been cleared by Program Committee chairperson, session convener, staff, or other reviewers designated by the Program Committee chairperson.

## **4. INTERPRETATION AND ENFORCEMENT**

### **4.1 Distribution**

This policy will be sent to all authors of submissions and presentations in the Association forums.

### **4.2 Assessment Process**

Reviewers of submissions and presentations will accept only those that comply with this policy. Drafts of submissions and presentations will be reviewed for commercialism concurrently by both staff and technical reviewers selected by the Program Committee chairperson. All reviewer comments shall be sent to and coordinated by either the Program Committee chairperson or the designated staff. If any submissions are found to violate this policy, authors will be informed and invited to resubmit their materials in revised form before the designated deadline.

### **4.3 Author Awareness**

In addition to receiving a printed copy of this policy, all authors presenting in a forum will be reminded of this policy by the Program Committee chairperson, their session convener, or the staff, whichever is appropriate.

### **4.4 Monitoring**

Session convenors are responsible for ensuring that presentations comply with this policy. If it is determined by the session convener that a violation or violations have occurred or are occurring, he or she will publically request that the author immediately discontinue any and all presentations (oral, visual, audio, etc.), and will notify the Program Committee chairperson and staff of the action taken.

### **4.5 Enforcement**

While both technical reviewers, session convenors, and/or staff may check submissions and presentations for commercialism, ultimately it is the responsibility of the Program Committee chairperson to enforce this policy through the session convenors and staff.

### **4.6 Penalties**

If the author of a submission or presentation violates this policy, the Program Committee chairperson will notify the author and the author's agency or company of the violation in writing. If an additional violation or violations occur after a written warning has been issued to an author and his agency or company, the Association reserves the right to ban the author and the author's agency or company from making presentations in the Association forums for a period of up to two (2) years following the violation or violations.

## **Amendment to 3-A<sup>®</sup> Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Number 20-20**

Formulated by  
International Association of Food Industry Suppliers (IAFIS)  
International Association of Milk, Food and Environmental Sanitarians (IAMFES)  
United States Public Health Service (USPHS)  
The European Hygienic Equipment Design Group (EHEDG)  
The Dairy Industry Committee (DIC)

It is the purpose of the IAFIS, IAMFES, USPHS, EHEDG, 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. Multiple-use plastic materials used as product contact surfaces for dairy equipment heretofore or hereafter developed which so differ in design, materials, and fabrication or otherwise as not to conform to the following standards but which, in the fabricator's opinion, are equivalent or better may be submitted for the joint consideration of the IAFIS, IAMFES, USPHS, EHEDG, and DIC at any time. The 3-A Sanitary Standards and 3-A Accepted Practices provide hygienic criteria applicable to equipment and systems used to produce, process, and package milk, milk products, and other perishable foods or comestible products. Standard English is the official language of 3-A Sanitary Standards and 3-A Accepted Practices.

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**These amended standards are effective August 21, 1999, at which time the 3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces in Dairy Equipment, Number 20-19 are rescinded and become null and void.**

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Table 1 has been amended to include Polyphenylsulfone for 3-A<sup>\*</sup> Sanitary Standard 20-20.

Generic Classes (Code of Federal Regulations Citation <sup>5</sup> )	Maximum % Weight Gain		
	Section E - Cleanability Response	Section F - Product Treatment (Solution I)	Section F - Product Treatment (Solution J)
Acrylics (21 CFR 177.1010)	0.20	0.50	1.50
Acrylonitrile butadiene styrene (21 CFR 177.1020)	0.30	0.45	0.90
Chlorinated polyether (21 CFR 177.2430)	0.05	0.05	0.05
Cross-linked polyester resins (vinyl ester-styrene copolymer) (21 CFR 177.2420)	0.20	0.02	0.20
Epoxy resin as coating (21 CFR 175.300)			
(a) Isopropylidenediphenol Hardener-TETA Triethylenetetramine	0.10	0.15	0.25
(b) Phenol-Formaldehyde Polymer, glycidyl ether (silica filled) Hardener - DETA Adduct	0.15	0.15	2.0
Ethylene-vinyl acetate copolymers (21 CFR 177.1350)	0.25	0.55	0.10
Fluorocarbons (21 CFR 170.39, 177.1380, 177.1550, 177.2510)			
(a) CTFE, PTFE, FEP, PFA, and ETFE types	0.05	0.05	0.05
(b) Vinylidene fluoride types	0.05	0.05	0.15
Nylon (21 CFR 177.1500)			
(a) Nylon Type 66	2.00	3.00	8.00
(b) Nylon Type 610	1.00	2.00	4.00
(c) Nylon Type 6	2.00	3.00	8.00
Nylon 66-Nylon 6-aramid fiber blend (21 CFR 177.1500, 177.1632)	2.00	3.00	8.00
Nylon 66-Nylon 6-aramid fiber-PTFE blend (21 CFR 177.1500, 177.1380, 177.1632)	2.00	3.00	8.00
Plasticized polyvinyl chloride (21 CFR 175.300)			
(a) For contact with high-water, low-fat products (8% milk fat)	0.25	0.55	0.90
(b) For contact with high-fat products (>8% milk fat)	0.10	0.20	0.55
Polyarylsulfone resin (21 CFR 177.1560)	0.40	0.80	1.50
Polycarbonates (21 CFR 177.1580)	0.10	0.15	0.25
Polyetherimide (21 CFR 177.1595)	0.20	0.25	0.75
Polyethylene (21 CFR 177.1520)			
(a) ASTM Type I	0.20	0.50	0.20
(b) ASTM Type II	0.20	0.20	0.20
(c) ASTM Type III	0.20	0.20	0.20
Polyethylene phthalate polymers (21 CFR 177.1630)	0.10	0.15	0.65
Polymethylpentene (21 CFR 177.1520)	0.10	0.20	0.20
Polyoxymethylene copolymer (21 CFR 177.2470)	0.25	0.60	1.00
Polyphenylene oxide (21 CFR 177.2460)	0.10	0.15	0.25
Polyphenylene sulfide (21 CFR 177.2490)	0.06	0.08	0.08
Polyphenylene sulfide-PTFE (alloy) (21 CFR 177.2490, 177.1380)	0.06	0.08	0.30
<b>Polyphenylsulfone (repeated use)</b>	<b>0.40</b>	<b>0.80</b>	<b>1.50</b>
Polypropylene - (unmodified and modified for impact resistance) (21 CFR 177.1520)	0.10	0.20	0.20
Polystyrene - Normal (unmodified) Type 3 of ASTM D703-78 (21 CFR 177.1640)	0.10	0.10	0.10
Polystyrene - Modified (impact), Type III, Grade 6, of ASTM D1892-78 (21 CFR 177.1640)	0.10	0.10	0.10
Polysulfone resin (21 CFR 177.1655)	0.05	0.1	0.1
Polysulfone-PTFE (alloy) (21 CFR 177.1655, 177.1380)	0.30	0.45	0.45
Polytetramethylene terephthalate (21 CFR 177.1660)	0.10	0.15	0.65
Polytetramethylene terephthalate-PTFE blend (21 CFR 177.1660, 177.1380)	0.10	0.15	0.65
Polyurethane (21 CFR 177.1680)	1.22	1.59	1.29
Propoxylated bisphenol-A fumarate polyester-styrene copolymer (21 CFR 177.2420)	0.20	0.20	0.20
Reinforced epoxy, molded, natural (no color added), and black (21 CFR 175.300)	0.20	0.25	0.35
Styrene-acrylonitrile (21 CFR 177.1040)	0.20	0.50	0.50
Thermoplastic polyether-ester (21 CFR 177.2600)	0.35	1.1	0.50

These amendments to include polyphenylsulfone are effective August 21, 1999.

**Note:** These amendments do not affect the plastics currently in these standards.

<sup>5</sup>Citations are by title, part, and section number, thus 21 CFR 177.1010 refers to Title 21, Part 177, Section 1010. CFR references include the basic polymers, optional adjuvants, specifications, and limitations and conditions of use.

# 3-A<sup>®</sup> Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Number 18-03

Formulated by  
International Association of Food Industry Suppliers (IAFIS)  
International Association of Milk, Food and Environmental Sanitarians (IAMFES)  
United States Public Health Service (USPHS)  
The European Hygienic Equipment Design Group (EHEDG)  
The Dairy Industry Committee (DIC)

It is the purpose of the IAFIS, IAMFES, USPHS, EHEDG, 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. Multiple-use rubber and rubber-like materials heretofore or hereafter developed which so differ in design, materials, and fabrication or otherwise as not to conform to the following standards but which, in the fabricator's opinion, are equivalent or better, may be submitted for the joint consideration of the IAFIS, IAMFES, USPHS, EHEDG, and DIC at any time. The 3-A Sanitary Standards and 3-A Accepted Practices provide hygienic criteria applicable to equipment and systems used to produce, process, and package milk, milk products, and other perishable foods or comestible products. NOTE: Standard English is the official language of 3-A Sanitary Standards and 3-A Accepted Practices.

## A SCOPE

- A1 These sanitary standards cover the material and serviceability requirements<sup>1</sup> of rubber and rubber-like materials intended for multiple use as product contact surfaces or solution contact surfaces in the production, processing, and handling of milk or milk products. Test procedures and criteria are also provided for rubber and rubber-like materials as a means of determining their acceptance as to their ability to be cleaned and to receive effective bactericidal treatment or steam sterilization and to maintain their essential properties in these accelerated use-simulating conditions.<sup>2</sup> These standards are not meant to cover design and fabrication criteria for individual rubber or rubber-like components, because such criteria are provided for in other 3-A Sanitary Standards and 3-A Accepted Practices, nor are these standards intended to cover RTV silicone adhesives or sealants.
- A2 In order to conform with these 3-A Standards, multiple-use rubber and rubber-like materials shall comply with the following material, original physical properties, and serviceability requirements.<sup>3</sup>

## B DEFINITIONS

### B1 Rubber Materials

- B1.1 *Rubber*: See ASTM D1566 - Terminology Relating to RUBBER<sup>4</sup>. (Except for hard rubber as defined in B1.3.)
- B1.2 *Rubber-Like*: See ASTM D1566 - Terminology Relating to RUBBER<sup>4</sup>. (Except for hard rubber as defined in B1.3.)
- B1.3 *Hard Rubber*: Shall mean a vulcanized rubber having a ratio of combined sulfur to rubber hydrocarbon in excess of 15% and a Shore A Durometer value in excess of 90.
- B1.4 *Low-fat Tolerance Rubber and Rubber-Like Materials*: Shall mean rubber and rubber-like materials designed to meet the requirements of this standard only when used in contact with products containing 8.0% fat or less.
- B2 *Temperature of Exposure*: Shall mean temperatures to which rubber material is subjected when in contact with the product and/or cleaning and bactericidal treatment or steam sterilization.
- B3 **Classifications** (See Appendix, Section F, for examples.)

B3.1 **Class I:** Shall mean rubber materials suitable for temperature of exposure to product or sterilization up to 300°F (149°C) and temperature of exposure to chemical solution used in cleaning and bactericidal treatment up to 180°F (82°C).

B3.2 **Class II:** Shall mean rubber materials suitable for temperature of exposure to product or sterilization up to 250°F (121°C) and temperature of exposure to chemical solution used in cleaning and bactericidal treatment up to 180°F (82°C).

B3.3 **Class III:** Shall mean rubber materials suitable for temperature of exposure to product up to 120°F (49°C) and temperature of exposure to chemical solution used in cleaning and bactericidal treatment up to 180°F (82°C).

B3.4 **Class IV:** Shall mean rubber materials suitable for temperature of exposure to product up to 100°F (38°C) and temperature of exposure to chemical solution used in cleaning and bactericidal treatment up to 180°F (82°C).

B4 **Product Definitions**

B4.1 **Product:** Shall mean milk and milk products.

B5 **Surfaces**

B5.1 **Product Contact Surfaces:** Shall mean all surfaces which are exposed to the product or from which liquids may drain, drop, diffuse, or be drawn into the product.

B5.2 **Solution Contact Surfaces:** Shall mean the interior surfaces of the equipment or system which are used exclusively for supply and recirculation of cleaning and/or sanitizing solutions, except those used to supply concentrated cleaning and/or sanitizing materials to the point of use.

B5.3 **Nonproduct Contact Surfaces:** Shall mean all other exposed surfaces.

C **MATERIALS**

C1 Rubber and rubber-like materials used as product contact and/or solution contact surfaces shall be nontoxic, shall not adversely affect the product, and shall comply with the Food, Drug and Cosmetic Act, The Code of Federal Regulations, Title 21, Part 177.2600<sup>5</sup> and shall comply with these materials criteria and be compatible with cleaning and sanitizing agents as defined by the procedures in Section D herein.

C2 The allowable physical properties of rubber and rubber-like materials, as determined by the testing procedures specified, are the following (for suggested report form, see Appendix, Section K):

C2.1 Low-fat tolerance rubber and rubber-like materials used for contact with products with a maximum of 8.0% milk fat shall be exempt from the test

criteria and acceptable maximum changes in Section C2.2.1 but shall meet the test criteria in Sections C2.1.1, C2.2.2, C2.2.3 and C3.1.

C2.1.1 **TABLE – Low Fat Tolerance Absorption<sup>a, b</sup>**

Class	Acceptable Maximum Changes		
	Hardness Shore A Points	Weight %	Volume %
I	± 6	± 5	± 5
II	± 15	± 25	± 25
III	± 20	± 25	± 25
IV	± 20	± 60	± 75

<sup>a</sup> ASTM D471 – Standard Test Method for Rubber Property—Effect of Liquids.<sup>4</sup> Immersion 22 ± 1/4 h at 158°F (70°C).

<sup>b</sup> The high fat media shall be butter oil or anhydrous milk fat meeting the composition specifications found in the General Specifications for USDA-Approved Dairy Plants, paragraphs 58.305 (b), 58.305 (c) and 58.347. Federal Register, Volume 40, No. 198 – Friday, October 10, 1975.<sup>5</sup>

C2.2 **Absorption and Aging**

C2.2.1 **TABLE – Milk Fat Absorption<sup>a, b</sup>**

Class	Acceptable Maximum Changes		
	Hardness Shore A Points	Weight %	Volume %
I	± 5	± 5	± 5
II	± 5	± 10	± 10
III	± 10	± 25	± 25
IV	± 10	± 40	± 60

<sup>a</sup> ASTM D471 – Standard Test Method for Rubber Property—Effect of Liquids.<sup>4</sup> Immersion 22 ± 1/4 h at 158°F (70°C).

<sup>b</sup> The high fat media shall be butter oil or anhydrous milk fat meeting the composition specifications found in the General Specifications for USDA-Approved Dairy Plants, paragraphs 58.305 (b), 58.305 (c) and 58.347. Federal Register, Volume 40, No. 198 – Friday, October 10, 1975.<sup>4</sup>

C2.2.2 **TABLE – Distilled Water Absorption<sup>a</sup>**

Class	Acceptable Maximum Changes		
	Hardness Shore A Points	Weight %	Volume %
I	±5	±5	±5
II	±5	±10	±10
III	±10	±15	±15
IV	±10	±20	±25

<sup>a</sup> ASTM D471 – Standard Test Method for Rubber Property—Effect of Liquids.<sup>4</sup> Immersion 22 ± 1/4 h at 158°F (70°C).

C2.2.3 TABLE – Air Aging Stability<sup>a</sup>

Class	Acceptable Maximum Changes	
	Temperature	Shore A Points
I	212°F (100°C)	± 10
II	212°F (100°C)	± 10
III	158°F (70°C)	± 10
IV	158°F (70°C)	± 10

<sup>a</sup> ASTM D573 Standard Test Method for Rubber Deterioration in an Air Oven<sup>d</sup> (166 ± 1/2 h).

C3 The minimum original physical properties of rubber and rubber-like materials, except hard rubber as determined by the test procedures specified, are the following:

C3.1 TABLE – Original Physical Properties<sup>a</sup>

Class	Acceptable Minimums	
	Tensile Strength PSI	Elongation %
I	1200	100
II	1100	100
III	1000	100
IV	500	75

<sup>a</sup> ASTM D412 – Standard Test Methods for Rubber Properties in Tension.<sup>d</sup>

D COMPATIBILITY WITH CLEANING AND SANITIZING AGENTS

D1 References

ASTM D471 – Standard Test Method for Rubber Properties – Effect of Liquids.<sup>d</sup> ASTM D2240 – Standard Test Method for Rubber Property – Durometer Hardness.<sup>d</sup>

D2 Apparatus

Appropriate glassware, temperature controlled oven or water bath, analytical balance, and hardness measuring device for type Shore A Durometer points (ref: ASTM D2240).

D3 Test Solution (Accelerated Use Test Reagents): (See Appendix, Section J.)

D3.1 Acid Cleaner Test Solutions

D3.1.1 Nitric Acid: For testing Class I and Class II rubber and rubber-like materials:

0.50% Nitric acid (5.00g acid/l of solution) is prepared by volumetrically diluting 5.0 ml of 70.0% nitric acid (Sp. Gr. 1.41) to 1 l with distilled water.

D3.1.2 Phosphoric Acid: For testing Class III and Class IV rubber and rubber-like materials:

1.0% orthophosphoric acid (10.00g acid/l of solution) is prepared by volumetrically diluting

7.00 ml of 85.0% orthophosphoric acid (Sp. Gr. 1.69) or 8.5 ml of 75.0% orthophosphoric acid (Sp. Gr. 1.58) to 1 l with distilled water.

D3.2 Alkaline Cleaner Test Solution: For all classes of rubber and rubber-like materials:

1.0% sodium hydroxide (caustic) is prepared by dissolving 1.92g sodium tripolyphosphate, 10.20g sodium hydroxide, 0.36g trisodium phosphate, 0.26g anionic-type detergent (Aerosol O.T.<sup>8</sup>) to 1 l with distilled water.

D3.3 Chlorine Sanitizer Test Solution: For all classes of rubber and rubber-like materials:

Sodium hypochlorite solution – 200 ppm available chlorine – prepared daily. Dilute a 4.0 to 6.0% sodium hypochlorite solution with distilled water in a volumetric flask to yield 200 ppm of available chlorine. Approximate dilution of sodium hypochlorite per liter with water to yield 200 ppm available chlorine percentage active chlorine:

4.0%	5.0 ml
5.0%	4.0 ml
6.0%	3.4 ml

Adjust pH of solution to 8.0 ± 0.5 with sodium bicarbonate.

D4 Test Procedures and Acceptable Results

D4.1 Sample preparation – see ASTM D471, 8. “Test Specimens – Change in Mass or Volume” for preparation of test samples.

D4.2 Submerge test specimens completely in loosely closed test tubes, see ASTM D471, 7. “Nonvolatile Liquids.”

D4.3 “Procedure for Change in Mass,” see ASTM D471, 9.

D4.4 “Procedure for Change in Volume – Water Displacement Method for Water Insoluble Liquids and Mixed Liquids,” see ASTM D471, 10.

D4.5 Visual changes in the rubber material’s product surface finish shall be examined by comparing test samples to a control.

D4.6 TABLE – Nitric Acid-Class I and II<sup>a, b, c, c</sup>

Class	Acceptable Maximum Changes		
	Hardness Shore A Points	Weight %	Volume %
I	± 5	± 5	± 5
II	± 10	± 15	± 15

<sup>a</sup> ASTM D471, 7., 8., 9. and 10.<sup>d</sup> Immersion 22 ± 1/4 h at 180° ± 2°F (82° ± 1°C).

<sup>b</sup> Test solution D3.1.1.

<sup>c</sup> The surface smoothness of the tested specimens shall be equal to that of the control.

D4.7 TABLE - Phosphoric Acid-Class III and IV<sup>a, b, c</sup>

Class	Acceptable Maximum Changes		
	Hardness Shore A Points	Weight %	Volume %
III	± 10	± 15	± 15
IV	± 10	± 20	± 25

<sup>a</sup> ASTM D471, 7., 8., 9. and 10<sup>4</sup>. Immersion 22 ± 1/4 h at 180° ± 2°F (82° ± 1°C).

<sup>b</sup> Test solution D3.1.2.

<sup>c</sup> The surface smoothness of the tested specimens shall be equal to that of the control.

D4.8 TABLE - Alkaline Cleaner-All Classes<sup>a, b, c</sup>

Class	Acceptable Maximum Changes		
	Hardness Shore A Points	Weight %	Volume %
I	± 5	± 5	± 5
II	± 10	± 10	± 10
III	± 10	± 15	± 15
IV	± 10	± 20	± 25

<sup>a</sup> ASTM D471, 7., 8., 9. and 10.<sup>5</sup> Immersion 22 ± 1/4 h at 180° ± 2°F (82° ± 1°C).

<sup>b</sup> Test solution D3.2.

<sup>c</sup> The surface smoothness of the tested specimens shall be equal to that of the control.

D4.9 TABLE - Chlorine Sanitizer-All Classes<sup>a, b, c</sup>

Class	Acceptable Maximum Changes		
	Hardness Shore A Points	Weight %	Volume %
I	± 5	± 5	± 5
II	± 5	± 10	± 10
III	± 10	± 15	± 15
IV	± 10	± 20	± 25

<sup>a</sup> ASTM D471, 7., 8., 9. and 10.<sup>4</sup> Immersion 22 ± 1/4 h at 70° ± 2°F (21° ± 1°C).

<sup>b</sup> Test solution D3.3.

<sup>c</sup> The surface smoothness of the tested specimens shall be equal to that of the control.

## D5 Testing and Compliance

D5.1 Test samples of rubber and rubber-like materials for each formulation shall be tested and certified to be in compliance with the criteria herein. (See Appendix, Section G.) Test results and a statement of compliance issued by the testing laboratory shall be kept by the manufacturer. These results shall be made available to distributors, users, and regulatory agents upon request. In addition,

rubber and rubber-like materials shall be certified to be in compliance with the Food and Drug Administration's regulations<sup>4</sup> and FD&C Act of 1938, as amended, requirements.<sup>4</sup>

## APPENDIX

### E FABRICATION

Components and devices manufactured from rubber or rubber-like materials should be designed and fabricated as provided in other appropriate 3-A Sanitary Standards. Good manufacturing practices should be used in the manufacture of rubber and rubber-like components to assure quality and cleanliness.

### F RUBBER CLASSES AND SELECTION

**Class I:** Some heat exchanger gaskets, O-rings, CIP gaskets, flange gaskets, rotary seals and hoses.

**Class II:** Plate heat exchanger gaskets, homogenizer seals, static seals and hoses.

**Class III:** Cold applications such as milk and milk products and air tubing, manhole and door gaskets, seals and hoses.

**Class IV:** Inflatons and hoses.

For satisfactory service, it is important that the right kind of rubber materials be selected for specific dairy applications. These sanitary standards cover a large variety of rubber and rubber-like materials which have a wide range of chemical and physical characteristics. These characteristics may be measured by established ASTM tests, such as hardness, resilience, elongation, compression set, adhesion to various substrates, vapor transmission, and many more tests. In order to select a suitable rubber material, it is also important to know the intended conditions of dairy use, such as composition of the dairy product, temperature of the process, pressure or vacuum conditions, and the kinds and strengths of cleaners and sanitizers. As in the selection of metal or plastic materials for construction of dairy equipment, there is no single best rubber material for all functions.

### G VERIFICATION TESTING

Independent verification testing of these physical requirements herein, although not mandatory, should be sought by the manufacturer of a part made from rubber or rubber-like materials.

### H EXPECTED SERVICE PERIOD

The service period of rubber and rubber-like materials is dependent on their formulation and the environment of use, which in turn is influenced by the product, process temperature, cleaning and bactericidal compounds, and time

of exposure. Users should frequently monitor the physical condition of the rubber material product contact surfaces. Such observations are necessary to determine the actual sanitary service period of rubber materials. It is further recommended that rubber products be replaced before surface imperfections or sloughing occurs. Routine replacement schedules should be established and followed.

## I COLOR

The color of rubber materials will vary depending on the ingredients and formulation. The color of the final product is not of sanitary significance, provided the components used are in compliance with the applicable provisions of the FD&C Act and the Code of Federal Regulations.<sup>5</sup>

## J MATERIAL/CHEMICAL LIST FOR TEST SOLUTIONS (Simulated Reagents)

Material or Chemical	Formula	Concentrations or Grade
Aerosol O.T. <sup>R(a)</sup> (Dioctyl sodium sulfosuccinate) (anionic detergent)	N/A	100% dry solid
Nitric acid 42 <sup>0</sup> Be	HNO <sub>3</sub>	ACS or reagent
Orthophosphoric acid, concentrated	H <sub>3</sub> PO <sub>4</sub>	ACS or reagent
Sodium hydroxide, pellets	NaOH	ACS or reagent
Sodium hypochlorite	NaOCl	4-6% available Cl <sub>2</sub> , purified
Sodium phosphate, tripoly	Na <sub>5</sub> P <sub>3</sub> O <sub>10</sub>	Purified
Trisodium phosphate (Sodium phosphate, tribasic)	Na <sub>3</sub> PO <sub>4</sub> ·12H <sub>2</sub> O	ACS or reagent
Sodium bicarbonate	NaHCO <sub>3</sub>	ACS or reagent
Butter oil	N/A	min 99.6% fat, max 0.15% water
Anhydrous milk fat	N/A	min 99.8% fat, max 0.15% water

<sup>a</sup> Available from American Cyanamide Company, Mt. Prospect, IL 60056 (708) 827-8871 and Sigma Chemical Company, St. Louis, MO 63118 (800) 325-3010.

<sup>1</sup>Procedures in Section C are serviceability requirements performed to evaluate the original physical properties of rubber or rubber-like materials.

<sup>2</sup>Procedures in Section D are not normal cleaning and bactericidal treatment tests but are accelerated use tests.

<sup>3</sup>Use current revisions or editions of all referenced documents cited herein.

<sup>4</sup>Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Phone: 610.832.9500.

<sup>5</sup>For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Phone: 202.512.1800.

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**These amended standards are effective August 21, 1999, at which time the 3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Number 18-02 are rescinded and become null and void.**

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**TEST RESULT FORM**

<b>COMPANY:</b>	
<b>CUSTOMER:</b>	
<b>PART NUMBER:</b>	<b>PART NAME:</b>
<b>COMPOUND NUMBER</b>	<b>PRODUCT CLASS:</b>
<b>COMMENTS:</b>	

PROPERTIES	UNIT	SPECIFICATION	MEASURED
Tensile Strength	PSI	MIN	
Elongation at Break	%	MIN	
Hardness Shore A Durrmeter	PTS	+/-	

<b>CHANGE IN PROPERTIES AFTER AGING FOR</b>	<b>HOURS AT</b>
Change in Tensile Strength	%      MAX
Change in Elongation	%      MAX
Change in Hardness	PTS      MAX
Visual Change	Observation:

<b>CHANGE IN PROPERTIES AFTER IMMERSION FOR</b>	<b>HOURS AT</b>
<b>Immersion Material:</b>	
Change in Volume	%      MAX
Change in Mass	%      MAX
Change in Hardness	PTS      MAX
Visual Change	Observation:

<b>CHANGE IN PROPERTIES AFTER IMMERSION FOR</b>	<b>HOURS AT</b>
<b>Immersion Material:</b>	
Change in Volume	%      MAX
Change in Mass	%      MAX
Change in Hardness	PTS      MAX
Visual Change	Observation:

**TEST RESULT FORM**  
(page 2)

<b>CHANGE IN PROPERTIES AFTER IMMERSION FOR</b>	<b>HOURS AT</b>
---	-----------------

<b>Immersion Material:</b>			
Change in Volume	%	MAX	
Change in Mass	%	MAX	
Change in Hardness	PTS	MAX	
Visual Change		Observation:	

<b>CHANGE IN PROPERTIES AFTER IMMERSION FOR</b>	<b>HOURS AT</b>
---	-----------------

<b>Immersion Material:</b>			
Change in Volume	%	MAX	
Change in Mass	%	MAX	
Change in Hardness	PTS	MAX	
Visual Change		Observation:	

<b>CHANGE IN PROPERTIES AFTER IMMERSION FOR</b>	<b>HOURS AT</b>
---	-----------------

<b>Immersion Material:</b>			
Change in Volume	%	MAX	
Change in Mass	%	MAX	
Change in Hardness	PTS	MAX	
Visual Change		Observation:	

<b>CHANGE IN PROPERTIES AFTER IMMERSION FOR</b>	<b>HOURS AT</b>
---	-----------------

<b>Immersion Material:</b>			
Change in Volume	%	MAX	
Change in Mass	%	MAX	
Change in Hardness	PTS	MAX	
Visual Change		Observation:	

<b>TESTED BY:</b>	<b>DATE:</b>
<b>APPROVED BY:</b>	<b>DATE:</b>

## EXAMPLE OF A RUBBER CERTIFICATION FORM

Please type all information except signature:

**Company Name:** \_\_\_\_\_

**Address:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Rubber Compound:** \_\_\_\_\_

**Compound # or Grade:** \_\_\_\_\_

**Part Name:** \_\_\_\_\_

**Rubber Class:** \_\_\_\_\_

The rubber or rubber-like materials listed above have been evaluated according to the test procedures contained in the 3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Number 18-. These materials are (this material is) covered by the Scope and applicable definitions in these Standards. These materials comply (this material complies) with The Code of Federal Regulations, Title 21, Part 177.2600, and complies with the applicable material and compatibility criteria found in Sections C and D. (See attached Test Results Form.)

**Company Representative:**

**Name:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

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These amended standards are effective August 21, 1999, at which time the 3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Number 18-02 are rescinded and become null and void.

# 3-A® Sanitary Standards for Batch and Continuous Freezers for Ice Cream, Ices and Similarly Frozen Dairy Foods, Number 19-05

Formulated by  
International Association of Food Industry Suppliers (IAFIS)  
International Association of Milk, Food and Environmental Sanitarians (IAMFES)  
United States Public Health Service (USPHS)  
The European Hygienic Equipment Design Group (EHEDG)  
The Dairy Industry Committee (DIC)

It is the purpose of the IAFIS, IAMFES, USPHS, EHEDG, 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, materials, and fabrication or otherwise as not to conform to the following standards but which, in the fabricator's opinion, are equivalent or better, may be submitted for the joint consideration of the IAFIS, IAMFES, USPHS, EHEDG, and DIC at any time. The 3-A Sanitary Standards and 3-A Accepted Practices provide hygienic criteria applicable to equipment and systems used to produce, process, and package milk, milk products, and other comestible products.<sup>1</sup> **NOTE:** Standard English is the official language of 3-A Sanitary Standards and 3-A Accepted Practices.

## A SCOPE

A1 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 as a part of the freezer. These standards do not cover equipment designed for the freezing of ice cream, ices, and similarly-frozen products which are served to the consumer without further hardening.

A2 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

B1 *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.

B2 *Continuous Freezers:* Shall mean equipment designed to be operated in such a manner as to (1) partially freeze and incorporate air into the product as it flows continuously through the freezing cylinder(s) and (2) discharge the product(s).

B3 *Integral Mix Supply Tank:* Shall mean a covered vessel which is attached to the freezer and holds unfrozen, cooled mix.

B4 *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.

**B5 Surfaces**

- B5.1 *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 sanitary check valve to the point of entrance into the mix.
- B5.2 *Nonproduct Contact Surface*: Shall mean all other exposed surfaces.
- B6 *Mechanical Cleaning or Mechanically Cleaned*: 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.
- B7 *Engineering Plating*: shall mean plated to specific dimensions or processed to specified dimensions after plating.<sup>2</sup>

**C MATERIALS**

- C1 Sanitary fittings that have product contact surfaces that are integral parts of and furnished with freezers shall comply with applicable provisions of the 3-A Sanitary Standards for Fittings, Parts I and II, Number 08, rev.
- C2 Pumps that have product contact surfaces that are integral parts of and furnished with freezers shall comply with applicable provisions of the 3-A Sanitary Standards for Centrifugal and Positive Rotary Pumps, Number 02- and/or 3-A Sanitary Standards for Homogenizers and Pumps of the Plunger Type, Number 04.
- C3 Instrument fittings that have product contact surfaces that are integral parts of and furnished with freezers shall comply with the applicable provisions of the 3-A Sanitary Standards for Sensors and Sensor Fittings and connections used on fluid Milk and Milk Products Equipment, Number 74.
- C4 Sanitary tubing having product contact surfaces that are integral to and furnished with freezers shall comply with the applicable provisions of the 3-A Sanitary Standards for Polished Metal Tubing, Number 33.
- C5 All other product contact surfaces shall be of stainless steel of the American Iron and Steel Institute (AISI) 300 Series<sup>3</sup> or corresponding Alloy Cast Institute<sup>4</sup> (ACI) 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 nontoxic and nonabsorbent, except that:

- C5.1 Freezing cylinder liners (tubes) made of the materials provided for in C5 may be covered with an engineering plating of chromium.
- C5.2 Freezing cylinder liners (tubes) may also be made of other nontoxic structurally suitable heat-exchange metal made corrosion-resistant and wear resistant by covering the product contact surface(s) with an engineering plating of chromium.
- C5.3 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 nontoxic, nonabsorbent 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.
- C5.4 Solder, when used, shall be silver solder and shall be corrosion resistant, free of cadmium, lead and antimony, nonabsorbent, and shall not impart any toxic substance to the product when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment.
- C5.5 Rubber and rubber-like materials may be used for metering devices, air tubing, port covers, gaskets, seals, and parts having the same functional purposes.
- C5.6 Rubber and rubber-like materials when used for the above specified applications shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials, Number 18.
- C5.7 Plastic materials may be used in sight openings and for bearings, metering devices, air tubing, port covers, scraper blades, gaskets, seals, and parts having the same functional purposes.
- C5.8 Plastic materials when used for the above specified applications shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Plastic Materials, Number 20.
- C5.9 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.
- C5.10 The final bond and residual adhesive, if used, of bonded rubber and rubber-like materials and bonded plastic materials shall be nontoxic.

- C5.11 Where materials having certain inherent functional properties are required for specific applications, such as scraper parts and seal parts, tungsten carbide, carbon or ceramic materials may be used. Tungsten carbide, carbon and ceramic materials shall be inert, nonporous, nontoxic, nonabsorbent, insoluble and resistant to scratching, scorching, and distortion when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment.
- C5.12 Scraper blades, shafts, bearings, discharge gates and front heads for these freezers may also be made of a metal alloy or metal that is as corrosion resistant as AISI 300 Series stainless steel, and is nontoxic and nonabsorbent under the conditions of intended use as AISI 300 Series stainless steel. (See Appendix, Section H.)
- C6 Nonproduct contact surfaces shall be of corrosion-resistant materials or material that is rendered corrosion resistant. If coated, the coating used shall adhere. Nonproduct contact surfaces shall be relatively nonabsorbent, durable, and cleanable. Parts removable for cleaning having both product contact and nonproduct contact surfaces shall not be painted.
- D FABRICATION**
- D1 All product contact surfaces shall have a finish at least as smooth as a No. 4 ground finish on stainless steel sheets, and be free of imperfections such as pits, fold, and crevices in the final fabricated form. (See Appendix, Section F.)
- D2 Permanent joints in metallic product contact surfaces shall be continuously welded. If it is impractical to weld, they may be silver soldered. These areas having product contact surfaces shall be at least as smooth as a No. 4 ground finish on stainless steel sheets and be free of imperfections such as pits, folds, and crevices.
- D3 Silver solder may be used for attaching blade mounting pins, bushings, and bearings.
- D4 The thickness of engineering plating on product contact surfaces shall be not less than 0.0002 in. (0.005 mm) except that when these surfaces are other than stainless steel, the thickness of engineering plating shall be not less than 0.002 in. (0.05 mm).
- D5 Freezers that are to be mechanically cleaned shall be designed so that the product contact surfaces of the freezer, and all nonremovable appurtenances thereto can be mechanically cleaned and are accessible for inspection.
- D6 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.
- D7 Gasket retaining grooves in product contact surfaces shall be no deeper than their width.
- D8 **Radii**
- Internal angles of 135° or less on product contact surfaces shall have radii of not less than 1/4 inch (6 mm) except that:
- D8.1 Smaller radii may be used when required for essential functional purposes such as sealing ring grooves, scraper blade mounting pins, holes or grooves, guides for batch freezer discharge gates and other assemblies of machined parts. In no case shall such radii be less than 1/32 in. (1 mm).
- D8.2 The radii in grooves for standard 1/4 in. (6 mm) O-rings shall be not less than 3/32 in. (2 mm) and for standard 1/8 in. (3 mm) O-rings shall be not less than 1/32 in. (1 mm).
- D9 Sanitary fittings shall comply with the applicable provisions of the 3-A Sanitary Standards for Sanitary Fittings for Milk and Milk Products, Number 63-.
- D10 Instrument fittings and connections shall comply with the applicable provisions of the 3-A Sanitary Standards for Sensors and Sensor Fittings and Connections Used on Fluid Milk and Milk Products Equipment, Number 74-.
- D11 Sanitary tubing shall comply with the applicable provisions of the 3-A Sanitary Standards for Polished Metal Tubing, Number 33-.
- D12 Pumps having product contact surfaces shall comply with the applicable provisions of the 3-A Sanitary Standards for Centrifugal and Positive Rotary Pumps, Number 02- and 3-A Sanitary Standards for Homogenizers and Pumps of the Plunger Type, Number 04-.
- D13 There shall be no threads on product contact surfaces, except those in pumps as provided for in the 3-A Sanitary Standards for Centrifugal and Positive Rotary Pumps, Number 02-.
- D14 Coil springs having product contact surfaces shall have at least 3/32 in. (2 mm) openings between coils including the ends when the spring is in a free position.
- D15 Shafts of freezers shall have a seal of a packless-type, sanitary in design. Bearings having a product contact surface shall be of nonlubricated type. Lubricated bearings, including the permanent sealed type, shall be located outside the product

- contact surface with at least one in. (2.54 cm) clearance open for inspection between the bearing and any product contact surface. When a shaft passes through a product contact surface, the portion of the opening surrounding the shaft shall be protected to prevent the entrance of contaminants.
- D16 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 end covers.
- D17 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 practical 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.
- D18 When air under pressure is introduced into the product, a single service air filter shall be installed in the air line as close as practical to the point of air application, and a product check valve of sanitary design shall be installed downstream from the filter.
- D19 The filter required in D17 and D18 shall be equivalent to the air pipeline and disposable filter performance found in 3-A Accepted Practices for Supplying Air Under Pressure, Number 604.
- D20 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.
- D21 Bonded rubber and rubber-like gaskets and bonded plastic gaskets shall be bonded in a manner that the bond is continuous and mechanically sound 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 base material to which it is bonded.
- D22 **Freezer Supports**  
The means of supporting a freezer shall be one of the following:
- D22.1 *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 in. (15 cm). Legs made of hollow stock shall be sealed.
- D22.2 *With casters:* Casters shall be of sufficient length to provide a clearance between the lowest part of the base and the floor of no less than 4 in. (10 cm). Casters, if provided, shall be durable and of a size that will permit easy movement of the freezer.
- D23 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 and shall be such that it can be sealed to the wall.
- D23.1 All product connections to freezers shall be within a process area.
- D24 Guard(s) required by a safety standard that will not permit accessibility for cleaning and inspection when in place shall be designed so that they can be removed without the use of tools.
- D25 Nonproduct contact surfaces shall be smooth, free of pockets and crevices and be readily cleanable. Surfaces to be coated shall be effectively prepared for coating.
- D26 **Mix Supply Tanks**  
Integral mix supply tanks, if used, shall comply with the following:
- D26.1 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 in. (10 mm) along each edge and (4) shall be close fitting.  
The edges of openings in the cover shall extend upwards at least 3/8 in. (10 mm) 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 in. (6 mm). Nonremovable 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.
- D26.2 Tank valves shall conform to the applicable provisions of the 3-A Sanitary Standards for Sanitary Fittings for Milk and Milk Products, Number 63.

- D26.3 Tanks having such a capacity 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).
- D26.4 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 plastic shall be relatively flush with the inner surface of the tank or cover.
- D27 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 in. (6 mm) and handles of sanitary design.

D28 **Information Plates**

- D28.1 Continuous freezers shall be provided with a prominently displayed information plate which provides guidance to the user for the selection of correct cleaning procedures and cleaning compounds.
- D28.1.1 The information plate shall list the materials used in the construction of product contact surfaces which are susceptible to attack by acid cleaners and it shall warn against the use of acid cleaners on these materials.
- D28.1.2 The information plate shall recommend that a cleaning compound supplier be consulted for the proper selection of chemicals and procedures. (See Appendix, Section G.)
- D28.2 Batch freezers shall have a prominently displayed information plate noting that manual cleaning is required in accordance with the manufacturer's recommendations and that the use of acid cleaners is not recommended. (See Appendix, Section G.)

**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 C1 herein. Where

welding is involved, the carbon content of the stainless steel should not exceed 0.08%. The first reference cited in C1 sets forth the chemical ranges and limits of acceptable stainless steel of the 300 Series. Cast grades of stainless steel corresponding to types 303, 304, and 316 are designated CF-16F, CF-8, and CF-8M, respectively. The chemical compositions of these cast grades are covered by ASTM specifications<sup>5</sup>A351/A351M, A743/A743M and A744/A744M.

F **PRODUCT CONTACT SURFACE FINISH**

Surface finish equivalent to 150 grit or better as obtained with silicon carbide properly applied to stainless steel sheets is considered in compliance with the requirements of Section D1 herein.

G **INFORMATION PLATES**

The specific information displayed on the information plate required in D28.1 for continuous freezers will vary among freezer manufacturers. The following example is for illustration purposes only.

**CAUTION**

Some product contact parts in this machine are made of chrome plated nickel. Acid cleaning compounds will cause serious corrosive damage to these parts. Consult your cleaning compound supplier for the selection of correct chemicals and procedures.

- G2 The following example illustrates a typical information plate for the batch freezers as required in D28.2.

**CAUTION**

Manual cleaning of this machine is required. Follow the recommended cleaning instructions in your operator's manual. Do not use acid cleaning compounds.

Metal alloys or metals other than the above may be as corrosion resistant as 300 Series Stainless steel. This may be shown when metal alloys or metals are tested in accordance with ASTM G31 Laboratory Immersion Corrosion Testing of Metals and have a corrosion rate of less than 20 mil per year. The test parameters such as the type of chemical(s), their concentration(s) and temperature(s) should be representative of cleaning and sanitizing conditions used in dairy equipment. Alloys containing lead, leachable copper or other toxic metals should not be used.



H COMPOSITION OF OPTIONAL ALLOYS \*

The following metal alloys or metals have been shown to be as corrosion resistant as AISI 300 Series Stainless Steel:

	UNS S21800	UNS S20161	UNS N26055	UNS N26455	UNS S17400	UNS S15500	UNS S32900	UNS R20500	UNS R50400
	ASTM A743 Grade		ASTM A494 Grade	ASTM A494 Grade	ASTM A747 Grade	ASTM A747 Grade		ASTM A560 Grade	ASTM B67 Grade
	CF-10 SMnN		CY5SnBiM	CW-2M	CB7Cu-1	CB7Cu-2		50Cr-50Ni	C-2
C	0.10	0.15	0.05	0.02	0.07	0.07	0.20	0.10	0.10
Mn	7.00-9.00	4.00-6.00	1.5	1.00	0.70	0.70	1.00	0.30	
Si	3.50-4.50	3.00-4.00	0.5	0.80	1.00	1.00	0.75	1.00	
P	0.040	0.040	0.03	0.03	0.035	0.035	0.040	0.02	
S	0.030	0.040	0.03	0.03	0.03	0.03	0.030	0.02	
Cr	16.00-18.00	15.0-18.0	11.0-14.0	15.0-17.5	5.50-17.7	14.0-15.50	23.0-28.0	48.0-52.0	
Ni	8.00-9.00	4.00-6.00	Balance	Balance	3.60-4.60	4.50-5.50	2.50-5.00	Balance	
Mo			2.0-3.5	15.0-17.5			1.00-2.00		
Cb					0.15-0.35	0.15-0.35			
Cu					2.50-3.20	2.50-3.20			
N	0.08-0.18	0.08-0.20			0.05	0.05		0.30	
Fe	Balance	Balance	2.00	2.00	Balance	Balance	Balance	1.00	0.30
Sn			3.0-5.0						
Bi			3.0-5.0						
W				1.0					
Ti								0.50	Balance
Al								0.25	
other									H = 0.015 N = 0.03 O = 0.25

\* Percentage is maximum unless range is given.

<sup>1</sup>Use current revisions or editions of all referenced documents cited herein.

<sup>2</sup>Federal Specification #QQ-C-320B for Chromium Plating (Electrodeposited), June 17, 1995 with Amendment 4 on June 7, 1985. Federal Specification #QQ-N-290A for Nickel Plating (Electrodeposited), November 12, 1971. Available from the General Services Administration, Federal Supply Services Bureau, Specification Section, 470 East L'Enfant Plaza, Suite 8100, Washington, D.C. 20407; (202) 755-0325.

<sup>3</sup>The data for this series are contained in the *AISI Steel Products Manual, Stainless & Heat Resisting Steels*, November 1990, Table 2-1, pp. 17-20. Available from the American Iron and Steel Society, 410 Commonwealth Drive, Warrendale, PA 15086; (412) 776-1535.

<sup>4</sup>Steel Founders Society of America, Cast Metal Federation Building, 455 State Street, Des Plaines, IL 60016; (708) 299-9160.

<sup>5</sup>Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959; (610) 832-9500.

**This amended to 3-A Sanitary Standards for Batch and Continuous freezers for Ice Cream, Ices and Similarly Frozen Dairy Foods, Number 19-05 are effective November 21, 1999.**

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the temperature monitoring device is another example of a validation activity that is applied to a monitoring procedure. The monitoring procedures for chemical hazards such as aflatoxin or physical hazards such as metal fragments must also be validated. Usually it is possible to use testing procedures that have been developed and approved by regulatory agencies, professional associations, or equipment manufacturers, although sometimes a company will develop its own testing procedure to meet a particular need. It is essential that such a procedure be thoroughly validated to assure its efficacy. Obviously, such a procedure needs to be at least as sensitive as the "official" procedure it replaces.

### THE ROLE OF VALIDATION IN HACCP PLAN REVIEWS

The use of validation in HACCP plan reviews is the application that has received more formal attention in recent years. Before the HACCP plan can be implemented, it must be reviewed to determine that it is accurate in all of its details. This is the initial validation of the HACCP plan. It must be confirmed that all of the likely hazards have been identified, that the process flow diagram is accurate, that the correct CCPs have been established, and that the critical limits, monitoring procedures, and corrective actions are appropriate to permit effective management of food safety.

Just as with HACCP plan development, this validation must be performed by a knowledgeable food safety expert who is familiar with the HACCP system

of food safety. It is incumbent upon the HACCP team to be sure that reliable expertise is available when necessary. In some cases the food safety expert may be part of the plant's staff and will already be filling this role. In other cases, the expert may be part of the company's divisional or corporate staff. Companies that do not have the necessary level of expertise available internally must rely upon external consultants to validate their HACCP plans.

Once the HACCP system is implemented, subsequent HACCP plan validations are necessary whenever there is a significant process, formulation, or packaging change, when a HACCP system failure occurs, or when a previously unrecognized hazard is detected. It is a good practice to conduct the subsequent validations at least annually, even when there is no immediate reason for otherwise requiring a validation. This practice will assure auditors that the HACCP plan's validation is current.

Like record keeping, validation is an important procedure that is applied at many stages in the development and implementation of a HACCP plan. For those of you who are keeping score, record keeping was elevated to HACCP principle status in 1989 (along with critical limits, corrective actions, and verification). It is not my intent in this commentary to argue that validation should also be established as a HACCP principle, but rather to point out that it is an important procedure and that we should anticipate further improvements in the definition and application of the HACCP system of food safety.



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### Reader Service Card *DFES* December '99

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101	116	131	146	162	176	191	206	221	236	251	266	281	296	311	326	341
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109	124	139	154	170	184	199	214	229	244	259	274	289	304	319	334	349
110	125	140	155	171	185	200	215	230	245	260	275	290	305	320	335	350
111	126	141	156	172	186	201	216	231	246	261	276	291	306	321	336	
112	127	142	157	172	187	202	217	232	247	262	277	292	307	322	337	
113	128	143	158	173	188	203	218	233	248	263	278	293	308	323	338	
114	129	144	160	174	189	204	219	234	249	264	279	294	309	324	339	

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OF MILK, FOOD AND ENVIRONMENTAL  
SANITARIANS, INC.**

**General Fund Statement of Activity  
For the Year Ended August 31, 1999**

**Revenue:**

Advertising	\$ 88,877
Membership & Administration	390,016
Communication	571,818
Annual Meeting	296,808
Workshops	29,288
	<hr/>
Total revenue	\$1,376,807

**Expense:**

Advertising	67,242
Membership & Administration	434,999
Communication	581,785
Annual Meeting	241,446
Workshops	19,410
	<hr/>
Total expense	1,344,882

<b>Change in General Fund</b>	<b>\$ 31,925</b>
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**Net Assets as of 8/31/99:**

General Fund	(38,601)
Foundation Fund	80,184
Restricted Fund	45,731
	<hr/>
Total net assets	\$ 87,314

# In Memory of...

*Evert Wallenfeldt  
Madison, Wisconsin*

We would like to extend our deepest sympathy to the family and friends of Evert Wallenfeldt who recently passed away.

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# Coming Events

## JANUARY

• **3-6, Milk Pasteurization and Control School**, Madison, WI. This 4-day short course provides in-depth training for those dairy industry personnel involved with thermal processing of milk and milk products. For more information, contact Bob Bradley at 608.263.2007.

• **9-12, 2000 Dairy Forum**, at the Westin Mission Hills Resort, Rancho Mirage, CA. For more information, contact Melinda Witter at 202.737.4332.

• **17-18, International Poultry Scientific Forum**, at the Georgia World Congress Center, Atlanta, GA. The forum will be a place where internationally recognized experts can share the latest findings in such areas as the environment, nutrition, pathology, microbiology, food science, and processing. For more information, contact Sylvia Small, US Poultry, 1530 Cooledge Road, Tucker, GA 30084-7303; Phone: 770.493.9401; Fax: 770.493.9257; E-mail: promo@poultryegg.org.

• **19-21, International Poultry Exposition**, Atlanta, GA. For more information, contact The International Poultry Exposition, US Poultry & Egg Association, 1530 Cooledge Road, Tucker, GA 30084-7303; Phone: 770.493.9401; Fax: 770.493.9257.

## FEBRUARY

• **16-17, California Association of Dairy and Milk Sanitarians**, Sacramento, CA. For further information, contact John Bruhn at 530.752.2192; E-mail: jcb Bruhn@ucdavis.edu.

• **25-26, Korea Association of Milk, Food and Environmental Specialists**. For additional information, contact Deog-Hwan Oh (Secretary); Phone: 82.361.250.6457 or

Kook Hee Kang (President and Affiliate Contact) at 82.33.1.290.7802.

• **28-29, Principles of Warehouse Sanitation Seminar**, Manhattan, KS. Helping sanitarians and managers meet customer expectations and comply with federal laws and regulations. For additional information, contact AIB, 1213 Bakers Way, Manhattan, KS 66505-3999; Phone: 785.537.4750; Fax: 785.537.1493.

## MARCH

• **3, Baking Industry Sanitation Standards Committee (BISSC) 2000 Annual Membership Meeting**, at the Chicago Marriott Hotel, Chicago. For more information, contact Bonnie Sweetman, Executive Director, BISSC, 1400 W. Devon Ave., Suite 422, Chicago, IL 60660; Phone: 773.761.4100; Fax: 773.274.3242; E-mail: bakesan@aol.com.

• **7-8, Basic Food Microbiology Seminar**, Holiday Inn - Portland Airport, Portland, OR. Participants will be introduced to the fundamental characteristics of microorganisms and relate the application of microbiology to foods, food safety, and sanitation. The information is designed for those who work with food processing, preparation, or sanitation, but have a limited background in microbiology. For additional information, contact Jack Brook, Science Division, Mt. Hood Community College, 26000 SE Stark St., Gresham, OR 97030; Phone: 503.491.7473; E-mail: brookj@mhec.cc.or.us.

• **9-11, International Fresh-cut Produce Association's 13th Annual Conference and Exhibition, "Dallas 2000: the Future is Now,"** Dallas, TX. This conference will provide fresh-cut processors, their suppliers, and their customers

with an in-depth understanding of internal and external factors that will change the industry as it enters the twenty-first century. For more information, call Sherry Greenwood at 703.299.6282.

• **15, Dairy HACCP Workshop**, Madison, WI. This one-day workshop will cover design and implementation of HACCP plans in dairy plants. For additional information, contact Marianne Smukowski at 608.265.6346.

• **15-16, Carolinas Association of Milk, Food & Environmental Sanitarians**. For additional information, contact Joe Neely, SCDHEC Division of Environmental Health, 2600 Bull St., Columbia, SC 29201; Phone: 803.935.7890.

## APRIL

• **6-9 IAFIS Annual Conference**, The Westin LaPaloma, Tucson, AZ. For further information, contact Dorothy Brady at 703.761.2600.

• **7-12, 2000 Conference for Food Protection**, Hyatt Regency Hotel, Milwaukee, WI. For additional information, contact Trevor Hayes, CFP Executive Secretary, 1085 Denio Ave., Gilroy, CA 95020-9206; Phone/Fax: 408.848.2255; E-mail: TWHgilroy@aol.com.

• **12-14, Michigan Environmental Health Association 55th Annual Conference**, Sault Ste. Marie, MI. For further information, contact Chuck Lichon at 517.832.6656.

• **16-19, Foodborne Pathogens 2000: Perspectives and Interventions**, Crowne Plaza, Arlington/Crystal City, VA. Sponsored by the Society for Industrial Microbiology. For more information, contact 3929 Old Lee Highway, Suite 92A, Fairfax, VA 22030-2421; Phone: 703.691.3357; Fax: 703.691.7991; E-mail: info@simhq.org.



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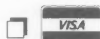
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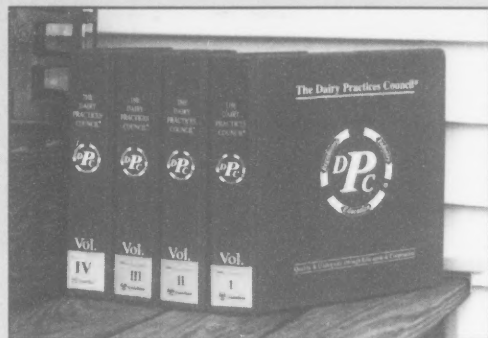
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# THOUGHTS on Today's Food Safety...

## The Role of Validation in HACCP Plans

William H. Sperber  
Senior Corporate Microbiologist  
Cargill, Inc.  
Minneapolis, Minnesota

During the past ten years the HACCP concept of food safety has been greatly expanded and refined. Partly as a result of these activities, HACCP is now very widely accepted and used by food producers and food regulators worldwide. However, the rapid expansion and application of HACCP has not been entirely smooth. In this commentary I want to address the frequent misunderstanding and confusion surrounding the term "validation" and attempt to clarify its legitimate role in HACCP plans.

In the United States, the modern application of HACCP principles has been guided predominantly by the reports of the National Advisory Committee on Microbiological Criteria for Foods (NACMCF). Three reports on HACCP principles were adopted by the Committee in 1989, 1992, and 1997. In its 1997 report on the application of HACCP principles (J. Food Prot. 61:762-775), NACMCF defined validation as "that element of verification focused on collecting and evaluating scientific and technical information to determine if the HACCP plan, when properly implemented, will effectively control the hazards." On the international scene, the Codex Alimentarius Committee on Food Hygiene (1997) defined validation as "obtaining evidence that the elements of the HACCP plan are effective." Quite like the NACMCF, Codex explained HACCP as a part of the verification procedures.

Therein lies the cause of some misunderstandings. Defining validation as a subordinate part of verification (which enjoys a lofty status as HACCP principle 6) has sometimes led to a confusion of the two procedures and has obscured a very important application of validation in establishing management parameters at critical control points (CCPs). This situation could be remedied as future refinements are applied to the HACCP concept. In fact, validation has been treated more prominently in each succeeding NACMCF report. In contrast to the 1997 report, the 1992 report gave considerably less attention to the topic of validation, which was never mentioned in the 1989 report. Obviously, validation is an emerging concept that is receiving more attention with time.

Today some food safety professionals suggest that validation is such an important procedure that it should be elevated to a HACCP principle, just as verification was elevated to this status in 1989. We may live long enough to see this happen. Remember, before 1989 there were only three HACCP principles (in contrast to today's seven). Before 1971 there were none. HACCP development is on a relatively fast track and we will likely see more changes.

What is meant by "validation," and what is its role in the development of HACCP plans? Simply put, validation is the determination or proof that the intended result can be achieved. It is evidence of process capability. One role of validation is fulfilled when the HACCP team establishes the critical limits and monitoring procedures at each CCP. The other role, as emphasized in the 1997 NACMCF report, is fulfilled when it is determined that the HACCP plan is accurate in all details.

### THE ROLE OF VALIDATION IN CCP DEVELOPMENT

The role of validation is somewhat obscured, or tacitly assumed, in the NACMCF/Codex reports. It is imperative that the critical limits and monitoring procedures be validated for each CCP before the HACCP plan is implemented. For example, if a product requires an in-process heat treatment to kill microbial pathogens, that heat treatment must be tested to prove (validate) that it will in fact provide the intended level of destruction of the identified microbiological hazard. The intended level of destruction could be a 5-log reduction of *Salmonella* in a cooked meat product, or a 12-log reduction of *Clostridium botulinum* in a low-acid canned food. The validation of a critical limit is often accomplished by means of a microbiological challenge study. It can also be done by reference to the scientific literature, existing regulations, or previous challenge studies that have been performed on very similar products. This validation procedure should be done for each of the three types of hazards—biological, chemical, and physical—that are managed in a HACCP plan.

Similarly, the monitoring procedures used at each CCP must be validated to prove that deviations beyond the critical limit will be detected. For example, the critical limits for a heating step may require that the temperature be monitored within a range of  $\pm 1^\circ\text{C}$ . The temperature monitoring device at this step needs to be validated to prove that this degree of sensitivity is attainable. Clearly, it would be foolish to use at this step a device that had a temperature sensitivity of  $\pm 5^\circ\text{C}$ . The use of a certified thermometer to calibrate

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