June 2008

Vol. 28, No. 6
ISSN:1541-9576
Periodicals
6200 Aurora Avenue • Suite 200W
Des Moines, Iowa 50322-2864, USA

Food Protection Trends

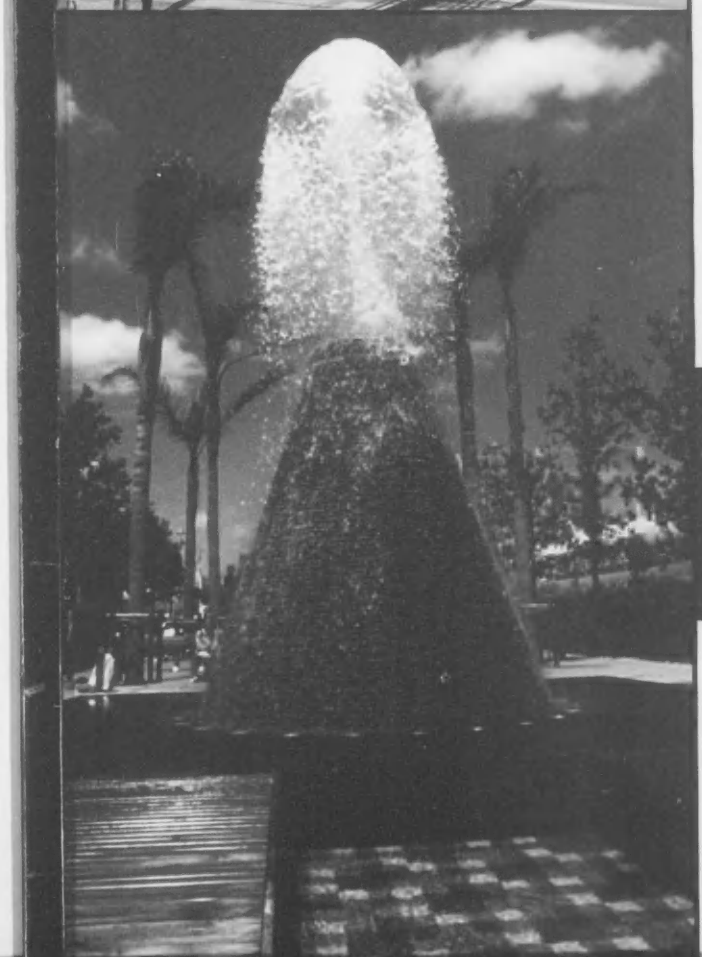
Science and News from the International Association for Food Protection

Alternative Methods to Pasteurization of Apple Cider

Consumer Perceptions of the Food Safety System

IAFP Gold Sustaining Member Profiles

www.foodprotection.org



International Association for Food Protection®

Advancements in Food Safety

Lisbon, Portugal
19-21 November 2008

Government, academia, and industry speakers from Europe and beyond will present their experiences and views during eight critical sessions specific to food safety issues in European countries.

Register Online at www.foodprotection.org

In collaboration with ILSI Europe, the Society for Applied Microbiology and the World Health Organization. With the technical cooperation of the Food and Agricultural Organization of the United Nations.

IAFP's Fourth Lisbon, Portugal † 19-21 November 2008

EUROPEAN Symposium on Food Safety

ABOUT THE COVER...

Photo courtesy of Photo Researchers, Inc.

Use of the photos does not imply endorsement of any product by the International Association for Food Protection.

VOLUME 28, NO. 6

International Association for Food Protection.

FOOD PROTECTION TRENDS

ARTICLES

ASSOCIATION NEWS

DEPARTMENTS

EXTRAS

IAFP FOUNDATION

Everyone Benefits When You Support **The IAFP Foundation**

We live in a global economy and the way food is grown, processed, and handled can impact people around the world. Combine these issues with the complexity of protecting the food supply from food security threats and the challenges to food safety professionals seem overwhelming. However, with your support the IAFP Foundation can make an impact on these issues.

Funds from the Foundation help to sponsor travel for deserving scientists from developing countries to our Annual Meeting, sponsor international workshops, distribute *JFP* and *FPT* journals to developing countries through FAO in Rome, and supports the future of food scientists through scholarships for students or funding for students to attend IAFP Annual Meetings.

It is the goal of the Association to grow the IAFP Foundation to a self-sustaining level of greater than $1.0 million by 2010. With your generous support we can achieve that goal and provide additional programs in pursuit of our goal of *Advancing Food Safety Worldwide*®.

Contribute today by calling 515.276.3344 or visiting www.foodprotection.org

IAFP FOUNDATION

International Association for Food Protection®
6200 Aurora Avenue, Suite 200W
Des Moines, IA 50322-2864, USA
Phone: 800.369.6337 • 515.276.3344
Fax: 515.276.8655
E-mail: info@foodprotection.org
Web site: www.foodprotection.org

FPT JOURNAL STAFF

David W. Tharp, CAE: *Executive Director*
E-mail: dtharp@foodprotection.org

Lisa K. Hovey, CAE: *Managing Editor*
E-mail: lhovey@foodprotection.org

Donna A. Bahun: *Production Editor*
E-mail: dbahun@foodprotection.org

Pam J. Wanninger: *Proofreader*

INTERNATIONAL ASSOCIATION FOR FOOD PROTECTION STAFF

David W. Tharp, CAE: *Executive Director*
E-mail: dtharp@foodprotection.org

Lisa K. Hovey, CAE: *Assistant Director*
E-mail: lhovey@foodprotection.org

Donna A. Bahun: *Design and Layout*
E-mail: dbahun@foodprotection.org

Farrah L. Benge: *Accounting Assistant*
E-mail: fbenge@foodprotection.org

Julie A. Cattanach: *Membership Services*
E-mail: jcattanach@foodprotection.org

Tamara P. Ford: *Communications Coordinator*
E-mail: tford@foodprotection.org

Donna Gronstal: *Senior Accountant*
E-mail: dgronstal@foodprotection.org

Karla K. Jordan: *Order Processing*
E-mail: kjordan@foodprotection.org

Didi Loynachan: *Administrative Assistant*
E-mail: dloynachan@foodprotection.org

Leilani K. McDonald: *Association Services*
E-mail: lmcdonald@foodprotection.org

Pam J. Wanninger: *Proofreader*

Trinette R. Worthington: *Executive Assistant*
E-mail: tworthington@foodprotection.org

ADVERTISING

David Larson
Phone: 515.440.2810
Fax: 515.440.2809
E-mail: larson6@mchsi.com

FOOD PROTECTION TRENDS
SCIENCE AND NEWS FROM THE INTERNATIONAL ASSOCIATION FOR FOOD PROTECTION

Food Protection Trends (ISSN-1541-9576) is published monthly beginning with the January number by the International Association for Food Protection, 6200 Aurora Avenue, Suite 200W, Des Moines, Iowa 50322-2864, USA. Each volume comprises 12 numbers. Printed by Heuss Printing, Inc., 911 N. Second Street, Ames, Iowa 50010, USA. Periodical Postage paid at Des Moines, Iowa 50318 and additional entry offices.

Manuscripts: Correspondence regarding manuscripts should be addressed to Donna A. Bahun, Production Editor, International Association for Food Protection.

News Releases, Updates, Coming Events and Cover Photos: Correspondence for these materials should be sent to Donna A. Bahun, Production Editor, International Association for Food Protection.

"Instructions for Authors" may be obtained from our Web site at www.foodprotection.org or from Donna A. Bahun, Production Editor, International Association for Food Protection.

Orders for Reprints: All orders should be sent to *Food Protection Trends*, International Association for Food Protection. Note: Single copies of reprints are not available from this address; address single copy reprint requests to principal author.

Reprint Permission: Questions regarding permission to reprint any portion of ***Food Protection Trends*** should be addressed to: Donna A. Bahun, Production Editor, International Association for Food Protection.

Business Matters: Correspondence regarding business matters should be addressed to Lisa K. Hovey, Managing Editor, International Association for Food Protection.

Membership Dues: Membership in the Association is available to individuals. Dues are based on a 12 month period. *Food Protection Trends*, *Journal of Food Protection* and *JFP* Online are optional Member benefits. See the Membership form at the back of this issue for pricing information. Correspondence regarding changes of address and dues must be sent to Julie A. Cattanach, Membership Services, International Association for Food Protection

Sustaining Membership: Three levels of sustaining membership are available to organizations. For more information, contact Julie A. Cattanach, Membership Services, International Association for Food Protection.

Subscription Rates: ***Food Protection Trends*** is available by subscription for $248.00 US, $263.00 Canada/Mexico, and $278.00 International. Single issues are available for $26.00 US and $35.00 all other countries. All rates include shipping and handling. No cancellations accepted. For more information contact Julie A. Cattanach, Membership Services, International Association for Food Protection.

Claims: Notice of failure to receive copies must be reported within 30 days domestic, 90 days outside US.

Postmaster: Send address changes to ***Food Protection Trends,*** 6200 Aurora Avenue, Suite 200W, Des Moines, Iowa 50322-2864, USA.

Food Protection Trends is printed on paper that meets the requirements of ANSI/NISO 239.48-1992.

Catch a (micro) Wave

THE INFORMATION IN THIS E-CARD WAS DEVELOPED BY THE PARTNERSHIP FOR FOOD SAFETY EDUCATION. WWW.FIGHTBAC.ORG

LEARN MORE AT:

Fight BAC!®

Be Food Safe

Microwave Cooking Basics

Catch a "wave" of food safety and follow these basics:

1. Food can cook unevenly in a microwave oven and cooking times vary due to appliance power and efficiency.

2. Stir or rotate food midway through microwaving. Harmful bacteria can survive in cold spots! Always observe the standing time which completes the cooking.

3. Use a food thermometer to verify food has reached a safe minimum internal temperature.

More on microwaving at:

USDA Food Safety and Inspection Service "Cooking Safely in the Microwave Oven"

THE PARTNERSHIP REMINDS
CONSUMERS TO ALWAYS

CLEAN: Wash hands with warm water and soap for twenty seconds before and after handling food and wash surfaces often.

SEPARATE: Don't cross contaminate. Keep raw meat, poultry, seafood, and their juices away from other foods.

COOK: Cook to a safe internal temperature. Use a thermometer to measure the internal temperature of foods.

CHILL: Refrigerate or freeze perishables promptly. Keep your refrigerator at 40°F and use an appliance thermometer to monitor.

The non-profit Partnership for Food Safety Education reached thousands of food safety educators with an E-card focusing on the basics of microwave cooking. (shown). Additional outreach is planned to raise awareness among consumers of the importance of reading frozen food labels and of properly cooking frozen products. IAFP is a contributing member of the Partnership. For information on the Partnership's programming, contact Shelley Feist at sfeist@fightbac.org.

FUTURE ANNUAL MEETINGS

IAFP 2008

AUGUST 3–6

Hyatt Regency Columbus
Columbus, Ohio

IAFP 2009

JULY 12–15

Gaylord Texan Resort
Grapevine, Texas

IAFP 2010

AUGUST 1–4

Anaheim Convention Center
Anaheim, California

International Association for Food Protection

FOOD PROTECTION TRENDS

"The mission of the Association is to provide food safety professionals worldwide with a forum to exchange information on protecting the food supply."

FPT EDITORIAL BOARD

SUSTAINING MEMBERS

Sustaining Membership provides organizations the opportunity to ally themselves with IAFP in pursuit of *Advancing Food Safety Worldwide*. This partnership entitles companies to become Members of the leading food safety organization in the world while supporting various educational programs that might not otherwise be possible.

GOLD

BD Diagnostics
Sparks, MD
410.316.4467

bioMérieux, Inc.
Hazelwood, MO
800.638.4835

Bio-Rad Laboratories
Hercules, CA
510.741.5653

BPI Technology, Inc.
Dakota Dunes, SD
605.217.8000

Cargill
Minneapolis, MN
800.227.4455

The Coca-Cola Company
Atlanta, GA
404.676.2177

ConAgra Foods, Inc.
Omaha, NE
402.595.6983

DuPont Qualicon
Wilmington, DE
302.695.5300

Ecolab Inc.
St. Paul, MN
800.392.3392

JohnsonDiversey
Sharonville, OH
513.956.4869

Kraft Foods
Glenview, IL
847.646.3678

PepsiCo
Chicago, IL
312.821.3030

Silliker Inc.
Homewood, IL
708.957.7878

(Continued on next page)

SUSTAINING MEMBERS

SILVER (Continued)

BSI Management Systems
Reston, VA; 800.862.4977

F & H Food Equipment Co.
Springfield, MO; 417.881.6114

Food Safety Net Services, Ltd.
San Antonio, TX; 210.384.3424

MATRIX MicroScience, Inc.
Golden, CO; 303.277.9613

Orkin Commercial Services
Atlanta, GA; 404.888.2241

Quality Flow Inc.
Northbrook, IL; 847.291.7674

Weber Scientific
Hamilton, NJ; 609.584.7677

SUSTAINING

3-A Sanitary Standards, Inc., McLean, VA; 703.790.0295

3M Microbiology Products, St. Paul, MN; 612.733.9558

Abbott Nutrition, Columbus, OH; 614.624.7040

ABC Research Corporation, Gainesville, FL; 352.372.0436

Advanced Instruments, Inc., Norwood, MA; 781.320.9000

AEMTEK, Inc., Fremont, CA; 510.979.1979

ASI Food Safety Consultants, Inc., St. Louis, MO; 800.477.0778

Bentley Instruments, Inc., Chaska, MN; 952.448.7600

BioControl Systems, Inc., Bellevue, WA; 425.603.1123

Biolog, Inc., Hayward, CA; 510.785.2564

Burger King Corp., Miami, FL; 305.378.3410

Charm Sciences, Inc., Lawrence, MA; 978.687.9200

Chestnut Labs, Springfield, MO; 417.829.3724

DARDEN Restaurants, Inc., Orlando, FL; 407.245.5330

Decagon Devices, Inc., Pullman, WA; 509.332.2756

Deibel Laboratories, Inc., Lincolnwood, IL; 847.329.9900

DeLaval Cleaning Solutions, Kansas City, MO; 816.891.1549

Diversified Laboratory Testing, LLC, Mounds View, MN; 763.785.0484

DonLevy Laboratories, Crown Point, IN; 219.226.0001

DSM Food Specialties USA, Inc. Parsippany, NJ; 973.257.8290

Electrol Specialties Co., South Beloit, IL; 815.389.2291

Elena's, Auburn, Hills, MI; 248.373.1100

EMD Chemicals Inc., Gibbstown, NJ; 856.423.6300

SUSTAINING MEMBERS

SUSTAINING

Fisher Scientific, Pittsburgh, PA; 412.490.4488

Food Directorate, Health Canada, Ottawa, Ontario, Canada; 613.957.0880

FoodHandler Inc., Mesa, AZ; 800.338.4433

Food Lion, LLC, Salisbury, NC; 704.633.8250

GOJO Industries, Akron, OH; 330.255.6286

Grocery Manufacturers Association, Washington, D.C.; 202.639.5985

HiMedia Laboratories Pvt. Limited, Mumbai, Maharashtra, India; 91.22.2500.3747

IBA, Inc., Millbury, MA; 508.865.6911

Idaho Technology, Inc., Salt Lake City, UT; 801.736.6354

Institute for Environmental Health, Lake Forest Park, WA; 206.522.5432

International Dairy Foods Association, Washington, D.C.; 202.737.4332

Iowa State University Food Microbiology Group, Ames, IA; 515.294.4733

Jimmy Buffett's Margaritaville, Orlando, FL; 407.224.3216

Kellogg Company, Battle Creek, MI; 269.961.6235

The Kroger Co., Cincinnati, OH; 513.762.4209

Michelson Laboratories, Inc., Commerce, CA; 562.928.0553

Michigan State University–ProMS in Food Safety, East Lansing, MI; 517.432.3100

MicroBioLogics, Inc., St. Cloud, MN; 320.253.1640

Micro-Smedt, Herentals, Belgium; 32.14230021

Microbial-Vac Systems, Inc., Jerome, ID; 208.324.7522

Mol Industries, Grand Rapids, MI; 800.729.2358

Nasco International, Inc., Fort Atkinson, WI; 920.568.5536

The National Food Laboratory, Inc., Dublin, CA; 925.833.8795

Nelson-Jameson, Inc., Marshfield, WI; 715.387.1151

Neogen Corporation, Lansing, MI; 517.372.9200

Nestlé USA, Inc., Dublin, OH; 614.526.5300

NSF International, Ann Arbor, MI; 734.769.8010

Oxoid Canada, Nepean, Ontario, Canada; 800.567.8378

ParTech, Inc., New Hartford, NY; 315.738.0600

Penn State University, University Park, PA; 814.865.7535

PML Microbiologicals, Inc., Wilsonville, OR; 503.570.2500

Polar Tech Industries, Genoa, IL; 815.784.9000

Process Tek, Des Plaines, IL; 847.296.9312

The Procter & Gamble Co., Cincinnati, OH; 513.983.8349

Publix Super Markets, Inc., Lakeland, FL; 863.688.7407

Q Laboratories, Inc., Cincinnati, OH; 513.471.1300

Randolph Associates, Birmingham, AL; 205.595.6455

REMEL, Inc., Lenexa, KS; 800.255.6730

rtech™ laboratories, St. Paul, MN; 800.328.9687

Seiberling Associates, Inc., Dublin, OH; 614.764.2817

Strategic Diagnostics Inc., Newark, DE; 302.456.6789

Texas Agricultural Experiment Station, College Station, TX; 979.862.4384

United Fresh Produce Association, Washington, D.C.; 202.303.3400

Walt Disney World Company, Lake Buena Vista, FL; 407.397.6060

Wegmans Food Markets, Inc., Rochester, NY; 585.429.3623

WTI, Inc., Jefferson, GA; 706.387.5150

Zep Manufacturing Company, Atlanta, GA; 404.352.1680

"LONE STAR PERSPECTIVE"
FROM YOUR PRESIDENT

By GARY ACUFF
PRESIDENT

"A large audience glued to the television screen and primed to learn cooking techniques would be the perfect receptor for some quick food safety training"

Remember a few years ago when the only real television cooking shows were on Public Broadcasting channels? They were sort of an oddity, I think, and the number of viewers was probably low. Things have really changed in the last few years. Who would have imagined then that there would such a thing as a "Food Network?" I am amazed that there is enough interest in food and cooking that a television network completely devoted to food could be a successful venture. It is more than successful. It has turned into an extremely profitable industry with cooking show host endorsements of books, utensils, appliances, spices—the list goes on and on. We are living in a new era of consumer interest in food and cooking. Television chefs have become rock stars…

Back in the days when only a few cooking shows existed on PBS, I would watch with a critical eye as Justin Wilson (the Cajun chef) would prepare foods with a distinct Louisiana flavor and style. I used to recommend that students in my food microbiology classes watch his show and note how much cross contamination occurred. Even an inexperienced food microbiologist-in-training could spot when Justin would handle raw foods of animal origin and then wipe his hands on the towel attached to his belt before preparing a salad or other food to be eaten without heating. And the cross contamination just kept going. Before long, Justin had handled and contaminated just about every possible item on the television set.

Now, I am not trying to pick on Justin Wilson. His is just the only name I can remember from that era. He was not unique in his ability to demonstrate unsafe food handling practices, as there were several other television chefs who could match his skills. I used to get so fired up that I even wrote letters to some of the cooking show producers, complaining about the lack of food safety demonstrated in their programs. But I always got the same response—there was just not enough time in a 30-minute television show to go into food safety issues. I was never impressed by that argument. How long would it take to explain to viewers that it was important to wash their hands after handling raw meat?

Fast forward to the current era of the Food Network. Now we have more chefs than we can count, each with daily shows. Is there enough time to discuss food safety now? Apparently not. Both of my daughters love watching Rachael Ray, Paula Dean or Alton Brown. And these new age hosts can all match Justin Wilson for unsafe food handling techniques. Granted, Alton Brown does make a valiant attempt to explain food science and sometimes even safe food handling techniques on a regular basis, but even he pulls some real food safety stunts every now and then. I still get fired up about the unsafe techniques when watching some of these shows along with my daughters and will get on a rant about how bad things are. My kids know enough to let me blow off steam for a while, but even they get tired of hearing it and will ask me to keep quiet so they can follow the recipe.

A few weeks ago, I injured my ankle and was under doctor's orders to keep it elevated and iced for a couple of days. So I ended up watching more television than I had in a long time. I surfed channels, but often found myself watching the Food Network again. I couldn't believe what I saw. In at least two

programs on a single afternoon, hosts told viewers that the proper way to cook a hamburger was medium-rare. I watched with amazement as they cut hamburgers in half to reveal an obviously red center and then took a bite followed by exclamations of wonder at the flavors we had been missing by "overcooking" our burgers. There was even one show about a guy who grinds his own beef onsite so it will be safe. Please! How long has it been since the hamburger outbreak in the Pacific Northwest? Have we forgotten all the lessons learned in only 15 years? Apparently so.

If you read Doug Powell's FSNet E-mail news, you have probably spotted some of his rants against unsafe techniques demonstrated on television cooking shows, so I have some confidence that I am not the only one noticing this or concerned about it. Likely, you have noted it as well. It occurs to me that it would be very easy to educate people on proper food handling and application of food safety techniques during many of the food shows that are now so popular. The opportunity is huge. A large audience glued to the television screen and primed to learn cooking techniques would be the perfect receptor for some quick food safety training. Why can't this be done? Maybe it is because there really is too little time for that sort of thing in the allotted schedule. Possibly, it is because the hosts and producers of the shows really don't know much about food safety. It could be because the host is so wrapped up in explaining the recipe that food safety just doesn't come to mind. Maybe the producers of the shows believe that too much lecturing on food safety just won't sell. Likely, it is all of these things. Whatever the reason, it is a real shame that we can't take advantage of the situation, because I believe we could have a real impact.

So why am I spending the time in one of my columns to talk about this? Well, to be honest, I really don't know. It was just on my mind. An opportunity to reach a huge number of people with food safety training is something that doesn't happen every day. And what really bothers me about this is that the people who are actually watching are there to learn something anyway. So not only is there a large audience, many of them are watching to learn. What an incredible opportunity to advance food safety worldwide! I am afraid what they are currently learning is how to cross contaminate and undercook. And in my opinion, that is a real shame—and a lost opportunity.

Maybe you have some thoughts on how to address this situation. I would love to hear them, because, frankly, I am fresh out of ideas on this one. As always, you can contact me by E-mail at gacuff@tamu.edu.

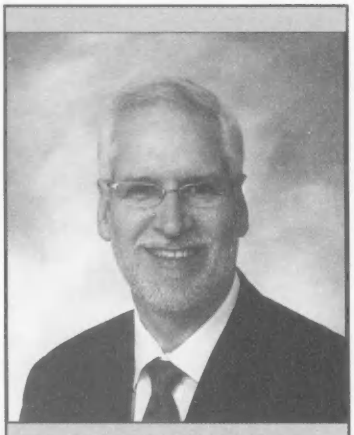
And, by the way, I hope you have already made your plans to attend the IAFP 2008 Annual Meeting in Columbus, Ohio. It is shaping up to be an outstanding meeting this year, and the only thing that can improve it at this point is your attendance. It is not too late to register, and we are counting on seeing you there.

"COMMENTARY" FROM THE EXECUTIVE DIRECTOR

Have you contributed to the IAFP Foundation recently? If you have, you are joined with more than 650 IAFP Members who contribute to the Foundation regularly and help to support many worthwhile projects. If you have not contributed recently, please read on to see what the Foundation does for IAFP!

The IAFP Foundation provides funding or full-support for many IAFP projects throughout the year. To simply provide a list would not be enough to inform you of how valuable the Foundation is to IAFP. Allow me to describe some of the programs supported by IAFP's Foundation. Let's start with how the Foundation helps promote student involvement in IAFP. The Foundation supports student activities through the Developing Scientist Competition at the Annual Meeting and by providing Travel Scholarships for students from North America and around the world.

The Developing Scientist Competition recognizes outstanding student presentations, both oral and poster, that take place at IAFP's Annual Meeting. Each year, there are between 70 and 90 students competing in this event. Ten students giving oral presentations and ten students with poster presentations are chosen as finalists. From these, three are selected through a judging process to be recognized in first, second and third places. A review of our past winners dating back to 1986 reveals many of today's IAFP leaders. Now how valuable can this program be? I think you can tell; its value is very great!



By DAVID W. THARP, CAE
EXECUTIVE DIRECTOR

"The IAFP Foundation helps further IAFP's mission around the world"

Our Student Travel Scholarship program began in 2005 with only two students receiving this support. For 2008, six students will receive travel scholarships bringing our total to seventeen students supported through this program. Of these 17, fifteen are still IAFP Members and two are now employed in food science positions. Of the six students coming to IAFP 2008, four of them are from outside of North America (one each from Korea, Australia, Ethiopia and Sweden). We are so very fortunate to have these students attend our Annual Meeting. It is exciting to see the enthusiasm in our scholarship winner's eyes when they have the opportunity to meet our active IAFP Members in person at the Annual Meeting. This is truly a life-changing opportunity for those selected to receive this honor.

Another very worthwhile project supported by the IAFP Foundation is our shipment of excess journals to scientists in developing countries through the United Nations Food and Agricultural Organization (FAO). Each year, we send complete volumes of both the *Journal of Food Protection* and *Food Protection Trends* directly to FAO in Rome, Italy. FAO then distributes through their network, to those scientists in need of this research information. These scientists are grateful to receive this information which they would not be able to otherwise obtain. This is truly a small investment made by the IAFP Foundation to help provide food safety information to those in need.

The IAFP Foundation also supports the Audiovisual Library containing more than 90 video tape and DVD titles. This information can be used by IAFP Members at no cost to the user. Simply "check it out" of the Library for a two-week period, then pay to return the material to IAFP. Our Audiovisual Library provides Members a very economical method to obtain training materials on a wide range of subjects.

IAFP's Foundation has sponsored the Ivan Parkin Lecture at the Annual Meeting each year

since 1986. In 2004, the John H. Silliker Lecture began and has been supported by the Foundation through an annual contribution from Silliker, Inc. In addition to these prestigious lectures, the Foundation has been instrumental in supporting the IAFP European Symposium, our Rapid Response Symposium and the Timely Topics Symposium. This has allowed IAFP to offer more to our Members each and every year without having to charge higher registration rates.

For each of these projects, you can quickly see the value that the IAFP Foundation provides for the organization. Whether it is supporting student activities, providing Member training through lectures or symposia or supplying scientists in need with information, the IAFP Foundation helps further IAFP's mission, around the world. Without the Foundation's support, these worthwhile projects would not be possible.

Please consider a financial contribution to IAFP's Foundation today!

ARTICLES

Food Protection Trends, Vol. 28, No. 6, Pages 380–390

6200 Aurora Ave., Suite 200W, Des Moines, IA 50322-2864

International Association for Food Protection

Alternative Methods to Pasteurization of Apple Cider Focusing on the Elimination and Reduction of *Escherichia coli* O157:H7

LINDA ANKENMAN GRANATA,[1] JACKIE WHITE[2] and GEORGE J. FLICK, JR.[1]*
[1]Dept. of Food Science and Technology, Virginia Tech, Duck Pond Drive, Blacksburg, VA 24061, USA;
[2]Water Chemistry, Inc., 3404 Aerial Way Drive SW, Roanoke, VA 24018, USA

SUMMARY

This paper discusses alternative methods for reducing and/or eliminating *Escherichia coli* O157:H7 in apple cider. Many cider producers are small, producing 5,000 gallons or less each year. Pasteurization equipment can be a detriment financially, and heat compromises the sensory quality of apple cider. Nonthermal alternative methods of reducing pathogen levels in apple cider include ozone, pulsed electric fields, radio frequency electric fields, hydrogen peroxide, spices and essential oils, ultra violet light radiation, freeze-thaw cycles and combination treatments, chemical sanitizer washes and high pressure processing. Each process has advantages and disadvantages, depending on cost, efficiency and required equipment.

INTRODUCTION

The concern over the safety of fresh apple cider arises from the incidence of foodborne illnesses caused by *Escherichia coli* O157:H7 found in fresh unpasteurized cider *(64)*. *E. coli* O157:H7 is a newly identified pathogen that has emerged in the past twenty years *(96)*. This pathogen can contaminate fresh produce through various means, including the use of raw or improperly composted manure, irrigation water containing untreated sewage, improper hand-washing techniques, or contaminated waste water.

E. coli O157:H7 has been involved in recent outbreaks of foodborne illnesses *(87)*. These illnesses can be as mild as self-limiting diarrhea or as harsh as severe bloody diarrhea, hemolytic-uremia (HUS), and hemorrhagic colitis *(14, 15)*. The organism *E. coli* O157:H7 produces a powerful toxin that can cause severe illness. Only very few of these invasive bacteria are needed to produce enough toxin to cause severe illness. The groups that have a higher risk of infection include young children (under 5), the elderly, and the immunocompromised *(45)*.

A peer-reviewed article

*Author for correspondence: 540.231.6965; Fax 540.231.9293
E-mail: flickg@vt.edu

Incidence

E. coli was first recognized as a cause of illness in 1982 during an outbreak of severe bloody diarrhea; that was traced to contaminated undercooked ground beef. Most *E. coli* outbreaks and sporadic cases have been associated with undercooked ground beef. However, with the increased amount of fresh produce consumed, there has been a corresponding rise in the number of reported cases of foodborne illness *(87)*.

Despite documented evidence that specific pathogens are capable of survival in fruit juices, until recently it was widely accepted that most low-pH, high-acid foods were of little concern for food poisoning outbreaks. This was based on the general knowledge that organic acids have an inhibitory and sometimes microbiocidal effect on many bacteria. Massachusetts had an outbreak from *E. coli* O157:H7 in raw cider in 1991 *(8, 15)*, and an outbreak of HUS in Connecticut in 1996 *(15)* was attributed to the consumption of apple cider contaminated with *E. coli* O157:H7. In 1980, Canadian physicians investigated a cluster of illnesses that were textbook examples of severe *E. coli* O157:H7 infections *(14, 91)*. Three to six days before onset of symptoms, all had consumed unpasteurized apple cider from a local farm.

Safety

Because of the recent rise in the number of foodborne illnesses associated with juice products, on January 18, 2001 the Food and Drug Administration announced a final rule designed to improve the safety of fruit and vegetable juice and juice products *(32)*. All juice sold as juice or for use as an ingredient in other beverages is subject to the requirements of the juice HACCP regulation, with the exception of juice produced at a retail establishment *(47, 48)*. The Food and Drug Administration placed a mandate, effective September 8, 1999, that every container of apple cider that has not been pasteurized or processed utilizing an acceptable alternative method must be labeled with the following warning statement. **WARNING: This product has not been pasteurized and, therefore, may contain harmful bacteria that can cause serious illness to children, the elderly, and persons with weakened immune systems.** This label is required on apple cider and other non-citrus juices, unless the product has been processed in a manner that will provide a minimum 5-log (100,000-fold) reduction in the pertinent microorganisms. Cider processors must use one or more processing steps to destroy 99.999% of the population of *E. coli* O157:H7 in their cider. It is worth noting that apple cider does not need a warning label if the processor utilizes a heat treatment step that is equivalent to or greater than the time/temperature relationships accepted for pasteurization.

Nonthermal alternatives being studied for potential use in reducing numbers of pathogens in apple cider include ozone *(1, 19, 92, 109)*, pulsed electric fields *(3, 26, 32, 36, 52, 115)*, combination treatments *(17, 80, 102)*, hydrogen-peroxide *(86)*, essential oils and cinnamon *(34, 119, 120)*, chemical sanitizer washes *(79, 112)*, UV light treatment *(73, 114)*, and high-pressure processing (HPP) *(11, 21, 28, 74)*, as well as others.

PASTEURIZATION

The apple cider industry in Wisconsin is characterized by small operations, with 93% of cider mills producing less than 20,000 gal per year *(102)*. Approximately 88% of the mills do not heat pasteurize their product, citing reasons of cost or anticipated changes in the quality of juice after pasteurization *(19, 102)*. Likewise, a large portion of the Virginia cider industry consists of small, seasonal operations that produce less than 5,000 gal of cider per year, and only 12% produce over 50,000 gal annually. Seventy-eight percent of Virginia apple cider producers do not pasteurize their cider, which is not surprising given the small size and seasonal nature of most Virginia operations. With the increase of illness associated with raw apple cider, 80% of Virginia cider producers surveyed said they would be interested in using alternative processing technologies to help assure the safety of their products *(113)*. Thermal pasteurization has been considered the most likely way that cider makers could achieve the specified pathogen reduction *(102)*. Estimated costs of pasteurization equipment range from $24,000–$30,000 to as high as $185,000 *(59, 63)*. There are other costs associated with pasteurization, including power, water, waste disposal, supplies, maintenance, labor, training and building redesign *(59)*. The estimated cost of pasteurizing apple cider using a plate heat exchanger is $0.0017 per liter for a plant that processes 107 liters per min and $0.0064 per liter for a plant that processes 30 liters per min *(59)*. Despite the costs, thermal pasteurization remains a reliable way for apple cider operations to produce safe apple cider.

Researchers at the University of Wisconsin-Madison determined that a temperature of 68.1°C for 14 s was the lowest heat treatment that resulted in a 5-log reduction of *E. coli* O157:H7 in apple cider *(102)*. This was demonstrated using an *Escherichia coli* O157:H7 cocktail and two surrogates, FRIK 185 and FRIK 859, in conjunction with frozen and fresh apple cider (not pasteurized, no preservatives) purchased from local orchards. The objectives of the study were to validate time/temperature pasteurization conditions in laboratory experiments, using temperatures lower than 71.7°C; to investigate the effect of pH and °Brix on *E. coli* O157:H7 and acid-adapted *E. coli* O157:H7 in apple cider; to validate lab results using a surrogate *E. coli* with a bench-top plate heat-exchange pasteurizer; and to investigate consumer acceptance of heat-pasteurized apple cider.

Both pH and °Brix may have an effect on the survival of pathogens in apple cider, so thermo-tolerance was first evaluated in pH and °Brix adjusted ciders. Splittstoesser et al. *(90)* reported that the thermo-tolerance of *E. coli* O157:H7 in apple juice was not affected by °Brix. Uljas et al. *(100)* concluded that pH had no consistent effect on thermo-tolerance of *E. coli* O157:H7. Plating on MacConkey agar with sorbitol indicated that sub-lethal injury was consistently seen at heat treatments up to 68.1°C for 7 s, regardless of pH or °Brix. Acid-adaptation experiments showed that the thermo-tolerance of the *E. coli* O157:H7 cocktail was unaffected by storage in apple cider for 4 or 24 h at 4°C *(100)*. A 5-log reduction was obtained by a pasteurization treatment of 68.1°C for 14 s after both 4 and 24 h of acid adaptation. Labo atory studies with fresh cider confirmed that pasteurizing at 68.1°C for 14 s would be sufficient to achieve a 5-log reduction in

E. coli O157:H7. Consumer acceptance of this pasteurized cider was high, with no significant difference in preference for cider pasteurized at 68.1°C for 14 s (research recommendations) versus cider pasteurized at 71.1°C for 6 s, (New York State recommendations *(100)*.

ALTERNATIVE METHODS

Ozone

Ozone, the triatomic allotrope of oxygen, is characterized by high oxidation potential, bactericidal and viricidal properties *(10, 41, 55)*, and a high diffusion capability through biological membranes *(43)*. Ozone results from the rearrangement of atoms when oxygen molecules are subjected to high-voltage electric discharge *(54)*, producing a very unstable and reactive molecule. As a disinfectant, in gaseous form or dissolved in an aqueous solution, ozone quickly destroys the microorganisms it contacts leaving behind only common oxygen. The lethal effect of ozone is caused by its high oxidation potential, reacting up to 3,000 times faster than chlorine with organic material *(27)*. Ozone is readily soluble in water, and its solubility increases with decreasing temperatures *(39, 92)*. Ozone has been evaluated for its efficacy in preserving foods including, milk, gelatin, albumin, casein, and meat products *(55)*.

In July 1997, ozone was deemed "generally recognized as safe" (GRAS) as a disinfectant for foods by an independent panel of experts sponsored by the Electric Power Research Institute. Prior to July 1997, the only use of ozone in food products was for the storage of meat in gaseous ozone, approved by USDA in 1957. Processors of fresh fruits, vegetables, poultry, and red meats are examining ozone as one of several new technologies to ensure food safety.

Organic load present during treatment is known to decrease the effectiveness of ozone as a disinfectant. Restaino et al. *(76)* found that the type of organic material present affects ozone efficiency more than the amount. Apple cider contains sugars, pectic substances and compounds such as ascorbic acid that may react with ozone, causing delayed inactivation of microorganisms *(109)*. Lag times are also dependent on the type of microorganisms being treated, as well as the presence of other organic material.

Streenstrup and Floros *(92)* indicate that there may be a critical concentration of dissolved ozone that marks the onset of microbial inactivation. Dissipation of ozone from treated apple cider was very slow; after 2 h the dissolved ozone concentration was still about 5 mg/L. The long dissipation time also indicates that once ozone is present in concentrations greater than what is needed to oxidize organic material in the cider, there may be difficulty in obtaining a cider free of residual ozone. Applying ozone at doses that are large enough for effective decontamination may change the sensory qualities of food products *(54)*.

A study by Achen and Yousef *(1)* to define conditions for effective ozonation processes of whole apples inoculated with *E. coli* O157:H7 (ATCC 35150) showed promising results. Dipping inoculated apples in ozonated water was compared to washing the apples in bubbling ozone water. Pretreatments were also used to enhance the effectiveness of ozone: (1) Sterile distilled water was sprayed on apples before the ozone treatment. The water spray was directed for 10 s at the calyx and the stem ends of inoculated apples. (2) Apples were cored, before or after ozone treatment, to physically remove the hard-to-reach *E. coli* O157:H7 contaminants. (3) The apples were dipped in a 0.1% solution of the wetting agent tetrasodium pyrophosphate at 22 to 24°C and agitated for 3 min. The results showed maximum decrease in surface counts for *E. coli* O157:H7 of 3.7- and 2.6-log CFU/g when apples were treated for 3 min by washing in water with bubbling ozone or dipped in ozonated water. The study also showed that water temperature had little effect on results of different treatments. The residual ozone concentration was greatest at 4°C and decreased with increasing temperature *(1)*.

Another study involving ozone and temperature gave similar results. Kinman *(57)* reported that when bacteria were treated with ozone at 0°C to 30°C, treatment temperature had virtually no effect on the disinfection rate. It has been stated that when treatment temperature increases, the increase in ozone reactivity compensates for the decrease in its stability, so that no appreciable change in efficacy is observed *(1)*.

An important concern related to ozone is its toxicity. Low concentrations of ozone (~0.1 mg/L) cause irritation to the nose, throat, and eyes *(110)*. Thorp *(99)* indicated that a one hour exposure to ozone concentrations of 2, 4, 15, and 95 mg/L induces symptomatic, irritant, toxic, and irreversible lethal effects, respectively, in humans. In the final rule, OSHA is retaining the 8 h TWA limit of 0.1 ppm and establishing a 15-min Short Term Exposure Limit of 0.3 ppm *(46)*. Other problems associated with ozone processing include juice foaming and off-gassing of ozone difficulties associated with determination of ozone concentration.

Pulsed electric fields

High intensity pulsed electric fields (PEF) involves the application of pulses of high voltage (typically between 20 and 80 KV/cm) to foods placed between 2 electrodes. PEF treatment is conducted at ambient, sub-ambient, or slightly-above-ambient temperature for less than 1 s, and energy loss due to heating of foods is minimized. For food quality attributes, PEF technology is considered superior to traditional heat treatment of foods because it avoids or greatly reduces the detrimental changes of the sensory and physical properties of foods. To date, PEF has been applied to preserve the quality of foods; and to improve the shelf life of bread, milk, orange juice, liquid eggs, and apple juice; and to improve the fermentation properties of brewer's yeast. According to Qin et al. *(72)*, PEF is more energy-efficient than thermal pasteurization, particularly when a continuous system is used.

Two mechanisms have been proposed as the mode of action of PEF on microorganisms: electrical breakdown and electroporation. According to Zimmermann *(123)*, electrical breakdown causes the cell membrane to develop a membrane potential difference V due to charge separation across the membrane. In contrast, electroporation is the process in which cells exposed to high voltage electric field pulses undergo temporary destabilization of the lipid bi-layer and proteins cell membrane *(13)*. The main effect of an electric field on a microorganism is to increase membrane permeability through membrane compression and effects on pore size *(31, 106)*.

PEF technology is covered in detail in a report from FDA's CFSAN; the FDA report *(31)* describes three types of critical process factors that affect microbial inactivation with use of PEF: (1) the process (electric field intensity, pulse width, treatment time and temperature, and pulse wave shapes), (2) microbial entity (type, concentration, and growth stage of microorganisms), and (3) treatment media (pH, antimicrobials, ionic compounds, conductivity, and medium ionic strength).

Experimental results have demonstrated that, in challenge tests, both treatment temperatures and process temperatures impact microbial survival and recovery *(31)*. PEF treatments at moderate temperatures (50 to 60°C) have been shown to exhibit synergistic effects on the inactivation of microorganisms *(25, 51)*. The FDA reports indicate that constant electric field strength inactivation increases with increased temperature. Because the application of electric field intensity does cause some increase in the temperature of the foods, proper cooling is necessary to maintain food temperatures far below those generated by thermal pasteurization *(31)*. The effect of temperature was observed when *E. coli* reduction increased from 1- to 6.5-log with a temperature change of 32 to 55°C *(105)*.

Gram positive organisms are more resistant to PEF than Gram negative organisms *(31)*. Yeasts are more sensitive to electric fields than bacteria because of their large size, although at low electric fields they seem to be more resistant than Gram negative cells *(72, 83)*. *E. coli* cells in the logarithmic phase were more sensitive to PEF treatment cells in the stationary and lag phase *(71)*. The number of microorganisms in food may have an effect on their inactivation with electric fields *(31)*. Researchers have reported that smaller microorganisms are more difficult to inactivate than larger microorganisms because cross-membrane potential depends on the size of the cell. Smaller cells develop smaller membrane potential, resulting in less inactivation of cells *(58, 61)*. Therefore, higher field intensity is required to inactivate smaller as opposed to larger microorganisms *(66)*.

The FDA has reported on several technical drawbacks of PEF technology. First is the limited availability of commercial units. Second, the presence of bubbles can lead to non-uniform treatment as well as operational and safety problems. Third, the process is restricted to food products that can withstand high electric fields. Fourth, the maximum particle size in the liquid must not be smaller than the gap of the treatment region in the chamber if a proper processing operation is to be maintained. Last, methods to measure treatment delivery accurately are lacking.

PEF processing is being investigated in order to extend the shelf life of food while avoiding the adverse effects on sensory properties of foods associated with thermal processing. *E. coli* O157:H7 was found to be very PEF resistant in apple juice. Similar results were observed by Iu et al. *(50)* and Ravishankar et al. *(75)*. Garcia et al. *(35)* attribute this phenomenon to the low pH of juice. Results demonstrate that PEF treatment of up to 25 kV/cm causes sublethal injury but not a 5-log reduction of *E. coli*. Results from a PEF treatment of 22 to 25 kV/cm for 400 µs and subsequent refrigerated temperatures may indeed achieve a 5-log reduction of *E. coli* O157:H7. Prolonged refrigeration storage with a PEF of less than 22 kV/cm did not achieve a 5-log reduction. Optimum conditions are 48 h refrigeration storage after a 25 kV/cm for 400 µs treatment. Overall it was demonstrated that a combination of PEF and refrigerated storage conditions was effective in reducing *E. coli* as recommended by the US FDA *(36)*.

The energy requirement for pasteurization by PEF is estimated at 100 to 400 J/ml, compared to thermal pasteurization, which requires only 30 to 40 J/ml. Pulsed electric field equipment is extremely specialized. The high pulse frequency and large scale of operation for industrial applications, the charging power supply and high-speed electrical switch are the major costs of the pulse generator *(121)*. The results of the FDA report indicate that PEF has the potential for commercial use in the cider industry.

Radio frequency electric fields

Radio frequency electric fields (RFEF) processing is similar to PEF processing in that high electric fields are applied to liquids for extremely short periods at moderately low temperatures *(123)*. The PEF generator consists of a charging power supply and high-speed electric switch, whereas the RFEF generator consists of a simple AC power supply *(38)*. Geveke and Brunkhorst *(38)* examined RFEF processing for treating apple juice containing bacteria at moderately low temperatures. They found that RFEF significantly reduces the population of *E. coli* K12 in apple juice at 45°C. Inactivation is dependent on the temperature, number of treatment stages, and electric field strength up to 16 kV/cm. Significantly greater inactivation occurs at radio frequencies between 15 and 20 kHz. Inactivation is independent of initial microbial concentration in the range of 4- to 6-log CFU/ml. They reported a 3-log reduction with a 3-step process at 18 kV/cm and 50°C, with a calculated electrical cost of $0.015/gal; conventional thermal pasteurization requires $0.002/gal. The process does not yet meet the standard of a 5-log reduction in *E. coli*.

Ultraviolet light

Ultraviolet (UV) processing involves the use of radiation from the ultraviolet region of the electromagnetic spectrum for purposes of disinfection *(30)*. The wavelength for UV processing ranges from 100 to 400 nm, with wavelengths between 200 to 280 nm considered the germicidal range because it effectively inactivates bacteria and viruses, and with the greatest effect at wavelengths between 250 and 260 nm *(68, 117)*. UV has been used for years for water sterilization, showing effectiveness against a wide variety of microorganisms *(4, 114, 116)*. It has also been used successfully on beef *(53, 93)*, fish *(42)*, and poultry *(94, 107)* to control bacteria and increase shelf life while causing little effect on food quality *(114)*. The FDA approved the use of UV irradiation to effectively achieve the 5-log reduction of pathogens in fruit and vegetable juice products.

According to the FDA *(31)*, to achieve microbial inactivation, the UV radiant exposure must be at least 400 J/M² in all parts of the product. Critical factors include the transmissibility properties of the product, the geometric configuration of the reactor, the power, wavelength and physical arrangement of the UV sources,

the product flow profile, and the radiation path length. Pressure, temperature, and pH of the medium appear to have little effect on the absorption properties. Product composition, solids content, color, starches, and the overall chemistry of the food have a major effect. The presence of dissolved solids can greatly decrease the effectiveness of UV radiation; apple cider contains between 9.8 to 16.9% dissolved solids *(65)*.

A study by Wright et al. *(114)* using UV light for the reduction of *E. coli* O157:H7 in apple cider resulted in a 3.1-to 5.4-log reduction. The highest reduction was obtained when cider with very low initial levels of yeasts and molds (< 1-log CFU/mL) was subjected to the highest UV dosage tested (61,005 µW-s/cm²). However, levels of background microflora, especially yeasts, in cider are typically higher than 1-log CFU/mL. Their study concluded that with the equipment used, the FDA mandate for a 5-log reduction of *E. coli* O157:H7 in apple cider would not likely be met using UV light alone *(114)*. Worobo *(111)* reported a 5-log reduction in *E. coli* O157:H7 in apple cider using a *CiderSure* 3500 UV unit. Fresh cider was inoculated with *E. coli* O157:H7 ATCC 43889 and ATCC 43895. The *CiderSure*3500 UV unit is programmed to automatically compensate for differences of total solids and color in apple cider, ensuring that all apple cider achieves the appropriate UV exposure to achieve a 5-log reduction. Worobo *(111)* reported between 5.83- and 6.12-log reductions of the *E. coli* strains used. Worobo, in association with FPE, Inc. has designed a UV unit for apple cider that could cost as little as $6,000, compared to $30,000 for pasteurization equipment *(59)*. Quintero-Ramos et al. *(73)* have also shown that UV light is effective against *E. coli* O157:H7 in apple cider. They were able to consistently reduce *E. coli* 5- to 6-logs with a minimum dose of 6,500 to 9,781µJ/cm².

Since approval by the Food and Drug Administration, UV processing has become an essential process in the success of the *Naked Foods*® line of fresh refrigerated juices marketed by California Day-Fresh Foods, Inc., Glendora, CA. *(40)*. The company's proprietary UV technology is patented under the name *Light Process*. This early adopter sees UV technology as a key competitive advantage that provides a cost-effective alternative to heat pasteurization and preservatives. Other major companies working to expand the processing capabilities of UV light include Aquionics, Erlanger, KY, and Safe Foods Corp., North Little Rock, AR *(40)*.

High pressure processing

High pressure processing (HPP) is a promising alternative to heat pasteurization for preservation of minimally processed foods without additives or preservatives *(6, 116)*. HPP is the technology by which a food product is treated with pressure between 100 and 900 MPa. Pressure is transmitted uniformly and instantaneously throughout the food, which results in homogeneous treatment of the product *(74)*. High pressure inactivation of vegetative microorganisms is caused by membrane damage, protein denaturation, and decrease of intracellular pH, suggesting that pressure results in deactivation of membrane-bound enzymes associated with efflux of protons *(88)*. A major advantage in using HPP is that it can destroy some microorganisms and undesirable enzymes in foods while leaving flavor molecules, vitamins, and pigments largely unaffected *(2, 12, 56, 95)*.

It has been reported that the pH of fruit juices can affect a microorganism's response to pressure *(60, 70, 116)*. Various studies have shown that the higher the pH, the more resistant microorganisms are to pressure treatment *(37, 60, 81, 88, 116)*. High acid foods, with pH less than 4.0, can be preserved by use of pressures of 580 MPa or higher with a process hold time of 3 min. This treatment has been shown to result in a 6-log reduction of *E. coli* O157:H7, *Listeria* spp. and *Staphylococcus* spp. *(31)*. Yeow-lim et al. *(116)* used 615 MPa for 2 min at 15°C on a 3 strain *E. coli* O157:H7 (SEA13B99, ATCC 43895, and 932) cocktail in grapefruit juice (pH 3.0) and reported a 8.34-log reduction, but only a 0.41-log reduction was obtained in apple juice (pH 3.7).

Temperature may also have an effect on the reduction of *E. coli* by use of HPP. Garcia-Graells et al. *(37)* reported a 5-log reduction of high pressure-resistant mutants of *E. coli* in apple juice (pH 3.3) after use of 300 MPa for 15 min at 20°C.

Chlorination and irradiation

Chlorination is the most common procedure used in the food industry to disinfect fresh produce *(7)*. It helps prevent cross contamination and reduces microbial loads. Chlorination does not completely eliminate pathogens. Irradiation on the other hand does eliminate pathogenic bacteria, as well as parasitic and protozoan pathogens. *E. coli* O157:H7 has been shown to be sensitive to radiation *(104)*. The FDA has approved irradiation up to 1.0 kGy for use on fruits and vegetables to control sprouting and for insect disinfestations *(30)*, but not for pathogen reduction. Foley et al. *(33)* combined a chlorine wash with low dose gamma irradiation to treat *E. coli* inoculated cilantro. They reported that a low dose of 0.56 kGy was enough to eliminate between 4.1- and 5.3-log cycles of *E. coli*. Repeated experimentation has revealed that 1.0 kGy will inactivate at least a 5-log cycle of *E. coli* on shredded lettuce, diced celery, and cilantro. A combination of irradiation at 1.05 kGy and chlorination was reported to reduce *E. coli* O157:H7 more than 7-log cycles on inoculated cilantro.

Freeze thaw combinations and preservatives

Freezing is a common method of extending the shelf life of apple cider and has been shown to have considerable lethality against *E. coli* O157:H7 *(102)*. Freezing can extend the shelf life of cider and reduce *E. coli* O157:H7 from 0.63- to 3.43-log CFU/ml *(82, 102)*. Uljas and Ingham *(101)* examined the separate and combined effects of short-term storage (0 to 12 h and 4, 25 or 35°C), freeze-thawing (48 h at -20°C; 4 h at 4°C) and addition of organic acids (lactic, sorbic and propionic). They reported that a 5-log reduction of *E. coli* O157:H7 in cider with pH 3.3 was achieved by a freeze-thaw cycle, -20°C for 48 h, or storage at 35°C for 6 h. For cider with pH 3.7, storage for 6 h at 4°C, 2 h at 25°C or 1 h at 35°C combined with the freeze-thaw cycle reduced *E. coli* by > 5-log. The addition of 0.1% lactic acid with 4 h storage at 35°C or 0.1% sorbic acid with 12 h storage at 25°C resulted in a 5-log reduction. For a 5-log reduction in cider tested at pH 4.1 a 6-h storage at 35°C plus freeze-thawing was required; or 0.1% sorbic acid and 12-h storage at

25°C plus freeze-thawing was required; or 0.1% sorbic acid and 4 or 6 h at 35°C plus freeze-thawing was required. Cider that was stored, freeze-thawed, or stored and then freeze-thawed was significantly ($P < 0.05$) preferred over pasteurized cider for taste. However, pasteurized cider was found to be significantly ($P < 0.05$) better than cider with 0.1% sorbic or lactic acid in combination with storage and freeze-thawing. Uljas and Ingham *(101)* were able to show that combined treatments exposing cells to the low pH of the cider, warm temperature, and/or added organic acids did in fact sensitize *E. coli* O157:H7 cells to subsequent freezing and thawing. The results showed that the survival of *E. coli* O157:H7 in apple cider during a 6 h storage period was inversely related to storage temperature.

Uljas et al. *(102)* reported that a 5-log reduction was most probable when cider contained 0.05 or 0.1% sorbate or benzoate, had a pH between 3.1 and 3.9, was stored at 25°C for up to 12 h or at 35°C for up to 6 h, and went through freeze-thawing. The study determined cider pH to be the most important factor affecting the probability of a 5-log reduction of *E. coli* O157:H7, followed by temperature and then time. The preservative concentrations were also always significant ($P < 0.001$). According to the authors, benzoate was more effective than sorbate in reducing cell populations. Therefore, if a lower preservative concentration is preferred for optimal organoleptic properties, benzoate allows the user to reduce concentrations and still maintain overall effectiveness of the preservative, especially if a freeze/thaw treatment is applied *(102)*.

Commonly used food additives in cider, such as potassium sorbate and sodium benzoate, have been shown to have a minimal lethal effect on *E. coli* O157:H7 *(101)*. A 0.1% solution of sodium benzoate has been shown to cause a 5-log reduction in *E. coli* O157:H7 during 2 to 10 days at 8°C *(101, 122)*. However, concentrations of benzoate higher than 0.0125% reportedly impart a noticeable taste *(84, 101)*. The survival of *E. coli* O157:H7 in fresh unpasteurized cider has been shown to exceed the typical 1 to 2 week refrigerated shelf life *(67, 78)*. Refrigeration is an essential part of extending the shelf life of apple cider; however, if *E. coli* O157:H7 is present in cider; refrigeration will enhance its survival *(67, 100, 122)*.

Spices and plant essential oils

Spices, condiments and plant extracts have strong medicinal, preservative and antioxidant properties and thus contribute to overall safety and preservation of foods and beverages *(5)*. Cinnamon effectively inhibits growth of bacteria (with Gram-positive being more sensitive than Gram-negative), and yeasts and molds *(90)*. Cinnamon contains cinnamaldehyde and eugenol as the major compounds responsible for microbial inactivation.

Ceylon et al. *(16)* reported that cinnamon inactivated *E. coli* O157:H7 at temperatures of 8 and 25°C. Yuste et al. *(119)* investigated the combined effect of cinnamon and CO_2 on apple cider stored at 5°C, inoculated with *E. coli* O157:H7. They found the addition of 1 and 4% CO_2 did not change the pH of the apple cider (initial pH was 3.65; after CO_2 addition pH was between 3.61 and 3.71). The combined effect of CO_2 and cinnamon does inhibit *E. coli* in apple cider, but not by 5-logs. Day 7 at 5°C with 4% CO_2 and 0.3% cinnamon resulted in the first non-detected levels of *E. coli*. The conclusion is that cinnamon and CO_2 do inhibit *E. coli* but to a small extent.

Friedman et al. *(34)* studied the effect of 26 essential oils/oil compounds for their inhibitory effect on *E. coli* in both clear and cloudy commercial apple juice and four freshly prepared apple juices. The ten essential oils found most effective against *E. coli* were carvacrol, oregano oil, geraniol, eugenol, cinnamon leaf oil, citral, clove bud oil, lemongrass oil, cinnamon bark oil, and lemon oil.

Fumaric acid and sodium benzoate

A study by Comes and Beelman *(18)* showed that a combination of fumaric acid and sodium benzoate (0.15% and 0.05% w/v respectively) was effective in reducing the *E. coli* populations in apple cider by 5-log units. The temperatures used were 25°C for 6 h, and 35°C for 3 h. The combination of fumaric acid and sodium benzoate was more effective than a combination of fumaric acid and potassium sorbate in reducing *E. coli*, and even fumaric acid alone was more effective than sodium benzoate and potassium sorbate together. Chikthimmah et al. *(17)* went a step further and studied the effect of fumaric acid and sodium benzoate under different storage temperatures and pH ranges. A 5-log reduction of *E. coli* was reported for 4 cider varieties after 9 h storage at 25°C. They found that increasing storage temperature to between 15 and 25°C significantly increased *E. coli* destruction. The higher the holding temperature, the faster a 5-log reduction was reached (5 h at 25°C and 3 h at 35°C). The pH was determined to be an important factor. If the pH is > 3.8, the addition of fumaric acid and sodium benzoate may not be practical. For apple cider between pH 3.2 and 3.8 addition of the mixture was shown to reduce the *E. coli* by at least 5-log units.

Chemical sanitizers

Although chlorine is the most commonly used chemical sanitizer, there are other alternatives. Chlorine compounds can react with trace amounts of organic material on fresh produce to form various carcinogenic organochlorine compounds *(77)*. Chlorine compounds are also rapidly inactivated by organic material, which is inherent to fresh produce *(79)*. Peroxyacetic acid, another approved food grade sanitizer, is not corrosive like chlorine, its effectiveness is not dictated by temperature, the presence of organic matter will not lower its effect and Hwang et al. *(44)* reported a reduction in pesticide residue after its use. Rodgers et al. *(79)* studied the effectiveness of chlorine dioxide, ozone, and peracetic acid to chlorinated trisodium phosphate for inactivating *E. coli* O157:H7 on raw inoculated apples, strawberries, lettuce and cantaloupe. They reported that peracetic acid (80 ppm), chlorinated trisodium phosphate (100 and 200 ppm), chlorine dioxide (3 and 5 ppm), and ozone (3 ppm) effectively decreased the numbers of *E. coli* and *L. monocytogenes* on fresh produce. Chlorine dioxide and ozone were the most effective, while chlorinated trisodium phosphate and peroxyacetic acid were less effective, but better at retarding yeasts and molds during refrigerated storage.

Chlorine dioxide has 2.5 times the oxidation capacity of chlorine and is generally more effective than chlorine. Chlorine dioxide does not react with ammonia to form chloramines and is less reactive toward organic compounds, so fewer toxic, mutagenic byproducts are formed when chlorine dioxide is used.

Chlorine dioxide (ClO_2) is a strong oxidizing and sanitizing agent that has broad and high biocidal effectiveness. The FDA now allows the use of ClO_2 as an antimicrobial agent in water to wash fruits and vegetables *(29)*. Du et al. *(23)* reported a 5.5-log reduction of *Listeria monocytogenes* on the skin surface of apples and a 3-log reduction on the stem and calyx cavities with use of 4.0 mg/l ClO_2 for 10 min at 90% relative humidity and 22°C. Du et al. *(24)* then investigated the reduction of *E. coli* using ClO_2, striving for a 5-log reduction on the skin surface and at least a 3-log reduction on the stem and calyx cavities. A 3.7-log reduction in the calyx area was reached with ClO_2 levels of 12.0 mg/l for 10 min, 21°C and 90–95% RH. A 3.0-log reduction was reached in the stem area with ClO_2 at 12.0 mg/l and a 3.8-log reduction when ClO_2 concentration was increased to 18.0 mg/l. A 7.2 mg/l treatment for the skin resulted in a 5.8-log reduction with no visible surface discoloration. Treatment time, RH conditions, temperatures and ClO_2 concentrations are important variables in the reduction of *E. coli* on whole apples. Treating the whole apples before pressing may be a very viable alternative.

Electron beam irradiation

Low-dose irradiation (< 10 kGy) is effective in pathogen reduction *(9, 69, 97, 98, 103, 104)* and could be an alternative to pasteurization. Wang et al. *(108)* conducted a study to determine the dose of ionizing radiation needed to reduce *E. coli* by 5-log units. The study demonstrated that an irradiation treatment of 2.47 kGy could achieve a 5-log reduction of acid-resistant *E. coli* O157:H7 in apple cider along with elimination of most of the background microorganisms.

Hydrogen peroxide

Hydrogen peroxide (H_2O_2) is an antiseptic that acts quickly to kill microorganisms and has no long-term or preserving effect *(62)*. The antimicrobial action of hydrogen peroxide is not due to its oxidative properties as a molecule, but primarily to the production of other powerful oxidants such as singlet oxygen, superoxide radicals, and the hydroxyl radical *(20)*. These reactive oxygen species cause irreversible damage to a host of cell components such as enzymes, membrane constituents, and DNA.

Hydrogen peroxide has been used as an antimicrobial agent since the early 1800s, and is well known for its use as a topical skin application at 3% concentrations *(20)*. In foods, hydrogen peroxide was used as a disinfectant in milk as early as 1904 *(62)*. For antimicrobial purposes, H_2O_2 is allowed for treating milk used in cheese manufacturing, thermophile-free starch production, and the preparation of modified whey, at levels of 0.05, 0.15, and 0.4% respectively. It is used as an oxidizing and reducing agent in wine, dried eggs, and corn syrup, and as a bleaching agent in tripe, beef feet, instant tea, colored cheese whey, and certain emulsifiers.

Research related to the activity of hydrogen peroxide on various bacteria, molds, and yeast has been performed. Sapers et al. *(85)* washed apples in solutions containing hydrogen peroxide, alone and with commercial sanitizing agents; the population reductions achieved for *E. coli* were as great as 3- to 4-log CFU/g. Doyle et al. *(22)* reported > 5-log reduction in *E. coli* O157:H7 on apples treated with 1.5% lactic acid plus 1.5% hydrogen peroxide for 15 min at 40°C. The study used a spot inoculation method, preliminary trials on the treatment of apples with 1.5% lactic acid plus 1.5% hydrogen peroxide for 15 min at 40°C revealed that the sensory qualities of apples were not adversely affected by the treatment.

Schurman *(86)* examined the effects of H_2O_2 in combination with malic acid on *E. coli* in apple cider; results showed that cells were reduced to undetectable numbers (< 1 CFU/ml) within 48 h for most treatment combinations. An analysis after 24 h showed that averaged over temperatures, H_2O_2 and malic acid concentration were significant factors in microbial reduction ($P < 0.05$). Thus, increasing the concentration of either factor significantly decreased the number of viable *E. coli* O157:H7 cells.

Two important observations were noted in regard to temperature. First, at both malic acid concentrations, 0.017% H_2O_2 reduced *E. coli* O157:H7 to undetectable levels within 24 h at 25°C, whereas at 4°C, between 1- and 2-log CFU/ml were cultured on TSAN. Second, at 25°C and the lowest treatment level (0.012% H_2O_2 + 0.1% malic acid), bacterial survival was observed for the duration of the experiment, except at 4°C for 96 h *(86)*. After 24 h, *E. coli* O157:H7 had decreased to 0.84-log CFU/ml, but at 96 h, approximately 4.5-log cells had regained their ability to grow in TSAN. Results indicate that H_2O_2 at levels of 0.017% or above is an effective antimicrobial for *E. coli* O157:H7.

A cause for concern in utilizing H_2O_2 as an antimicrobial agent is gas formation (foaming). Schurman *(86)* reported that at 0.015% H_2O_2, the degree of gas production in treated juices appeared dependent on both time and temperature. Gas liberation was obvious in 10 and 25°C samples for the duration of the experiment, but noticeably decreased in volume from 12 to 24 h, indicating a decrease in H_2O_2 concentration. Samples at 40°C had very little gas production at 12 h, and none at 24 h *(86)*.

CONCLUSION

The United States Department of Agriculture Economic Research Service (ERS) estimates that in the United States, foodborne *E. coli* O157:H7 caused 73,480 illnesses, 2,168 hospitalizations, and 61 deaths in 1997. The estimated cost for cases in 1997 is $405.2 million dollars (in 2003 dollars). Premature deaths cost $370 million, medical care cost $30 million and lost productivity cost $5 million.

New techniques used to achieve the required 5-log reduction in *E. coli* O157:H7 from apple cider and apple juice are emerging constantly. Research shows that the most effective and proven method for achieving the 5-log reduction in *E. coli* O157:H7 in apple juice and cider is pasteurization. However, most cider mills are small seasonal operations that cannot afford the costs of equipment needed to pasteurize. With the increase in the already large economic burden due to foodborne *E. coli* O157:H7, the cider industry has expressed an interest in alternative processing techniques to achieve the 5-log reduction in *E. coli* O157:H7 in their products.

The methods discussed have the potential to be used as alternatives to pasteurization. Some techniques can achieve the reduction alone, others in combination. Pulsed electric fields has promise and is already approved by the FDA. More research is needed to find ways to reduce the cost, expand applications, and accurately measure PEF levels.

Ultraviolet light appears very promising, with the Cidersure 3500 being approved in December 2000. The cost is manageable, FDA has approved UV light for other applications and it seems reliable. High pressure processing can also be promising, with little or no changes in sensory characteristics and proven performance. The cost of HPP equipment may be prohibitive to smaller producers. The freeze-thaw method also seems like an easy, inexpensive way to eliminate *E. coli* O157:H7. It is clear from this critical review that more research is needed both on the alternatives already discussed and on potential new alternatives to pasteurization to achieve a 5-log reduction in *E. coli* O157:H7 from apple cider and apple juice so as to create safe products while maintaining their unique, enjoyable flavor.

REFERENCES

1. Achen, M., and A. E. Yousef. 2001. Efficiency of ozone against *Escherichia coli* O157:H7 on apples. J. Food Sci. 66 (9):1380–1384.
2. Ashie, I. N. A., and B. K. Simpson. 1996. Application of high hydrostatic pressure to control enzyme related fresh seafood texture deterioration. Food Res. Int. 29:569–575.
3. Ayhan, Z., Q. H. Zhang, and D. B. Min. 2002. Effects of pulsed electric field processing and storage on the quality and stability of single-strength orange juice. J. Food Prot. 65(10):1623–1627.
4. Bachman, R. 1975. Sterilization by intense ultraviolet radiation. The Brown Boveri Rev. 62:206–209.
5. Bahk, J., A. E. Yousef, and E. H. Marth. 1990. Behavior of *Listeria monocytogenes* in the presence of selected spices. Lebenm-Wiss Technol. 23:66–69.
6. Barbosa-Canovas, G. V., U. R. Pothakamury, E. Palou, and B. Swanson. 1997. Nonthermal preservation of foods, Marcel Dekker Inc. New York.
7. Beuchat, L. R., and J-H. Ryu. 1997. Produce handling and processing practices. Emerg. Infect. Dis. 3(4):1–10.
8. Bresser, R. E., S. M. Lett, J. T. Weber, M. P. Doyle, T. J. Barrett, J. G. Wells and P. M. Griffin. 1993. J. American Med. Assoc. 268(17):2217.
9. Buchanan, R. L., S. G. Edelson, K. Snipes, and G. Boyd. 1998. Inactivation of *Escherichia coli* O157:H7 in apple juice by irradiation. Appl. Environ. Microbiol. 64(11): 4533–4535.
10. Burleson, G. R., T. M. Murray, and M. Pollard. 1975. Inactivation of viruses and bacteria by ozone with and without sonication. Appl. Microbiol. 29:340–344.
11. Butz, P., Y. Serfert, A. Fernandez Garcia, S. Dieterich, R. Lindauer, A. Bognar, and B. Tauscher. 2004. Influence of high-pressure treatment at 25°C and 80°C on folates in orange juice and model media. J. Food Sci. 69(3):SNQ117–121.
12. Cano, M. P., A. Hernandez, and B. D. Ancos. 1997. High pressure and temperature effects on enzyme inactivation in strawberry and orange products. J. Food Sci. 62:85–88.
13. Castro, A. J., G. V. Barbosa-Canovas, and B. G. Swanson. 1993. Microbial inactivation of foods by pulsed electric fields. J. Food Process Pres. 17:47–73.
14. Center For Disease Prevention & Epidemiology, Oregon Health Division CD Summary, November 26, 1996. Vol 45, No 24.
15. Centers for Disease Control and Prevention. 1997. Outbreak of *Escherichia coli* O157:H7 infection and cryptosporidiosis associated with drinking unpasteurized apple cider – Connecticut and New York, October 1996. MMWR. 46(1):4–8.
16. Ceylan, E., J. R. Sabah, and D. Y. C. Fung. 1999. Effect of cinnamon on *Escherichia coli* O157:H7 in apple juice. In: Preceedings of the Food Safety Consortium Annual Meeting, Afton, OK. P 152–160.
17. Chikthimmah, N., L. F. LaBorde, and R. B. Beelman. 2003. Critical factors affecting the destruction of *Escherichia coli* O157:H7 in apple cider treated with fumaric acid and sodium benzoate. J. Food Sci. 68(4):1438–1442.
18. Comes, J. E., and R. B. Beelman. 2002. Addition of fumaric acid and sodium benzoate as an alternative method to achieve a 5-log reduction of *Escherichia coli* O157:H7 populations in apple cider. J. Food Prot. 65:476–483.
19. Choi, L. H., and S. S. Nielsen. 2004. The effects of thermal and nonthermal processing methods on apple cider quality and consumer acceptability. J. Food Quality 28:13–29.
20. Davidson, M. P., and A. L. Branen. 1993. Antimicrobials in foods. 2nd ed. Marcel Dekker, Inc. New York.
21. Deliza, R., A. Rosenthal, F. B. D. Abadio, C. H. O. Silva, and C. Castillo. 2005. Application of high pressure technology in the fruit juice processing: benefits perceived by consumers. J. Food Engineering 67:241–246.
22. Doyle, M. P., K. S. Venkitanarayanan, C-M. Lin, and B. Hannalore. 2002. Inactivation of *Escherichia coli* O157:H7, *Salmonella* Enteritidis, and *Listeria monocytogenes* on apples, oranges, and tomatoes by lactic acid with hydrogen peroxide. J. Food Prot. 65(1):100–105.
23. Du, J., Y. Han, and R. H. Linton. 2002a. Inactivation by chlorine dioxide gas (ClO_2) of *Listeria monocytogenes* spotted onto different apple surfaces. Food Microbiol. 19:481–490.
24. Du, J., Y. Han, and R. H. Linton. 2002b. Efficacy of chlorine dioxide gas in reducing *Escherichia coli* O157:H7 on apple surfaces. Food Microbiol. 20:583–591.
25. Dunn, J. E., and J. S. Pearlman. 1987. Methods and apparatus for extending the shelf-life of fluid food products. Maxwell Laboratories, Inc. U.S. Patent 4,695,472.
26. Elez-Matinez, P., J. Escola-Hernandez, R. C. Soliva-Fortuny, and O. Martin-Belloso. 2004. Inactivation of *Saccharomyces cerevisiae* suspended in orange juice using high-intensity plused electric fields. J. Food Prot. 67(11):2596–2602.
27. EPRI, 1997. Ozone-GRAS affirmation for use in food processing. Food Industry Cur. 1:1–6.
28. Erkmen, O., and C. Dogan. 2004. Effects of ultra high hydrostatic pressure on *Listeria monocytogenes* and natural flora in broth, milk, and fruit juices. Internat. J. Food Sci. and Technol. 39(1):91–97.
29. FDA and Department of Health and Human Services. 1998a. Secondary direct food additives permitted in food for human consumption. 21 CFR. Part 173.300 chlorine dioxide.
30. FDA US Food and Drug Administration. 1998b. Irradiation in the production, processing, and handling of food. 21 CFR 179.

31. FDA. Center for Food Safety and Applied Nutrition June 2, 2000. Kinetics of microbial inactivation for alternative food processing technologies. Overarching principles: Kinetics and pathogens of concern for all technologies. US Food and Drug Administration Center for Food Safety and Applied Nutrition: June 2, 2000.1–42.
32. FDA HHS News, Jan 18, 2001.
33. Foley, D., M. Euper, F. Caporaso, and A. Prakash. 2004. Irradiation and chlorination effectively reduces *Esherichia coli* O157:H7 inoculated on cilantro (*Coriandrum sativum*) without negatively affecting quality. J. Food Prot. 67(10):2092–2098.
34. Friedman, M., P. R. Henika, C. E. Levin, and R. E. Mandrell. 2004. Antibacterial activities of plant essential oils and their components against *Escherichia coli* O157:H7 and *Salmonella enterica* in apple juice. J. Agric. Food Chem. 52:6042–6048.
35. Garcia, D., N. Gomez, S. Condon, J. Raso, and R. Pagan. 2003. Pulses electric fields cause sublethal injury in *Escherichia coli*. J. Appl. Microbiol. 36:140–144.
36. Garcia, D., M. Hassani, P. Manas, S. Condon, and R. Pagan. 2004. Inactivation of *Escherichia coli* O157:H7 during the storage under refrigeration of apple juice treated by pulsed electric fields. J. Food Safety 25:30–42
37. Garcia-Graells, C., K. J. A. Hauben, and C. W. Michiels. 1998. High-pressure inactivation and sublethal injury of pressure-resistant *Escherichia coli* mutants in fruit juices. Appl. Environ. Microbiol. 64:1566–1568.
38. Geveke, D. J., and C. Brunkhorst. 2004. Inactivation of *Escherichia coli* in apple juice by radio frequency radio fields. J. Food Sci. 69(3):FEP135–138.
39. Graham, D. M. 1997. Use of ozone for food processing. Food Technol. 51:72–75.
40. Hollingsworth, P. 2001. Niche players pushing UV light applications. Food Technol. 55(12):16.
41. Horvath, M., L. Bilitzky, and J. Huttner (eds.). 1985. Ozone. New York. Elsevier.
42. Huang, Y., and R. Toledo. 1982. Effect of high doses of high and low intensity ultraviolet irradiation on the surface microbiological counts and storage life of fish. J. Food Sci. 47:1667–1669,1731.
43. Hunt, N. K., and B. J. Marinas. 1997. Kinetics of *Escherichia coli* inactivation with ozone water. Water Res. 31(6):1355–1362.
44. Hwang, E. S., J. N. Cash, and M. J. Zabik. 2001. Postharvest treatments for reduction of mancozeb in fresh apples. J. Agric. Food Chem. 49:3127–3132.
45. http://www.cdc.gov/ncidod/dbmd/diseaseinfo/escherichiacoli.com.
46. http://www.cdc.gov/Niosh/pel188/10028-15.html.
47. http://www.cfsan.fda.gov/~dms/juicgu10.html.
48. http://www.cfsan.fda.gov/~lrd/haccp.html.
49. http://www.ers.usda.gov/html. USDA Economic Research Services, September 2007.
50. Iu, J., G. S. Mittal, and M.W. Griffiths. 2001. Reduction in levels of *Escherichia coli* O157:H7 in apple cider by pulsed electric fields. J. Food Prot. 64:964–969.
51. Jayaram, S., G. S. P. Castle, and A. Margaritis. 1992. Kinetics of sterilization of *Lactobacillus brevis* cells by the application of high voltage pulses. Biotechnol. Bioeng. 40(11):1412–1420.
52. Jin, Z. T., and Q. H. Zhang. 1999. Pulsed electric field inactivation of microorganisms and preservation of quality of cranberry juice. J. Food Process. Preserv. 23:481–497.
53. Kaess, G., and J. F. Weidermann. 1973. Effects of ultraviolet irradiation on the growth of microorganisms on chilled beef slices. J. Food Technol. 8:59–69.
54. Khadre, M. A., A. E. Yousef, and J-G Kim. 2001. Microbiological aspects of ozone applications in food: A Review. J. Food Sci. 66(9): 1242–1252.
55. Kim, J., A. E. Yousef, and S. Dave. 1999. Application of ozone for enhancing the microbiological safety and quality of foods: A Review. J. Food Prot. 62:1071–1087.
56. Kimura, K., M. Ida, Y. Yosida, K. Ohki, T. Fukumoto, and N. Sakui. 1994. Comparison of keeping quality between pressure-processed jam and heat-processed jam: changes in flavor components, hue and nutrients during storage. Bio. Sci. Biotechnol. Biochem. 58:1386–1391.
57. Kinman, R. N. 1975. Water and wastewater disinfection with ozone: A critical review. Crit. Rev. Environ. Cont. 5:141–152.
58. Knorr, D., M. Geulen, T. Grahl, and W. Sitzman. 1994. Food application of high electric field pulses. Trends in Food Sci. and Technol. 5:71–75.
59. Kozempel, M., A. McAloon, and W.Yee. 1998. The cost of pasteurizing apple cider. Food Technol. 52:50–52.
60. Linton, M., J. M. J. McClements, and M. F. Patterson. 1999. Inactivation of *Escherichia coli* O157:H7 in orange juice using a combination of high-pressure and mild heat. J. Food Prot. 62:277–279.
61. Liu, D., R. D. Astumian, and T. Y. Tsong. 1990. Activation of Na and K pumping modes of (Na,K)-ATPase by an oscillating electric field. J. Biol. Chem. 265:7260–7267.
62. Lück, E., and M. Jager. 1997. Antimicrobial food additives: characteristics, uses, effects. 2nd ed. Springer-Verlag, Germany.
63. Majchrowics, A. 1999. Innovative technologies could improve food safety. Food Safety 22:16–20.
64. Mak, P. P., B. H. Ingham, and S. C. Ingham. 2001. Validation of apple cider pasteurization treatments against *E. coli* O157:H7, *Salmonella*, and *Listeria monocytogenes*. J. Food Prot. 64(11):1679–1689.
65. Mattick, L. R., and J. C. Moyer. 1983. Composition of apple juice. J. Assoc. Off. Anal. Chem. 66:1251–1255.
66. Merters, B., and D. Knorr. 1992. Developments of nonthermal processes for food preservation. Food Technol. 5:124–133.
67. Miller, L. G., and C.W. Kaspar. 1994. *Escherichia coli* O157:H7 acid-tolerance and survival in apple cider. J. Food Prot. 57:460–464.
68. Morgan, R. 1989. Green light disinfection. Dairy Ind. Int. 54:33–35.
69. Murray, D. R. 1990. Biology of Food Irradiation. John Wiley and Sons, New York.
70. Patterson, M. F., M. Quinn, R. Simpson, and A. Gilmour. 1995. Sensitivity of vegetative pathogens to high hydrostatic pressure treatment in phosphate-buffered saline and foods. J. Food Prot. 58:524–529.
71. Pothakamury, U. R., H. Vega, Q. H. Zhang, G.V. Barbosa-Canovas, and B. G. Swanson. 1996. Effect of growth

stage and processing temperature on the inactivation of *E. coli* by pulsed electric fields. J. Food Prot. 59(11):1167–1171.

72. Qin, B. L., Q. Zhang, G.V. Barbosa-Cánovas, and B. G. Swanson. 1995. Nonthermal inactivation of *S. cerevisiae* in apple juice using pulsed electric fields. Lebensm. Wiss. Technol. 28(6):564–568.
73. Quintoero-Ramos, A., J. J. Churey, P. Hartman, J. Barnard, and R.W. Worobo. 2004. Modeling of *Escherichia coil* inactivation by UV irradiation at different pH values in apple cider. J. Food Prot. 67(6):1153–1156.
74. Ramaswamy, H. S., E. Riahi, and E. Idziak. 2003. High-pressure destruction kinetics of *E. coli* (29055) in apple juice. J. Food Sci. 68(5):1750–1756.
75. Ravishankar, S., G. J. Fleischman, and V. M. Balasubramaniam. 2002. The inactivation of *Escherichia coli* O157:H7 during pulsed electric field (PEF) treatment in a static chamber. Food Microbiol. 19:351–361.
76. Restaino, L., E. W. Frampton, J. B. Hemphill, and P. Palikar. 1995. Efficacy of ozonated water against various food-related microorganisms. Appl. Environ. Microbiol. 61:3471–3475.
77. Richardson, S.W., A. D.Thruston Jr., T. V. Caughran, T. W. Collette, K. S. Patterson, and B.W. Lykins Jr. 1998. Chemical by-products of chlorine and alternative disinfectants. Food Technol. 52:58–61.
78. Robinson, J. F., C. F. Woodward, W. O. Harrington, C. H. Hills, K. M. Hayes, and T. Nold. 1977. Making and preserving apple cider. US Department of Agriculture, Agricultural Research Service, Farmers' Bulletin No. 2125. US Department of Agriculture, Washington, D.C.
79. Rodgers, S. L., J. N. Cash, M. Siddiq, and E.T. Ryser. 2003. A comparision of different chemical sanitizers for inactivating *Escherichia coli* O157:H7 and *Listeria monocytogenes* in solution and on apples, lettuce, strawberries and cantaloupe. J. Food Prot. 67(4):721–731.
80. Rodgers, S. L., and E.T. Ryser. 2003. Reduction of microbial pathogens during apple cider production using sodium hypochlorite, copper ion, and sonication. J. Food Prot. 67(4):766–771.
81. Ronner, U. 1998. Resistance of microorganisms exposed to high pressure, p. 39–45. *In* K.Autio (ed.), Fresh novel foods by high pressure. VTT Technical Research Center of Finland.
82. Sage, J. R., and S. C. Ingham. 1998. Evaluating survival of *Escherichia coli* O157:H7 in frozen and thawed apple cider: potential use of a hydrophobic grid membrane filter-SD-39 agar method. J. Food Prot. 61:490–494.
83. Sale, A. J. H., and W. A. Hamilton. 1967. Effects of high electric fields on microorganisms. Killing of bacteria and yeasts. Biochem. Biophys. Acta. 148:781–788.
84. Salunkhe, D. K. 1955. Sorbic acid as a preservative for apple juice. Food Technol. 9:590.
85. Sapers, G. M., R. L. Miller, M. Jantschke, and A. M. Mattrazzo. 2000. Factors limiting the efficacy of hydrogen peroxide washes for decontamination of apples containing *Escherichia coli*. J. Food Sci. 65(3):529–532.
86. Schurman, J. J. 2001. Antibacterial activity of hydrogen peroxide against *Escherichia coli* O157:H7 and *Salmonella* spp. in fruit juices, both alone and in combination with organic acids. Masters Thesis. Virginia Polytechnic Institute and State University, Blacksburg, VA.
87. Sewell, A. M., and J. M. Farber. 2001. Foodborne outbreaks in Canada linked to produce. J. Food Prot. 64(11):1863–1877.
88. Smelt, J. P. P. M. 1998. Recent advances in the microbiology of high pressure processing. Trends in Food Sci. Technol. 9:152–158.
89. Smith-Palmer, A., J. Stewart, and L. Fyfe. 1998. Antimicrobial properties of plant essential oils and essences against five important foodborne pathogens. Lett. Appl. Microbiol. 26:118–122.
90. Splittstoesser, D. F., M. R. McLellan, and J. J. Churey. 1995. Heat resistance of *Escherichia coli* O157:H7 in apple cider. J. Food Prot. 59: 226–229.
91. Steele, B. T., N. Murphy, and G. S. Arbus. 1982. An outbreak of hemolytic uremic sydrome associated with ingestion of fresh apple juice. J. Pediatrics. 101:963–965.
92. Steenstrup, L. D., and J. D. Floros. 2004. Inactivation of *E. coli* O157: H7 in apple cider by ozone at various temperatures and concentrations. J. Food Process. Pres. 28:103–116.
93. Sterner, R. A., M. Lasater-Smith, and C. F. Brasington. 1987. Ultraviolet radiation–an effective bactericide for fresh meat. J. Food Prot. 30:108–111.
94. Sumner, S. E., E. A. Wallner-Pendleton, G.W. Froning, and L. E. Stetson. 1996. Inhibition of *Salmonella* Typhimurium on agar medium and poultry skin by ultraviolet energy. J. Food Prot. 59:319–321.
95. Tauscher, B. 1998. Effect of high pressure treatment nutritive substances and natural pigments, p. 83–95. in K. Autio (ed.), Fresh novel foods by high pressure. VTT Technical Research Center of Finland.
96. Tauxe, R. 1997. Emerging foodborne diseases: An evolving public health challenge. Emerg. Infect. Dis. 3:425–434.
97. Thayer, D. W., and G. Boyd. 1993. Elimination of *Escherichia coli* in meats by gamma irradiation. Appl. Environ. Microbiol. 59:1030–1034.
98. Thayer, D. W., and G. Boyd. 2001. Effect of irradiaton temperature on inactivation of *Escherichia coli* O157:H7 and *Staphylococcus aureus*. J. Food Prot. 64:1624–1626.
99. Thorp, E. D. 1950. The toxicity of ozone: A report and bibliography. Ind. Med. Surg. 15:49–57.
100. Uljas, H. E., and S. C. Ingham. 1998. Survival of *Escherichia coli* O157:H7 in synthetic gastric fluid after cold and acid habituation in apple juice of Trypticase Soy Broth acidified with hydrochloric acid or organic acids. J. Food Prot. 61:939–947.
101. Uljas, H. E., and S .C. Ingham. 1999. Combinations of intervention treatments resulting in 5-$\log_{10}$-unit reductions in numbers of *Escherichia coli* O157:H7 and *Salmonella* Typhimurium DT104 organisms in apple cider. Appl. Environ. Microbiol. 65(5):1924–1929.
102. Uljas, H. E., D.W. Schaffner, S. Duffy, Zhao Lihui, and S. C. Ingham. 2001. Modeling of combined processing steps for reducing *Escherichia coli* O157:H7 populations in apple cider. Appl. Environl. Microbiol. 67(1):133–141.
103. Urbain, W.M. 1986. Food irradiation. Academic Press. Orlando.
104. US General Accounting Office (USGAO). 2000. Food irradiation: available research indicates that benefits outweigh risks. USGAC, Washington, D.C.

105. Vega-Mercado, H., O. Martin-Bellose, F. J. Chang, G. V. Barbosa-Canovas, and B. G. Swanson. 1996a. Inactivation of *Escherichia coli* and *Bacillus subtilis* suspended in pea soup using pulsed electric fields. J. Food Process. Preserv. 20(6):501–510.
106. Vega-Mercado, H., U. R. Pothakamury, F. J. Chang, G. V. Barbosa-Canovas, and B. G. Swanson. 1996b. Inactivation of *Escherichia coli* by combining pH, ionic strength and pulsed electric fields hurdles. Food Res. Int. 29(2):117–121.
107. Wallner-Pendleton, E. A., S. S. Sumner, G. W. Froning, and L. E. Stetson. 1994. The use of ultraviolet radiation to reduce *Salmonella* and psychrotrophic bacterial contamination on poultry carcasses. Poultry Sci. 73:1327–1333.
108. Wang, H., C. A. Reitmeier, and B. A. Glatz. 2004. Inactivation of *Escherichia coli* O157:H7 and other naturally occurring microorganisms in apple cider by electron beam irradiation. J. Food Prot. 67(8):1574–1577.
109. Williams, R. C., S. S. Sumner, and D. A. Golden. 2004. Survivial of *Escherichia coli* O157:H7 and *Salmonella* in apple cider and orange juice as affected by ozone and treatment temperature. J. Food Prot. 67(11):2381–2386.
110. Witheridge, W. I. and C. P. Yaglou. 1939. Ozone in ventilation: Its possibilities and limitations. Trans. Am. Soc. Heat Vent. Eng. 45:509–522.
111. Worobo, R. W. 2000. Efficacy of the CiderSure 3500 ultraviolet light unit in apple cider. Ithaca, NY. Cornell University, Department of Food Science and Technology. 1–6.
112. Wright, J. R., S. S. Sumner, C. R. Hackney, M. D. Pierson, and B. W. Zoecklein. 2000a. Reduction of *Escherichia coli* O157:H7 on apples using wash and chemical sanitizer treatments. Dairy Food Environ. Sanit. 20(2):120–126.
113. Wright, J. R., S. S. Sumner, C. R. Hackney, M. D. Pierson, and B. W. Zoecklein, 2000b. A survey of Virginia apple cider procedures' practices. Dairy Food Environ. Sanit. 20(3):190–195.
114. Wright, J. R., S. S. Sumner, C. R. Hackney, M. D. Pierson, and B. W. Zoecklein, 2000c. Efficacy of ultraviolet light for reducing *Escherichia coli* O157:H7 in unpasteurized apple cider. J. Food Prot. 63:563–567.
115. Yeom, H. W., K. T. McCann, C. B. Streaker, and Q. H. Zhang. 2002. Pulsed electric field processing of high acid liquid foods: a review. Adv. Food Nutr. Res. 44:1–31.
116. Yeow-lim, T., R. Sadhana, and C. E. Sizer. 2001. Effect of low-temperature, high-pressure treatment on the survival of *Escherichia coli* O157:H7 and *Salmonella* in unpasteurized fruit juices. J. Food Prot. 64(8):1122–1127.
117. Yip, R. W., and D. E. Konasewich. 1972. Ultraviolet sterilization of water its potential and limitations. Water Pollution Control 110:14–18.
118. Yuste, J., and D. Y. C. Fung. 2002. Inactivation of *Listeria monocytogenes* Scott A 49594 in apple juice supplemented with cinnamon. J. Food Prot. 65(10):1663–1666.
119. Yuste, J., D. Y. C. Fung, L. K. Thompson, and B. A. Crozier-Dodson. 2002. Combination of carbon dioxide and cinnamon to inactivate *Escherichia coli* O157:H7 in apple juice. J. Food Sci. 67(8):3087–3090.
120. Zaika, L. L. 1988. Spices and herbs: their antimicrobial activity and its determination. J. Food Safety. 9:97–118.
121. Zhang, Q. H., B. L. Qin, G. V. Barbosa-Cànovas, and B. G. Swanson. 1995. Inactivation of *E. coli* for food pasteurization by high-strength pulsed electric fields. J. Food Process. Preserv. 19(2):103–118.
122. Zhao, T., M. P. Doyle, and R. E. Besser. 1993. Fate of enterohemorrhagic *Escherichia coli* O157:H7 in apple cider with and without preservatives. Appl. Environ. Microbiol. 59:2526–2530.
123. Zimmermann, U. 1986. Electrical breakdown, electropermeabilization and electrofusion. Rev. Physiol. Biochem. Pharmacol. 105:175–256.

Food Protection Trends, Vol. 28, No. 6, Pages 391–406

6200 Aurora Ave., Suite 200W, Des Moines, IA 50322-2864

Consumer Perceptions of the Food Safety System: Implications for Food Safety Educators and Policy Makers

ANDREW J. KNIGHT*[1,9], MICHELLE R. WOROSZ[1], MARIA K. LAPINSKI[2,3], TOBY A. TEN EYCK[2,4], CRAIG K. HARRIS[1,2,4,8], LESLIE D. BOURQUIN[1,2,5], THOMAS M. DIETZ[4,7], PAUL B. THOMPSON[6] and EWEN C.D. TODD[1,2]

[1]Food Safety Policy Center, Michigan State University, East Lansing, MI 48824, USA; [2]National Food Safety and Toxicology Center, Michigan State University, East Lansing, MI 48824, USA; [3]Dept. of Communication, Michigan State University, East Lansing, MI 48824, USA; [4]Dept. of Sociology, Michigan State University, East Lansing, MI 48824, USA; [5]Food Science and Human Nutrition, Michigan State University, East Lansing, MI 48824, USA; [6]Depts. of Philosophy and Community, Agriculture, Recreation & Resources, Michigan State University, East Lansing, MI 48824, USA; [7]Environmental Science & Policy, Michigan State University, East Lansing, MI 48824, USA; [8]Michigan Agricultural Experiment Station, Michigan State University, East Lansing, MI 48824, USA; [9]Dept. of Sociology and Anthropology, Susquehanna University, Selinsgrove, PA 17870, USA

SUMMARY

This study examines consumers' opinions about the food safety system and about the prevalence and acceptability of foodborne illness. The results, based on data collected in a nationwide telephone survey (n = 1,014), indicate that food safety is an important consideration for a majority of consumers in the United States and that it affects the purchasing choices of a significant portion of the population. Respondents most likely to think about food safety and avoid purchasing or eating some foods based on food safety concerns were those who did all or most of the meal preparation, had someone in the household who is allergic to foods, were female, were African-American or described their ethnicity as "other," had less than a high school education, and had a household income less than $20,000. Although consumers believed that they have at least some knowledge of food safety, the data showed that the majority was not aware of the prevalence of foodborne illness. Perceived knowledge was significantly related to meal preparation, having someone allergic to foods in the household, marital status, gender, age, education, thinking about food safety, and perceived control. The results suggest that food safety specialists might better serve particular segments of the population, such as those who possess less knowledge about food safety, those who believe they have had food poisoning, those who are middle aged, those with less than a high school education, and those who believe they have no control over food safety.

A peer-reviewed article

*Author for correspondence: 570.372.4694; Fax: 570.372.2870
Email knight@susqu.edu

INTRODUCTION

Both industry and government have recognized that they cannot guarantee a risk-free food system, as evidenced by the 2006 *E. coli* outbreak related to spinach in the United States, which resulted in 199 infections in 26 states *(7)*. Although there is extensive publicity over problems with processed food, most foodborne illnesses have been linked to improper food handling, either in foodservice institutions or in the home *(11, 22, 29)*. Influencing consumer behavior is especially important in view of the fact that about 71 percent of all meals and 78 percent of all snacks are prepared in the home *(14)*. Prior research suggests that consumer perceptions of food safety are related to their food safety behaviors, with consumer food safety studies focusing mostly on four areas: (1) level of concern about food safety issues *(4, 5, 9, 10, 19)*; (2) awareness and knowledge of food safety risks and behaviors *(1, 6, 11, 15, 28)*; (3) observed and self-reported food safety behaviors *(3, 20, 24)*; and (4) the relationship between perceptions of food safety and food purchases *(2, 12, 17, 26)*.

This study departs from previous research by suggesting that consumer perceptions about the food safety system and the prevalence and acceptability of foodborne illness might also affect the food safety behaviors of consumers. More specifically, this study was designed to determine (1) how important food safety is to consumers; (2) the extent of consumer knowledge about the prevalence of foodborne illness, and whether consumers find these levels acceptable or unacceptable; (3) who consumers believe is most responsible for food safety; (4) how consumers rate the performance of various food actors; and (5) how consumers rate the level of resources that various food actors dedicate to food safety. In this context, the term "actor" refers to a particular group within the food system—farmers; food processors and manufacturers; retailers such as grocery stores or supermarkets and restaurants; consumers; and governmental agencies that regulate and formulate policy governing the food system. The implications of these results for food safety educators and policy makers will be discussed.

This research builds upon four studies that have examined consumer perceptions of the food safety actors. The first was conducted in 1994 by Smith and Riethmuller *(25)*. They mailed surveys to 1,448 residents of Adelaide and Brisbane (Australia) and 1,368 residents of Tokyo (Japan). Participants were asked to rate the performance of farmers, marketers, and government in making sure the foods they eat were safe. The authors found that only 52% of the Australian respondents and 46% of Japanese respondents agreed that the government was doing a good job of making sure the foods they ate were safe; 50% of Australian and only 22% of Japanese respondents said that farmers were doing a good job; and only 44% of Australian and 22% of Japanese respondents reported that marketers were doing a good job.

A second study was conducted by Roseman and Kurzynske *(24)*, who used a telephone survey of 728 Kentucky (US) residents in the fall of 1999, asking general questions about confidence in the safety of the nation's food supply and the frequency of foodborne illness. Their results indicated that 19% of respondents were very confident in the safety of the nation's food supply and 70% were somewhat confident; only 11% were not very confident in the nation's food supply. Less than a third (31%) believed that the frequency of foodborne illness was relatively common, 60% reported that it was somewhat common, and close to 10% said that it was not common at all.

In a third study, Cates et al. *(6)* asked 1,212 US adults, in an Internet Web-based survey, how much responsibility different actors have for ensuring the safety of the United States food supply, on a scale of 1 to 5, with 1 = no responsibility and 5 = a lot of responsibility. Consumers believed that food manufacturers were most responsible for insuring the safety of the food supply, (91% rated them a 4 or 5), followed by restaurants (89%), supermarkets (85%), federal government (81%), farmers (69%), and consumers (68%). Finally, in a self-administered survey of 100 Cardiff (United Kingdom) residents, Redmond and Griffith *(21)* found that respondents believed that they were ultimately responsible for their own food safety (a mean of 8.5 on a scale of 1 to 10, with 1 = no responsibility and 10 = total responsibility). These respondents also ranked the risk of illness from consuming foods to be low; on a scale of 1 to 10, with 1 = very low risk and 10 = very high risk, the mean risk was 2.1 for food consumed by respondents themselves and 4.1 for foods consumed and prepared by others.

MATERIALS AND METHODS

Sampling and data collection

The data for this study were gathered in a nationwide telephone survey in the 48 contiguous states. The survey was conducted with 1,014 randomly selected adults aged 18 and older between October 31, 2005 and February 9, 2006 by the Institute for Public Policy & Social Research (IPPSR) at Michigan State University. Because of the damage caused by Hurricane Katrina, affected counties in the Gulf of Mexico, including the city of New Orleans, were omitted from the sample design. To insure the inclusion of both listed and unlisted telephone numbers, random-digit dialing procedures were used. Two calling protocols were utilized. For the first protocol, the traditional standard of a minimum of 12 call attempts to contact the sample member was employed, or call attempts were made until a final disposition was determined; cases in the second protocol were randomly assigned to be called at different times of the day and days of the week, but each case rceived only a single call attempt. The cooperation rate was 42 percent for the traditional protocol and 67 percent for the one-call protocol, for a total cooperation rate of 52 percent. The utilization of two protocol procedures did not significantly affect the composition of respondents or the responses of respondents. Results were weighted to reflect the socio-demographic characteristics (age, sex, race, and education) and geographic regions (Northeast, Midwest, South, and the West) of the United States population, based on 2000 census data. The demographic profile of respondents is presented in Table 1.

Survey instrument

An interdisciplinary research team designed survey questions over a period of several months, with the guidance of survey methodology experts at IPPSR. The survey comprised questions about general food safety, policy preferences, trust in the food system, trade-offs between food safety and other attributes, knowledge and acceptability of foodborne disease, and socio-demographics. In this study, we focus on questions pertaining to the importance of food safety, knowledge and prevalence of food safety

TABLE 1. Characteristics and socio-demographic profile of survey respondents (n = 1,014)

Characteristics of survey respondents	% of survey respondents
Meal preparation in household	
All	29.3
Most	30.3
Some	26.0
Hardly any	8.9
None at all	4.9
Food shopping in household	
All	37.1
Most	24.2
Some	22.2
Hardly any	12.3
None at all	4.3
Someone in household allergic to foods	
Yes	24.8
No	74.1
Child under age of 6 in household	
Yes	23.2
No	76.8
Senior aged 65 or over in household	
Yes	23.8
No	76.2
Marital status	
Married	55.9
Divorced/separated	5.1
Widowed	7.8
Single/never married	29.9
Gender	
Female	54.5
Male	45.5
Age	
18–24	15.2
25–34	18.6
35–44	20.5
45–54	17.5
55–64	11.9
65 or older	15.0
Race or ethnicity	
Caucasian/white	72.4
Black/African-American	11.3
Hispanic	11.8
Other	4.5

TABLE 1. *(continued)* **Characteristics and socio-demographic profile of survey respondents (n=1,014)**

Characteristics of survey respondents	% of survey respondents
Education	
Less than high school	6.3
High school graduate	37.4
Some college or associate degree	29.8
College degree or higher	25.5
Household annual income	
Less than $20,000	11.9
$20,000–$39,999	19.6
$40,000–$59,999	22.5
$60,000 or greater	30.9

Note: Percentages may not equal 100% because "don't know" and "refusal" categories are not presented.

The actual wording for the questions are as follows:

Meal preparation: Would you say you do…1. All of the food preparation in your household, 2. Most of the food preparation, 3. Some, 4. Hardly any, 5. Or none at all

Food shopping: Do you do…1. All of the food shopping in your household, 2. Most of the food shopping, 3. Some, 4. Hardly any, 5. Or none at all

Someone in household allergic to foods: Is anyone in your household allergic to any foods? 1. Yes, 2. No

Child under age of 6: Are there any children under the age of 6 in your household? 1. Yes, 2. No

Senior aged 65 or over: Is there anyone in your household age 65 or over? 1. Yes, 2. No

Marital status: What is your marital status? 1. Married, 2. Divorced, 3. Separated, 4. Widowed, 5. Member unmarried couple, 6. Single, never been married

Gender: Sex of respondent recorded by interviewer 1. Male, 2. Female

Age: In what year were you born?

Race or ethnicity: How would you describe your race or ethnicity? 1. Caucasian/White, 2. African American/Black, 3. Hispanic, 4. Asian, 5. Aboriginal/Native American, 6. Other

Education: What is the highest level of education that you have completed? Interviewer recorded number of years of schooling

Household annual income: Respondents were asked to state whether their income was greater or less than a specific value, and based on that response provided with another income level. For example, initially respondents were asked the following. To get a picture of people's financial situations, we'd like to know the general range of incomes of all households we interview. This is for statistical analysis purposes and your answers will be kept strictly confidential. Now, thinking about your household's total annual income from all sources (including your job), did your household receive $30,000 or more in 2004?

and foodborne diseases, and perceptions about individual actors in the food system (i.e., federal government agencies, food processors/manufacturers, farmers, grocery stores/supermarkets, restaurants, average Americans, and the respondents themselves). Prior to being used in the survey, survey questions were pilot tested in an upper-level undergraduate class and then pre-tested by IPPSR staff with a sample from an existing database of the United States population. Based on these preliminary results, guidance of IPPSR staff and respondent comments, survey questions were revised. The length of time for a respondent to complete the survey was approximately 20 minutes.

Statistical procedures

Data were analyzed using SPSS software 14.0 for Microsoft Windows. The data analysis includes descriptive analyses for all relevant survey questions. In addition, cross-tabulation and Chi-square tests were performed to determine differences between perceived importance of food safety, knowledge, and level of resources for respondents and characteristics of respondents. One-sample *t*-tests were utilized to test for significant differences among means of perceived performance and resources of food system actors. In all analyses, $P < .05$ was used as the standard for statistically significant differences.

RESULTS

Profile of survey respondents

Table 1 provides a statistical overview of survey respondents. About 29% indicated that they prepared all of the meals in their households, 30% prepared most of the meals, and about a quarter (26%) prepared some of the meals. Less than 15% prepared hardly any or no meals. Over a third (37%) of respondents said that they do all of the food shopping in the household, with almost a quarter (24%) stating that they do most of the food shopping. About one fifth (22%) reported performing some of the food shopping duties, with 12% saying that they do hardly any of the shopping, and 4% do not shop for food. A quarter of the households had someone who is allergic to foods, and almost a quarter of the households had a child present under the age of 6 (23%) or a member aged 65 or over (24%). A majority of the respondents (56%) were married, 30% had never been married, 5% were divorced, and 8% were widowed. Just over half (54%) of the respondents were female. Age of respondents was fairly equally distributed, with 20% being 35–44, 19% being 25–34, 18% being 45–54, 15% being 18–24 or 65 or older, and 12% being 55–64. As for race and ethnicity, 72% of the respondents were Caucasian, 12% were Hispanic, and 11% were African-American. About 6% of respondents had not graduated from high school, whereas 37% were high school graduates, 30% had attended some college or earned an associates degree, and 26% had obtained at least one college degree. About 31% had an annual household income of at least $60,000, with another 22% having an income between $40,000 and $59,999, 20% having an income between $20,00 and $39,999, and 12% of the households having incomes of less than $20,000.

Importance of food safety

To get a sense of how important food safety was to consumers, respondents were asked two questions about how often they think about food safety and whether or not food safety influenced their purchasing of food items. Cross-tabulations and Chi-square tests were used to identify differences between answers to questions about the importance of food safety and the socio-demographic variables listed in Table 1. Statistically significant results ($P < .05$) are presented in Table 2 a–c. Meal preparation, food shopping, having a household member allergic to foods, gender, race or ethnicity, education, and income were significantly related to how often respondents think about food safety. Respondents who did all or most of the meal preparation and food shopping in the household were more likely to think about food safety every day or several times a week and to think about food safety when shopping for foods than those who prepared meals and shopped for food some of the time, hardly at all, or never. The presence of someone allergic to foods in the household was related to respondents thinking about food safety more often. Females were more likely than males to think about food safety every day or several times a week. African-Americans and those who identified their ethnicity as "other" were likely to think about food safety more often than whites and Hispanics. Respondents with less than a high school diploma and with-household incomes less than $20,000 were most likely to think about food safety every day or several times a week. Conversely, highly educated (college degree or higher) and high income ($60,000 or more) respondents thought about food safety less often.

The results for how often consumers think about food safety when shopping for foods were similar to results for how often consumers think about food safety in general, except that thinking about food safety when shopping for foods also varied by age. Respondents between the ages of 55 and 64 were less likely than other age groups to think about food safety when shopping for foods. Those who did most of the meal preparation and food shopping were more likely to think about food safety when shopping for foods. African-Americans, those with lower levels of education and those with lower household incomes also thought more about food safety when shopping for foods.

Meal preparation, having someone in the household allergic to foods, gender, race or ethnicity, education, and income were significantly related to consumer behavior. Respondents who did all or most of the meal preparation were more likely to avoid purchasing or eating certain foods for food safety reasons. Respondents with someone in the household who is allergic to foods, females, African-Americans, those who described their ethnicity as "other," and those with household incomes less than $20,000 were also more likely to avoid purchasing or eating foods because of food safety concerns. Even though respondents with lower levels of education (high school or less) indicated that they were more likely to think about food safety, they were less likely to avoid foods based on food safety reasons.

Knowledge

Assessing the level of consumer knowledge about food safety and the prevalence of foodborne illness is important because these topics can affect the adoption of food safety behaviors *(8, 24)*. Knowledge of food safety was measured in three ways. First, respondents were asked to self-report their knowledge about food safety; second, they were asked to estimate the prevalence of foodborne ill-

TABLES 2A–C. Importance of food safety as influenced by socio-demographic variables

2a. Would you say you think about food safety.

Variable	Every day/several times a week (%)	Once in a while/ hardly ever/never (%)	Total (n)	Chi-square
Meal preparation in household				
All	62.7	37.3	295	
Most	55.0	45.0	307	
Some	39.0	61.0	264	
Hardly any	25.3	74.7	91	
None at all	12.0	88.0	50	
Total	48.3 (n = 486)	51.7 (n = 521)	1007	84.959***
Food shopping in household				
All		59.2	40.8	373
Most	62.0	38.0	245	
Some	28.6	71.4	224	
Hardly any	28.2	71.8	124	
None at all	32.6	67.4	43	
Total	48.2 (n = 486)	51.8 (n = 523)	1009	95.636***
Someone in household allergic to foods				
Yes		56.0	44.0	252
No		44.9	55.1	750
Total	47.7 (n = 478)	52.3 (n = 524)	1002	8.744**
Gender				
Female	52.6	47.4	551	
Male	42.6	57.4	460	
Total	48.1 (n = 486)	51.9 (n = 525)	1011	9.692**
Race or ethnicity				
Caucasian/white	45.9	54.1	732	
Black/African-American	64.9	35.1	114	
Hispanic	43.3	56.7	120	
Other	55.6	44.4	45	
Total	48.2 (n = 487)	51.8 (n = 524)	1011	16.415***
Education				
Less than high school	60.9	39.1	64	
High school graduate	48.8	51.2	377	
Some college or associate degree	49.0	51.0	302	
College degree or higher	41.3	58.7	259	
Total	47.7 (n = 478)	52.3 (n = 524)	1002	9.123*
Household annual income				
Less than $20,000	65.3	34.7	121	
$20,000–$39,999	50.0	50.0	198	
$40,000–$59,999	51.5	48.5	227	
$60,000 or greater	37.9	62.1	314	
Total	48.1 (n = 414)	51.9 (n = 446)	860	28.774***

*$P < .05$; **$P < .01$; ***$P < .001$

TABLE 2B. The last time you were shopping for food, did you think about whether the food you were buying was safe to eat?

Variable	Yes (%)	No (%)	Total (n)	Chi-square
Meal preparation in household				
All	60.9	39.1	294	
Most	63.1	36.9	295	
Some	47.5	52.5	257	
Hardly any	53.4	46.6	88	
None at all	52.9	47.1	34	
Total	57.0 (n = 552)	43.0 (n = 416)	968	16.432**
Food shopping in household				
All	64.7	35.3	374	
Most	64.5	35.5	245	
Some	48.2	51.8	224	
Hardly any	35.2	64.8	125	
None at all	57.0 (n = 552)	43.0 (n = 416)	968	45.966***
Total				
Someone in household allergic to foods				
Yes	66.7	33.3	243	
No	53.4	46.6	716	
Total	56.7 (n = 544)	43.3 (n = 415)	959	12.566***
Gender				
Female	61.4	38.6	542	
Male	51.4	48.6	426	
Total	57.0 (n = 552)	43.0 (n = 416)	968	9.388**
Age				
18–24	60.4	39.6	144	
25–34	54.1	45.9	183	
35–44	58.9	41.1	207	
45–54	64.3	35.7	168	
55–64	41.9	58.1	117	
65 or older	56.6	43.4	136	
Total	56.8 (n = 542)	43.2 (n = 413)	955	16.145**
Race or ethnicity				
Caucasian/white	54.4	45.6	698	
Black/African-American	77.0	23.0	113	
Hispanic	52.1	47.9	117	
Other	59.0	41.0	39	
Total	57.0 (n = 551)	43.0 (n = 416)	967	21.478***
Education				
Less than high school	68.5	31.5	54	
High school graduate	64.4	35.6	362	
Some college or associate degree	51.4	48.6	288	
College degree or higher	49.0	51.0	255	
Total	56.6 (n = 543)	43.4 (n = 416)	959	21.159***
Household annual income				
Less than $20,000	69.8	30.2	116	
$20,000–$39,999	59.4	40.6	192	
$40,000–$59,999	52.1	47.9	215	
$60,000 or greater	50.8	49.2	297	
Total	55.9 (n = 458)	44.1 (n = 362)	820	14.411**

*$P < .05$; **$P < .01$; ***$P < .001$

TABLE 2C. Are there any foods you won't buy or eat because they are likely to be unsafe?

Variable	Yes (%)	No (%)	Total (n)	Chi-square
Meal preparation in household				
All	48.6	51.4	296	
Most	54.9	45.1	304	
Some	31.6	68.4	263	
Hardly any	44.0	56.0	84	
None at all	16.0	84.0	50	
Total	44.0 (n = 439)	56.0 (n = 558)	997	49.768***
Someone in household allergic to foods				
Yes	60.2	39.8	246	
No	38.1	61.9	746	
Total	43.5 (n = 432)	56.5 (n = 560)	992	35.837***
Gender				
Female	50.4	49.6	542	
Male	36.1	63.9	462	
Total	43.8 (n = 440)	56.2 (n = 564)	1004	19.917***
Race or ethnicity				
Caucasian/white	41.2	58.8	726	
Black/African-American	60.7	39.3	112	
Hispanic	38.7	61.3	119	
Other	57.8	42.2	45	
Total	43.8 (n = 439)	56.2 (n = 563)	1002	19.885***
Education				
Less than high school	29.5	70.5	61	
High school graduate	40.5	59.5	378	
Some college or associate degree	47.3	52.7	296	
College degree or higher	47.5	52.5	259	
Total	43.7 (n = 434)	56.3 (n = 560)	994	9.661*
Household annual income				
Less than $20,000	58.7	41.3	121	
$20,000–$39,999	47.4	52.6	194	
$40,000–$59,999	41.7	58.3	228	
$60,000 or greater	37.9	62.1	314	
Total	44.0 (n = 377)	56.0 (n = 480)	857	16.751***

*$P < .05$;** $P < .01$; *** $P < .001$

ness; and third, they were asked whether they had had a case of food poisoning within the last year or not. A majority of respondents (58%) indicated that they possessed "quite a bit" or "a lot of" knowledge about food safety. Cross-tabulations and Chi-square tests were used to determine significant relationships between perceived knowledge about food safety and socio-demographics, thinking about food safety, and perceived control over food safety. Perceived control was added to the analysis because it has been found to be an important conceptual variable in previous food safety studies *(9, 10, 13)*. The statistically significant results ($P < .05$) are presented in Table 3. As demonstrated in this table, meal preparation, having someone who is allergic to foods in the household, marital status, gender, age, education, thinking about food safety, and perceived control were significantly related to perceived knowledge. Respondents who prepared all or most of the meals in the household were most likely to state that they knew "a lot" or "quite a bit" about food safety, as were those with someone in the household who is allergic to foods, married and widowed respondents, females, middle aged respondents (35–44 and 45–54), those with higher educational attainment (some college or associates degree and a college degree or higher), those who think about food safety every day or several times a week, and those who think about food safety when shopping for foods. In addition, respondents who believed that they had "a great deal" or "some" control over food safety rated their knowledge of food safety higher than those who believed that they had only "a little" or "no" control over food safety.

To assess knowledge about the prevalence of foodborne illness in the United States, consumer responses were compared to the estimates derived by Mead et al. *(16)*. These estimates were chosen because they are the official estimates cited by the Center for Disease Control and Prevention; they are frequently referred to in the food safety literature; and no current estimates are available. When we asked respondents about the prevalence of foodborne illness in the United States, 8% were able to provide an accurate estimate of the percentage of the population that gets ill (the estimate of Mead et al. estimate is 25%) (Table 4). Just over a quarter (26%) of respondents gave an estimate between 20% and 30%. Close to half of the respondents (48%) underestimated the official estimate of foodborne illness, while a third overestimated the prevalence of foodborne illness and 11% said they did not know. Ten percent of respondents correctly estimated that 1% of the population was hosptalized each year because of consuming contaminated foods and beverages. A third of respondents estimated that between 1% and 5% of the population is hospitalized because of contaminated foods and beverages. In general, respondents tended to underestimate the prevalence of illness and overestimate the prevalence of hospitalizations. However, a third of the respondents were able to estimate correctly that 1% to 2% of those hospitalized die each year from contaminated foods and beverages, even though many respondents (48%) overestimated the prevalence of deaths. Although many respondents overestimated the prevalence of hospitalizations and deaths resulting from contaminated foods and beverages, respondents may have underestimated their own prevalence of food poisoning. Among the study respondents, 7% reported cases of foodborne poisoning within the past year, which is considerably lower than the official government estimate of 25% *(16)*.

Acceptability

After respondents had been asked to estimate the annual prevalence of foodborne illness, they were provided with the official United States government estimates *(16)* and asked whether they found these estimates to be acceptable or unacceptable. The majority of respondents stated that the current level of food safety is either unacceptable or very unacceptable (Table 5). Close to three-fourths of respondents (74%) stated that the annual prevalence of foodborne illness (estimated to be 25% of the population) is either unacceptable or very unacceptable, while a quarter felt these numbers were acceptable or very acceptable. Three-fifths (60%) indicated that the number of hospitalizations (estimated to be less than 1% of the population, or about 325,000 people) is either unacceptable or very unacceptable, while 36% said they were acceptable or very acceptable. Just over two-thirds (68%) said that the number of deaths caused by foodborne disease (estimated to be less than 2% of those who are hospitalized, or about 5,000 people) is either unacceptable or very unacceptable, whereas 30% found these numbers to be acceptable or very acceptable.

Responsibility

Before asking questions about the prevalence of foodborne disease, we asked respondents a series of questions about who should be responsible for food safety and how they would rate the performance of various food system actors. The first question was "Which ONE of the following groups do you believe should be most responsible for insuring that the foods you eat are safe? Over a third of respondents (38%) indicated that the federal government should be most responsible. Close to a quarter (23%) stated that food processors and manufacturers should be most responsible, followed by individual consumers (11%), state government (10%), farmers (7%), grocery stores and supermarkets (4%), and restaurants (2%).

Performance

Respondents were then asked to rate the performance of various groups in insuring food safety on a scale of 1 to 5, with 1 = very good and 5 = very poor. Respondents ranked their own performance much higher than that of other actors in the food chain, with 97% of respondents reporting that they were doing a very good or good job of insuring that the foods they ate were safe (Table 6). Farmers were ranked second highest (89%), followed by grocery stores and supermarkets (82%), federal government agencies (78%), food processors and manufacturers (78%), restaurants (69%), and average Americans (63%). One-sample *t*-tests were used to determine whether the mean performance scores of each actor differed from each other. All of the means differed significantly from each other ($P < .001$), except those for the performance of federal government agencies and food processors/manufacturers. Although the majority of respondents believed that all groups are doing a good job of insuring food safety, there is room for improvement in perceived performance for some groups, particularly average Americans and restaurants. Almost a quarter of respondents (24%) said that average Americans were doing a poor or very poor job of food safety, and 20% indicated that restaurants were doing a poor or very poor job of food safety.

TABLE 3. Perceived knowledge of food safety as influenced by socio-demographic variables

How would you rate your knowledge about food safety? Would you say you know...

Variable	A lot or quite a bit	A little or none at all	Total (n)	Chi-square
Meal preparation in household				
All	62.2	37.8	294	
Most	67.8	32.2	307	
Some	51.9	48.1	260	
Hardly any	54.9	45.1	91	
None at all	20.0	80.0	50	
Total	58.5 (n = 586)	41.5 (n = 416)	1002	48.151***
Someone in household allergic to foods				
Yes	64.7	35.3	252	
No	57.0	43.0	744	
Total	58.9 (n = 587)	41.1 (n = 409)	996	4.291*
Marital status				
Married	64.5	35.5	561	
Divorced/separated	45.1	54.9	51	
Widowed	58.2	41.8	79	
Single/never married	50.3	49.7	302	
Total	58.7 (n = 583)	41.3 (n = 410)	993	20.485***
Gender				
Female	62.9	37.1	550	
Male	53.6	46.4	457	
Total	58.7 (n = 591)	41.3 (n = 416)	1007	8.522**
Age				
18–24	44.2	55.8	154	
25–34	52.7	47.3	188	
35–44	63.9	36.1	208	
45–54	75.3	24.7	178	
55–64	52.9	47.1	119	
65 or older	59.5	40.5	148	
Total	58.8 (n = 585)	41.2 (n = 410)	995	40.497***
Education				
Less than high school	33.9	66.1	62	
High school graduate	53.2	46.8	376	
Some college or associate degree	64.2	35.8	302	
College degree or higher	66.4	33.6	259	
Total	58.8 (n = 587)	41.2 (n = 412)	999	30.654***
Think about food safety				
Every day	76.1	23.9	347	
Several times a week	67.6	32.4	139	
Once in a while	42.8	57.2	383	
Hardly at all	53.5	46.5	114	
Never	29.2	70.8	24	
Total	58.6 (n = 590)	41.4 (n = 417)	1007	97.467***
Think about food safety when shopping				
Yes		65.0	35.0	548
No		52.3	47.7	415
Total	59.5 (n = 573)	40.5 (n = 390)	963	15.221***
Perceived control over food safety				
A great deal or some	70.0	30.0	670	
A little or none	35.9	64.1	337	
Total	58.6 (n = 590)	41.4 (n = 417)	1007	106.030***

*$P < .05$; **$P < .01$; ***$P < .001$

TABLES 4A–C. Knowledge of foodborne illness

4A. About what percentage of the US population do you think gets sick from consuming contaminated foods and beverages each year?

Underestimated	47.5%
Correctly estimated (25%)	7.8%
Overestimated	33.6%
Did not know	10.7%

4B. About what percentage of the US population do you think is hospitalized from consuming contaminated foods and beverages each year?

Underestimated	0.6%
Correctly estimated (1%)	10.0%
Overestimated	78.7%
Did not know	9.7%

4C. And about what percentage of those hospitalized do you think die from consuming contaminated foods and beverages each year?

Underestimated	4.9%
Correctly estimated (1%–2%)	33.3%
Overestimated	48.4%
Did not know	13.0%

Note: Percentages in parentheses (%) represent the actual percentages as estimated by Mead et al. (1999). Percentages may not sum to 100% because of rounding.

Resources

Because the resources available might affect the performance of these groups in insuring food safety, respondents were asked whether each actor in the food chain had enough resources (defined as staff, expertise, money, and information) to insure that the foods they eat are safe. Respondents who answered "no" to this initial question were then asked whether that actor needs a few more, some additional, or a lot more resources. Three-quarters of respondents named food processors and manufacturers and 74% named grocery stores and supermarkets, as having enough resources to insure food safety (Table 7). Restaurants followed with 68%, the respondents themselves were next with 66%, and 62% said farmers had enough resources. Less than 60% of the respondents indicated that average Americans (56%) and federal government agencies (51%) had enough resources. One sample *t*-tests were used to determine whether the mean resources scores of each actor differed from one another. All of the means were significantly different from each other ($P < .001$), except food processors and manufacturers compared with grocery stores and supermarkets, federal government agencies compared with average Americans, and restaurants compared with respondents.

To explore the issue of resources further, we examined the relationship between respondents' opinions of their resource needs and socio-demographics, whether or not the respondent had food poisoning within the past year, perceived knowledge about food safety, and perceived control over food safety. Chi-square tests were utilized to measure the significance of the relationship between each of these variables and resources. As demonstrated in Table 8, perceived knowledge, food poisoning, age, education, frequency of meal preparation, and perceived control were found to be significantly related to perceptions of adequacy of resources ($P < .05$).

Although a majority of all food preparers believed that they had enough resources to insure the safety of the foods they eat, 32% of those who prepare meals stated that they need more resources. The respondents most likely to say that they need more resources were respondents who knew "not much at all" about food safety, believed that they had food poisoning in the past year, and had less than a high school education. Younger (18–24) and older (65 years of age or older) respondents, as well as those 45–54 years old, were more likely to indicate that they have enough resources, as were those who hardly prepare any meals. In addition, the percentage of respondents who indicated that they had enough resources increased with perceived control over food safety. Almost half of those who believed that they had no control over food safety (49%) stated that they need more resources.

TABLES 5A–C. Acceptability of prevalence of foodborne illness (in percent)

5A. The Center for Disease Control and Prevention estimates that about 25 percent of the population will get sick because of consuming contaminated foods and beverages. Do you think this percentage is…

Very acceptable	3.7%
Acceptable	21.1%
Neither acceptable nor unacceptable	0.4%
Unacceptable	47.9%
Very unacceptable	25.6%

5B. The Center for Disease Control and Prevention estimates that less than one percent of the US population, or about 325,000 people, are hospitalized because of foodborne diseases in a given year. Do you think this percentage is…

Very acceptable	3.0%
Acceptable	33.4%
Neither acceptable nor unacceptable	1.7%
Unacceptable	41.6%
Very unacceptable	18.3%

5C. The Center for Disease Control and Prevention estimates that of those who are hospitalized, less than two percent of them, or about 5,000 people, die. Do you think this percentage is…

Very acceptable	2.6%
Acceptable	26.9%
Neither acceptable nor unacceptable	0.3%
Unacceptable	44.5%
Very unacceptable	23.6%

Note: Percentages may not sum to 100% because "Do not know" or "Refused" categories are not presented.

DISCUSSION

These results have a number of important implications for food safety educators, food safety policy, and future research. First, the findings show that food safety is an important consideration for a majority of consumers and that food safety concerns affect the purchasing of food items for a significant portion of the population. Although consumers believe they have some knowledge about food safety, the results show that the majority are not aware of the prevalence of foodborne illness. When provided estimates of the prevalence of foodborne illness, the majority of respondents found these estimates to be unacceptable. A particularly interesting finding in this study was that only 7% of respondents stated that they had had a case of food poisoning within the past year. This percentage is lower than that reported in a national survey conducted by the FDA in 1993 *(8)*, in which 14% of respondents reported experiencing a foodborne illness in the past year, and is about 18% lower than official United States government estimates.

In addition, 48% of respondents in this study underestimated the prevalence of foodborne illness in the United States population, and a third overestimated its prevalence. These findings highlight the need for more studies on illness surveillance and consumer perceptions and experiences with foodborne illness. For example, is the prevalence of foodborne illness overestimated by Mead et al. *(16)* or do consumers not recognize the symptoms associated with foodborne illness *(8)*? Although we cannot answer these questions from the data collected in this study, the results are consistent with previous research that suggests that consumers tend to underreport incidences of foodborne illness *(16)*. Thus, food safety educators should keep in mind when developing communication strategies and outreach materials that many consumers may not associate the classic symptoms of foodborne illness (e.g., diarrhea and vomiting) with food consumption. As a consequence, it is plausible that this knowledge gap is what leads consumers to underestimate the prevalence of foodborne illness and to fail to recognize the symptoms when they experience the symptoms themselves. Conversely, a significant portion of respondents overestimated the prevalence of foodborne illness, indicating that they believe food safety is worse than it actually is regardless of the cause or whoever is at fault, which further suggests that most people have a poor perception of food safety.

The data in this study are in part consistent with results published by Cates et al. *(6)* in that consumers believe that the responsibility for food safety is shared among a number of groups.

TABLE 6. Responses to the question "How would you rate the performance of (food safety group) in making sure the foods you eat are safe

Food safety group	Very good	Good	Neither good nor poor	Poor	Very poor	Mean
Federal government agencies	9.5%	68.2%	4.8%	13.4%	1.9%	3.716[a]
Food processors and manufacturers	8.6%	69.4%	3.4%	15.5%	1.6%	3.687[a]
Farmers	16.6%	72.8%	1.5%	4.7%	0.5%	4.043
Grocery stores and supermarkets	13.7%	68.4%	4.2%	10.3%	1.5%	3.842
Restaurants	4.8%	64.6%	6.3%	17.4%	2.5%	3.542
Average Americans	6.8%	55.8%	6.9%	21.7%	2.4%	3.458
Respondents	43.9%	52.8%	0.5%	2.4%	0.1%	4.384

Note: Percentages may not sum to 100% because "Do not know" or "Refused" categories are not presented.

All means are statistically significantly different from each other ($P < .001$), except [a]federal government agencies compared with food processors and manufacturers. One-sample *t*-tests were used to compare mean scores.

TABLE 7. Respondents' perceptions of different food safety groups about the adequacy of their level of resources (staff, expertise, knowledge, money) to insure that the foods they eat are safe

Food safety group	Have enough resources	A few more resources	Some additional resources	A lot of resources	Mean
Federal government agencies	51.3%	5.3%	17.8%	15.7%	1.977[b]
Food processors and manufacturers	74.9%	3.4%	8.7%	9.8%	1.520[a]
Farmers	61.5%	3.7%	18.1%	13.0%	1.818
Grocery stores and supermarkets	73.7%	6.0%	10.4%	7.9%	1.515[a]
Restaurants	68.0%	4.9%	12.1%	11.2%	1.651[c]
Average Americans	55.9%	5.5%	20.4%	15.6%	1.956[b]
Respondents	66.1%	8.0%	16.8%	8.0%	1.664[c]

Note: Percentages may not sum to 100% because "Do not know" or "Refused" categories are not presented.

All means are statistically significantly different from each other ($P < .001$), except [a]food processors and manufacturers compared with grocery stores and supermarkets, [b]federal government agencies compared with average Americans, and [c]restaurants compared with respondents. One-sample *t*-tests were used to compare mean scores.

Most respondents, however, believed that the government and food processors and manufacturers should be primarily responsible for insuring that the foods they eat are safe. These results do differ somewhat from those of Cates et al. *(6)*, which might be explained by the different methodological approaches utilized. In contrast to our telephone survey, which asked respondents which ONE group was *most* responsible for insuring that the foods they eat are safe, Cates et al. *(6)* used an Internet web-based survey and asked respondents to rate the responsibility of each group on a scale of 1–5.

An important consideration for food safety communicators is that consumers may not change their food preparation and/or handling habits if they believe that others hold the lion's share of the responsibility for food safety and that those groups are doing a good job of insuring that the foods they eat are safe. Although food safety educators suggest that consumers ought to think about food safety every time they purchase, prepare, cook, serve, and store food, only 34% of consumers surveyed think about it every day and more than half do so only once in a while. The cross-tabulation results suggest that the primary meal preparer and food shopper in the household was more likely to think about food safety, whereas particular segments of the population, in particular Caucasians, Hispanics, males, and those with higher levels of education and income, were less likely to think about food safety. It is quite possible that many consumers do not perceive a need to take precautions. These data would suggest that food safety communicators must do

TABLE 8. Respondents' perceptions about the adequacy of their own level of resources (expertise, knowledge, money) to insure that the foods they eat are safe as influenced by socio-demographics, whether the respondent had food poisoning, perceived knowledge about food safety, and perceived control over food safety

Variable	Have enough resources	Need more resources	Total (n)	Chi-square
Age				
18–24	71.0	29.0	155	
25–34	58.5	41.5	188	
35–44	59.4	40.6	207	
45–54	74.0	26.0	177	
55–64	58.8	41.2	119	
65 or older	77.6	22.4	147	
Total	66.3 (n = 658)	33.7 (n = 335)	993	27.003**
Education of respondent				
Less than high school	43.5	56.5	62	
High school graduate	66.3	33.7	377	
Some college or associate degree	71.5	28.5	302	
College degree or higher	66.9	33.1	257	
Total	66.6 (n = 665)	33.4 (n = 333)	998	18.136**
Meal preparation in household				
All	68.1	31.9	295	
Most	63.4	36.6	306	
Some	63.0	37.0	262	
Hardly any	84.4	15.6	90	
None at all	59.2	40.8	49	
Total	66.4 (n = 665)	33.6 (n = 337)	1002	17.279*
Had food poisoning within the past year				
Yes	36.0	64.0	75	
No	69.1	30.9	918	
Total	66.6 (n = 661)	33.4 (n = 332)	993	34.057**
Perceived knowledge				
A lot or quite a bit	71.4	28.6	588	
A little or not much at all	59.3	40.7	415	
Total	64.1 (n = 666)	33.6 (n = 337)	1003	15.562**
Perceived control				
A great deal or some	69.9	30.1	668	
A little or none	59.6	40.4	337	
Total	66.5 (n = 668)	33.5 (n = 337)		10.137**

*$P < .01$; **$P < .001$

two things in creating messages to help reduce the incidence of foodborne illness. First, they must build awareness among consumers about the critical role they play in insuring the safety of the foods consumed. Second, they must persuade consumers that there are simple, efficacious steps that can be taken to reduce the potential for foodborne illness *(30)*.

Another possible impediment to food safety education is the finding that close to 97% of respondents rated their own food safety performance as "good" or "very good." These results are consistent with prior research *(23)* showing that consumers are extremely confident in their own food safety practices. This high level of confidence in their own ability, coupled with the statement, by a majority of respondents, that they have "a lot" or "quite a bit" of knowledge about food safety and enough resources to insure that the foods they eat are safe, might also impact consumers' adoption of recommended food safety practices. Redmond and Griffith *(21)* claim that consumers associate the lowest personal risk with home-prepared meals because they perceive more personal control in this environment. Our data support this claim, as we found that only 8% of respondents believed that they had "no control over food safety," while two-thirds stated that they had "some" or "a great deal" of control over food safety. Of particular significance is the cross-tabulation finding that 78% of those aged 65 years or older believed that they have enough resources to insure that the foods that they eat are safe. In addition, 60% of those 65 years of age or older said that they know "a lot" or "quite a bit" about food safety. As the elderly are becoming an increasingly larger segment of the North American and European populations and are more likely to experience severe effects from foodborne illnesses, our results point to the need for more in-depth research to evaluate the relationship between perceptions and food safety practices of the elderly.

Although a majority of respondents indicated that they have enough resources to insure the safety of the foods they eat, the cross-tabulation results show that particular segments of the population—those who do not possess much knowledge about food safety, those who believe that they have had food poisoning, those who are middle aged, those with less than a high school education, and those who believe that they have no control over food safety—may need additional education on food safety and its relationship to foodborne illness. This is also highlighted by the apparent discrepancy between the frequency of thinking about food safety and purchasing behavior of respondents with less than a high school education. These respondents, although more likely to think about food safety, were less likely to avoid any foods based on food safety concerns, a fact that may be due to limited resources.

There are several limitations to this study. First, the survey did not include questions designed to capture what resources people perceive they need to insure food safety. Future research should investigate what types of resources consumers need, e.g., money, expertise, or education. Other studies might compare consumer perceptions and resource needs with those of other food safety actors, primarily government and industry leaders. Nevertheless, our data do provide some guidance on where resource and knowledge gaps exist, such as linking common symptoms to foodborne illness; clearly designating the consumer's role in food safety issues; and providing simple, efficacious behaviors for people to enact. Second, in the survey, we used the term "food poisoning" because it is a commonly used term, and assumed it to be synonymous with the term "foodborne illness"; a future research project should test this assumption. Third, we did not measure respondents' actual knowledge of food safety, nor did the survey contain food safety behavioral questions; this was intentional, in order to limit the scope of the study. Despite these limitations, this research raises several interesting questions for policy makers and further research. As Palojoki and Tuomi-Grohn *(18)* state, "it is not possible to understand the rationale behind human choices without knowing the context and life situation of the persons involved" (p. 16). This research shows that we need to learn more about not only why persons make the food safety choices they do, but also how food safety educators and communicators can develop persuasive outreach programs that efficiently and effectively segment audiences in order to tailor messages to positively influence food safety attitudes and behaviors. Further, a majority of respondents in this study stated that the current level of food safety is unacceptable, which leads to the following question: what is an acceptable level of food safety? In other words, is there a tolerable level of risk for most consumers? And how can industry, policy-makers, regulators and other actors in the food supply chain help ensure that the United States reaches these levels? One of the primary goals of the Healthy People 2010 initiative is to reduce the number of foodborne illnesses by half by 2010, in part by increasing the proportion of consumers who follow key recommended food safety practices. Will consumers view this reduction as acceptable, or will they call for further reductions? In the past few years, foodborne illness has not decreased appreciably *(27)*, despite major industry efforts. These questions call for more research to determine the appropriate level of risk associated with foods, one that is acceptable both to the scientific community and the public at large.

REFERENCES

1. Altekruse, S. F., D. A. Street, S. B. Fein, and A. S. Levy. 1995. Consumer knowledge of foodborne microbial hazards and food-handling practices. J. Food Prot. 59:287–294.
2. Bocker, A., and C.-H. Hanf. 2000. Confidence lost and – partially – regained: consumer response to food scares. J. Econ. Behav. Org. 43:471–485.
3. Bremer, V., N. Bocter, S. Rehmet, G. Klein, T. Breuer, and A. Ammon. 2005. Consumption, knowledge, and handling of raw meat: A representative cross-sectional survey in Germany, March 2001. J. Food Prot. 68:785–789.
4. Brewer, M. S., and C. J. Prestat. 2002. Consumer attitudes toward food safety issues. J. Food Safety 22:67–83.
5. Bruhn, C. M., and H. G. Schutz. 1999. Consumer food safety knowledge and practices. J. Food Safety 19:73–87.
6. Cates, S. C., R. A. Morales, S. A. Karns, L.-A. Jaykus, K. M. Kosa, T. Ten Eyck, C. M. Moore, and P. Cowen. 2006. Consumer knowledge, storage, and handling practices regarding *Listeria* in frankfurters and deli meats: results of a web-based survey. J. Food Prot. 69:1630–1639.
7. Centers for Disease Control and Prevention. October 6, 2006, posting date. *E. coli* O157:H7 outbreak from fresh spinach. [http://

www.cdc.gov/foodborne/ecolispinach/100606.htm.]
8. Fein, S. B., C.-T. J. Lin, and A. S. Levy. 1995. Foodborne illness: Perceptions, experience, and preventive behaviors in the United States. J. Food Prot. 58:1405–1411.
9. Fife-Schaw, C., and G. Rowe. 1996. Public perceptions of everyday food hazards: A psychometric study. Risk Anal. 16:487–500.
10. Fife-Schaw, C., and G. Rowe. 2000. Extending the application of the psychometric approach for assessing public perceptions of food risk: some methodological considerations. J. Risk Res. 3:167–179.
11. Garayoa, R., M. Cordoba, I. Garcia-Jalon, A. Sanchez-Villegas, and A. I. Vitas. 2005. Relationship between consumer food safety knowledge and reported behavior among students from health sciences in one region of Spain. J. Food Prot. 68:2631–2636.
12. Herrmann, R. O., A. Sterngold, and R. H. Warland. 1998. Comparing alternative question forms for assessing consumer concerns. J. Cons. Aff. 32:13–29.
13. Knight, A. J., and R. Warland. 2005. Determinants of food safety risks: A multi-disciplinary approach. Rural Sociol. 70:253–275.
14. Lin, B.-H., E. Frazao, and J. Guthrie. 1999. Away-from-home foods increasingly important to quality of American diet. Agriculture Information Bulletin No. 749. US Dept. of Agriculture, Economic Research Service, January.
15. Lin, C.-T. J., K. L. Jensen, and S. T. Yen. 2005. Awareness of foodborne pathogens among US consumers. Food Qual. Pref. 16:401–412.
16. Mead, P. S., L. Slutsker, V. Dietz, L. F. McCaig, J. S. Bresee, C. Shapiro, P. M. Griffin, and R. V. Tauxe. 1999. Food-related illness and death in the United States. Emerging Infect. Dis. 5:607–625.
17. Mueller, W. 1990. Who's afraid of food? American Demographics 12:40–43.
18. Palojoki, P., and T. Tuomi-Grohn. 2001. The complexity of food choices in an everyday context. Int. J. Cons. Stud. 25:15–23.
19. Priest, S. H. 2000. US public opinion divided over biotechnology? Nature Biotechnol. 18:939–942.
20. Redmond, E. C., and C. J. Griffith. 2003. A comparison and evaluation of research methods used in consumer food safety studies. Int. J. Cons. Stud. 27:17–33.
21. Redmond, E. C., and C. J. Griffith. 2004. Consumer attitudes and perceptions towards microbial food safety in the domestic kitchen. J. Food Safety 24:169–194.
22. Redmond, E. C., and C. J. Griffith. 2005a. Consumer perceptions of food safety education sources: Implications for effective strategy development. British Food J. 107:467–483.
23. Redmond, E. C., and C. J. Griffith. 2005b. Factors influencing the efficacy of consumer food safety communication. British Food J. 107:484–499.
24. Roseman, M., and J. Kurzynske. 2006. Food safety perceptions and behaviors of Kentucky consumers. J. Food Prot. 69:1412–1421.
25. Smith, D., and P. Riethmuller. 2000. Consumer concerns about food safety in Australia and Japan. British Food J. 102:838–855.
26. van Ravenswaay, E. O., and J. P. Hoehn. 1996. The theoretical benefits of food safety policies: a total economic value framework. (Proceedings from the Annual Meeting of the American Agricultural Economics Association Held 28–31 July 1996 at San Antonio, Texas). Amer. J. Agri. Econ. 78:1291–1296.
27. Vugia, D., A. Cronquist, J. Hadler, M. Tobin-D'Angelo, D. Blythe, K. Smith, S. Lathrop, D. Morse, P. Cieslak, T. Jones, K. G. Holt, J. J. Guzewich, O. L. Henao, E. Scallan, F. J. Angulo, P. M. Griffin, R. V. Tauxe, and S. K. Greene. 2007. Preliminary FoodNet data on the incidence of infection with pathogens transmitted commonly through food – 10 states, 2006. MMWR 56:336–339.
28. Wilcock, A., M. Pun, J. Khanona, and M. Aung. 2004. Consumer attitudes, knowledge and behaviour: A review of food safety issues. Trends Food Sci. Technol. 15:56–66.
29. Williamson, D. M., R. B. Gravani, and H. T. Lawless. 1992. Correlating food safety knowledge with home food-preparation practices. Food Technol. 46:94–100.
30. Witte, K. 1992. Putting the fear back into fear appeals: The extended parallel process model. Comm. Mono. 59:329–349.

Highlights of the Executive Board Meeting
April 23–25, 2008
Des Moines, Iowa

The following is an unofficial summary of actions from the Executive Board Meeting held in Des Moines, Iowa on April 23–25, 2008.

Approved the following:

- Minutes of February 17–18, 2008 Executive Board Meeting
- Minutes of February 17, 2008 Executive Board Executive Session
- Request support of $25,000 from IAFP Foundation for 2008 European Symposium
- Set registration fees for 2008 European Symposium
- Policy on Program Committee meeting attendance
- Honorary Life Memberships for three IAFP Members

Discussed the following:

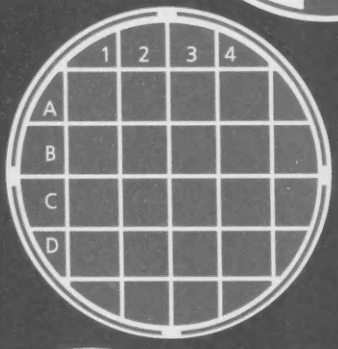
- E-mail votes taken since the last meeting
- Committee appointments for 2008–2009
- Planning update for IAFP 2008
- No tours for IAFP 2008
- Long-range planning with Board and staff
- Marketing materials for IAFP Membership
- Latin America Symposium on Food Safety, Campinas, SP, Brazil – May 26–28, 2008
- 2008 European Symposium planning, Lisbon, Portugal – November 19–21, 2008
- China International Food Safety & Quality, Beijing, China – September 24–26, 2008
- Dubai International Food Safety Conference, Dubai, U.A.E. – February 2009
- IAFP's International Symposium for 2009 – location
- Electronic Secretary election comments
- *Journal of Food Protection* Author survey on page charges
- *FPT* Editor guidelines
- International Food Information Council (IFIC) joint projects
- Non O157 *E. coli* white paper
- WHO-NGO update
- 3-A Sanitary Standards, Inc.
- Springer proposals
- Student Travel Scholarship – additional awardees for 2008 and 2009
- Sample Prep Working Group – white paper drafted and in review
- Compendium on Methods for Microbial Examination of Foods
- Request to record selected presentations at IAFP 2008
- Organizational meeting at IAFP 2008 for an International Food Protection Issues PDG
- Exhibit at FoodMicro 2008, Aberdeen, Scotland – September 1–4, 2008

Reports received:

- *IAFP Report*
- *Food Protection Trends*
- *Journal of Food Protection*
- IAFP Web site
- Membership
- Advertising & sponsorship update
- Board Members attending Affiliate meetings
- *Affiliate View* newsletter
- Future Annual Meeting schedule
- Exhibiting (IAFP On the Road)

Next Executive Board meeting – August 1–7, 2008.

BD Diagnostics
Microbiology Media Solutions



Microbiology – It's what we do.

With over 100 years of experience in the development and manufacturing of peptones and microbiological culture media, BD Diagnostics is committed to providing you with the most highly responsive and technically relevant solutions, increasing operational efficiency, and elevating quality standards.

BBL™ and Difco™ Culture Media Brands provide you with:

- Consistency in quality
- Consistency in performance
- Assurance in meeting regulatory requirements

Find out what we can do for you. Visit us on the web at www.bd.com/ds or contact your local BD sales representative.

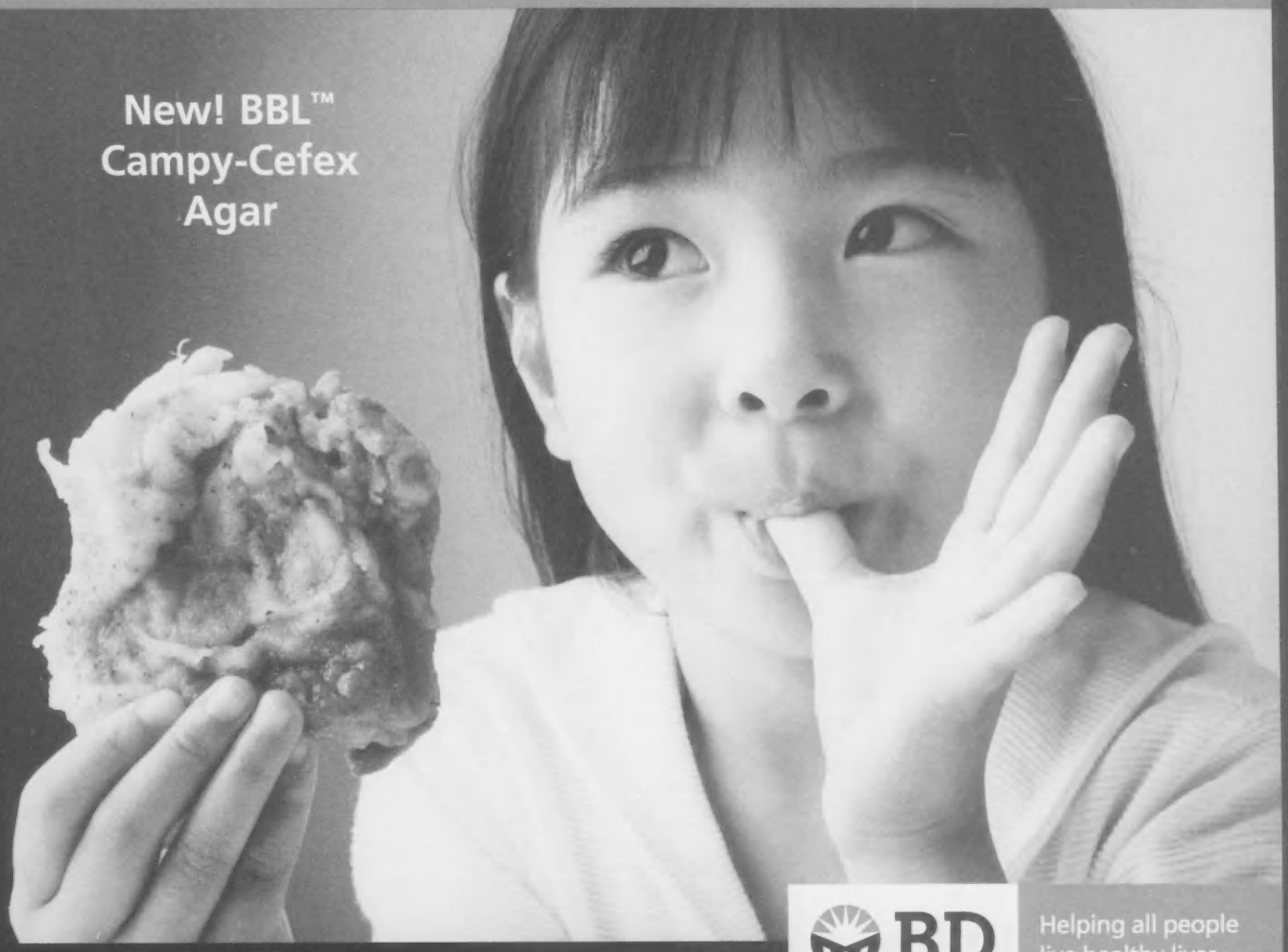
BD

Helping all people live healthy lives

BD Diagnostics
800.638.8663
www.bd.com/ds

BD Diagnostics

Microbiology Media Solutions for Food Safety



BD

Helping all people live healthy lives

Microbiology – It's what we do

New! BBL Campy-Cefex Agar* prepared plated medium for the isolation, enumeration and detection of *Campylobacter* species directly from poultry.[1]

- Campy-Cefex Agar formulation was adopted by the National Advisory Committee on Microbiological Criteria for Foods for the isolation of *Campylobacter* species from chicken carcasses.[1]
- The proven experience of BBL in prepared media manufacturing provides consistency in quality and performance
- BBL Campy-Cefex Agar & BBL GasPak™ EZ *Campylobacter* atmospheric generating systems – Microbiology Media Solutions

Find out what we can do for you. Visit us on the web at www.bd.com/ds.

* U.S. Patent No. 5,891,709 licensed to Becton Dickinson & Company

NACMCF Executive Secretariat,* 2007. Analytical utility of *Campylobacter* methodologies. U.S. Department of Agriculture, Food Safety and Inspection Service, Washington, D.C. Journal Food Protect. 70:241-250.

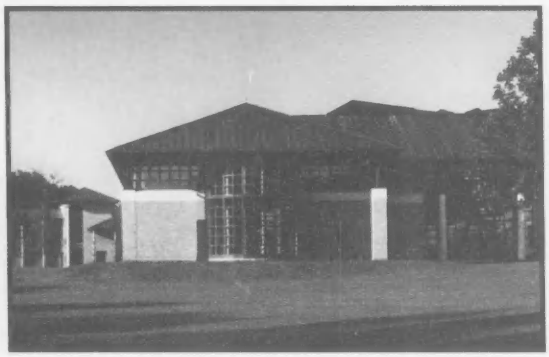
BD Diagnostics
800 638 8663
www.bd.com/ds

Gold Sustaining Member Profile

BD

Helping all people live healthy lives

BD, a leading global medical technology company that manufactures and sells medical devices, instrument systems and reagents, is dedicated to improving people's health throughout the world. BD is focused on improving drug therapy, enhancing the quality and speed of diagnosing infectious diseases, and advancing research and discovery of new drugs and vaccines. The Company's capabilities are instrumental in combating many of the world's most pressing diseases. Founded in 1897 and headquartered in Franklin Lakes, New Jersey, BD employs approximately 27,000 people in approximately 50 countries throughout the world. The Company serves healthcare institutions, life science researchers, clinical laboratories, industry and the general public.



The Company's original microbiology products division, Baltimore Biological Laboratories (founded in 1935 and acquired by BD in 1955), undertook the study of the preparation of peptones and development of culture media. The acronym "BBL" became the brand name for products offered by the company.

Difco Laboratories, founded in 1895, produced high quality enzymes, dehydrated tissues, and glandular products. In 1934, the focus was to develop new and improved bacteriological culture media, many of which were adopted as "standard" formulations in water, dairy, food, pharmaceutical and other microbiological laboratories.

In June 1997, the merge of Difco Laboratories with the Microbiology Systems division brought together the leading providers of microbiology products to industrial and clinical microbiology laboratories worldwide, with a combined total of over 180 years of experience. Today, both businesses comprise BD Diagnostics – Diagnostic Systems, headquartered in Sparks, MD, near the city of Baltimore.

Continuing this tradition of excellence, BD has developed an innovative line of media that incorporates carefully selected synthetic chromogenic and/or fluorogenic substrates. This novel technology has been shown to provide improved accuracy and faster detection than other traditional primary culture media. Depending on the media type and organism, identification may be accomplished without the need for confirmatory testing, subculturing, or supplemental biochemical or latex testing, leading to more efficient use of technologist time and earlier reporting of final results. In addition, four chromogenic media, all BBL™ CHROMagar™ formulations, have been developed and AOAC™–RI approved for rapid detection and identification of *E. coli* O157:H7, *Listeria monocytogenes*, *Salmonella* and *Staphylococcus aureus* from foods.

The business that now constitutes BD Diagnostics – Diagnostic Systems was founded by entrepreneurs whose ideas, diligence and foresight have contributed to making BD one of the world's leaders in the healthcare field. Through its products and services, BD is committed to "helping all people live healthy lives."

For more information, please visit www.bd.com/ds.

Gold Sustaining Member Profile

BIOMÉRIEUX INDUSTRY

Advancing Diagnostics to Improve Public Health

bioMérieux is a leading international group specializing in the field of in vitro diagnostics. Through 38 subsidiaries and a large network of distributors, the company is present in more than 150 countries.

TEMPO® System

bioMérieux provides diagnostic solutions (reagents, instruments, software), which determine the source of disease and contamination to improve patient health and ensure consumer safety. Its products are used for diagnosing infectious diseases and providing high medical value results for cardiovascular emergencies and cancer screening and monitoring. They are also used for microbiological analysis of food, drug or air samples to monitor and confirm the quality of the production process and finished product.

Microbiological analysis plays a crucial role in a changing global food market. Microbiological food safety is evolving due to ongoing changes in demographics, globalization, food product and processing, and food consumption patterns. These changes are also reflected in the transformation of the role of the microbiologist. Twenty years ago, the role of food microbiologists were limited and underestimated. Today, food microbiologists are at the forefront of food safety, anticipating the challenges generated in today's global market.

A Family History Rooted in Microbiology

bioMérieux's commitment to public health is rooted in its unique history. Marcel Mérieux, a student of Louis Pasteur, opened a medical analyses laboratory and started off the century-long fight that the Mérieux family has waged against infectious diseases. The Institut Mérieux he created became the world leader in human and veterinary vaccines (now evolved into two companies, Sanofi Pasteur and Mérial, no longer belonging to the family). In 1963, Alain Mérieux, grandson of Marcel, established the diagnostics company, bioMérieux.

Its launch from the field of clinical diagnostics soon led to the development of a new division, bioMérieux Industry, a pioneer in providing solutions to improve the safety and quality of food, biopharmaceutical and cosmetic products. Presently, Alexandre Mérieux, the son of Alain Mérieux, leads this division, which has become number 1 worldwide in industrial microbiology.

Innovations from bioMérieux

bioMérieux's innovations encompass a full range of, manual and fully automated microbiology testing solutions, including prepared culture media, the API® and VITEK® 2 Compact identification systems, VIDAS® Automated Pathogen Detection System, BacT/ALERT® 3D Microbial Detection System, and air IDEAL® environmental air sampling system.

New additions include TEMPO® and DiversiLab™. Based on a unique concept developed by bioMérieux, TEMPO is the first automated quality indicator testing system for the food industry. The system offers enumeration of quality indicators, which are vital in determining overall product hygiene. DiversiLab provides food companies with a rapid, easily implemented and automated bacterial strain typing method, an essential tool in tracking the source of microbial contamination. Rounding out the product portfolio are two recent distribution agreements with Elisa Systems, adding a full range of allergen tests, and with Charles River Laboratories, Inc. for its PTS Gram ID System.

Food professionals are faced with unique challenges in a changing global market. bioMérieux is committed to educating its customers about advances in the field. The company recently released the Food Safety Handbook: Microbiological Challenges, an overview of modern approaches to microbiological food safety. More than twenty internationally renowned experts contributed to chapters covering the key issues in food safety today.

IAFP Gold Sustaining Member

Over the years, bioMérieux has grown relationships with customers and leaders in the food safety community, including the IAFP Foundation. As an IAFP Gold Sustaining Member, bioMérieux proudly promotes the Foundation's endeavors to provide a forum for technical exchange between all sectors of the food safety industry. bioMérieux strives not only to supply food safety and quality solutions for the food industry, but also to be a partner and educator with the food community in ensuring public health.

bioMérieux's food safety and quality solutions can be found at www.biomerieux-usa.com and www.biomerieux-industry.com or by calling 800.634.7656.

Gold Sustaining Member Profile

BIO-RAD

Bio-Rad Laboratories has played a leading role in the advancement of scientific discovery for over 50 years by providing a broad range of innovative products and services to the life science research and clinical diagnostic markets. Founded in 1952 and incorporated in 1957, Bio-Rad has a global team of more than 6,300 employees and serves more than 85,000 research and industry customers worldwide through its global network of operations. Throughout its existence, Bio-Rad has built strong customer relationships that advance scientific research and development efforts and support the introduction of new technology used in the growing fields of genomics, proteomics, drug discovery, food safety, medical diagnostics, and more.

Bio-Rad's Life Science Group develops, manufactures, and markets a wide range of laboratory instruments, apparatus, and consumables used for research in functional genomics, proteomics, and food safety. The group ranks among the top five life science companies worldwide, and maintains a solid reputation for quality, innovation, and commitment to its customers. Bio-Rad's life science products are based on technologies used to identify, separate, purify, and analyze biological materials such as proteins and nucleic acids. Some of these technologies include electrophoresis, imaging, multiplex immunoassay, chromatography, microbiology, bioinformatics, protein function analysis, transfection, amplification, and real-time PCR. Bio-Rad products support researchers in laboratories throughout the world.

The Food Science Division produces tests for food safety, veterinary diagnostics, water and TSE (Transmissible Spongiform Encephalopathy) testing. Bio-Rad has a complete line of RAPID chromogenic media for isolation and detection of *Salmonella*, *E. coli* O157:H7, *Listeria monocytogenes*, *Staphylococcus aureus*, and indicator organisms *Listeria* spp. and coliforms/*E. coli*. Bio-Rad has launched a complete menu of iQ-Check™ real-time PCR test kits for detection of food pathogens with reduced enrichment times. With the iQ-Check kits, real-time PCR has been adapted to fit the needs of food safety professionals.

Gold Sustaining Member Profile

Expect a higher standard

Beef Products, Inc., the world's leading manufacturer of boneless lean beef, is headquartered in the heartland of America, Dakota Dunes, South Dakota. Since its inception in 1981, BPI has operated with one simple guideline, to be the best at what we do. This drive to be a leader within the beef industry has resulted in continuous development of new processing techniques, sanitation programs, and food safety innovations. BPI's dedication to quality and innovation spans over two decades of proven leadership in the lean meat manufacturing industry. At BPI and affiliated companies, we expect a higher standard of ourselves and, consequently, deliver a higher standard for our customers.

Producing 80,000 pounds of production a week in its beginnings, BPI's products are now found in over two-thirds of all ground beef produced in the United States each year. With current production of over 10 million pounds per week, BPI is clearly the leading manufacturer of boneless lean beef in the world. With continued process improvements, we anticipate production to reach 11 to 12 million pounds per week within the next year.

At BPI, food safety is more than an afterthought. Food safety is a critical element in the design and construction of each BPI facility. Food safety is so vital that nearly 20 percent of the total cost to construct BPI's South Sioux City facility went directly into sanitation and food safety related items. For example, outside air is washed, refrigerated, and sanitized before entering the processing room. The chilled air creates positive pressure within the processing room that, we believe, prevents contaminated air from entering the processing area. This eliminates the need for refrigeration coils, which can harbor bacteria.

That commitment to food safety carries through all aspects of production and beyond. BPI's finished product sampling and testing program is the most rigorous in the industry, assuring our customers of product quality and safety. The sampling and testing program was recently evaluated by Iowa State University Microbiology and Statistics departments in conjunction with BPI's reassessment of its HACCP plans. Reviewer comments follow:

BPI's sampling and testing program is currently the most rigorous program in the industry I am aware of... The sampling and testing program managed by BPI is in fact statistically superior to other programs sometimes referred to by USDA as models for the industry, with higher probabilities of detection at all projected population levels for *E. coli* O157:H7.

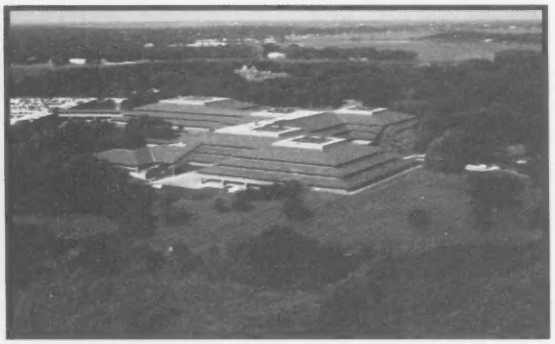
By maintaining our focus on BPI's core values of communication, cooperation, and innovation, BPI will continue to be the leading supplier of high-quality lean beef to the meat industry.

To learn more about BPI, please visit us at http://www.beefproducts.com.

Gold Sustaining Member Profile

Cargill™

Cargill is an international provider of food, agricultural, and risk management products and services. We are committed to using our knowledge and experience to meet customers' unique needs and help them succeed.



Cargill employs more than 158,000 people in 66 countries, and services five key customer segments: Crop and Livestock; Food; Health and Pharmaceutical; Financial and Risk Management; and Industrial. Cargill partners with farmers in growing crops, raising animals, and feeding people. We help our food and industrial customers reduce risk, expand markets, and streamline supply chains. We work to ensure that our people, products, and facilities are safe. We buy, trade, transport, blend, mill, crush, process, refine, season, distribute and deliver around the clock, around the globe. You can taste the results at your table each day: the meat made more flavorful, the bread made healthier, the beverage made more refreshing. Behind the scenes, Cargill employees are discovering new ways to improve the foods you eat. With our partners, we're working every day to nourish ideas and nourish people.

The history of Cargill dates back to 1865 when it was founded as a single grain elevator in Iowa. From its roots in the pioneer farming lands of America's Midwest, Cargill owes its long heritage to an early culture of business ethics, innovation, and leadership. Our world headquarters is based just outside Minneapolis, Minnesota. Cargill is a privately-held, professionally-managed company with more than $88 billion in revenue in 2007. Our customers and partners are some of the best known in the world: McDonald's, Kraft, Nestlé, Coca-Cola, Pepsi-Co., Wal-Mart, and Unilever. They choose Cargill because they know we're committed to doing what it takes to help them succeed. Providing solutions is what being a valued business partner is all about.

Cargill's four-fold Vision Statement is intended to unite, challenge, and inspire everything we do:

- Our purpose is to be the global leader in nourishing people.
- Our mission is to create distinctive value.
- Our approach is to be trustworthy, creative and enterprising.
- Our performance measures are engaged employees, satisfied customers, enriched communities, and profitable growth.

Success in each of these measures ensures success for Cargill and our customers.

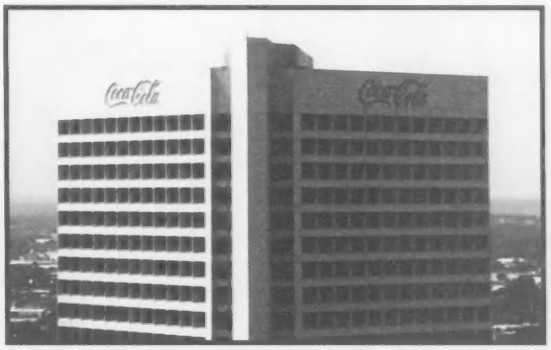
Through our breadth of knowledge across the agri-food chain and depth of experience in global markets, we help move food from the fields where it's grown to the homes where it's consumed. No matter where you look, you'll see Cargill working hand in hand with customers, suppliers, and communities to nourish ideas and nourish people.

To learn more about Cargill, please visit us at www.cargill.com.

Gold Sustaining Member Profile

The Coca-Cola Company

People in more than 200 countries around the world reach for the beverages of The Coca-Cola Company 1.5 billion times each day. They expect great taste and the highest quality in every serving. Our promise to consumers worldwide is to meet their expectations for enjoyment, refreshment, nutrition and hydration through a variety of beverages produced to the same level of safety and quality, everywhere and every time.



Founded in 1886, The Coca-Cola Company is the world's largest beverage company. While known for Coca-Cola, Diet Coke, Fanta, Sprite and a wide range of other beverages, we offer more than 450 brands and more than 2,800 beverage products. The world's largest juice and juice-drinks company, we are also the world's third largest bottled-water business.

We listen to consumers to understand their interests and concerns, providing them with a wide variety of beverages and portion sizes to meet their individual needs. Our beverage portfolio includes regular, diet and light sparkling beverages; waters; juices and juice drinks; teas and coffees; energy and sports drinks; Minute Maid and Odwalla juice products; Dasani bottled water; and POWERade sports beverages. We are continuously building our innovation pipeline and packaging options to expand consumer choice, such as soy-based drinks and beverages with enhanced nutrition; and we have successfully expanded our still portfolio through key acquisitions like glacéau, Fuze and Jugos del Valle.

Delivering the safety and quality our consumers expect requires consistent and flawless implementation, execution, evaluation and improvement of our systems. To that end, The Coca-Cola Quality System (TCCQS) is our branded safety and quality management system designed to reflect our integrated approach to managing safety and quality, preserving the environment, strengthening the community and ensuring associate safety and health. Everyone associated with our Company is expected to maintain the highest standards of quality in products, processes and relationships. TCCQS is the framework around which The Coca-Cola System coordinates and guides its activities, drives continuous improvement, and works vigilantly to ensure that safety and quality remain our number one goal and continue at the forefront of everything we do.

More than a paper system, TCCQS is backed by a network of food safety and quality professionals with laboratories throughout the world. Just as the International Association for Food Protection provides food safety professionals worldwide a forum to exchange information on protecting the food supply, TCCQS provides the framework for food safety professionals at The Coca-Cola Company to apply industry-leading best practices to protecting the safety and quality of our brands.

Whether consumers purchase our products in Anchorage or New Zealand, New York or New Delhi, our commitment ensures that their beverages are produced to the same level of safety and quality everywhere and every time.

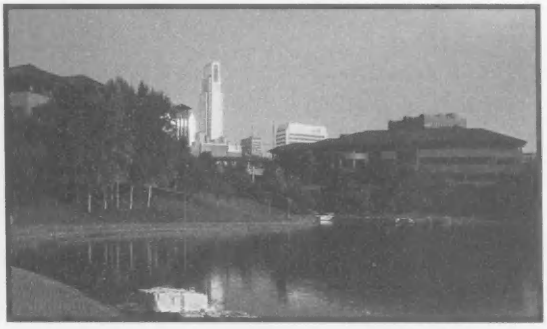
The Coca-Cola Company exists to benefit and refresh everyone we touch. Our corporate citizenship framework distinguishes this through four main areas of focus: to refresh the marketplace; to enrich the workplace; to strengthen the community; and to preserve the environment. This philosophy manifests itself in our actions every day

For more information about The Coca-Cola Company, please visit www.thecoca-colacompany.com.

Gold Sustaining Member Profile

ConAgra Foods®

Since our first bag of flour was sold in 1867, ConAgra Foods has grown from a small Nebraska company into one of America's largest food companies. Today ConAgra Foods is one of North America's leading packaged food companies, with a strong presence in consumer grocery as well as restaurant and foodservice establishments. ConAgra nourishes the lives of its consumers, customers, and employees by providing trusted, brand-name food and quality ingredients, while fostering a workplace that grows talented people and values inclusion. We work every day to find a better way—to make meal time convenient, to help schools provide nutritious meals for students, to improve the communities in which we operate, and more.



ConAgra Foods had net sales of $12 billion in 2007, with over 100 manufacturing locations and 26,500 employees spanning the globe. The company is organized into three businesses:

- Consumer Foods, which manufactures and markets many respected, dynamic name-brand products sold at retail venues from supermarkets to convenience stores, and foodservice arenas from restaurants to stadiums. Among our popular consumer brands are Healthy Choice, Chef Boyardee, Hebrew National, PAM, Egg Beaters, Orville Redenbacher's and Slim Jim.
- Commercial Products, which provides food and ingredients to major foodservice establishments and commercial customers worldwide. We work carefully with our customers to develop solutions that meet their unique needs, with specialty potato products from Lamb Weston; Spicetec's spices and flavor blends; garlic, onions, capsicums and vegetables from Gilroy Foods; and grain and flour from ConAgra Mills, including Ultragrain, our proprietary whole-wheat flour that has the taste and texture for refined white flour. Commercial Products also includes the ConAgra Foods Trade Group, which manages a portfolio of agricultural and energy commodities and services.
- International, which markets more than 40 brands in retail channels outside the US. Our products are found in key markets of Canada, Mexico, Puerto Rico, Latin America and the Caribbean, China, India, and a number of integral export markets.

ConAgra Foods is proud to be a Gold Sustaining Member of IAFP and we are dedicated to the safety, quality, and wholesomeness of our products. We are committed to the highest possible standards of food safety throughout our operations and are taking demonstrable measures to that end. This includes the consolidation of responsibility for existing and future companywide oversight of food safety initiatives and systems into a single leadership position and the formation of a Food Safety Advisory Committee of leading independent experts, uniquely positioned in the industry to help the company's efforts in this area.

ConAgra's vision is simple: one company growing by nourishing lives and finding a better way today… one bite at a time!

Gold Sustaining Member Profile

DUPONT®

Technology rules. Results matter. Fast, accurate results are critical for delivering safer food products for consumers and more profitable growth for food companies. That's why, at DuPont Qualicon, our food safety science is focused on continually developing state-of-the-art technologies that are faster and more accurate. In fact, for more than a decade, we have been revolutionizing food safety.

DuPont Qualicon was the first company to apply PCR technology to food testing with rapid, DNA-based assays for *Salmonella*, *E. coli* O157:H7 and *Listeria monocytogenes*. Our use of automated PCR processing with tableted rather than liquid reagents created a dramatic increase in speed and consistency, helping to usher in a new era of easy-to-use testing methodology.

Our unwavering focus on delivering increased speed and accuracy in food testing landed us on the R&D 100 Most Important Technological Developments list for two years in a row, and helped DuPont win the 2005 Black Pearl Award from the International Association for Food Protection. Frost & Sullivan recognized the commitment of DuPont Qualicon toward innovation with the 2006 North American Excellence in Technology award.

While we're proud to have been a part of food safety history, we're always looking ahead to provide the next cutting-edge solution. Our scientists are committed to producing world-class technologies that can address the most pressing issues facing the food industry today.

Consider our latest innovation: a BAX® system assay that uses advanced, reverse-transcriptase PCR to jumpstart the DNA-based reaction and deliver *Listeria* results within 8 hours of environmental sampling.

We've also introduced a number of new assays to meet the evolving needs of the food industry for fast, accurate testing:

- A real-time PCR assay for detecting the presence of *Staphylococcus aureus* in powdered infant formula, and threshold levels in ground beef and soy protein. Traditional testing methods for *Staphylococcus aureus* require three to five days or more for cultural growth and detection. With this AOAC-RI-certified BAX® system test, accurate results are available the next day.
- A real-time PCR assay, also certified by AOAC-RI, that can detect and differentiate among three species of pathogenic *Campylobacter* in the same sample—and provide quantitative values for each.
- A PCR assay that detects yeast and mold in food—including in shredded cheese and flour products—at customizable thresholds set by the user. The standard protocol detects concentrations of 25 CFU/g or more within 48 hours, reducing product hold time by three days compared to traditional culture methods. Alternative protocols for ultra-sensitive detection of low concentrations are also available.

From sophisticated analytical platforms to soluble packets of enrichment media, DuPont Qualicon is a company you can trust to deliver the technology innovations you need to reduce risk, react to issues quickly, and ultimately deliver the safest food possible to consumers.

To find out how DuPont Qualicon technology can help you deliver results that matter, visit our Web site at qualicon.com or call us at 800.863.6842.

Gold Sustaining Member Profile

ECOLAB®

Based in St. Paul, Minnesota, Ecolab is the leading provider of cleaning, food safety and health protection products and services. Around the world, it operates directly in 70 countries, employing more than 26,000 associates, and reaching customers in roughly 100 other countries through distributors, licensees and export operations.

Founded in 1923, Ecolab serves customers in a variety of markets, including foodservice, hospitality, healthcare, and food and beverage industries, helping them to achieve cleaner, safer and healthier environments. Ecolab uses an integrated systems approach to food safety and brand protection issues. Innovative solutions such as automated product dispensing systems, specialized solid detergents, and EPA-registered sanitizers combine with Ecolab's promise of service excellence to provide customers with uncompromised cleanliness and operational efficiency in any market.

At the start of the food chain, Ecolab associates provide customers with premium cleaning and sanitation products, programs, and expertise in food production environments. For example, the Ecolab Livestock Disease Intervention™ program is aimed at helping control cross contamination within animal production facilities, between such facilities, and between production facilities and processing plants. Ecolab also provides complete udder health, hoof management, and fly control programs for dairy production facilities.

Reducing pathogens and other microbial counts on food surfaces in the processing stage, meanwhile, improves the quality and shelf life of food products such as meat, poultry, seafood, fruits and vegetables. These patented food surface treatments are effective solutions for minimizing microbial contamination during processing.

Contamination at any point in a food processing operation can shut down plant operations, costing customers time and money. Therefore, Ecolab also provides custom-designed programs to meet the individual needs of food and beverage processing plants, as well as foodservice and food retail businesses. The emphasis is on sanitation, structural concerns within a facility, and preventative exclusion services for pests in every aspect of the food production process.

Once the food supply reaches foodservice vendors, Ecolab offers numerous high-quality, patented product solutions to help prevent many of the leading causes of foodborne illnesses. These include products to improve employee hygiene practices and sanitize the kitchen equipment used to prepare or serve food, as well as high-performance detergents and cleansers to sanitize every surface within a facility. In fact, Ecolab personnel hygiene programs provide comprehensive, worker-focused hygiene systems including hand cleaners and sanitizers, doorway sanitizing systems for food processors, state-of-the-art, no-touch dispensers, and employee training.

Finally, Ecolab provides a comprehensive intervention program that focuses on compliance. Ecolab's quality assurance food safety management program helps customers establish a routine program of self-inspection, provide comprehensive employee training, and conduct periodic independent audits to help identify areas in need of improvement. It also brings Ecolab's commitment to its customers full circle.

For more information visit www.ecolab.com or call 651.293.2233.

Gold Sustaining Member Profile

JohnsonDiversey

JohnsonDiversey is a global leader in commercial cleaning and hygiene solutions. Across the globe, JohnsonDiversey develops, manufactures, and provides cleaning and hygiene products and services, including safety and hygiene application training, consulting and auditing.

Addressing Every Food Protection Need

Our ongoing commitment to food protection is supported by a continuously expanding portfolio of JohnsonDiversey products and services designed to address virtually every food safety need. To simplify the complicated business of ensuring that food is safe, JohnsonDiversey developed the SafeKey™ portfolio. Under SafeKey™, we've organized the many elements of food protection, from sophisticated risk management consulting to essential cleaning chemicals, to provide seamless food protection from processing to consumption.

SafeKey™ makes food protection straightforward, with integrated solutions that are easy to implement and manage. Together with JohnsonDiversey Consulting, we deliver intellectual property and methodologies to thousands of customers around the world who know that partnering with a global food protection expert ensures a distinct competitive advantage.

Our consultants use the proprietary Hygieneomics™ Matrix to assess performance and quantitatively benchmark opportunities for improvements. Then, customized action plans map out an integrated risk management program.

JohnsonDiversey works with customers to develop a Food Safety Management System (FSMS) for the business and a Vendor Assurance Program, to ensure that food safety is managed, and traceable, all along the supply chain. The FSMS program includes HACCP (Hazard Analysis Critical Control Point) validation.

With strategy and management oversight established, the operational cornerstone of the process, HotSpots™, is put to work. JohnsonDiversey's HotSpots™ program assembles all the elements of an effective food protection program into one customizable solution. It maps high-risk areas throughout individual facilities, and then provides data, guidelines, training, and online tools to drive "best practices" for efficiently matching internal and external resources for improved food safety management.

Our comprehensive approach to food and beverage protection includes plant-wide cleaning and sanitation solutions, a broad range of food surface antimicrobial treatments, and water quality and management expertise. Our CIP cleaning and disinfection agents, application expertise, and control systems ensure that the highest standards of hygiene are obtained for all production equipment, safeguarding even the most sensitive foods and beverages. The unique AquaCheck program measures, analyzes, and solves water usage problems to manage operating costs, improve operational efficiencies, save water and energy, and reduce waste.

JohnsonDiversey History

JohnsonDiversey has its roots in S.C. Johnson and Son, Inc., which was founded in 1886 in Racine, WI. Beginning as the Services Division of S.C. Johnson in the 1940s, the company gained independence from its parent in 1999 as Johnson Wax Professional.

JohnsonDiversey was formed in 2002 when Johnson Wax Professional acquired DiverseyLever from global food conglomerate Unilever PLC, making the new company a global leader in the institutional and industrial cleaning and hygiene business.

We offer our professional products directly or through third-party distributors and channel partners to end users in the following sectors: food service, lodging, food and beverage, building service contractors, retail, health care, industrial, government, and education.

Headquartered in Racine, WI, JohnsonDiversey maintains operations in 56 nations and provides products and services in more than 160 countries. To learn more, visit www.johnsondiversey.com.

Gold Sustaining Member Profile

Kraft Foods is a global leader in branded foods and beverages with net revenues of more than $34 billion.

Built on more than 100 years of quality and innovation, Kraft has grown from modest beginnings to become the largest food and beverage company in North America and the second largest in the world, marketing many popular brands in more than 150 countries around the globe. The Kraft brand portfolio is one of the strongest of any packaged goods company, with more than fifty $100 million brands and seven $1 billion brands (Kraft-branded products, Jacobs and Maxwell House coffees, Oscar Mayer meats, and Philadelphia cream cheese). Our global brands include Kraft, the number one cheese brand in the world, as well as our best-known brand for salad and spoonable dressings, packaged dinners, barbecue sauce, and other products; Philadelphia, the world's number one brand of cream cheese; Jacobs and Maxwell House coffees; Milka and Toblerone chocolates; Oreo cookies; Ritz crackers; and Crystal Light/Clight and Tang beverages.

The history of Kraft dates back to 1903, when—with $65 in capital, a rented wagon, and a horse named Paddy—J.L. Kraft started purchasing cheese at Chicago's Water Street wholesale market and reselling it to local merchants. From that first idea of selling wholesale cheese to stores, Kraft has been a company built on innovation. Through the years many people have contributed to the success of Kraft and its numerous predecessor companies, some of which trace their heritage back to the 1700s.

These contributions have resulted in numerous breakthrough ideas, such as the 1898 introduction of the Uneeda biscuit, which featured the first "inner-seal" packaging; the 1906 launch of Kaffee Hag, the first decaffeinated coffee; the 1927 introduction of Kool Aid, the first successful powdered soft drink; the 1950 introduction of Kraft Deluxe, the first commercially packaged process-cheese slices; the 1995 launch of DiGiorno Rising Crust pizza, revolutionizing the frozen pizza category; the 2004 introduction of the Tassimo hot beverage system; and the 2005 introduction of the South Beach Diet line of foods.

To learn more about Kraft please visit us at www.kraft.com.

Gold Sustaining Member Profile

PEPSICO

PERFORMANCE WITH PURPOSE

Human • Environment • Talent

PepsiCo is a world leader in convenient foods and beverages, with 2007 revenues of more than $39 billion and more than 185,000 employees worldwide. Sold in approximately 200 countries, its products include Frito-Lay snacks, Pepsi-Cola beverages, Gatorade sports drinks, Tropicana juices, and Quaker foods. The PepsiCo portfolio includes 17 brands that generate $1 billion or more each in annual retail sales. PepsiCo's commitment to sustainable growth, defined as "Performance with Purpose," is focused on generating healthy financial returns while giving back to the communities the Company serves. This includes meeting consumer needs for a spectrum of convenient foods and beverages, reducing the Company's impact on the environment through water, energy and packaging initiatives, and supporting its employees through a diverse and inclusive culture that recruits and retains world-class talent. PepsiCo is listed on the Dow Jones North America Sustainability Index and the Dow Jones World Sustainability Index.

The safety and integrity of our products is our single highest priority. It's our duty as a responsible company. People buy our brands because they know they can count on consistent quality—every time. We follow very rigorous standards of safety and quality. Our policies ensure strict adherence to all applicable regulations and legislation. Our policies cover food safety, sanitation, recalls, and allergens, as well as requirements that our products be coded, labeled, identifiable and traceable.

At every level of PepsiCo, we take great care to ensure that the highest standards are met in our manufacturing processes. We strive for excellence, because our consumers expect and deserve nothing less. The PepsiCo Product Integrity Council provides strategic and technical guidance on product integrity. Our compliance systems include Web site training, monitoring, preventative measures, and readiness for corrective action. We have regular management review of our procedures and activities regarding our products. Our standards are equally rigorous in New York, London, Beijing, and wherever else we operate. We stand behind each and every product we sell.

PepsiCo is committed to providing safe, wholesome products and protecting equity in our brands, trademarks, and goodwill. Our divisions have implemented policies related to food safety, labeling product integrity and quality. PepsiCo products meet a broad variety of needs and preference—from fun-for-you treats to healthy eats. The Company has stated, as part of its Performance with Purpose vision, that it is committed to "doing better by doing better": delivering solid financial performance while focusing its efforts in the areas of Human Sustainability (its products and the communities it serves), Environmental Sustainability, and Talent Sustainability (attracting and retaining the best qualified and most committed workforce).

Gold Sustaining Member Profile

SILLIKER®
Food Safety & Quality Solutions

When John H. Silliker, Ph.D., founded Silliker in 1967, the field of food testing was in its relative infancy. With a small staff of four professionals, Dr. Silliker, a revered microbiologist, sought to take food testing to a new and higher level. He had a practical philosophy: Give the clients more than just analytical results; give them practical solutions to their problems. This enduring philosophy has guided and sustained the Silliker organization for 40 years.

Today as part of the Mérieux-Alliance group, Silliker is the leading internationally-accredited food testing and consulting network, with 50 locations in 13 countries. CEO and President Philippe Sans leads the company in its quest to provide the most comprehensive solutions to help guarantee product quality and safety, protect individual brands, and reduce the risk of financial loss for suppliers, manufacturers, retailers, and food service companies. Our services include:

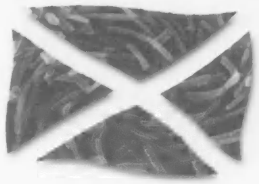
- **Laboratory Services.** Utilizing state-of-the art technologies and the latest validated methods, Silliker microbiologists and chemists can handle routine and complex analytical requests with fast, accurate and responsive service. At the core of our expertise, we offer a unique range of microbiology services to help companies solve issues throughout the food chain. Our services include analyses for spoilage/process indicator organisms and pathogens. Serving various sectors of the supplement, food, and feed industries, we offer a broad spectrum of chemistry services ranging from nutrient analyses to contaminant testing. All Silliker laboratories meet or exceed ISO 17025, an international standard that assures testing laboratories maintain a well-defined quality system and the necessary technical competencies to generate reliable test results. Our laboratories have specific internal quality requirements and performance programs in place to further assure the competency of our testing services.
- **Auditing.** With years of experience in almost every food industry environment and segment of the food chain, Silliker auditors can help retailers, distributors, and foodservice companies identify potential risks in their safety programs and adhere to industry and regulatory standards.
- **Consulting.** Highly knowledgeable and skilled Silliker consultants provide companies with professional, expert services to improve quality assurance programs, reduce the risk of product recalls, and find practical, workable solutions to science-based problems.
- **Education and Training.** Silliker public short courses, training videos, online learning programs, customized training programs, and learning management solutions provide upper management and line workers with multi-level tools to put recognized food safety principles into immediate action.
- **Research.** From shelf life and challenge studies to microbial identifications, the Silliker Food Science Center provides a host of expert studies to help companies assure product safety and quality.

For its abundant contributions to food science, Silliker has been the recipient of numerous industry honors including the International Association for Food Protection's Black Pearl Award.

To learn more about the Silliker international network, please log on to www.silliker.com.

FOOD MICRO 2008

ABERDEEN ❖ SCOTLAND



The 21st International ICFMH Symposium

"Evolving microbial food quality and safety"

Register now! Don't miss out!

1 – 4 September 2008

Aberdeen Exhibition and Conference Centre

Food Micro 2008 Aberdeen aims to build on the success of previous FOOD MICRO meetings by combining the very latest scientific developments in the field with extensive social opportunities featuring the best that Aberdeen and Scotland have to offer – castles, golf, hill-walking, distilleries and excellent home produced food.

We are planning an exciting meeting to cover all aspects of Food microbiology within the major themes of:

- Foodborne Pathogens: Listeria, VTEC, Campylobacter, Salmonella & Viruses
- Fish Microbiology – Spoilage and Safety
- Food Safety And Quality: Ready to Eat Foods, Fermented Foods
- Food Mycology
- Food Attribution, Risk Assessment, Predictive Modelling
- Food Allergies
- Biological Toxins
- Control of Pathogens: Bacteriocins, Phage Control
- Advanced Methods: Rapid Detection, Molecular Typing
- Dairy Microbiology
- Validation of Methods
- Antimicrobial Resistance
- Hygienic Design
- Stress Response

For further information on the programme, registration or sponsoring or exhibiting at Food Micro 2008 please visit **www.foodmicro2008.org**

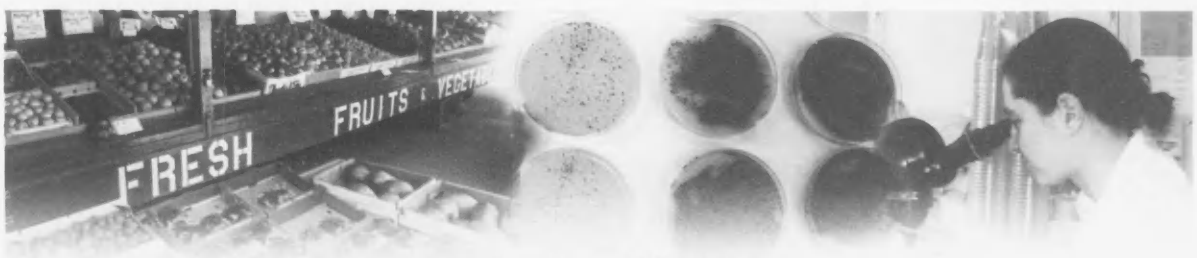
The Co-Chairs of Food Micro 2008, Iain Ogden and Norval Strachan, look forward to welcoming you to Aberdeen in 2008!

KINDLY SUPPORTED BY:

FOOD STANDARDS AGENCY SCOTLAND

IUMS ICFMH

1495 UNIVERSITY OF ABERDEEN



www.foodmicro2008.org

NEW MEMBERS

ARGENTINA

Carlos F. Leoncini
General Mills
Victoria, Buenos Aires

Paola C. Ubago
General Mills
Victoria, Buenos Aires

AUSTRALIA

Allison J. Clark
Houston's Farm
Cambridge, Tasmania

BELGIUM

Mieke Uyttendaela
Ghent University
Ghent

BRAZIL

Andre K. Otuki
University of São Paulo – USP
São Paulo

CANADA

Matthew D. Barr
Toronto, Ontario

Janet Colpitts
Dairytown Products Ltd.
Sussex, New Brunswick

Tim C. Ells
Agriculture and Agri-Food Canada
Cambridge Station, Nova Scotia

Vanessa K. Morton
Health Canada
Ottawa

DENMARK

Nete Bernbom
Danish Institute for Fisheries Research
Kongens, Lyngby

Vicky G. Kastbjerg
Technical University of Denmark
Kgs. Lyngby

HONG KONG

Marco Mou
bioMérieux
Hong Kong

JAMAICA

Marva G. Hewitt-Heaven
Food Hygiene Bureau
Kingston

JAPAN

Masashi Ando
Kinki University
Nara

Mami Ando
Osaka-Shoin Women's University
Higashi-Osaka

KENYA

Kimoni M. Raphael
Delmonte Kenya Limited
Thika

THE NETHERLANDS

Alexander V. Semenov
Wageningen University
Wageningen

SOUTH KOREA

Jung Hwa Choi
Yonsei University
Seoul

Ji-Yeon Hyeon
Konkuk University
Seoul

Na Young Yi
Yonsei University
Seoul

UNITED ARAB EMIRATES

Gayathri K. Nagarajan
Binca International GmbH. Co. KG
Dubai

UNITED KINGDOM

Jeanne-Marie Membre
Unilever, SEAC
Bedford

UNITED STATES

ALABAMA

William Burkhardt
DHHS/US FDA
Dauphin Island

Susan A. McCarthy
FDA
Dauphin Island

CALIFORNIA

Rhiannon W. Woo
NSF International
San Jose

DISTRICT OF COLUMBIA

Richard Podolak
Grocery Manufacturers Association
Washington

ILLINOIS

Claudia P. Rodriguez
National Center for Food Safety and Technology
Summit-Argo

Jeffery G. Stenner
Orval Kent Foods
Wheeling

INDIANA

Eric Willinghan
Eli Lilly
Indianapolis

NEW MEMBERS

MARYLAND

Zerlinde Johnson
AOAC Research Institute
Gaithersburg

Deborah McKenzie
AOAC International
Gaithersburg

MINNESOTA

Erin R. Brown
Ecolab
Eagan

Cari Dufner
Cargill Kitchen Solutions
Monticello

Susan Frye
General Mills
Minneapolis

Karen M. Silbernagel
AOAC Research Institute
Woodbury

Beth Volk
General Mills
Golden Valley

Julie Yang
3M
St. Paul

MISSISSIPPI

Taejo Kim
Mississippi State University
Mississippi State

NEW YORK

Nadia O. Melnyk
Rich Products Corporation
Buffalo

Kitiya Vongkamjan
Cornell University
Ithaca

NORTH DAKOTA

Margaret L. Khaitsa
North Dakota State University
Fargo

OKLAHOMA

Lacey M. Guillen
Oklahoma State University
Stillwater

PENNSYLVANIA

Ann Carraher
ECC
West Chester

Mei Lok
Pennsylvania State University
University Park

TEXAS

Alison L. Brown
Texas Tech University
Lubbock

Scot E. Dowd
USDA/ARS
Lubbock

Tammy M. Platt
West Texas A&M University
Canyon

VIRGINIA

Heather R. Totty
Virginia Tech
Blacksburg

WASHINGTON

Kristine M. Hagen
Nurition Now, Inc.
Vancouver

A. Reum Han
Washington State University
Pullman

WEST VIRGINIA

P. Brett Kenney
West Virginia University
Morgantown

WYOMING

Lea L. Zeitlin
Wyoming Dept. of Agriculture
Worland

VENEZUELA

Luz B. Villalobos De Bastardo
Universidad De Oriente
Cumana, Estado Sucre

NEW SUSTAINING MEMBER

Mol Industries
Barry Whitman
Grand Rapids, Michigan

UPDATES

Silliker, Inc. Announces Promotions

Silliker, Inc., recently announced three promotions within its North American network:

- Robert Colvin was named vice president of operations
- Pamela Coleman was promoted to vice president of marketing and business development
- Mark Carter was named division vice president of technical services

NSF Appoints New Director of Corporate Sales

NSF International has announced the promotion of David Kirkpatrick as its new director of corporate sales.

Most recently, Mr. Kirkpatrick worked as NSF's corporate retail accounts executive, where he worked directly with corporate account managers and their suppliers to identify new sales solutions for his clients. In his new position, Mr. Kirkpatrick works closely with NSF's senior management and the marketing team to positively impact NSF's sales growth. This includes offering leadership and implementing new sales strategies as well as providing effective training and development of the sales team.

David Kirkpatrick has a proven track record of success working with major companies, including Ubiquity Brands, Procter & Gamble and the Coca-Cola Company. As vice president of national sales for Ubiquity Brands, he was responsible for building and managing a national sales team for all non-foods retailers. Ubiquity Brands include O-KE-DOKE Popcorn, Fiddle Faddle, Poppycock and Jays and Krunchers! Potato Chips.

Mr. Kirkpatrick has also served as the vice president of national sales for Procter & Gamble's Yardley of London Ltd. subsidiary and as the director of national sales for the Coca-Cola Company, where his leadership earned him seven promotions. He has a bachelor's degree in business administration from Michigan State University.

Aquionics Appoints New Vice President of Sales and Marketing

UV disinfection specialist Aquionics has appointed Kevin Shannon as its new vice president of sales and marketing.

Kevin has considerable experience managing the sale of electrical equipment, lighting ballasts and specialty electronics. He joins Aquionics from Schneider Electric–Square D, where he was senior product marketing manager with responsibility for a portfolio of electrical equipment products. Prior to that he was product marketing manager for Busway and Wire Management Products. Kevin has a B.S. in Industrial Engineering from Clarkson College of Technology, Potsdam, NY.

Gregory to Lead FPSA Meat Council Board of Directors – New Officers and Directors Elected

The Meat Industry Suppliers Alliance (MISA) elected the officers and directors for 2008 at the FPSA Conference held in Bonita Springs, FL.

Officers elected were:

- Scott Gregory, chair, Bettcher Industries Inc.
- Shawn Nicholas, vice-chair, Baader North America Corporation
- Janet Bergeron, past chair, Stork Townsend
- Scott Scriven, board liaison, Weber, Inc.

New directors elected were:

- Einar Einarsson, Marel Food Systems Inc.
- Dennis Hicks, Pemberton & Associates Inc.
- Mark Koopman, Tipper Tie
- Chris Mason, Wolf-Tec, Inc.
- Gil Williams, Poly-clip System Corp.

These new officers and directors join the board consisting of:

- Tony Bayat, CFS North America
- George Reed, F.R. Drake Company
- Tom Hoffmann, MEPACO
- Jan Kuhlmann, Multivac, Inc.
- Tony Carter, Packaging Technologies
- Craig Hess, Speco, Inc.
- Jarrod McCarroll, Marlen
- Keith Wietharn, Cozzini, Inc.

The MISA Foundation elected Janet Bergeron of Stork-Townsend to fill the vacancy left by John Dupps of the Dupps Company who retired from the Foundation after many years of service. She will join Steve Tennis of Handtmann, Chairman, and Craig Hess of Speco to continue the work of the Foundation in supporting the education of the next generation of professionals entering the industry.

American Frozen Food Institute Announces Staff Promotions

The American Frozen Food Institute (AFFI) has announced the promotions of three members of its staff.

UPDATES

Lucas Darnell has been named vice president for member services. He previously served as senior director of member services. Mr. Darnell administers member retention and recruitment programs, plans and implements programs and events focusing on the frozen food industry's distribution and logistics sector, and oversees affinity programs and revenue-generating initiatives. During his years at AFFI, he has served the Institute's members in the communications, public policy and industry affairs, departments. In his new role, Darnell will report to AFFI's Senior Vice President of Financial Operations and Special Projects Linda K. Ziglar.

Mr. Darnell is a graduate of West Virginia University, where he earned a bachelor's degree in English, with a concentration in grammar and creative writing and a minor in communications. He received from the American Society of Association Executives his certified association executive designation and is a graduate of the US Chamber of Commerce's Institute for Organization Management.

Elise Cortina has been named director of public and industry affairs. She previously served as senior manager for communications and marketing. Ms. Cortina oversees many of the organization's communications activities, including marketing for AFFI events, maintaining the AFFI Web site and publishing *Freeze Flash*, AFFI's weekly electronic newsletter. Recently, she has taken an active industry affairs role, lending support to the membership as well as AFFI's public policy team. Cortina will continue to report to AFFI's Vice President of Communications Jorge Martinez.

Ms. Cortina is a graduate of the University of Virginia, where she earned a bachelor's degree with a double major in Spanish and foreign affairs. While at UVA, she studied at La Universidad de Sevilla, las Facultades de Filología y Geografía e Historia. She also earned a master's degree in mass communications from the University of Florida.

Finally, Jason Bassett has been promoted to the position of director of legislative affairs. He previously served as manager of legislative affairs. Mr. Bassett will work to increase AFFI's profile on Capitol Hill and to advocate on behalf of the frozen food industry. In his enhanced capacity, Mr. Bassett will report to AFFI's Senior Vice President of Public Policy and International Affairs Robert L. Garfield.

Mr. Bassett joined AFFI in 1997, having most recently worked at the US Senate Committee on Small Business and Entrepreneurship, where he served as a member of the committee's minority professional staff, working closely with the ranking member. Previously, he served as a political appointee at the US Dept. of Agriculture and the US Small Business Administration. Mr. Bassett is a graduate of George Mason University where he earned a bachelor's degree in political science.

New Kansas Health Department Leader, Dan Partridge, Turns Focus on Food Safety

Dan Partridge replaced Kay Kent, who retired after 33 years, as director of the Lawrence-Douglas County Health Dept. and began setting a new course, stating, "I was the new kid on the block. Getting to know the staff is something you just can't discount."

Mr. Partridge's game plan for the county includes establishing a food service inspection unit, which would contract with the Kansas Dept. of Health and Environment to inspect local restaurants and follow up on complaints. That job will belong to the four-member sanitation unit who are now being trained. Mr. Partridge hopes they can start inspections July 1.

NEWS

3-A SSI Announces New Public List of 3-A Symbol Holders

3-A Sanitary Standards, Inc. (3-A SSI) announces new public information on current 3-A Symbol holders to assist regulatory sanitarians, processors, equipment fabricators, and other interested parties. The list of current 3-A Symbol licensees, now available on the 3-A SSI web site, is important public information because it shows all equipment that conforms to 3-A Sanitary Standards for dairy and food processing equipment and meets provisions of the 3-A Symbol authorization program.

"Use of the list has increased significantly in recent years," according to 3-A SSI Executive Director Tim Rugh. "Concern about food safety extends to every part of the chain, including the sanitary design of processing equipment. The 3-A Symbol is a respected and reliable means for specifiers, users, inspection authorities and others to help assure the equipment conforms to the appropriate 3-A Sanitary Standards," he said.

The value of the 3-A Symbol in the marketplace has been enhanced by the Third Party Verification (TPV) inspection requirement that was initiated in 2003 as a requirement for 3-A Symbol authorization. Since 1956, the 3-A Symbol has been used to identify equipment that meets 3-A Sanitary Standards for design and fabrication. Use of the 3-A Symbol was based on self-certification until the new TPV requirement was instituted. Voluntary use of the 3-A Symbol on dairy and food equipment assures processors that equipment meets sanitary standards, provides accepted criteria to equipment manufacturers for sanitary design, and establishes guidelines for uniform evaluation and compliance by sanitarians.

Between 2003 and the end of 2007, approximately 520 TPV inspections were completed for equipment fabricated in the US and 21 other countries around the world, according to 3-A SSI. Inspections have been completed for 3-A Symbol authorizations in all but a very small number of equipment groups, in which standards are under revision, according to 3-A SSI.

3-A SSI maintains the list of current 3-A Symbol licensees as well as a separate list of discontinued 3-A Symbol holders. The lists of current and discontinued 3-A Symbol holders are available on the 3-A SSI web site at http://www.3-a.org/symbol/holders.htm. The discontinued symbol holders' list shows the reason for discontinuation, such as the equipment is no longer in production, the equipment was consolidated in another 3-A Symbol authorization resulting from a change in company ownership, or the failure of the holder to maintain the authorization in accordance with the terms and conditions for use of the 3-A Symbol.

NSF Food Safety Leadership Awards Presented at the 2008 Food Safety and Security Summit

NSF International announced the 2008 recipients of its Food Safety Leadership Awards at the Food Safety and Security Summit in Washington, D.C. NSF's Food Safety Leadership Awards program, now in its fifth year, recognizes the extraordinary efforts of individuals and organizations that have demonstrated outstanding dedication and achievement in foodservice safety. The following were the award winners:

- Paul A. Lachance, Ph.D., F.A.C.N., C.N.S., is recognized for his Lifetime Achievement Award in education & technology. Dr. Lachance is also Professor Emeritus of Food Science at Rutgers University and the creator of HACCP at NASA.
- Daniel L. Engeljohn, Ph.D., is recognized for his Lifetime Achievement Award in public service. Dr. Engeljohn serves as the Deputy Assistant Administrator for the US Dept. of Agriculture (USDA) in the policy office of the Department's public health regulatory agency.
- Elizabeth A. Bugden, MS, Food Scientist for Kids First, managed an initiative to prevent foodborne illness in school children funded by the Centers for Disease Control and Prevention (CDC).
- Dr. Jan Singleton, National Program Leader for the USDA's Cooperative State Research, Education, and Extension Services, accepts the Food Safety Leadership Award for education and training on behalf of Jeanne Gleason, Ph.D., Director of Media Productions at New Mexico State University.
- Christine Moe, Ph.D., accepts her award for outstanding achievements in research advancement. Dr. Moe is the Eugene J. Gangarosa Professor of Safe Water and Sanitation and Director of the Center for Global Safe Water at Emory University.

- Dennis Romer, Vice President of Foodservice and Hospitality, accepts the Food Safety Leadership Award in equipment design on behalf of Sterilox Food Safety Systems.
- Norm Faiola, Ph.D., is recognized for his achievements in product development. Dr. Faiola is the Associate Dean of the College of Human Ecology and tenured Associate Professor in the Department of Nutrition and Hospitality Management at Syracuse University.
- Tom Dickey, NEHA Assistant Manager, Research & Development, accepts the Food Safety Leadership Award in education and training on behalf of the National Environmental Health Association.

Leaf Age May Contribute to Contamination of Lettuce with *E. coli* and *Salmonella*

A new study presents the first evidence that harmful pathogens frequently linked with foodborne illnesses are more commonly found on younger inner leaves than on older outer leaves of romaine lettuce. The researchers from the Produce Safety and Microbiology Research Unity, Albany, California and the University of California, Berkley report their findings in the journal, *Applied and Environmental Microbiology*.

Lettuce (*Lactuca sativa*) is the fresh produce item most commonly implicated in epidemics of foodborne illness, while *Escherichia coli* O157:H7 and *Salmonella enterica* are the most frequently attributed bacterial agents. Although previous studies have focused on *E. coli* O157:H7 colonization on cut or shredded lettuce leaves, little is known of its ability to colonize whole lettuce leaves in both pre- and post-harvest environments.

In the study, researchers investigated the growth of *E. coli* O157:H7 and *S. enterica* on romaine lettuce leaves both pre- and post-harvest. The increased population size of *E. coli* O157:H7 on young lettuce plants ranged from 16- to 100-fold in the presence of warm temperatures and free water on the leaves.

The increase in population size also varied significantly with leaf age, however the colonization was consistently 10-fold higher on the young (inner) leaves than on the middle leaves. Growth rates of *S. enterica* were found to be similarly leaf age dependent. Both bacterial pathogens also displayed higher population rates on younger leaves than on middle leaves harvested from mature lettuce heads.

The results indicate that leaf age and nitrogen content contribute to shaping the bacterial communities of preharvest and postharvest lettuce and that young lettuce leaves may be associated with a greater risk of contamination with *E. coli* O157:H7.

FDA Strengthens Safeguards for Consumers of Beef

The US Food and Drug Administration has issued a final regulation barring certain cattle materials from all animal feed, including pet food. The final rule further protects animals and consumers against bovine spongiform encephalopathy (BSE, also known as "mad cow disease").

"This FDA action serves to further protect the US cattle population from the already low risk of BSE," said Dr. Bernadette Dunham, director of FDA's Center for Veterinary Medicine. "The new rule strengthens existing safeguards."

The materials that can no longer be used in animal feed are the tissues that have the highest risk for carrying the agent thought to cause BSE. These high risk cattle materials are the brains and spinal cords from cattle 30 months of age and older. The entire carcass of cattle not inspected and passed for human consumption is also prohibited, unless the cattle are less than 30 months of age, or the brains and spinal cords have been removed. The risk of BSE in cattle less than 30 months of age is considered to be exceedingly low.

The removal of high-risk materials from all animal feed will further protect against inadvertent transmission of the agent thought to cause BSE, which could occur through cross contamination of ruminant feed (intended for animals with four-chambered stomachs, such as cattle) with non-ruminant feed or feed ingredients during manufacture and transport, or through misfeeding of non-ruminant feed to ruminants on the farm. The added measure of excluding high-risk materials from all animal feeds prevents any accidental feeding of such ingredients to cattle.

This regulation finalizes a proposed rule that the FDA issued for public comment in October 2005. The final rule is effective in 12 months to allow the livestock, meat, rendering, and feed industries time to adapt their practices to comply with the new regulation. Under the new requirements of the final rule, renderers that process cattle not inspected and passed for human consumption must make available for FDA inspection their written protocols for determining the age of cattle and demonstrating that the brain and spinal cords of cattle have been effectively removed.

Scientific studies have linked BSE to cases of variant Creutzfeldt-Jakob Disease (vCJD) in humans, an invariably fatal disease that most likely results from human consumption of infectious material from cattle with BSE. A 1997 rule prohibited specific risk materials from use in the human food supply. There have been no vCJD cases linked to consumption of US beef and the risk of BSE among US cattle is low.

FDA regulates feed and drugs. The US Department of Agriculture (USDA) and FDA together promulgate and enforce the regulations that ensure the exclusion of specific risk materials from the human food supply.

GMA Introduces Food Safety Site

The Grocery Manufacturers Association has launched www.keepfoodsafe.org, a new food safety information Web site for policymakers, the media and consumers. The site features a food safety 101 page, links to food safety stories and a page from which consumers can email their representative to express their support for "giving the (Food and Drug Administration) the resources it needs to ensure the safety of the food supply."

"Food safety is in the news today like no other time in recent history and is the subject of intense debate in Washington, D.C.," said GMA Senior Vice President and Chief Science & Regulatory Affairs Officer Robert Brackett, in a statement. "Keepfoodsafe.org is intended to be a resource for congressional staff, through leaders and the media, helping to keep them informed and up-to-date on the public debate around strengthening America's food safety net."

Arsenic in Rice

The Food Standards Agency issued reassurance to consumers, following reports on arsenic levels in baby rice and in rice milk.

One study measured the levels of arsenic in rice milk and showed that exposure to arsenic would be increased by the consumption of rice milk. Another study on baby rice claimed that the levels of arsenic present in some baby rice samples were unsafe. The Agency disagrees with this claim and says the current levels do not raise concern.

Arsenic occurs naturally in a wide range of foods at low levels. Its toxicity depends on the chemical form in which it is present. The organic form is less harmful but the inorganic form is known to cause cancer. The Agency's independent advisory committee on toxicity, the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT), has therefore concluded that exposure to inorganic arsenic should be as low as reasonably practicable (ALARP). Arsenic occurs in a wide range of foods but most arsenic in the diet is present in the less toxic, organic form.

Rice is a food grain that has the tendency to accumulate arsenic. While the concentration of total arsenic is low, about 50% of it is present as inorganic arsenic. The Agency is carrying out research on the levels of arsenic present in rice and rice products as well as the effect of cooking on arsenic concentrations. Our present findings show that for the average UK consumer the exposure to arsenic from consuming rice is not a concern.

The Agency has carried out a number of surveys on the levels of arsenic (and other metals) present in baby food and infant formula. These show that the low intakes of arsenic from infant foods have not increased, indicating that they are as low as reasonably practicable. The measured levels do not raise concern for the health of infants. In the case of rice milk, our advice to consumers who were concerned about increasing their exposure to arsenic was to reduce their intake or find alternate sources of milk. However, we will be carrying out further research and will publish our results in due course.

The studies make comparisons with drinking water standards that are not appropriate. Drinking water standards are based on a level that is as low as reasonably practicable or achievable in water and it is not relevant to compare with intakes from food.

The amount of arsenic present in food is regulated by the UK Arsenic in Food Regulations 1959 as amended, and all the rice and rice products tested so far do not exceed the limits set by this legislation.

National Restaurant Association Applauds Food Safety Legislation

The National Restaurant Association welcomed the introduction of bipartisan food safety legislation in the Congress by US Representatives Jim Costa (D-CA) and Adam Putnam (R-FL). The bill, "The Safe Food Enforcement, Assessment, Standards and Targeting Act of 2008," was introduced at a press conference on Capitol Hill.

"The restaurant industry welcomes the food safety bill introduced by Representatives Jim Costa and Adam Putnam and commends their bipartisan leadership," says Michelle Reinke, director of legislative affairs for the National Restaurant Association. "This is a good bill for the restaurant industry

and its patrons. While we believe the public should have confidence in our food supply, the legislation addresses beneficial reforms to our food safety system that are achievable. We look forward to working with Congressmen Costa and Putnam to improve food safety and help assure our customers that we are doing everything we can to keep our food supply safe."

"There are very good provisions in this bill, including solid standards for produce safety," said Donna Garren, vice president of health and safety regulatory affairs for the Association. "The National Restaurant Association supported the produce industry's 2007 call for Food and Drug Administration produce safety standards for the entire industry with an additional focus on higher risk products. This bill addresses those higher risk standards and, if implemented, will improve compliance with good agricultural practices and improve food safety. Tighter produce standards will ensure that the proper handling procedures are being utilized to produce the safest fresh fruits and vegetables possible."

"Mandatory recall authority is an area of key interest for restaurants," continues Ms. Garren. "Most recalls are performed in a rapid manner, but this bill provides enforcement options for FDA where bad actors do not comply. Increased FDA recall authority that ensures a recall is done swiftly and properly can give consumers, and restaurateurs, peace of mind in knowing that food that does not meet the highest safety standards will not be served on our tables."

"The legislation would also require that foods coming from international suppliers adhere to the same safety standards set by the FDA, and that the supply chain is doing its part to make sure we know where our food is coming from and how it is produced," notes Ms. Garren. "Recognizing that we need to focus at every point in the foodservice supply chain – knowing your supplier – really is where confidence in food safety has to begin."

"Food safety is one of the restaurant industry's highest priorities, and we are working at the local, state, federal and international level to strengthen food safety systems and increase consumer confidence," said Ms. Reinke. "The Costa-Putnam bill is a laudable effort to move food safety forward in the Congress, and we believe this legislation will make our food safer. The National Restaurant Association and its member companies remain strongly committed to working with Congress to enact effective food safety reform."

Protozoa May Enable Foodborne Pathogens on Leafy Vegetables

Protozoa found on lettuce and spinach may sequester harmful foodborne pathogens ultimately contributing to their survival on produce surfaces say researchers from Tennessee Technological University, Cookeville, and the Produce Safety and Microbiology Research Unit, Albany, CA.

Several outbreaks of foodborne illnesses attributed to *Escherichia coli* O157:H7 and *Salmonella enterica* have received national attention in recent years. The Centers for Disease Control and Prevention reported that fresh produce was the most significant source of foodborne illness in 2005.

Protozoa are single-celled organisms whose main function is bacterial consumption. They are commonly found in the natural microflora of plants and several species of amoebae have been associated with fresh salad vegetables. The recent occurrence of multiple outbreaks has encouraged researchers to further examine the interaction between foodborne pathogens and protozoa.

In the study, protozoa (*Glaucoma* sp., *Colpoda steinii*, and *Acanthamoeba palestinensis*) as well as the soil-borne strain, *Tetrahymena pyriformis*, were cultured from store-bought spinach and lettuce and washed and allowed to graze on green fluorescent protein — or red fluorescent protein-labeled enteric pathogens including *E. coli* O157:H7, *S. enterica*, and *Listeria monocytogenes*.

They were then monitored for their ability to sequester the bacteria and for vesicle production (food vacuoles released by protozoa offering a means of protection to some bacteria). Results showed Glaucoma produced vesicles with all bacterial strains and *Tetrahymena* also displayed vesicle production, but only of *E. coli* O157:H7 and *S. enterica*, not *L. monocytogenes*. Further studies of *E. coli* O157:H7 following vesicle production revealed that 4 hours after the addition of spinach extract, the bacteria had multiplied and escaped the vesicles. *C. steinii* did not produce any vesicles from any of the pathogens.

"The presence of protozoa on leafy vegetables and their sequestration of enteric bacteria in vesicles indicate that they may play an important role in the ecology of human pathogens on produce," say the researchers.

INDUSTRY PRODUCTS

Jeio Tech, Inc.

New Benchtop Refrigerated Incubated Shaker

The new SI-600R from Lab Companion combines a benchtop refrigerated incubator with a dual-action orbital and reciprocating shaker.

This versatile unit fulfills a variety of molecular biology, general incubation, and cell culture applications.

Selectable between orbital or reciprocating action, the speed range is from 10 to 300 rpm. The SI-600-R can be programmed for a run time from 10 seconds to 1,000 hours with forward-backward-pause cycles.

The platform is 16.1″ × 16.1″ and can be equipped with a wide range of clamps, racks and platforms.

The temperature range is 15°C to 60°C with uniformity of ±1.0°C at 38°C.

Additional features include microprocessor PID control, auto-tuning and calibration, and the ability to program temperature in 9 profile steps along with repeating for up to 200 cycles.

Over-temperature protection, door opening alarm, digital LED display for temperature, speed, and shaking motions are all standard.

The Lab Companion SI-600R is one of seven different benchtop shakers (three models) and temperature-controlled shakers.

Jeio Tech, Inc.
781.376.0700
Woburn, MA
www.jeiotech.com

Enviro San® and ES-1000™ Sterilant System is First and Only Peracid-Based Product Validated for Sterilization against *Bacillus cereus*

Ecolab Inc. has announced that the US Food & Drug Administration's Center for Food Safety and Applied Nutrition has issued a Letter of Non-Objection (LNO) for a high-speed rotary filler utilizing the Enviro San® and ES-1000™ commercial sterilant system for low-acid aseptic packaging. This system consists of Enviro San, an EPA-registered peracid-based product, and ES-1000, an adjuvant that allows for effective antimicrobial sterilization with lower temperature and lower concentrations of peroxyacetic acid.

The Enviro San® and ES-1000™ sterilant system was used to validate a high-speed, low-acid aseptic rotary filler using a surrogate for *Bacillus cereus*. *Bacillus cereus* is the most resistant pathogen of concern for peroxyacetic acid-based sterilants. This is the first and only commercial sterilant registered by both the US Environmental Protection Agency (EPA) and the California Dept. of Pesticide Regulation that has met the agency requirements of sterilization against *Bacillus cereus*.

"Because Ecolab's commercial sterilant system is effective against *Bacillus cereus*, one of the most difficult spores to kill, these are unique clearances from both US EPA and California EPA," said Steve Christenson, vice president, Ecolab regulatory affairs.

Enviro San is registered for use on most packaging types, including PET and HDPE, and most food products, which maximizes plant operational efficiency and flexibility. Enviro San and ES-1000 can be used at lower operating temperatures than hydrogen peroxide sterilizing solutions, providing customers with reduced energy costs associated with heating. Hermetically sealed containers of aseptically packaged foods do not require refrigeration, which also reduces energy consumption and costs.

"Enviro San and ES-1000 will help bottling facilities achieve more efficient, sustainable operations," said Larry Grab, vice president, food & beverage research & development. "This high-speed capable system offers greater throughput and lower aseptic packaging costs by reducing operating temperatures, raw materials and freight costs while enhancing food safety."

The National Food Laboratory served as the Process Authority that performed the validation tests for Aseptic Solutions in Ontario, CA. The validation studies were performed on a Procomac rotary aseptic filler.

Ecolab Inc.
866.781.8787
St. Paul, MN
www.ecolab.com

Bio-Rad Laboratories iQ-Check™ Real-Time PCR Test Kits Approved by AOAC Research Institute

The AOAC Research Institute has granted Performance Tested Method status to Bio-Rad Laboratories' iQ-Check™ test kits. The iQ-Check family of kits is based on automated real-time polymerase chain reaction (RTi-PCR) amplification and detection. Currently, kits are available for *Listeria* spp., *Listeria monocytogenes*, *Salmonella*, and *E. coli* O157:H7, all of which are approved. All tests can be run at the same time in the same reaction plate. Since the reaction occurs in closed PCR tubes, the chance for cross-contamination is limited. An internal amplification control is performed in each well to verify the validity of the PCR and confirm a negative result.

Two instrument platforms are available, to meet every user's needs. The 96-well instrument is suitable for high throughput analysis, with the ability to run 4 instruments from a single computer at the same time. For lower volume users, we offer a 48-well instrument, also with the ability to run 4 instruments from a single computer at the same time. Since Bio-Rad manufacturers both of these instruments, we provide complete instrument and kit technical support.

iQ-Check *E. coli* O157:H7 is validated with a non-specific 8–24 hour enrichment in Buffered Peptone Water. Modified EC broth (as per USDA MLG) and EHEC Enrichment broth (as per FDA BAM) were also validated for use with shortened enrichment times. iQ-Check *Salmonella* II requires a single 21 ± 1 hour enrichment in nonselective Buffered Peptone Water, with no selective enrichment step. iQ-Check *Listeria* spp. and iQ-Check *Listeria monocytogenes* II are validated with a 25 ± 1 hour enrichment in *Listeria* Special Broth (LSB), a 24-hour time saving over the reference method. LSB is an enrichment media specially formulated to meet the growth requirements of *Listeria* while inhibiting competitor organisms.

Bio-Rad Laboratories
800.424.6723
Hercules, CA
www.bio-rad.com

DuPont Qualicon and USDA Agricultural Research Service to Collaborate on New Test for *E. coli* O157:H7

DuPont Qualicon will collaborate with the US Meat Animal Research Center (USMARC) at Clay Center, NE, on developing a new test for detecting *E. coli* O157:H7 in beef and trim. After responding to an ARS request for proposals on collaboration, DuPont Qualicon and USMARC entered into a cooperative research and development agreement (CRADA).

USMARC is operated by the Agricultural Research Service (ARS), the chief scientific research agency of the US Dept. of Agriculture. "Our mission is to develop scientific information and new technology to solve high priority problems for the US beef, sheep and swine industries," said Mohammad Koohmaraie, USMARC director. "In the case of *E. coli* O157:H7 detection, we're looking at collaborative ways to quickly develop a new test."

"We are very pleased to be working with Dr. Koohmaraie and his team of experts at USMARC," said Ravi Ramadhar, business development director for DuPont Qualicon. "Our long history of commitment to the meat industry with applications of the best science available fits well with USMARC goals for a better *E. coli* O157:H7 test."

E. coli O157:H7 is a foodborne pathogen usually associated with eating undercooked, contaminated ground beef. Even in low concentrations, it can cause severe illness, sometimes leading to hemolytic uremic syndrome (HUS) and kidney failure in at-risk populations. After several years of declining incidence, 2007 saw a resurgence with more than 30 million pounds of ground beef recalled due to possible *E. coli* O157:H7 contamination.

DuPont Qualicon
800.863.6842
Wilmington, DE
www2.dupont.com

Component Hardware Group Faucet Spouts Now Internally Treated with SANIGUARD® Antimicrobial Technology

Component Hardware Group (CHG) proudly introduces SANIGUARD antimicrobial-treated spouts for use with potable water on its Encore® premium plumbing fixtures. The inside diameter (ID) of the spout is coated with an inorganic, silver ion antimicrobial to reduce bio-fouling by inhibiting the growth of a broad spectrum of bacteria and odor-causing molds and fungi. The efficacy of SANIGUARD

antimicrobial on treated surfaces can be expected to last for the life of the product.

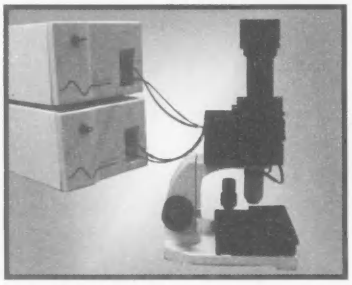
"The inside of faucet spouts tend to be an ideal breeding ground for various microorganisms, such as legionella and pseudomonas, because they are always damp and dark with a rough surface that promotes biofouling," states Tom Carr, president of CHG. "Our SANIGUARD-treated spouts are unique in the industry because the antimicrobial coating is located on the inside of the spout, where the bacteria and odor-causing molds and mildew can normally grow. Independent clinical and evidence-based testing also proves that our SANIGUARD antimicrobial treatment effectively inhibits the growth of these microorganisms on the inner surfaces of the spout."

SANIGUARD antimicrobial spouts are the first to be listed by the National Sanitation Foundation (NSF) International under Standard 61, Section 9 for use with potable water. The SANIGUARD treated spouts are currently being offered as an option on all Encore faucets manufactured by CHG and can be retro-fitted to Encore plumbing fixtures that are currently in the field.

Component Hardware Group
1.877.SANIGUARD
Lakewood, NJ
www.componenthardware.com

New Double Wavelength Micro Raman System!

Lambda Solutions, Inc. has introduced its new MMR duplex. The first low cost, high performance,



Lamdba Solutions, Inc.

double wavelength micro raman system.

This new unit features modular design with 785 nm/532 nm DM-1 adapters for double λ micro raman analysis.

The MMR duplex can be used with each dimension -P2 independently for micro raman, or extend the range of applications with raman vector probes and the external sampling module.

The 1.3 mega pixel CMOS camera is provided for sample imaging and capture.

For exact positioning the MMR comes with the LSI-XYZ: Scanning range is 70 mm × 20 mm; the Z scanning range is 17 mm with 1μ steps. All LSI micro raman adaptors are also compatible with Nikon, Olympus and Zeiss microscope systems.

The MMR duplex is ideal for materials analysis including polymers, films carbon fibers and single and multi-wall carbon nanotubes.

Lambda Solutions, Inc.
781.478.0170
Waltham, MA
www.LambdaSolutions.com

Onset Computer Corporation Introduces New Data Logger with LCD Display

New HOBO U14 data logger tracks temperature and humidity around the clock, provides instant alarm notification of out-of-range conditions

Onset Computer Corporation, the "HOBO" Data Logger Company, has introduced the HOBO® U14 LCD Data Logger, a low-cost environmental monitoring system that displays and tracks temperature and humidity levels in a broad range of indoor environments including office buildings, museums, and storage facilities.

The HOBO U14 features an easy-to-read backlit LCD display that enables users to make immediate visual checks of temperature and humidity conditions, while providing long-term data logging for trend analysis. The data logger can notify users when environmental conditions exceed set limits on the LCD display, and via an optional audible alarm and auto phone dialer unit.

Other features include:

- High-speed data offload – The HOBO U14 data logger provides high-speed data offload to a PC or Mac computer via a convenient, direct-USB interface.
- Easy, intuitive software – For plotting and analyzing data, Onset offers HOBOware® software, a highly intuitive

graphing and analysis software package for PC and Mac computers. HOBOware provides a user-friendly interface which enables users to quickly and easily plot, analyze and print data files, as well as export data to spreadsheet programs.

- Large memory – The HOBO U14 LCD data logger stores 43,000 12-bit temperature/humidity measurements with significantly improved accuracy and resolution over previous models.

The HOBO U14 provides high-accuracy, reliable data in a range of monitoring applications. For example, in food storage applications, it can be used to verify that temperature conditions in refrigeration units stay within a certain threshold. In art galleries, it can help prevent climate-induced deterioration to works of art by keeping continuous watch on temperature and humidity levels. Greenhouse growers can use the HOBO U14 as part of their overall climate control strategy to help promote favorable growing conditions.

Onset Computer Corporation
800.564.4377
Bourne, MA
www.onsetcomp.com

Eriez® Redesigned Dry, Vibrating Magnetic Filters Handle Food and Pharmaceutical Powders

Eriez® announces the availability of its newly redesigned dry, vibrating magnetic filter (DVMF) with a stainless steel construction option that makes it an ideal choice for handling food and pharmaceutical powders.

Eriez' DVMF features a high intensity, high gradient magnetic field generated in the bore of a solenoid coil encased in steel housing. Filter elements are provided by a matrix system that consists of a series of stainless steel metal discs. The matrix amplifies the externally applied magnetic field, produces regions of extremely high gradient and provides collection sites for the capture of ferrous contaminants.

Dave Heubel, Eriez' national sales manager, explains that while Eriez has offered the DVMF for some time, this new construction option provides many advantages for the food and pharmaceutical industries. "The main difference is in the canister and matrix construction. We can manufacture units that are polished and passivated to pass the most stringent sanitary standard for product contact surfaces. The magnet in these units is so powerful that it will successfully remove fine abraded 316 stainless steel, a metal that is typically non-magnetic to most magnetic separators," he said. "The real benefit is that the DVMF will attract fine particulate that metal detectors and x-ray would otherwise not identify," Mr. Heubel added.

Eriez
888.300.ERIEZ
Erie, PA
www.eriez.com

95th Annual Meeting

IAFP 2008

Columbus, Ohio • August 3–6

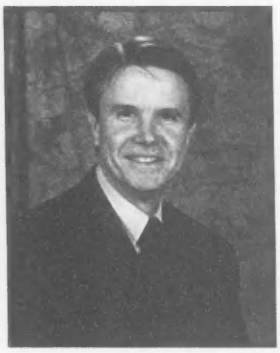
Ivan Parkin Lecture

Sunday, August 3

6:00 p.m.

Utility of Microbiological Testing for Food Safety Assurance: The Good, the Bad, and the Ugly

Dr. Russell S. Flowers
Silliker Group Corporation
Homewood, Illinois



Dr. Russell S. Flowers, Jr. is Chairman and Chief Scientific Officer of Silliker Group Corporation in Homewood, Illinois, where he spearheads strategic growth opportunities and assures that Silliker remains on the forefront of science and technology.

Dr. Flowers earned his BS and MS degrees from North Carolina State University, and his Ph.D. from the University of Illinois. He began his career with Silliker as a Laboratory Director in 1979, advancing to President in 1990. At that time, Silliker expanded to a global network with more than 45 locations, offering analytical and advisory services related to food safety and quality. He assumed his present position in January 2007.

Dr. Flowers has been an active researcher, author and speaker in the field of food microbiology, with particular emphasis on the development and validation of rapid analytical methods, and laboratory performance. He was the study director for the validation of the first Enzyme Immuno-Assay and Nucleic Acid Hybridization Assay approved by AOAC, and many subsequent studies that have led to industry-wide method implementation for the detection of pathogens in foods and food environments. Dr. Flowers also chaired the Food Laboratory Accreditation Working Group, which developed specific ISO accreditation criteria adopted by AOAC and A2LA for food testing laboratories.

The recipient of numerous industry awards and honors, Dr. Flowers is an active member of IAFP and several other professional organizations and societies, including the International Commission on Microbiological Specifications for Foods (ICMSF); AOAC International; Institute of Food Technologists (IFT); and the International Dairy Foods Association (IDFA).

95th Annual Meeting

IAFP 2008

Columbus, Ohio • August 3–6

JOHN H. SILLIKER LECTURE

WEDNESDAY, AUGUST 6

4:00 P.M.

FROM WILD PIGS IN SPINACH TO TILAPIA IN ASIA: THE CHALLENGE OF THE FOOD SAFETY COMMUNITY

DR. MICHAEL P. DOYLE
University of Georgia
Griffin, Georgia

Dr. Michael P. Doyle is a Regents Professor of Food Microbiology and Director of the Center for Food Safety at the University of Georgia. He is an active researcher in food safety and security, working closely with the food industry on issues related to the microbiological safety of foods.

Dr. Doyle is a graduate of the University of Wisconsin-Madison, where he earned his BS in Bacteriology, and MS and Ph.D. in Food Microbiology. The author of more than 400 scientific publications, Dr. Doyle has given more than 600 invited presentations at national and international scientific meetings, and has received several research awards from academic and national scientific organizations. He is a Fellow of IAFP, the American Academy of Microbiology, and the Institute of Food Technologists (IFT), and is a member of the National Academy of Sciences-Institute of Medicine.

In addition to current service on the food safety committees of several scientific organizations, Dr. Doyle has also served as a scientific advisor to many of them, including the World Health Organization (WHO); the National Academy of Sciences-Institute of Medicine and National Research Council; the International Life Sciences Institute-North America (ILSI); the Food and Drug Administration (FDA); the US Department of Agriculture (USDA); the US Department of Defense; and the US Environmental Protection Agency (EPA).

95th Annual Meeting

IAFP 2008

Columbus, Ohio • August 3–6

IAFP 2008 PRELIMINARY PROGRAM

SUNDAY, AUGUST 3

Opening Session – 6:00 p.m. – 7:00 p.m.

Ivan Parkin Lecture – Utility of Microbiological Testing for Food Safety Assurance: The Good, the Bad, and the Ugly
— Russell S. Flowers, Ph.D., Silliker Group Corp., Homewood, IL

MONDAY, AUGUST 4

Morning – 8:30 a.m. – 12:00 p.m.

Symposium Topics

- S1 2008 Foodborne Disease Outbreak Update: *Salmonella* in Processed Foods
- S2 Coming Out of the *Campylobacter* Closet: International Strategies for Reducing Human Campylobacteriosis
- S3 Globalization of Acceptance Criteria for Microbiological Methods: Separating the Science from the Politics

Roundtable Topic

- RT1 Eating Seafood – Is It Worth the Risk?

Technical Sessions

- T1 Pathogens, Beverages and Water
- T2 Antimicrobials and General Microbiology

Poster Session

- P1 Produce, Toxicology and Sanitation

Afternoon – 1:30 p.m. – 5:00 p.m.

Symposium Topics

- S4 Bacterial Physiology — A Forgotten Theme That is Critical for the Food Microbiologist
- S5 Sampling and Sample Prep: Unglamorous but Very Necessary
- S6 New and Innovative Ways to Derive Risk-Based Management Options
- S7 Food Safety Issues in Food Transportation – Keeping It Cold and Keeping It Clean

Roundtable Topics

- RT2 Occurrence and Control of Norovirus: *Is Public Vomiting Public Enemy #1?*
- RT3 Does Internalization of Pathogens Occur in Fresh Produce During Commercial Production and Processing?

Technical Session

- T3 Toxicology, Seafood and Meat and Poultry

Poster Session

- P2 Meat and Poultry, Microbial Food Spoilage, Beverage and Dairy

TUESDAY, AUGUST 5

All Day – 8:30 a.m. – 5:00 p.m.

Interactive Session

The Sequel to the Mystery Outbreak – What to Do When It Happens to You!

Session 1: 8:30 a.m. – 10:00 a.m.
Session 2: 10:30 a.m. – 12:00 p.m.
Session 3: 1:30 p.m. – 3:00 p.m.
Session 4: 3:30 p.m. – 5:00 p.m.

Morning – 8:30 a.m. – 12:00 p.m.

Symposium Topics

- S8 Validating Processes for Reducing *Salmonella* in Low Water Activity Foods
- S9 Advancements in Retail Food Safety
- S10 From Fish to Table
- S11 Best Practices in Global Food Export and Import

Roundtable Topic

- RT4 Global Perspectives and Novel Approaches for Effective Food Safety Communication within Culturally Diverse Audiences

Technical Session

- T4 Risk Assessment and Produce

Poster Session

- P3 Applied Laboratory Methods, Education and Epidemiology

Afternoon – 12:15 p.m. – 1:00 p.m.

IAFP Business Meeting

Afternoon – 1:30 p.m. – 5:00 p.m.

Symposium Topics

- S12 Back to the Future: How Clinical Microbiology Findings Today Predict the Food Microbiology Headaches for Tomorrow
- S13 Pathogen Data Sharing to Advance Food Safety
- S14 Food Safety and Regulatory Issues Associated with Non-Thermal Processing of Foods and Beverages
- S15 Harmonization of Irrigation Water Practices
- S16 Spores in the Dairy Industry – A Growing Concern – What Can You Do?

Technical Session

- T5 Applied Laboratory Methods and Novel Laboratory Methods

Poster Session

- P4 Pathogens and Novel Laboratory Methods

WEDNESDAY, AUGUST 6

Morning – 8:30 a.m. – 12:00 p.m.

Symposium Topics

- S17 Dairy Pasteurization in Today's Risk-Based Food Safety Environment – International Perspectives on the Use of Risk Assessment Tools
- S18 Innovative Applications of Bacteriophages in Rapid Enrichment, Detection and Identification of Foodborne Pathogens
- S19 Chemical Contaminants Testing in Foods

Roundtable Topics

- RT5 Comparative International Approaches to Regulating Unsafe Food
- RT6 Water: Potability vs. Drinkability

Technical Session

- T6 Education and Sanitation

Poster Session

- P5 Risk Assessment, Antimicrobials, Seafood and General Microbiology

Afternoon – 1:30 p.m. – 3:30 p.m.

Symposium Topics

- S20 Food Defense Educational Programs and Opportunities: Status, Focus and Future
- S21 Is It Overdone? Examining the Meat and Cancer Hypothesis and Its Impact on Food Safety
- S22 What is the 'Real' Issue with MDR?
- S23 The Greening of Food Packaging: Safety of Biodegradable, Reused, and Recycled Food Packaging
- S24 Food Allergens: Scientific Advances and Control Measures

Technical Session

- T7 Spoilage and Epidemiology

4:00 p.m. – 4:45 p.m.

John H. Silliker Lecture – From Wild Pigs in Spinach to Tilapia in Asia: The Challenges of the Food Safety Community, Michael P. Doyle, Ph.D., University of Georgia, Griffin, GA

Program subject to change

IAFP 2008 NETWORKING OPPORTUNITIES

IAFP FUNCTIONS

WELCOME RECEPTION
Saturday, August 2 • 5:00 p.m. – 6:30 p.m.

Reunite with colleagues from around the world as you socialize and prepare for the leading food safety conference. Everyone is invited!

COMMITTEE MEETINGS
Saturday, August 2 • 3:00 p.m. – 4:30 p.m.
Sunday, August 3 • 7:00 a.m. – 5:00 p.m.

Committees and Professional Development Groups (PDGs) plan, develop and institute many of the Association's projects, including workshops, publications, and educational sessions. Share your expertise by volunteering to serve on committees or PDGs. Everyone is invited to attend.

STUDENT LUNCHEON
Sunday, August 3 • 12:00 p.m. – 1:30 p.m.

Sponsored by Texas A&M University, Center for Food Safety

The mission of the Student PDG is to provide students of food safety with a platform to enrich their experience as Members of IAFP. Sign up for the luncheon to help start building your professional network.

EDITORIAL BOARD RECEPTION
Sunday, August 3 • 4:30 p.m. – 5:30 p.m.

Editorial Board Members are invited to this reception to be recognized for their service during the year.

OPENING SESSION AND IVAN PARKIN LECTURE
Sunday, August 3 • 6:00 p.m. – 7:00 p.m.

Join us to kick off IAFP 2008 at the Opening Session. Listen to the prestigous Ivan Parkin Lecture delivered by Dr. Russell S. Flowers.

CHEESE AND WINE RECEPTION
Sunday, August 3 • 7:00 p.m. – 9:00 p.m.

Sponsored by Kraft Foods

An IAFP tradition for attendees and guests. The reception begins in the Exhibit Hall immediately following the Ivan Parkin Lecture on Sunday evening.

IAFP JOB FAIR
Sunday, August 3 through Wednesday, August 6

Employers, take advantage of recruiting the top food scientists in the world! Post your job announcements and interview candidates.

COMMITTEE AND PDG CHAIRPERSON BREAKFAST
Monday, August 4 • 7:00 a.m. – 9:00 a.m.

Chairpersons and Vice Chairpersons are invited to attend this breakfast to report on the activities of your committee.

EXHIBIT HALL LUNCH
Monday, August 4 • 12:00 p.m. – 1:00 p.m.

Sponsored by JohnsonDiversey

Tuesday, August 5 • 12:00 p.m. – 1:00 p.m.

Sponsored by SGS North America

Stop in the Exhibit Hall for lunch and networking on Monday and Tuesday.

EXHIBIT HALL RECEPTIONS
Monday, August 4 • 5:00 p.m. – 6:00 p.m.

Sponsored by DuPont Qualicon

Tuesday, August 5 • 5:00 p.m. – 6:00 p.m.

Sponsored in part by The Kroger Co., Q Laboratories, Inc., Quality Assurance Magazine, and Springer

Join your colleagues in the Exhibit Hall to see the most up-to-date trends in food safety techniques and equipment. Take advantage of these great networking receptions.

PRESIDENT'S RECEPTION
Monday, August 4 • 6:00 p.m. – 7:00 p.m.

Sponsored by Fisher Scientific

This by invitation event is held each year to honor those who have contributed to the Association during the year.

BUSINESS MEETING
Tuesday, August 5 • 12:15 p.m. – 1:00 p.m.

You are encouraged to attend the Business Meeting to keep informed of the actions of YOUR Association.

JOHN H. SILLIKER LECTURE
Wednesday, August 6 • 4:00 p.m. – 4:45 p.m.

The John H. Silliker Lecture will be delivered by Dr. Michael Doyle.

AWARDS RECEPTION AND BANQUET
Wednesday, August 6 • 6:00 p.m. – 9:30 p.m.

Bring IAFP 2008 to a close at the Awards Banquet. Award recipients will be recognized for their outstanding achievements and the gavel will be passed from Dr. Gary R. Acuff to Incoming President, Dr. J. Stan Bailey.

95th Annual Meeting

IAFP 2008

Columbus, Ohio • August 3–6

IAFP 2008 General Information

REGISTRATION INCLUDES

Register to attend the world's leading food safety conference.

Full Registration includes:

- Program and Abstract Book
- Welcome Reception
- Ivan Parkin Lecture
- Cheese and Wine Reception
- Technical Sessions
- Poster Presentations
- Symposia
- Exhibit Hall Admittance
- Exhibit Hall Lunch (Mon. & Tues.)
- Exhibit Hall Reception (Mon. & Tues.)
- John H. Silliker Lecture
- Awards Banquet

PRESENTATION HOURS

Sunday, August 3	
Opening Session	6:00 p.m. – 7:00 p.m.
Monday, August 4	
Symposia & Technical Sessions	8:30 a.m. – 5:00 p.m.
Tuesday, August 5	
Symposia & Technical Sessions	8:30 a.m. – 5:00 p.m.
Wednesday, August 6	
Symposia & Technical Sessions	8:30 a.m. – 3:30 p.m.
Closing Session	4:00 p.m. – 5:00 p.m.

GOLF TOURNAMENT

Saturday, August 2

Golf Tournament at Golf Club of Dublin 6:00 a.m. – 2:00 p.m.

Join your friends and colleagues for an exciting round of golf before IAFP 2008. Golf the Golf Club of Dublin (Ohio) and you may envision yourself playing in Dublin, Ireland. The new Golf Club of Dublin was designed with the spirit of golf from the British Isles and will leave you thinking that you have just played Turnberry or Carnoustie. It is the first course in the region to be built with authentic links features such as stacked sod bunkers, rectangular teeing grounds, fescue covered dunes, stone walls and enormous greens. With 18-holes, a driving range, an Irish pub and a banquet hall on site–the Golf Club of Dublin offers a first-class resort style experience.

The Golf Club of Dublin was ranked one of the "Top 25 in America" by Golf Magazine and "Must Play Golf Courses" by ESPN just to name a few. For a true championship test and memorable experience you must play the Golf Club of Dublin. Price includes transportation, greens fees with a cart, range balls, breakfast, lunch and prizes.

REGISTER ONLINE

Register online at **www.foodprotection.org**

EXHIBIT HOURS

Sunday, August 3	7:00 p.m. – 9:00 p.m.
Monday, August 4	10:00 a.m. – 6:00 p.m.
Tuesday, August 5	10:00 a.m. – 6:00 p.m.

HOTEL INFORMATION

Hotel reservations can be made online at **www.foodprotection.org**.

The IAFP Annual Meeting Sessions, Exhibits and Events will take place or depart from the Hyatt Regency Colubmus. Official hotels for IAFP 2008 are as follows:

Hyatt Regency Columbus	$129 per night
Crowne Plaza	$129 per night
Drury Inn and Suites	$129 per night

CANCELLATION POLICY

Registration fees, less a $50 administration fee and any applicable bank charges, will be refunded for written cancellations received by July 18, 2008. No refunds will be made after July 18, 2008; however, the registration may be transferred to a colleague with written notification. Refunds will be processed after August 11, 2008.

Event and extra tickets purchased are nonrefundable.

International Association for Food Protection®

6200 Aurora Avenue, Suite 200W
Des Moines, IA 50322-2864, USA
Phone: 800.369.6337 • 515.276.3344
Fax: 515.276.8655
E-mail: info@foodprotection.org
Web site: www.foodprotection.org

95th Annual Meeting

IAFP 2008

Columbus, Ohio • August 3–6

IAFP 2008 REGISTRATION FORM

3 Ways to Register

ONLINE
www.foodprotection.org

FAX
515.276.8655

MAIL
6200 Aurora Ave., Suite 200W
Des Moines, IA 50322-2864, USA

Member Number: _____

First name (as it will appear on your badge) _____ Last name _____

Employer _____ Title _____

Mailing Address (Please specify: ❒ Home ❒ Work) _____

City _____ State/Province _____ Country _____ Postal/Zip Code _____

Telephone _____ Fax _____ E-mail _____

❒ Regarding the ADA, please attach a brief description of special requirements you may have.

❒ IAFP occasionally provides Attendees' addresses (excluding phone and E-mail) to vendors and exhibitors supplying products and services for the food safety industry. If you prefer NOT to be included in these lists, please check the box.

PAYMENT MUST BE RECEIVED BY JULY 1, 2008 TO AVOID LATE REGISTRATION FEES

REGISTRATION FEES	MEMBERS	NONMEMBERS	TOTAL
Registration	$ 415 ($ 465 late)	$ 630 ($ 680 late)	_____
Association Student Member	$ 80 ($ 90 late)	Not Available	_____
Retired Association Member	$ 80 ($ 90 late)	Not Available	_____
One Day Registration* ❒ Mon. ❒ Tues. ❒ Wed.	$ 225 ($ 250 late)	$ 350 ($ 375 late)	_____
Spouse/Companion* (Name): _____	$ 60 ($ 60 late)	$ 60 ($ 60 late)	_____
Children 15 & Over* (Names): _____	$ 25 ($ 25 late)	$ 25 ($ 25 late)	_____
Children 14 & Under* (Names): _____	FREE	FREE	_____
*Awards Banquet not included			
Additional Awards Banquet Ticket – Wednesday, 8/6	$ 50 ($ 60 late)	$ 50 ($ 60 late)	_____
Student Luncheon – Sunday, 8/3	$ 10 ($ 15 late)		_____
GOLF TOURNAMENT		**# OF TICKETS**	
Golf Club of Dublin, Saturday, 8/2	$ 140 ($ 150 late)	_____	_____
WORKSHOPS – PRE-MEETING			
Better Process Cheese Control School	$ 575 ($ 650 late)	$ 675 ($ 750 late)	_____
The Art of Fungal Characterization and Identification: A Hands-on Workshop	$ 620 ($ 695 late)	$ 720 ($ 795 late)	_____
Hands-on Workshop on Microbial Risk Assessment Modeling and Interpretation	$ 270 ($ 345 late)	$ 370 ($ 445 late)	_____
ABSTRACTS			
Annual Meeting Abstracts (citable publication to be mailed Oct. 1)	$ 25	$ 25	_____

Payment Options: ❒ **VISA** ❒ **Master Card** ❒ **American Express** ❒ **Discover**

❒ **Check Enclosed**

TOTAL AMOUNT ENCLOSED $ _____
US FUNDS on US BANK

Refunds subject to cancellation policy

CREDIT CARD # _____

CARD ID #* _____ EXP. DATE _____

SIGNATURE _____

*Visa, Mastercard and Discover: See 3-digit Card ID number on the back of the card after account number.
American Express: See 4-digit, non-embossed number printed above your account number on the face of your card.

❒ Check box if you are a technical, poster, or symposium speaker.

JOIN TODAY AND SAVE!!!
(Attach a completed Membership application)

EXHIBITORS DO NOT USE THIS FORM

International Association for Food Protection

95th Annual Meeting

IAFP 2008

Columbus, Ohio • August 3–6

IAFP 2008 WORKSHOPS

WORKSHOP 1	WORKSHOP 2	WORKSHOP 3
Better Process Cheese Control School	The Art of Fungal Characterization and Identfication: A Hands-on Workshop	Hands-on Workshop on Microbial Risk Assessment Modeling and Interpretation
Friday and Saturday August 1–2 8:00 a.m. – 5:00 p.m.	**Friday and Saturday August 1–2 8:00 a.m. – 5:00 p.m.**	**Saturday August 2 8:00 a.m. – 5:00 p.m.**

REGISTRATION – (Payment must be received by July 18, 2008 to avoid late registration rates).
Cancellations received by July 18, 2008 will be refunded, less a $50.00 administrative fee. No refunds will be made after this date.

	Early Rate	Late Rate
Member	$575.00	$650.00
Non-Member	$675.00	$750.00

	Early Rate	Late Rate
Member	$620.00	$695.00
Non-Member	$720.00	$795.00

	Early Rate	Late Rate
Member	$270.00	$345.00
Non-Member	$370.00	$445.00

Workshop 1 – Better Process Cheese Control School – Processing Controls for Shelf-Stable Pasteurized Process Cheese Product Manufacture – Friday and Saturday, August 1–2

Current regulations for Low Acid Canned Foods (LACF) require that "Operators of systems shall be under the operating supervision of a person who has attended a school approved by the Commissioner for giving instruction appropriate to the preservation technology involved and who has been identified by that school as having satisfactorily completed the prescribed course of instruction." The Better Process Control School (BPCS) training course currently available does not include process cheese formulation as a preservation technology.

This 2-day course is designed to cover LACF regulations as they pertain to shelf-stable process cheese manufacture, microbiology and control of *Clostridium botulinum*, thermal processing/pasteurization, formulation control, process instrumentation, HACCP, and production and packaging controls. Examinations will be given at the completion of each section. Satisfactory completion of this course will fulfill the regulatory certification requirements for operators of process cheese manufacturing systems.

Topics:

- Introduction to LACF Regulations for Shelf Stable Process Cheese
- Microbiology – Basic Microbiology, Factors Affecting Growth
- Thermal Processing – Microbial Death, D, Z, and F Values, Factors Affecting Thermal Resistance, Pasteurization, Commercial Sterilization, Sterilization
- Botulism and Control of *C. botulinum* – Disease, Risks, Methods to Control Toxin Production
- Formulation Control for Shelf Stable Process Cheeses – Ingredients That Affect Safety, FRI Studies, Additional Factors for Safety
- Process Controls for Process Cheese – Cheese Processing Overview, Preparations Prior to Cooking, Batch Cooking, Continuous Cooking, Testing
- Food Plant Sanitation and GMPs – Basic Principles of Sanitation, Good Manufacturing Practices
- HACCP and Production Controls – Principles of HACCP, Critical Control Points for Shelf Stable Process Cheese, Other Production Controls for Shelf Stable Process Cheese
- Packaging for Process Cheese – Package Development Process, Examples of Packaging, Development and Qualification Testing
- Records and Record-Keeping – Reasons for Record-Keeping, Proper Documentation on Records, Record Retention and Availability, Product Recalls, Processing Records

Instructors:

Kathy Glass, University of Wisconsin-Madison, Madison, WI, USA
Loralyn Ledenbach, Kraft Foods, Glenview, IL, USA
Virgil Metzger, Kraft Foods, Glenview, IL, USA
Don Zink, FDA-CFSAN, College Park, MD, USA

Organizer:

Loralyn Ledenbach, Kraft Foods, Glenview, IL, USA

INTENDED AUDIENCE

Operators, supervisors, and management in process cheese manufacturing facilities. Food safety professionals and regulatory officials involved in LACF filing for process cheese products

This workshop is dedicated to Dr. Nobi Tanaka, whose work at the Food Research Institute, University of Wisconsin-Madison has been instrumental in assuring the safety of shelf stable process cheese products.

Workshop 2 – The Art of Fungal Characterization and Identification: A Hands-on Workshop – Friday and Saturday, August 1–2

Mitigating the risks of yeasts and mold contamination remains a constant battle within certain segments of the food and beverage industry. Molds and yeasts cause significant pre- and post-harvest food spoilage losses and mycotoxigenic molds pose significant food safety/regulatory hazards. Fungal identification is a scientific challenge requiring both art and technical expertise. There are a limited number of scientists who understand and have developed the art of fungal identification to a sound science. This workshop provides a unique opportunity to interact with and learn first-hand from a group of experts the best practice for isolation and the basics of classical identification methods, along with current molecular methods being used. Fifty-percent of the workshop will involve live demonstration and a direct hands-on experience in a laboratory setting.

Topics:

- Classical and Molecular Methods of Identification of Yeast and Molds
- Basic Isolation and Analytical Methods of Fungal Contaminants
- Safe Handling of Fungal Cultures
- Environmental Sampling of Processing Plant

Instructors:

Anthony Armstrong, PepsiCo, Barrington, IL, USA
Frank Burns, DuPont Qualicon, Philadelphia, PA, USA
Maribeth Cousin, Purdue University, West Lafayette, IN, USA
Dave Pincus, bioMérieux, Inc., Hazelwood, MO, USA
Emilia Rico-Munoz, BCN Research Laboratories, Rockford, TN, USA

Organizers:

Frank Burns, DuPont Qualicon, Philadelphia, PA, USA
Dave Pincus, bioMérieux, Inc., Hazelwood, MO, USA
Patricia Rule, bioMérieux, Inc., Hazelwood, MO, USA

Laboratory Host – Ahmed Yousef, The Ohio State University, Columbus, OH, USA

INTENDED AUDIENCE

Microbiologists in quality assurance and quality control performing routine analysis as well as investigational work for the recovery and identification of yeast and mold from food or beverage

Workshop 3 – Hands-on Workshop on Microbial Risk Assessment Modeling and Interpretation – Saturday, August 2

Microbiological risk assessments (MRA) have received much interest in the last decade but require particular multi-disciplinary skills for successful development. This hands-on workshop should help create awareness of the principles of risk assessment/management, the skill requirements, and experience gained regarding the utility and validity of MRA studies. The lecturers will present several of the valuable resources available for risk assessors and managers and provide insights in the challenges to interpret and utilize risk assessment studies. Case studies will help participants to understand the principles of risk assessment and risk management and there will be an opportunity given to participants to propose cases relevant to them ahead of the workshop that may be dealt within plenary or one on one. The workshop will also cover a recent development, the establishment of a broad conceptual framework for risk governance by the International Risk Governance Council. This addresses the fact that the success with which risks are managed in society depends on a complex system of risk governance.

Topics:

- Different MRA Types and Scopes: From Risk Profiles to Probabilistic Approaches to Risk Assessment
- Interpreting Outputs from Different MRA Types for Risk Management Decision-making
- Detailed Example MRA Case Studies
- Learnings for Industry and Governments from Existing Risk Assessments
- Guidance on Utility and Validity of Microbiological Risk Assessments
- The Risk Governance Framework Developed by the International Risk Governance Council (IRGC)
- Risk Assessment Software and Decision Support Systems for Risk Evaluation and Risk Ranking (from ComBase, over Risk Ranger to FAO/WHO Web-Based MRA Tools)

Instructors:

Leon Gorris, Unilever, SEAC, Sharnbrook, UK
Tom Ross, Centre for Food Safety, Tasmanian Institute of Agricultural Research, School of Agricultural Science, University of Tasmania, Hobart, Tasmania, Australia
Ewen C. D. Todd, Michigan State University, East Lansing, MI, USA
Richard C. Whiting, FDA-CFSA, College Park, MD, USA

Organizers:

Leon Gorris, Unilever, SEAC, Sharnbrook, UK
Ewen C. D. Todd, Michigan State University, East Lansing, MI, USA

INTENDED AUDIENCE

Risk assessment and management staff from government, industry and academia interested in microbiological food safety management

TO REGISTER, GO ONLINE TO WWW.FOODPROTECTION.ORG.

95th Annual Meeting
IAFP 2008
Columbus, Ohio • August 3–6

IAFP 2008 Special Contributors

BD

JohnsonDiversey
Clean is just the beginning

BIOMÉRIEUX INDUSTRY

KRAFT

BIO-RAD

1883 Kroger 2008

Cargill

Nestlé
Good Food, Good Life

DEIBEL LABORATORIES

NSF

DUPONT

SGS

Fisher Scientific

SILLIKER
Food Safety & Quality Solutions

FSNS
Food Safety Net Services

SDI
Strategic Diagnostics Inc.

IAFP FOUNDATION

ATM
Texas A&M University
Center for Food Safety

Sponsors

3M Microbiology
ConAgra Foods, Inc.
Ecolab Inc.
F & H Food Equipment Company
Wilbur Feagan
GMA
International Life Sciences Institute, N.A. (ILSI, N.A.)
International Packaged Ice Association (IPIA)
John Morrell Company
Nasco International, Inc.
Nelson-Jameson, Inc.
Q Laboratories, Inc.
Quality Assurance and Food Safety Magazine
Springer
Standard Meat Company
Weber Scientific

95th Annual Meeting

IAFP 2008

Columbus, Ohio • August 3–6

Contribute to the Eleventh Foundation Silent Auction Today!

Proceeds from the Silent Auction Benefit the Foundation

Support the Foundation by donating an item today. A sample of items donated last year included:

- iPod
- Georgia Gift Basket
- Mickey Mouse Wrist Watch
- Oscar Mayer Hot Dog Golf Club, Towel and Balls
- Margaritaville Frozen Concoction Maker
- Half Gallon New York State Pure Maple Syrup
- New Zealand All Blacks vs. France Rugby Souvenir Pack
- *Listeria, Listeriosis and Food Safety*
- MP3 Player
- *Cuisine and Culture: A History of Food*
- Natural Freshwater Pearl Doubles
- 1966–2000 *JFP* Achives
- "Lucky Cow" Cow Figurine
- New York State Cheddar Cheese
- Kentucky Fun Pack

To donate an item go to our Web site at www.foodprotection.org and complete the Silent Auction Donation Form or contact Donna Gronstal at dgronstal@foodprotection.org 515.276.3344; 800.369.6337.

IAFP FOUNDATION

COMING EVENTS

JULY

- **8, HACCP – The Basics,** Chipping Campden, Gloucestershire, United Kingdom. For more information, go to www.campden.co.uk.
- **20–23, Canadian Institute of Public Health Inspectors Conference,** St. John's, New Foundland. For more information, go to www.ciphi.nl.ca.
- **21–25, Australian Association for Food Protection Annual Meeting,** Sydney Convention and Exhibition Centre, Sydney, Australia. For more information, contact Patricia Desmarchelier at 61.7.32142032; E-mail: patricia.desmarchelier@csiro.au.
- **21–25, HACCP – Advanced,** Chipping Campden, Gloucestershire, United Kingdom. For more information, go to www.campden.co.uk.

AUGUST

- **1–2, IAFP 2008 Workshops,**
  Workshop 1 – Better Process Cheese Control School
  Workshop 2 – The Art of Fungal Characterization and Identification: A Hands-on Workshop
  Workshop 3 – Hands-on Workshop on Microbial Risk Assessment Modeling and Interpretation

  For more information, contact Julie Cattanach at 800.369.6337; E-mail: jcattanach@foodprotection.org. See our workshop information on page 442.

- **3–6, IAFP Annual Meeting, Hyatt Regency Columbus,** Columbus, OH. contact Julie Cattanach at 800.369.6337; E-mail: jcattanach@foodprotection.org. See our registration form on page 441.

- **12–14, Statistical Process Control (SPC) for the Food Industry,** Athens, GA. For more information, contact University of Georgia Food Science Extension Outreach Program at 706.542.2574 or go to www.EFSonline.uga.edu.

SEPTEMBER

- **1–4, Food Micro 2008 – The 21st International ICFMH Symposium,** Aberdeen Exhibition and Conference Centre, Aberdeen, Scotland. For more information, go to www.foodmicro2008.org/.
- **4–5, ASI Food Safety Consultants Bioterrorism and Food Safety Seminar,** Las Vegas, NV. For more information, contact Vicki Bodrow at 800.477.0778; E-mail: vbodrow@asifood.com.
- **7–9, 5th International Whey Conference,** Paris, France. For more information, go to www.iwc-2008.org/home.asp.
- **9–12, ASTHO-NACCHO Joint 2008 Conference,** Sacramento Convention Center, Sacramento, CA. For more information call 703.964.1240 or go to www.naccho.org.
- **14–17, 2008 TAPPI PLACE Conference,** Renaissance Portsmouth Hotel, Portsmouth, VA. For more information, call 800.332.8686 or go to www.tappi.org/08place.
- **15, ASIS International – 54th Annual Seminar and Exhibits,** Atlanta, GA. For more information, call 800.465.3717 or go to www.qmi.com.
- **16–17, Upper Midwest Dairy Industry Association Annual Meeting,** Holiday Inn, St. Cloud, MN. For more information, E-mail Gene Watnass at saantaw@prtel.com.
- **16–18, New York State Association for Food Protection 85th Annual Conference,** Doubletree Hotel, East Syracuse, NY. For more information, contact Janene Lucia at 607.255.2892; E-mail: jgg3@cornell.edu.
- **21–24, AACC International Annual Meeting,** Hawaii Convention Center, Honolulu, Hawaii. For more information, call 651.454.7250 or go to http://meeting.aaccnet.org.
- **21–24, 122nd AOAC International Annual Meeting,** Dallas Texas. For more information, go to www.aoac.org.
- **24–25, 2nd Annual China International Food Safety and Quality Conference and Expo,** The Landmark Hotel & Towers, Beijing, China. For more information, go to www.chinafoodsafety.com.
- **24–25, Wisconsin Association for Food Protection Joint Educational Conference,** Holiday Inn, Manitowoc, WI. For more information, go to www.wafp-wi.org.
- **29–1 Oct., Indiana Environmental Health Association Fall Educational Conference,** Belterra Hotel and Conference Center, Belterra, IN. For more information, contact Kelli Whiting at 317.221.2256; E-mail: kwhiting@hhcorp.org.

OCTOBER

- **7–8, Advanced HACCP Training for Meat and Poultry Producers,** Athens, GA. For more information, contact University of Georgia Food Science Extension Outreach Program at 706.542.2574 or go to www.EFSonline.uga.edu.
- **9–11, Current Developments in Food and Environmental Virology Symposium,** Pisa, Italy. For more information, call 39.050.2213644 or go to www.cost929-environet.org.

IAFP UPCOMING MEETINGS

AUGUST 3-6, 2008
Columbus, Ohio

JULY 12-15, 2009
Grapevine, Texas

AUGUST 1-4, 2010
Anaheim, California

COMING EVENTS

- **12–16, 2nd ASM Conference on Beneficial Microbes: Beneficial Host-Microbial Interactions,** San Diego, CA. For more information, call ASM at 202.737.3600 or go to www.asm.org.
- **19–22, 28th Food Microbiology Symposium "Current Concepts in Foodborne Pathogens and Rapid and Automated Methods in Food Microbiology,** University of Wisconsin-River Falls, River Falls, WI. For more information, call 715.425.3704 or go to www.uwrf.edu/food-science.
- **25–28, American Society for Microbiology's Annual Interscience Conference on Antimicrobial Agents and Chemotherapy,** Washington, D.C. For more information, go to www.icaac.org.
- **28–29, AIB International's Principles of Inspecting and Auditing Food Plants,** Atlanta, GA. For more information, call 785.537.4740 or go to www.aibonline.org.

NOVEMBER

- **19–21, IAFP's 4th European International Symposium on Food Safety,** Lisbon, Portugal. For more information, contact the Association at 800.369.6337 or go to www.food-protection.org.
- **19–21, The ILSI Europe International Symposium on Food Packaging,** Prague, Czech Republic. For more information, call 32.2.771.00.14 or go to http://europe.ilsi.org/events/upcoming/4thfoodpckg.htm.

ADVERTISING INDEX

Journal of Food Protection®

ISSN: 0362-028X
Official Publication

International Association for Food Protection,

Reg. U.S. Pat. Off.

Vol. 71 May 2008 No. 5

Research Notes

Supplement

ERRATA

In the article "Comparative Effect of Direct-Fed Microbials on Fecal Shedding of *Escherichia coli* O157:H7 and *Salmonella* in Naturally Infected Feedlot Cattle" by E. S. Tabe, J. Oloya, D. K. Doetkott, M. L. Bauer, P. S. Gibbs, and M. L. Khaitsa, which appears in the *Journal of Food Protection* 71(3):539–544, the probiotic strains *Lactobacillus acidophilus* (LA 51) and *Propionibacterium freudenreichii* (PF 24) were quoted in error. The correct probiotic strain used in the study was *Lactobacillus acidophilus* (BT 1386).

In the article "Modification of the Submerged Coil To Prevent Microbial Carryover Error in Thermal Death Studies" by S. E. Keller, A. G. Shazer, G. J. Fleischman, S. Chirtel, N. Anderson, and J. Larkin that appears in the *Journal of Food Protection* 71(4):775–780, in row 1, last column of Table 1, the *D*-value of *Y. pseudotuberculosis* in the unmodified submerged coil using a continuous method should be changed from 1.5 ± 0.8 to 15 ± 0.8.

* Asterisk indicates author for correspondence.

AUDIOVISUAL LIBRARY ORDER FORM

The use of the Audiovisual Library is a benefit for **Association-Members only.** Limit your requests to five videos. Material from the Audiovisual Library can be checked out for 2 weeks only so that all Members can benefit from its use.

International Association for Food Protection®
6200 Aurora Avenue, Suite 200W
Des Moines, IA 50322-2864, USA
Phone: 800.369.6337; 515.276.3344;
Fax: 515.276.8655
E-Mail: info@foodprotection.org
Web Site: www.foodprotection.org

Member # _____

First Name _____ M.I. _____ Last Name _____

Company _____ Job Title _____

Mailing Address _____

Please specify: ❒ Home ❒ Work

City _____ State or Province _____

Postal Code/Zip + 4 _____ Country _____

Telephone # _____ Fax # _____

E-Mail _____ Date Needed _____

PLEASE CHECK BOX NEXT TO YOUR VIDEO CHOICE

(Allow 4 weeks minimum from date of request.)

DAIRY

- ❒ D1010 The Bulk Milk Hauler: Protocol & Procedures
- ❒ D1050 Gold Hard Facts
- ❒ D1051 Dairy Plant
- ❒ D1040 Ether Extraction Method for Determination of Raw Milk
- ❒ D1050 Food Safety: Dairy Details
- ❒ D1060 Frozen Dairy Products
- ❒ D1070 The Gerber Butterfat Test
- ❒ D1080 High-Temperature, Short-Time Pasteurizer
- ❒ D1090 Managing Milking Quality
- ❒ D1100 Mastitis Prevention and Control
- ❒ D1105 Milk Hauling Training
- ❒ D1110 Milk Plant Sanitation: Chemical Solution
- ❒ D1120 Milk Processing Plant Inspection Procedures
- ❒ D1125 Ohio Bulk Milk Hauling Video
- ❒ D1130 Pasteurizer: Design and Regulation
- ❒ D1140 Pasteurizer: Operation
- ❒ D1150 Processing Fluid Milk
- ❒ D1180 10 Points to Dairy Quality

ENVIRONMENTAL

- ❒ E2012 Better TEDs for Better Fisheries
- ❒ E3010 The ABCs of Clean – A Handwashing and Cleanliness Program for Early Childhood Programs
- ❒ E3020 Acceptable Risks?
- ❒ E3030 Air Pollution: Indoor
- ❒ E3031 Allergy Beware
- ❒ E3040 Asbestos Awareness
- ❒ E3055 Effective Handwashing – Preventing Cross-Contamination in the Food Service Industry
- ❒ E3060 EPA Test Methods for Freshwater Effluent Toxicity Tests (Using Ceriodaphnia)
- ❒ E3070 EPA Test Methods for Freshwater Toxicity Tests (Using Fathead Minnow Larva)
- ❒ E3075 EPA: This is Super Fund
- ❒ E3080 Fit to Drink
- ❒ E3110 Garbage: The Movie
- ❒ E3120 Global Warming: Hot Times Ahead
- ❒ E3125 Good Pest Exclusion Practices
- ❒ E3128 Integrated Pest Management (IPM)
- ❒ E3130 Kentucky Public Swimming Pool and Bathing Facilities
- ❒ E3131 Key Pests of the Food Industry
- ❒ E3133 Physical Pest Management Practices
- ❒ E3135 Plastics Recycling Today: A Growing Resource
- ❒ E3140 Putting Aside Pesticides
- ❒ E3150 Radon
- ❒ E3160 RCRA-Hazardous Waste
- ❒ E5161 The Kitchen Uncovered: Orkin Sanitized EMP – The New Superfund: What It Is and How It Works
- ❒ E3170 Tape 1 – Changes in the Remedial Process: Clean-up Standards and State Involvement Requirements
- ❒ E5180 Tape 2 – Changes in the Removal Process: Removal and Additional Program Requirements
- ❒ E5190 Tape 3 – Enforcement & Federal Facilities
- ❒ E3210 Tape 4 – Emergency Preparedness & Community Right-to-Know
- ❒ E3220 Tape 5 – Underground Storage Tank Trust Fund & Response Program
- ❒ E3230 Tape 6 – Research & Development/Closing Remarks
- ❒ E3235 Regulatory and Good Manufacturing Practices
- ❒ E3236 Rodent Control Strategies
- ❒ E3240 Sink a Germ
- ❒ E3245 Wash Your Hands
- ❒ E3250 Waste Not: Reducing Hazardous Waste
- ❒ E3251 Would Your Restaurant Kitchen Pass Inspection?
- ❒ E3260 Swabbing Techniques for Sampling the Environment and Equipment

FOOD

- ❒ F2005 A Lot on the Line
- ❒ F2007 The Amazing World of Microorganisms
- ❒ F2008 A Recipe for Food Safety Success
- ❒ F2009 Basic Personnel Practices
- ❒ F2010 Close Encounters of the Bird Kind
- ❒ F2011 Available: Post Harvest Processing Technologies for Oysters
- ❒ F2013 Control of *Listeria monocytogenes* in Small Meat and Poultry Establishments
- ❒ F2014 Controlling Food Allergens in the Plant
- ❒ F2015 Controlling *Listeria*: A Team Approach
- ❒ F2016 Bloodborne Pathogens: What Employees Must Know
- ❒ F2020 Egg Handling and Safety
- ❒ F2021 Egg Production
- ❒ F2025 The Special of the Day: The Eggceptional Egg
- ❒ F2030 "Egg Games" Foodservice Egg Handling & Safety
- ❒ F2035 Fabrication and Curing of Meat and Poultry Products
- ❒ F2036 Emerging Pathogens and Grinding and Cooking Comminuted Beef
- ❒ F2037 Cooking and Cooling of Meat and Poultry Products
- ❒ F2039 Food for Thought – The GMP Quiz Show
- ❒ F2040 Food Irradiation
- ❒ F2045 Food Microbiological Control
- ❒ F2050 Food Safe-Food Smart – HACCP and Its Application to the Food Industry (Part 1 & 2)
- ❒ F2060 Food Safe Series I (4 videos)
- ❒ F2070 Food Safe Series II (4 videos)
- ❒ F2080 Food Safe Series III (4 videos)
- ❒ F2081 Food Safety Begins on the Farm
- ❒ F2090 Food Safety: An Educational Video for Institutional Food Service Workers
- ❒ F2095 Food Safety for Food Service Series I
- ❒ F2100 Now You're Cooking
- ❒ F2101 Tape 1 – Food Safety for Food Service: Cross Contamination
- ❒ F2102 Tape 2 – Food Safety for Food Service: HACCP
- ❒ F2103 Tape 3 – Food Safety for Food Service: Personal Hygiene
- ❒ F2104 Tape 4 – Food Safety for Food Service: Time and Temperature Controls
- ❒ F2105 Food Safety for Food Service Series II
- ❒ F2106 Tape 1 – Basic Microbiology and Foodborne Illness
- ❒ F2107 Tape 2 – Handling Knives, Cuts, and Burns
- ❒ F2110 Tape 3 – Working Safely to Prevent Injury
- ❒ F2111 Tape 4 – Sanitation
- ❒ F2120 Food Safety is No Mystery
- ❒ F2121 Controlling *Salmonella*: Strategies That Work
- ❒ F2125 Food Safety: For Goodness Sake Keep Food Safe
- ❒ F2126 Food Safety the HACCP Way
- ❒ F2127 Food Safety: Zone Video Series
- ❒ F2128 Tape 1 – Food Safety Zone: Basic Microbiology
- ❒ F2129 Tape 2 – Food Safety Zone: Cross Contamination
- ❒ F2130 Tape 3 – Food Safety Zone: Personal Hygiene
- ❒ F2131 Tape 4 – Food Safety Zone: Sanitation
- ❒ F2133 Food Technology: Irradiation
- ❒ F2134 Food Safety: You Make the Difference
- ❒ F2135 Fruits, Vegetables, and Food Safety: Health and Hygiene on the Farm
- ❒ F2136 Food Safety First
- ❒ F2137 Food Safety: Fish and Shellfish Safety
- ❒ F2140 Get with a Safe Food Attitude
- ❒ F2143 GLP Basics: Safety in the Food Micro Lab
- ❒ F2147 GMP Basics: Avoiding Microbial Cross-Contamination
- ❒ F2148 GMP Basics: Employee Hygiene Practices
- ❒ F2150 GMP Basics: Guidelines for Maintenance Personnel
- ❒ F2151 GMP Basics: Process Control Practices
- ❒ F2152 GMP – GSP Employee
- ❒ F2155 GMP: Personal Hygiene and Practices in Food Manufacturing
- ❒ F2154 GMP Food Safety Video Series
- ❒ F2155 Tape 1 – Definitions
- ❒ F2160 Tape 2 – Personnel and Personnel Facilities
- ❒ F2161 Tape 3 – Building and Facilities
- ❒ F2162 Tape 4 – Equipment and Utensils
- ❒ F2163 Tape 5 – Production and Process Controls
- ❒ F2164 GMPs: Sources and Control of Contamination during Processing
- ❒ F2165 GMPs for Food Plant Employees: Five-volume Video Series Based on European Standards and Regulations
- ❒ F2168 Tape 1 – Definitions
- ❒ F2169 Tape 2 – Personnel and Personnel Practices
- ❒ F2170 Tape 3 – Building and Facilities
- ❒ F2172 Tape 4 – Equipment and Utensils
- ❒ F2173 Tape 5 – Production and Process Controls
- ❒ F2175 HACCP: Training for Employees – USDA Awareness
- ❒ F2180 The Heart of HACCP
- ❒ F2190 HACCP: Training for Managers
- ❒ F2191 Inside HACCP: Principles, Practices and Results
- ❒ F2210 Inspecting for Food Safety – Kentucky's Food Code
- ❒ F2220 HACCP: Safe Food Handling Techniques
- ❒ F2230 Is What You Order What You Get? Seafood Integrity
- ❒ F2240 Microbial Food Safety: Awareness to Action
- ❒ F2250 Northern Delight – From Canada to the World
- ❒ F2260 Proper Handling of Peracidic Acid
- ❒ F2265 Purely Coincidental
- ❒ F2266 On the Front Line
- ❒ F2270 On the Line
- ❒ F2271 100 Degrees of Doom…The Time and Temperature Caper
- ❒ F2280 A Day in the Deli: Service, Selection, and Good Safety
- ❒ F2290 HACCP: A Basic Understanding
- ❒ F2310 Pest Control in Seafood Processing Plants
- ❒ F2320 Preventing Foodborne Illness
- ❒ F2321 Principles of Warehouse Sanitation
- ❒ F2322 Product Safety and Shelf Life
- ❒ F2325 Safe Food: You Can Make a Difference
- ❒ F2330 Safe Handwashing
- ❒ F2340 All Hands on Deck
- ❒ F2341 The Why, The When, and The How Video
- ❒ F2342 Safe Practices for Sausage Production
- ❒ F2350 Sanitation for Seafood Processing Personnel
- ❒ F2350 Sanitizing for Safety
- ❒ F2350 Science and Our Food Supply
- ❒ F2350-1 Seafood HACCP Alliance Internet Training Course
- ❒ F2350-2 ServSafe Steps to Food Safety
- ❒ F2350-3 Step One: Starting Out with Food Safety
- ❒ F2350-4 Step Two: Ensuring Proper Personal Hygiene
- ❒ F2350-5 Step Three: Purchasing, Receiving and Storage
- ❒ F2350-6 Step Four: Preparing, Cooking and Serving
- ❒ F2370 Step Five: Cleaning and Sanitizing
- ❒ F2380 Step Six: Take the Food Safety Challenge: Good Practices, Bad Practices – You Make the Call
- ❒ F2390 Supermarket Sanitation Program – Cleaning and Sanitizing
- ❒ F2391 Supermarket Sanitation Program: Food Safety
- ❒ F2410 Take Aim at Sanitation
- ❒ F2420 Understanding Foodborne Pathogens
- ❒ F2430 Wide World of Food Service Brushes
- ❒ F2440 Your Health in Our Hands, Our Health in Yours
- ❒ F2450 Smart Sanitation: Principles and Practices for Effectively Cleaning Your Food Plant
- ❒ F2451 Cleaning and Sanitizing in Vegetable Processing Plants: Do It Well, Do It Safely!
- ❒ F2460 A Guide to Making Safe Smoked Fish
- ❒ F2500 A HACCP-based Plan Ensuring Food Safety in Retail Establishments
- ❒ F2501 Safer Processing of Sprouts
- ❒ F2502 Fast Track Restaurant Video Kit
- ❒ F2503 Tape 1 – Food Safety Essentials
- ❒ F2504 Tape 2 – Receiving and Storage
- ❒ F2505 Tape 3 – Service
- ❒ F2506 Tape 4 – Food Production
- ❒ F2600 Tape 5 – Warewashing
- Worker Health and Hygiene Program for the Produce Industry
- Manager Guide to Worker Health and Hygiene: Your Company's Success May Depend on It!
- Worker Health and Hygiene: Your Job Depends on It!
- Food Industry Security Awareness: The first Line of Defense

OTHER

- ❒ M4010 Diet, Nutrition and Cancer
- ❒ M4020 Eating Defensively: Food Safety Advice for Persons with AIDS
- ❒ M4030 Ice: The Forgotten Food
- ❒ M4050 Personal Hygiene and Sanitation for Food Processing Employees
- ❒ M4060 Psychiatric Aspects of Product Tampering
- ❒ M4070 Tampering: The Issue Examined
- ❒ M4071 Understanding Nutritional Labeling: Processing Employees

Visit our Web site at www.foodprotection.org for detailed tape descriptions.

BOOKLET ORDER FORM

SHIP TO:

Member # _____

First Name _____ M.I. ____ Last Name _____

Company _____ Job Title _____

Mailing Address _____

Please specify: ☐ Home ☐ Work

City _____ State or Province _____

Postal Code/Zip + 4 _____ Country _____

Telephone # _____ Fax # _____

E-Mail _____

BOOKLETS:

QUANTITY	DESCRIPTION	MEMBER OR GOV'T PRICE	NON-MEMBER PRICE	TOTAL
	Procedures to Investigate Waterborne Illness—2nd Edition	$12.00	$24.00	
	Procedures to Investigate Foodborne Illness—5th Edition	12.00	24.00	

SHIPPING AND HANDLING – $3.00 (US) $5.00 (Outside US) Each additional booklet $1.50 — Shipping/Handling

Multiple copies available at reduced prices.
Phone our office for pricing information on quantities of 25 or more. — Booklets Total

OTHER PUBLICATIONS:

QUANTITY	DESCRIPTION	MEMBER OR GOV'T PRICE	NON-MEMBER PRICE	TOTAL
	**JFP* Memory Stick – September 1966 through December 2000	$295.00	$325.00	
	*International Food Safety Icons and International Food Allergen Icons CD	25.00	25.00	
	Pocket Guide to Dairy Sanitation (minimum order of 10)	.75	1.50	
	Before Disaster Strikes…A Guide to Food Safety in the Home (minimum order of 10)	.75	1.50	
	Before Disaster Strikes…*Spanish language version* – (minimum order of 10)	.75	1.50	
	Food Safety at Temporary Events (minimum order of 10)	.75	1.50	
	Food Safety at Temporary Events – *Spanish language version* – (minimum order of 10)	.75	1.50	
	*Annual Meeting Abstract Book Supplement (year requested _____)	25.00	25.00	
	*IAFP History 1911-2000	25.00	25.00	

SHIPPING AND HANDLING – per 10 – $2.50 (US) $3.50 (Outside US) — Shipping/Handling

*Includes shipping and handling — Other Publications Total

TOTAL ORDER AMOUNT

Prices effective through August 31, 2008

PAYMENT:

Payment must be enclosed for order to be processed • US FUNDS on US BANK

☐ Check Enclosed ☐ Visa ☐ Mastercard ☐ American Express ☐ Discover

CREDIT CARD # _____

CARD ID #* _____ EXP. DATE _____

SIGNATURE _____

*Visa, Mastercard and Discover: See 3-digit Card ID number on the back of the card after account number.
American Express: See 4-digit, non-embossed number printed above your account number on the face of your card.

International Association for Food Protection®

4 EASY WAYS TO ORDER

PHONE	FAX	MAIL	WEB SITE
800.369.6337; 515.276.3344	515.276.8655	6200 Aurora Ave., Suite 200W Des Moines, IA 50322-2864, USA	www.foodprotection.org

MEMBERSHIP APPLICATION

Prefix (❑ Prof. ❑ Dr. ❑ Mr. ❑ Ms.)

First Name _____ M.I. ____ Last Name _____

Company _____ Job Title _____

Mailing Address _____

Please specify: ❑ Home ❑ Work

City _____ State or Province _____

Postal Code/Zip + 4 _____ Country _____

Telephone # _____ Fax # _____

E-Mail _____

❑ IAFP occasionally provides Members' addresses (excluding phone and E-mail) to vendors supplying products and services for the food safety industry. If you prefer NOT to be included in these lists, please check the box.

MEMBERSHIPS		US	Canada/Mexico	International
❑ **IAFP Membership** (Member dues are based on a 12-month period and includes the *IAFP Report*)		**$ 50.00**	**$ 50.00**	**$ 50.00**
Optional Benefits:				
❑ *Food Protection Trends*	Add	$ 60.00	$ 75.00	$ 90.00
❑ *Journal of Food Protection*	Add	$150.00	$170.00	$200.00
❑ *Journal of Food Protection* Online	Add	$ 36.00	$ 36.00	$ 36.00
❑ All Optional Benefits – ***BEST VALUE!***	Add	$200.00	$235.00	$280.00
❑ **Student Membership** (Full-time student verification required)		**$ 25.00**	**$ 25.00**	**$ 25.00**
Optional Benefits:				
❑ Student Membership with *FPT*	Add	$ 30.00	$ 45.00	$ 60.00
❑ Student Membership with *JFP*	Add	$ 75.00	$ 95.00	$125.00
❑ Student Membership with *JFP* Online	Add	$ 18.00	$ 18.00	$ 18.00
❑ All Optional Benefits – ***BEST VALUE!***	Add	$100.00	$135.00	$180.00

SUSTAINING MEMBERSHIPS

Recognition for your organization and many other benefits.

❑ **GOLD**	$5,000.00
❑ **SILVER**	$2,500.00
❑ **SUSTAINING**	$ 750.00

Contact the IAFP office for more information on the Sustaining Membership Program.

Payment must be enclosed for order to be processed • US FUNDS on US BANK

❑ Check Enclosed ❑ Visa ❑ Mastercard ❑ American Express ❑ Discover **TOTAL MEMBERSHIP PAYMENT $** _____

CREDIT CARD # _____

CARD ID #* _____ EXP. DATE _____

SIGNATURE _____

*Visa, Mastercard and Discover: See 3-digit Card ID number on the back of the card after account number.
American Express: See 4-digit, non-embossed number printed above your account number on the face of your card.

All prices include shipping and handling
Prices effective through August 31, 2008

International Association for Food Protection®

4 EASY WAYS TO JOIN

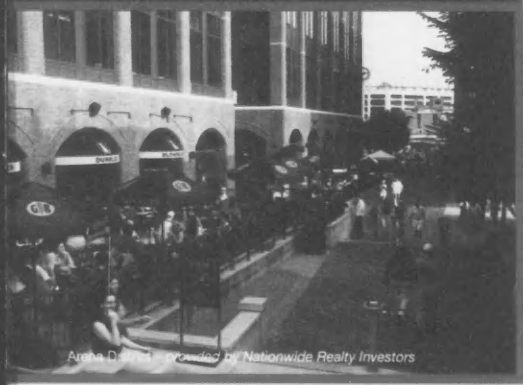
PHONE	FAX	MAIL	WEB SITE
800.369.6337; 515.276.3344	515.276.8655	6200 Aurora Ave., Suite 200W Des Moines, IA 50322-2864, USA	www.foodprotection.org

95th Annual Meeting

IAFP 2008

Columbus, Ohio • August 3–6

Columbus Skyline – photo by Rod Berry



Arena District – provided by Nationwide Realty Investors

Columbus Museum of Art – photo by Randall Lee Sh

German Village Oktoberfest – photo by Carol Schar/provided by the German Village Society

IAFP 2008

August 3–6

Hyatt Regency Columbus
Columbus, Ohio

One Destination.
Global Connections.

Be the creative force in your profession. Get ahead and stay ahead with three days of insightful presentations, challenging discussions, and networking with the world's leaders in food safety research and technology.

Explore, Participate, Exhibit!

Visit our Web site at
www.foodprotection.org

International Association for Food Protection®

World's Leading Food Safety Conference

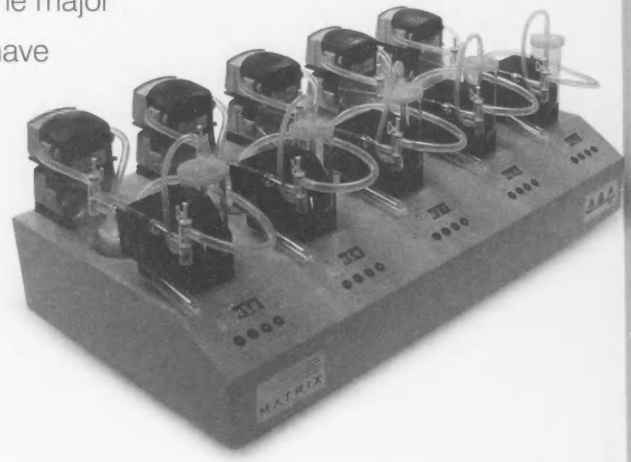
CURRENT PCR USER?
OR WANT TO BE A PCR USER?
YOU CAN SAVE 60% OF COSTS IMMEDIATELY!

If you're an existing user of PCR or want to be, but just cannot afford it, Matrix has developed the perfect solution for you. The PATHATRIX-***ULTRA*** system is widely used and approved by multi-national companies.

Using the **AOAC approved** Pooling Strategy that Matrix has developed you can save up to **60% of your PCR testing** costs without compromising sensitivity at all!

In fact many customers have reported the **elimination of "false positives"** and **increased** specificity and sensitivity.

We have customers using a wide variety of PCR systems from all of the major manufacturers and have successfully delivered the benefits of PATHATRIX Pooling to all of them.



MATRIX
MICROSCIENCE

If you want to know more...
Contact us at:

sales@matrixmsci.com
US Tel: 303 277 9613
UK Tel: +44 1638 723110
www.matrixmsci.com