Alternative Methods to Pasteurization of Apple Cider

Consumer Perceptions of the Food Safety System

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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.

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.
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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
Catch a (micro) Wave

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. 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
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"The mission of the Association is to provide food safety professionals worldwide with a forum to exchange information on protecting the food supply.”
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Is your organization in pursuit of “Advancing Food Safety Worldwide”?

As a Sustaining Member of the International Association for Food Protection, your organization can help to ensure the safety of the world’s food supply.

Sustaining Membership
Sustaining Membership provides organizations and corporations the opportunity to ally themselves with the International Association for Food Protection 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 through the IAFP Foundation that might not otherwise be possible.

Organizations who lead the way in new technology and development join IAFP as Sustaining Members. Sustaining Members receive all the benefits of IAFP Membership, plus:
- Monthly listing of your organization in Food Protection Trends and Journal of Food Protection
- Discount on advertising
- Exhibit space discount at the Annual Meeting
- Organization name listed on the Association’s Web site
- Link to your organization’s Web site from the Association’s Web site
- Alliance with the International Association for Food Protection

Gold Sustaining Membership $5,000
- Designation of three individuals from within the organization to receive Memberships with full benefits
- $750 exhibit booth discount at the IAFP Annual Meeting
- $2,000 dedicated to speaker support for educational sessions at the Annual Meeting
- Company profile printed annually in Food Protection Trends

Silver Sustaining Membership $2,500
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- $500 exhibit booth discount at the IAFP Annual Meeting
- $1,000 dedicated to speaker support for educational sessions at the Annual Meeting

Sustaining Membership $750
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- $300 exhibit booth discount at the IAFP Annual Meeting
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 Wegmans Food Markets, Inc., Rochester, NY; 585.429.3623

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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 Rachel 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.
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!

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

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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).
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 85 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. Lab 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 virucidal 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 Lu 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 proper- ies 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 CiderSure3500 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, 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 9,781 μJ/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). Yew-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-Grass 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 disinfections (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. Ulijas 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.

Ulijas 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 CO₂ on apple cider stored at 5°C inoculated with E. coli O157:H7. They found the addition of 1 and 4% CO₂ did not change the pH of the apple cider (initial pH was 3.65; after CO₂ addition pH was between 3.61 and 3.71). The combined effect of CO₂ and cinnamon does inhibit E. coli in apple cider, but not by 5-logs. Day 7 at 5°C with 4% CO₂ and 0.3% cinnamon resulted in the first non-detected levels of E. coli. The conclusion is that cinnamon and CO₂ 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 in 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). Peroxycetic 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 peroxycetic 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 (ClO₂) is a strong oxidizing and sanitizing agent that has broad and high biocidal effectiveness. The FDA now allows the use of ClO₂ 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 ClO₂ for 10 min at 90% relative humidity and 22°C. Du et al. (24) then investigated the reduction of E. coli using ClO₂, striving for a 3-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 ClO₂ 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 ClO₂ at 12.0 mg/l and a 3.8-log reduction when ClO₂ 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 ClO₂ 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 (H₂O₂) 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, H₂O₂ 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 H₂O₂ 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, H₂O₂ 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 variables were noted in regard to temperature. First, at both malic acid concentrations, 0.017% H₂O₂ 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% H₂O₂ + 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 H₂O₂ at levels of 0.017% or above is an effective antimicrobial for E. coli O157:H7.

A cause for concern in utilizing H₂O₂ as an antimicrobial agent is gas formation (foaming). Schurman (86) reported that at 0.015% H₂O₂, 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 H₂O₂ concentration. Samples at 40°C had very little gas production at 12 h, and none at 24 h (86).

**CONCLUSION**


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.

REFERENCES
50. lu, 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.
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The ARISTIDES DASKALOPOULOS Foundation

The ARISTIDES DASKALOPOULOS Foundation (IAD), an independent, nonprofit organization in Greece, within the framework of its aims, and aspiring to support young Greek researchers, is organizing the “2nd International Scientific Research Paper Competition on the subjects of: (A) Food Science and Technology – Food Safety and (B) Nutritional Science –Nutrition and Health”. Details of the competition may be found at www.iad.gr.
Consumer Perceptions of the Food Safety System: Implications for Food Safety Educators and Policy Makers

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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.

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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 responsibility of various food actors dedicated 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 Richmuller (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 ate 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 utilized. 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 received 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>
<thead>
<tr>
<th>Characteristics of survey respondents</th>
<th>% of survey respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meal preparation in household</td>
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</tr>
<tr>
<td>All</td>
<td>29.3</td>
</tr>
<tr>
<td>Most</td>
<td>30.3</td>
</tr>
<tr>
<td>Some</td>
<td>26.0</td>
</tr>
<tr>
<td>Hardly any</td>
<td>8.9</td>
</tr>
<tr>
<td>None at all</td>
<td>4.9</td>
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<tr>
<td>Food shopping in household</td>
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<tr>
<td>All</td>
<td>37.1</td>
</tr>
<tr>
<td>Most</td>
<td>24.2</td>
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<tr>
<td>Some</td>
<td>22.2</td>
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<tr>
<td>Hardly any</td>
<td>12.3</td>
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<tr>
<td>None at all</td>
<td>4.3</td>
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<tr>
<td>Someone in household allergic to foods</td>
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<td>Yes</td>
<td>24.8</td>
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<td>Child under age of 6 in household</td>
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<td>Yes</td>
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<tr>
<td>No</td>
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<tr>
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<td>Divorced/separated</td>
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<tr>
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<tr>
<td>Gender</td>
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<td>Female</td>
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</tr>
<tr>
<td>Male</td>
<td>45.5</td>
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<tr>
<td>Age</td>
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<td>45–54</td>
<td>17.5</td>
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<tr>
<td>55–64</td>
<td>11.9</td>
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<td>65 or older</td>
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<td>Race or ethnicity</td>
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<td>Hispanic</td>
<td>11.8</td>
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<tr>
<td>Other</td>
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TABLE 1. (continued) Characteristics and socio-demographic profile of survey respondents (n=1,014)

<table>
<thead>
<tr>
<th>Characteristics of survey respondents</th>
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<tbody>
<tr>
<td>Education</td>
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</tr>
<tr>
<td>Less than high school</td>
<td>6.3</td>
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<tr>
<td>High school graduate</td>
<td>37.4</td>
</tr>
<tr>
<td>Some college or associate degree</td>
<td>29.8</td>
</tr>
<tr>
<td>College degree or higher</td>
<td>25.5</td>
</tr>
<tr>
<td>Household annual income</td>
<td></td>
</tr>
<tr>
<td>Less than $20,000</td>
<td>11.9</td>
</tr>
<tr>
<td>$20,000-$39,999</td>
<td>19.6</td>
</tr>
<tr>
<td>$40,000-$59,999</td>
<td>22.5</td>
</tr>
<tr>
<td>$60,000 or greater</td>
<td>30.9</td>
</tr>
</tbody>
</table>

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


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

Age: In what year were you born?


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 $20,000 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 when shopping for foods. Those who described their ethnicity as "other," and those with household incomes less than $20,000 were less likely to think about food safety when shopping for foods.

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. 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-
<table>
<thead>
<tr>
<th>Variable</th>
<th>Every day/several times a week (%)</th>
<th>Once in a while/hardly ever/never (%)</th>
<th>Total (n)</th>
<th>Chi-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meal preparation in household</td>
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*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?

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*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 hospitalized 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 are 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...

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

*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?

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underestimated</td>
<td>47.5%</td>
</tr>
<tr>
<td>Correctly estimated (25%)</td>
<td>7.8%</td>
</tr>
<tr>
<td>Overestimated</td>
<td>33.6%</td>
</tr>
<tr>
<td>Did not know</td>
<td>10.7%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underestimated</td>
<td>0.6%</td>
</tr>
<tr>
<td>Correctly estimated (1%)</td>
<td>10.0%</td>
</tr>
<tr>
<td>Overestimated</td>
<td>78.7%</td>
</tr>
<tr>
<td>Did not know</td>
<td>9.7%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underestimated</td>
<td>4.9%</td>
</tr>
<tr>
<td>Correctly estimated (1%–2%)</td>
<td>33.3%</td>
</tr>
<tr>
<td>Overestimated</td>
<td>48.4%</td>
</tr>
<tr>
<td>Did not know</td>
<td>13.0%</td>
</tr>
</tbody>
</table>

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...

<table>
<thead>
<tr>
<th>Acceptability</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very acceptable</td>
<td>3.7%</td>
</tr>
<tr>
<td>Acceptable</td>
<td>21.1%</td>
</tr>
<tr>
<td>Neither acceptable nor unacceptable</td>
<td>0.4%</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>47.9%</td>
</tr>
<tr>
<td>Very unacceptable</td>
<td>25.6%</td>
</tr>
</tbody>
</table>

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...

<table>
<thead>
<tr>
<th>Acceptability</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very acceptable</td>
<td>3.0%</td>
</tr>
<tr>
<td>Acceptable</td>
<td>33.4%</td>
</tr>
<tr>
<td>Neither acceptable nor unacceptable</td>
<td>1.7%</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>41.6%</td>
</tr>
<tr>
<td>Very unacceptable</td>
<td>18.3%</td>
</tr>
</tbody>
</table>

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...

<table>
<thead>
<tr>
<th>Acceptability</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very acceptable</td>
<td>2.6%</td>
</tr>
<tr>
<td>Acceptable</td>
<td>26.9%</td>
</tr>
<tr>
<td>Neither acceptable nor unacceptable</td>
<td>0.3%</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>44.5%</td>
</tr>
<tr>
<td>Very unacceptable</td>
<td>23.6%</td>
</tr>
</tbody>
</table>

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.
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

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

*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 "food-borne 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 Tuomisto (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


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
- 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

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.
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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

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Gold Sustaining Member Profile

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.

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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.

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 Merial, no longer belonging to the family). In 1963, Alain Mérieux, grandson of Marcel, established the diagnostics company, 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.
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.
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 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 gláceau, 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.
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!
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 jump-start 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.
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, doorwaysanitizing 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.
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.
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.

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.

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.
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).
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.
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, lain Ogden and Norval Strachan, look forward to welcoming you to Aberdeen in 2008!

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
bioMerieux
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

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<th>MARYLAND</th>
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<td>Zerlinde Johnson</td>
<td>Nadia O. Melnyk</td>
<td>Tammy M. Platt</td>
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<td>AOAC Research Institute</td>
<td>Rich Products Corporation</td>
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<td>Deborah McKenzie</td>
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<td>Heather R. Totty</td>
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<td>Erin R. Brown</td>
<td>Margaret L. Khaisa</td>
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<td>Ecolab</td>
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<td>Eagan</td>
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<td>Cari Dufner</td>
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<td>A. Reum Han</td>
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<td>Cargill Kitchen Solutions</td>
<td>Oklahoma State University</td>
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<td>Stillwater</td>
<td>Pullman</td>
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<td>Susan Frye</td>
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<td>Ann Carrarah</td>
<td>P. Brett Kenney</td>
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<td>West Virginia University</td>
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<td>Karen M. Silbernapel</td>
<td>West Chester</td>
<td>Morgantown</td>
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<td>AOAC Research Institute</td>
<td>Mei Lok</td>
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<td>Woodbury</td>
<td>Pennsylvania State University</td>
<td>Lea L. Zeitlin</td>
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<td>Beth Volk</td>
<td>University Park</td>
<td>Wyoming Dept. of Agriculture</td>
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<td>Julie Yang</td>
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## NEW SUSTAINING MEMBER

Mol Industries
Barry Whitman
Grand Rapids, Michigan
Siller, Inc. Announces Promotions

Siller, 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.
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 Filologia y Geografia 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.
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.
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 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 (Glaucosa sp., Colpoda steini, and Acanthamoeba palestinensis) as well as the soilborne 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 Glaucosa 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. steini 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.
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” x 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, autotuning 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.

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-Object (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.
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, 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, 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 x 20 mm; the Z scanning range is 17 mm with 1 μ 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
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).
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).
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

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? — The New Relationship between Antimicrobials and the Microbiome
S23 The Emerging Microbiology of Food Poisoning: 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
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 prestigious 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.
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](http://www.foodprotection.org)

**EXHIBIT HOURS**

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<tr>
<td>Tuesday, August 5</td>
<td>10:00 a.m. – 6:00 p.m.</td>
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**HOTEL INFORMATION**

Hotel reservations can be made online at [www.foodprotection.org](http://www.foodprotection.org).

The IAFP Annual Meeting Sessions, Exhibits and Events will take place or depart from the Hyatt Regency Columbus. 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 1, 2008. Event and extra tickets purchased are nonrefundable.
**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.

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**

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<td>Registration</td>
<td>$415 ($465 late)</td>
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<tr>
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<tr>
<td>Children 14 &amp; Under (Names):</td>
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<tr>
<td>Additional Awards Banquet Ticket — Wednesday, 8/6</td>
<td>$50 ($60 late)</td>
<td>$50 ($60 late)</td>
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<td>Student Luncheon — Sunday, 8/3</td>
<td>$10 ($15 late)</td>
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**GOLF TOURNAMENT**

Golf Club of Dublin, Saturday, 8/2

$140 ($150 late)

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**WORKSHOPS — PRE-MEETING**

Better Process Cheese Control School

$575 ($650 late)

The Art of Fungal Characterization and Identification: A Hands-on Workshop

$620 ($695 late)

Hands-on Workshop on Microbial Risk Assessment Modeling and Interpretation

$270 ($345 late)

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<td>$270 ($345 late)</td>
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**ABSTRACTS**

Annual Meeting Abstracts (citable publication to be mailed Oct. 1)

$25

TOTAL AMOUNT ENCLOSED $  

Refunds subject to cancellation policy

JOIN TODAY AND SAVE!!!

(Attach a completed Membership application)

EXHIBITORS DO NOT USE THIS FORM

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

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

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)

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

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- 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.
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

- 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.asi.org.
- 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, NewYork 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.aacccnet.org.
- 21–24, 122nd AOAC International Annual Meeting, Dallas Texas. For more information, go to www.aoc.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 39.050.22 13644 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


- **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.

- **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 ILI! Europe International Symposium on Food Packaging, Prague, Czech Republic. For more information, call 32.2.771.00.14 or go to http://europe.ils.org/events/upcoming/4thfoodpkg.htm.

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**Vol. 71**

**May 2008**

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- ERRATA

In the article “Comparative Effect of Direct-Fed Microbials on Fecal Shedding of Escherichia coli O157:H7 and Salm. novella 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 strain Lactobacillus acidophilus (LA 51) and Propionibacterium freudenreichii (PF 24) were quoted in error. The correct probiotic strain used in the study was Lactobacillus acidophilus (LA 51).

In the article “Modification of the Submerged Coll Coil To Prevent Micronutrient Carryover Error in Thermal Death Studies” by S. E. Keller,* D. I. Bhain, D. D. Bains, S. Chord, N. Anderson, and I. Laekin that appears in the *Journal of Food Protection* 71(4):775-780, in row 1, last column of Table 1, the b-value of 1.8 has been deleted from the text and should be restated as 1.5 ± 0.8.

*Authors indicate author for correspondence.

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