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Food Protection Trends

Science and News from the International Association for Food Protection

The Role of Pallets in Microbial Food Safety

Safe Endpoint Temperature for Cooking Whole Raw Poultry: Health Canada Recommendation

Dry Heat Thermal Inactivation of *Listeria innocua* on Deli Slicer Components

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SCIENCE AND NEWS FROM THE INTERNATIONAL ASSOCIATION FOR FOOD PROTECTION

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

[2] Stern, N.J., B. Wojton, and K. Kwiatek. 1992. A differential-selective medium and dry ice-generated atmosphere for recovery of *Campylobacter jejuni*. J. Food Protect. 55:514-517.

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"REFLECTIONS" OF YOUR PRESIDENT

By LEE-ANN JAYKUS
PRESIDENT

"Our meeting continues to be The Key Food Safety Meeting"

Wow! What an incredible meeting! Not only did IAFP 2010 break all records (total attendance, number of exhibitors, diversity of sessions), our Annual Meeting continues to be "...THE KEY FOOD SAFETY MEETING at which to be seen, be heard and share information." (Elliot Ryser, Michigan State University.) Over the last several weeks, I have had the opportunity to digest comments from many IAFP 2010 attendees. Today, I would like to share with you some common themes.

Quality and Diversity of the Program. The depth and breadth of the Annual Meeting's scientific program never ceases to amaze. This year, the program included many topics of immediate importance to food microbiologists (e.g., risks associated with low water activity foods, traceability, non-O157 STEC) as well as old favorites (Jack Guzewich's annual foodborne disease outbreak update comes to mind). As stated by Manan Sharma of the USDA-Agricultural Research Service, "...I was so impressed with the diversity of topics that were addressed at the meeting. Food safety now encompasses everything from environmental microbiology to optimizing computer networks and data organization. The range of topics covered is scientifically diverse."

Quality and Relevance of Exhibits. I have to agree with Mary Lou Tortorello, U.S. FDA-National Center for Food Safety and Technology, who commented on the quality of this year's exhibits. The exhibitors were approachable and enthusiastic, and their interactions with attendees the same. As was the case for the program, the diversity of exhibits was vast, ranging from publishing houses, analytical service laboratories, diagnostic and testing kit/equipment manufacturers, food safety consultants, and food safety equipment suppliers, to name a few. According to Adrian Parton of MATRIX MicroScience, Ltd., "If I was forced to pick only one conference and exhibition to attend, the IAFP Annual Meeting would be my automatic choice, as the quality and relevance of the people that attend this meeting is second to none. It's a great opportunity to meet customers and industry experts in one forum, and my only issue is that it seems to be over so quickly!"

Opportunities for Networking. There are so many opportunities to meet and greet colleagues at Annual Meeting. I am constantly amazed at the broad representation (government, industry and academics), high degree of knowledge, and general approachability of IAFP Annual Meeting attendees. Those of us who are "old timers" get to catch up with one another, although we never do get the chance to catch up with everyone on our list! Exciting, new projects frequently arise from these interactions, as do new collaborations. Graduate students and young professionals get an opportunity to meet and talk with us older folks who have been around the block a time or two. To quote Judy Greig of the Public Health Agency of Canada, "I remember my first (IAFP) meeting back in 2000 – I told my friends 'It is like the Hollywood of microbiology!' Now I enjoy meeting those 'stars' from year to year...The professional connections made at IAFP have been invaluable to my career."

Friendships. Many of those networking opportunities have given rise to long and fulfilling friendships. As was so wonderfully stated by Warren S. Clark, Jr., International Dairy Foods consultant (retired), "As a long-time (50 year) member of IAFP (and its alias'), I am pleased to say that I saw far more enthusiasm at the 2010 meeting than at any previous meeting I attended. In addition to providing input and gaining information, ... I would be remiss in not admitting my personal enjoyment in having the opportunity to see and visit with old friends in what many times is a one-time-a-year opportunity!"

International Scope. Our Annual Meeting is becoming more international in scope with an increasing number of attendees from outside North America. This year, we welcomed the Chinese Association for Food Protection in North America, our newest international affiliate. Others are moving forward in their organizational efforts. As Bobby Krishna from the Dubai Municipality shared, "This year's Annual Meeting had many sessions that specifically addressed the food safety issues in the lesser developed countries of the world that lack scientific and economic resources required to ensure safety of food produced in their country. The food industry and the governments of developing countries can make full use of the outcomes of the meeting in their efforts to improve their food control system."

Highlights. There was resounding agreement that the highlight of this year's Annual Meeting was our distinguished speakers, who could not have given more different presentations. Michael Taylor's (Deputy Commissioner for Foods, U.S.-FDA) delivery of the Ivan Parkin Lecture focused on the need to modernize food safety in the U.S. toward a prevention-oriented, science and risk-based system that embraces the farm-to-table concept and holds imports to the same high standards faced by domestically produced products. Mr. Taylor discussed some of the challenges facing his agency and his ideas for moving forward to build an improved, sustainable food safety system into the future.

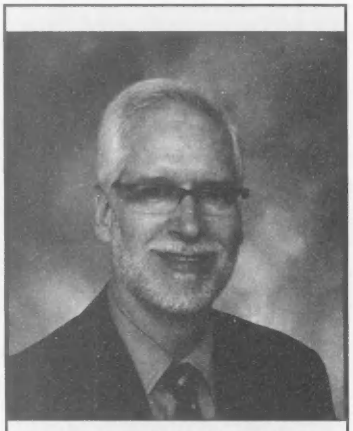
On the other hand, Bob Buchanan's (University of Maryland) delivery of the John H. Silliker Lecture focused on thinking outside the box. As stated by Manan Sharma, "The notion that we sometimes need to take a different perspective in studying food microbiology resonated with me. It's a reminder that looking at things from outside your comfort zone can be enlightening." Clearly, Bob did ask us to look outside our comfort zones. In fact, he presented a very interesting emerging pathogen, but I didn't quite get whether it was a Gram positive or Gram negative? I guess Dr. Buchanan will have to present more on its phenotypic characteristics next year!

Concluding Remarks. Perhaps the success of IAFP 2010 is best summed up by Dr. Vic Uzumeri, president of Interactive Point of View, a first time exhibitor and attendee. To quote: "I have been to lots of conferences and the IAFP event is one of the most enjoyable I have attended. I can't quite put my finger on it, but there was a level of passion, professionalism, and diversity that I haven't seen previously. Perhaps, it is just that I was a newbie, but I saw a lot of people come together, from a wide range of organizations, to talk about really important issues. There was a synthesis of industry, academia and government that ought to typify all industries—but very seldom does. There was also a level of mutual respect among the participants that was refreshing." Or how about the comments of Margaret Hardin of IEH Laboratories and Consulting: "The overall impression of the meeting was how well it was attended and how much we have grown as a respected scientific organization and yet still maintain that 'small town' feel of close comradeship and friendship."

We are indeed blessed to be part of such an amazing professional association. However, we cannot lose sight of the fact that IAFP's Annual Meeting does not occur without A LOT of support behind the scenes. From the PDGs and individuals who organized symposia, to the Program Committee who put it all together, and including the Local Arrangements Committee (the tie-died aprons were great, guys!), hats off to all. And more importantly, let's not forget the incredible IAFP staff. IAFP is your organization, and it's mine, too. But it is the collective efforts of all of us that make it "our" food safety association.

So, another Annual Meeting has come and gone. What did you take home from IAFP 2010? For those of you who attended, it was great to see you and catch up (sorry, I did not manage to catch up with everyone; it was a pretty busy meeting for me!). For those of you who missed this year's festivities, there's always next year (Milwaukee and the 100 year celebration). To use the words of Maria Teresa Destro (University of São Paulo), "food geeks" unite! Let's keep in touch over the course of the year until we come together again in August, 2011.

"COMMENTARY" FROM THE EXECUTIVE DIRECTOR



By DAVID W. THARP, CAE
EXECUTIVE DIRECTOR

"Our goal is to make the IAFP Annual Meeting the best organized meeting you'll ever attend"

Last month I told about IAFP 2010 and our expectations for a magnificent meeting and turnout. We are pleased to report that there were more than 2,170 people in attendance along with 154 booths in the Exhibit Hall this year in Anaheim. In addition, the program content was outstanding as is supported by our survey comments.

We were truly surprised by the overall, up-swing in attendance over one year ago in Texas. An increase of more than 400, accounting for more than a 23% gain in attendance is simply incredible. We had expected to exceed 1,900 and hoped to reach 2,000; but to blow past those numbers to a new record high was never anticipated. Well, I should say it was never expected until one-week prior to the commencement of the meeting. At that time, we had close to 2,000 already registered and many times we have more than 200 people register onsite.

With the unexpected increase in attendance, we experienced more than our share of challenging situations. There were a number of issues I want to report on, but I do so not to dwell on the negative, but to let you know that we are fully aware such complications existed. The registration system used for IAFP 2010 was new to our staff and as is the case with anything new, there are always obstacles to overcome. We had problems when printing badges and with our onsite pick up of materials for those pre-registered; therefore, our lines grew much too long for what we normally like to see.

As many people pointed out, the name and information on the badges were printed in too small of font to be easily read. To be truthful, we were happy to have the information printed on a badge for all the challenges we had prior to arriving in Anaheim! But, we do understand this concern and will have everything in better shape for next year. The new registration system also required entry of each attendee's first name and last name; exactly as it was entered in the registration system. This means "Mike Smith" would not be found if the registration was completed for "Michael Smith." This complication helped lead to our long lines at registration. Of course, this is a ridiculous requirement as a search of either a first or last name should be possible.

Because of the unexpected increase in attendance, we even ran out of bags containing our registration materials before we ran out of attendees. As I mentioned, we expected between 1,900 and 2,000 people to attend and actually had 200 in excess of this number. Our orders for program materials must be placed two months in advance of the meeting and at that time our numbers were tracking with our expectations. In the end, we did have enough program books for everyone, but not the bags to carry them in. For that, we apologize to those who did not receive a complete package of materials including the conference bag.

There were a number of times when coffee was served during the conference and it was difficult (or impossible) for attendees to get a cup of coffee. A few things contributed to this problem: (1) more attendees than anticipated, (2) fewer coffee stations than were needed, (3) a misunderstanding by the convention center on our coffee order for breaks. The first two are evident as to how to "fix" for next year. Number three can use some additional description. We instructed the convention center to put out a certain amount of coffee to start the break and to add to the initial quantity through a certain, specified time when the coffee break would then end. They misunderstood the "refill" instruction to mean they had to have approval before refilling the coffee. Then, to further complicate the issue, the coffee had to come from the other end of the convention center and took between 30 and 45

minutes to get to our exhibit hall – unbelievable! Even after discussing this with banquet captains, the second day did not go any smoother.

In addition, the food served in the convention center was sub-par, to say the least. The quality and taste was not what we would expect, especially for the price charged. Many of our survey comments were critical of the food service at the convention center. This issue is surely a hit or miss for us since our meeting changes location each year. We will hope for a better result on the exhibit hall lunches served next year.

We also received survey comments about the overlap of presentations, overlap of PDG meetings, the inability to get to sessions, posters and the exhibit hall all at the same time and in general, the hectic schedule created by so much on the Annual Meeting program. This is a problem that cannot be overcome when you bring together so many dedicated food safety professionals who are passionate about what they do each day and when they want to share their experiences with each and every attendee at the meeting! We have accommodated a large growth in not only attendance, but sessions too over the years.

Even with these pitfalls, the IAFP Annual Meeting was still a great success! As I said to begin with, I did not want to dwell on the negative; but I did want you to know that we are keenly aware there are problems to work on and issues to overcome. Each and every year, we come away from the Annual Meeting with a long list of items to work on for the following year. Our goal is to make the IAFP Annual Meeting the best organized meeting you'll ever attend. We strive to make it the best experience for each and every attendee that comes. We hope you understand that we operate at the mercy of our suppliers and facility operators. Most of the time these suppliers and operators help to make our meeting a great success. Sometimes, we have a hick-up and it shows. We can only learn from these circumstances and endeavor to do better next time.

With our 100-Year Anniversary coming at IAFP 2011, we will be working to keep all of our operations polished and smooth running. We hope you will plan now to be with us next year in Milwaukee!

ARTICLES

Food Protection Trends, Vol. 30, No. 10, Pages 576–579

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International Association for Food Protection

The Role of Pallets in Microbial Food Safety

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ABSTRACT

Pallets play an important role in food transportation but are seldom in direct contact with food and are not intended to be used in contact with food. We have surveyed information relevant to the possible influence of wood versus plastic pallets on food safety. Wood absorbs bacteria, which cannot later be recovered alive at its surface. Bacteria do not penetrate below the surface of new plastic and can be transferred to other surfaces. Scars on used plastic tend to harbor bacteria, which persist in a viable state. The choice of wood versus plastic pallets seems likely to have only a slight effect on food safety, but bacteria appear to be less easily transferred from wood than from plastic.

INTRODUCTION

Unintentional transfer of microbes from one surface to another is a means of spreading foodborne disease. The physical interactions between bacteria and a given material will influence the degree to which the microbes can be transferred from that material. Growth potential of the bacteria while attached and ease of removal are relevant factors in the consideration of cross contamination. Also important are the environments and processes to which the material and microbes are subjected during the period of physical interaction.

Pallets are characterized as tertiary packaging for purposes of food conveyance. Pallets come into contact either with packaging that contains food or with packaging that contains packages of food. In either case, pallets are often exposed to environments that are less sanitary than areas where food is packaged and prepared. It would be impractical, if not impossible, to maintain sterility while pallets are being used in every segment of the food supply chain, such as in transit in trucks and trailers. Therefore, the transferability properties of microbes from pallet construction materials are of interest.

Wood and plastic (polyethylene or polypropylene) are the two most widely used materials for pallet construction. Wood is by far the more common of the two and therefore has a longer record of safety in transport of food products. Although plastic has not been used as widely as wood, nestable plastic pallets have been popular in the grocery industry for over two decades. Recent publicity highlighting contamination of wooden pallets when used in unsanitary environments seems to imply that wood as a pallet construction material somehow exacerbates the risk of cross contamination. The possibility that a plastic pallet handled under unsanitary conditions will be safer than wood under the same conditions needs to be considered. A review of the existing scientific literature on the subject does not support this supposition.

The few studies that have directly compared wood and plastic in their potential for harboring and transferring bacteria have led to the conclusion that little practical difference exists, but if there is a difference, wood is less likely to serve as an inadvertent transfer medium *(6)*.

1. The number of bacteria that are recoverable from wood surfaces decreases within minutes of inoculation *(3)*. Bacterial colonies stay on the surface of plastic and actually grow if there is a sufficient supply of nutrients *(10)*.

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TABLE 1. Recoveries (Relative Light Units) of *E. coli* from cutting board surfaces washed 60 min after inoculation *(10)*

Comparison	Material	*E. coli* recovered[1]
Among wood species	Birch	2,753
	Maple	2,863
	Oak	1,785
Among plastics	Foamed polypropylene	7,605
	High-density polyethylene	4,621
	Polystyrene	3,117
Wood versus plastic	Maple	3,200
	High-density polyethylene	2,277
	Foamed polypropylene	5,315

Data are averages of triplicate samples from one trial. Number of cells applied, (1.0×10^6 CFU, or 5.0×10^4 RLU). Std. Error: ± 5%

2. When they penetrate into a wood matrix, bacteria do not grow, but rather die in a matter of hours *(10)*. The hygroscopic nature of wood, as well as the presence of secondary metabolites (tannins, lignin, flavonoids and, in the case of the pine family, terpenoids) directly inhibits the growth of bacteria *(11)*.
3. Bacteria within a lacunar network of scraped and gouged plastic do multiply *(10)*; the inevitable crevices on the surface of a used plastic pallet could well act as miniature havens for bacterial culture.
4. Ground wood powder or shavings has been shown to inhibit bacterial growth; ground plastic powder did not *(10, 11)*.
5. Pine wood has a significantly greater inhibitory effect than other wood species tested *(11)*.
6. The overall message from published literature reviews is that there is no advantage of plastic over wood in regard to food safety *(5)*; if there is a difference, wood is safer than plastic.

RECOVERY

Direct comparisons between several types of used wood and plastic cutting boards *(10)* showed that after washing with detergent, recovery of *E. coli* was slightly higher from plastic than from wood (Table 1). Blocks were washed with detergent 60 min after inoculation; levels of live bacteria in swab samples were measured by ATP bioluminescence, using a *GEM Biomedicals* BG-P Optocomp 1 luminometer (Hamden, CT) and *GEM Biomedicals* ATP Surface Hygiene Monitoring Kit (Sparks, NV).

In another set of experiments, carving knives were used in their normal cutting function, to determine whether bacteria beneath the surface could be recovered in this way (Table 2). Some of the inoculated block surfaces had been washed before recovery was attempted. Ak *(2, 3)* and her colleagues found that following inoculation of bacteria onto wood surfaces, recoverability of the microbes decreased significantly over the course of 3 to 60 min. During these experiments, bacteria were found inside the wood but did not multiply, and they were affected by an apparent antibacterial action of the wood, common to all of the species tested. This result was basically the same for new and used wood. However, scratches and grooves in used plastic cutting boards tended to harbor microbes even after washing.

Schönwälder *(11)* examined survival of *Escherichia coli* and *Enterococcus faecium* on wood of several tree species and on polyethylene. Using agar contact plates placed on the test surfaces at various times after inoculation, they found a significant difference in bacterial recoveries from wood versus plastic. The number of recoverable bacteria decreased over time on both surfaces, but the decrease was faster on wood. Pine was the fastest, followed by beech, and finally plastic.

In a second set of experiments, wooden blocks were submerged for 15 min in bacterial suspensions. The inoculum was absorbed to different degrees by the different types of wood. When the blocks were cut and inner surfaces tested, it was found that the inner portions of pine reduced viability of the bacteria. After 7–8 h, no bacteria could be cultured from the inner surfaces of unwashed pine blocks. From blocks of beech and poplar, levels of bacteria could be cultured over a 24-h period.

In a third set of experiments, the effect of wood age was tested with boards taken from pallets used since 1987, 1994, and 1996. The bacterial reduction effect over time was consistent and independent of wood age.

The authors attributed the antibacterial properties of wood to two factors: First, the hygroscopic nature of dried wood lowered the amount of moisture available to the bacteria. Second, the fact that bacterial recovery from pine was lower than from beech, poplar, or spruce was interpreted as being due to tannins, which are natural wood preservatives.

TABLE 2. *E. coli* recovered (Relative Light Units) from knife edges after cutting into used boards that had been washed, or not, 60 min after inoculation[1] *(10)*

Board material	Unwashed	Washed
Maple	476	368
High-density polyethylene	7,896	555
Foamed polypropylene	9,625	2,433

[1]*E. coli* levels on used maple and plastic cutting boards inoculated with 10^6 CFU/25 cm^2, dried, sampled on knife edges before or after washing.

REVIEW OF RELEVANT STUDIES

A bibliographical review of the subject by Carpentier *(5)* notes the variability in techniques used among studies and the inconsistent consideration of factors such as types of wood used, times between inoculation and evaluation, orientation of wood fibers, humidity levels, and surface state of wood. He concludes by stating that he has not found "in the existing literature, any real demonstration of the superiority of plastic."

Tests with ground beef

Aged ground beef patties were used by Miller et al. *(9)* to contaminate wood and plastic cutting boards. Patties were held in contact with cutting board material for up to 90 minutes at room temperature. Attachment and removal of beef bacteria on polyethylene and wooden cutting boards were statistically indistinguishable.

Miller et al. *(9)* did find that aqueous extracts of white ash dramatically inhibited recovery of *E. coli*. Slight inhibition of growth was observed from extracts of black cherry and red oak. Pine was not tested in this study. The key point made in this study was that regardless of the surface material, cutting boards need to be constantly maintained and monitored for cleanliness.

Tests with fluorescent powder

Snyder *(12)* compared adsorption of fluorescent powder onto used wood and plastic boards. The powder particles were 5 µm, approximately the size of bacteria. The powder was applied in an oil suspension and spread with a paper towel. After application of the powder, the boards were washed with Dawn® detergent and scrubbed with a brush under flowing 100°F water.

After the boards were washed and dried, the accumulation of fluorescent material was much greater on the polyethylene cutting board than on any of the wooden boards. The non-hygroscopic nature of the polyethylene and the absence of tannins or other antimicrobial compounds would allow bacteria within these grooves to attach and multiply.

SUMMARY

Approximately 1.9 billion pallets are used daily in the United States, and about 90 to 95% of those pallets are made of wood *(8)*. Of those wooden pallets, about 40% are used to ship food items, including dry groceries, dairy, frozen foods, and fresh fruit and vegetables. The large number of food/package/platform interactions that take place without incident attests to the general safety of the materials and processes of production and distribution. Nevertheless, any reasonable opportunity to reduce the potential for foodborne illness should be considered.

Food processors and distributors need to be vigilant in maintaining effective sanitation practices. Poor hygiene is unacceptable when working with primary food packaging, secondary containers, or tertiary platforms.

The potential increase in plastic pallet use in the food industry may seem to some as an opportunity for more hygienic distribution. Until 1994, comparisons between wood and plastic for bacterial retention and transmission were generally interpreted as favoring plastics *(1, 4, 7)*. More recent scientific findings, however, suggest the opposite interpretation. Bacteria are able to grow on plastic surfaces and subsequently be transferred to other surfaces. The evidence shows that bacteria are less likely to grow on wood surfaces and that they are less easily transferred from wood. The apparent conclusion is that if a hazard exists, the hazard is from plastic pallets.

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Safe Endpoint Temperature for Cooking Whole Raw Poultry: Health Canada Recommendation

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ABSTRACT

Poultry is a known carrier of *Salmonella*. However, it can be safely consumed when cooked to an appropriate internal temperature. The United States Department of Agriculture and some Canadian provinces recommend 74°C, whereas Health Canada currently recommends 85°C, as a safe internal temperature for cooking raw whole poultry, a difference that can potentially create consumer confusion. To address this, Health Canada evaluated three studies recently performed in Canada to examine the survival of *Salmonella* in raw inoculated whole poultry (stuffed and unstuffed whole chicken and turkey), at six different endpoint temperatures. It was found that 82°C was a safe endpoint cooking temperature for whole unstuffed and stuffed poultry. The studies found that variability exists between and within ovens, and that shorter cooking times typically resulted in positive *Salmonella* tests in poultry. The thickest part of the breast was determined to be the optimum location for temperature measurement, as it was the last to reach the desired endpoint temperature. Thigh readings were often inaccurate and difficult to perform. As a result of the evaluation of these studies, Health Canada will likely be recommending changing its endpoint temperature recommendation for raw whole poultry to 82°C, as measured in the thickest part of the breast.

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INTRODUCTION

Each year in Canada, approximately 6,000 cases of salmonellosis are reported to health authorities *(9)*. This number represents only a fraction of the actual salmonellosis cases, as the disease is often mistaken for stomach flu because of the similarity of symptoms, including vomiting, diarrhea and abdominal cramping. For every reported case of salmonellosis, it is believed that up to 37 cases go unreported *(21)*. *Salmonella* infections can be severe, especially in young children, the elderly and people with an impaired immune system, and in some cases they may require immediate hospitalization. Poultry are major carriers of *Salmonella*, and consequently contaminated poultry products are frequently associated with *Salmonella* infections *(9)*. A recent Canadian study examining human illness attribution as related to historical foodborne outbreak data sets found that between 14 and 23% of foodborne salmonellosis outbreaks could be attributed to poultry *(18)*.

Because of these public health concerns, various studies and surveillance programs throughout the world have evaluated the incidence of *Salmonella* contamination in poultry. In 2006, the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) found *Salmonella* in about 13% of the retail chicken samples analyzed *(8)*. A similar frequency was observed in 2002–2006 in the United States (US), where the National Antimicrobial Resistance Monitoring System (NARMS) isolated *Salmonella* from about 11.5% of retail chicken samples *(15)*. While the incidence of *Salmonella* found in poultry is similar in Canada and the United States, incidence rates vary in other parts of the world. For example, a higher *Salmonella* incidence rate was reported in Vietnam, where the bacterium was isolated from about 48.9% of retail chicken *(12)*, while lower incidence rates, i.e., 3.1% and 4.9%, were reported in New Zealand and United Kingdom, respectively *(14, 24)*. Because of extensive control measures, Sweden and Denmark have virtually eliminated *Salmonella* contamination in their poultry products *(23)*.

Although the presence of *Salmonella* in poultry is relatively common, poultry can be safely consumed when it is cooked to a safe internal endpoint temperature. While there is general consensus between governments and industry that an internal temperature of 74°C *(4, 10, 22)* is sufficient to inactivate *Salmonella* in raw poultry parts (e.g., chicken breasts, chicken thighs), disagreement remains as to what constitutes a safe endpoint temperature when cooking whole stuffed and unstuffed raw poultry. In Canada, for the past 25 years, Health Canada (HC) has recommended that an internal temperature of 85°C, measured in the thickest part of the breast or thigh muscle, not touching the bone *(10)*, would be sufficient to inactivate any *Salmonella* present in raw whole stuffed and unstuffed poultry. However, other Canadian and international government organizations, as well as members of the poultry industry, have recommended different endpoint temperatures. For example, for the inactivation of *Salmonella*, the Canadian Turkey Marketing Agency (CTMA) has recommended 74°C for stuffing in turkeys, and 77°C in the breast and 82°C in the thigh for whole raw turkey *(3)*. In the USA, the National Chicken Council and U.S. Poultry and Egg Association recommend 82°C as a safe endpoint cooking temperature, while the United States Department of Agriculture (USDA) and the governments of the Canadian provinces of British Columbia and Alberta recommend the lower endpoint temperature of 74°C *(1, 2, 16, 22)*.

These differences in endpoint temperature recommendations can confuse consumers as to what truly constitutes a safe endpoint temperature for cooking raw whole poultry. To address these uncertainties, two Canadian poultry industry associations, the Chicken Farmers of Canada (CFC) and CTMA, performed *Salmonella* survival studies on poultry to try to add to the body of scientific evidence for what constitutes a safe endpoint cooking temperature. Subsequent to these studies, Health Canada commissioned an investigation to assess the validity of its current recommendation of 85°C. In each of the three studies, whole raw poultry (stuffed and/or whole chicken and/or turkey) was inoculated with various strains of *Salmonella*, which included commonly observed strains such as *S.* Typhimurium, as well as the less common but known heat-resistant strain of *S.* Senftenberg. The endpoint Celsius temperatures used in these studies were specifically chosen to be equivalent to the Fahrenheit temperatures used in various US recommendations. The temperatures of 73.9, 76.7, 79.4 and 82.2°C used in the Canadian studies are equivalent to 165, 170, 175 and 180°F, respectively.

In the current investigation, Health Canada's objective was to examine the results of these three independent studies and make a recommendation on the safe endpoint temperature for cooking raw whole poultry.

MATERIALS AND METHODS

Although commissioned by different organizations over a 13-year span, all of the studies were conducted by the same independent testing facility "Diversified Research Laboratories Limited," now "Silliker Canada Co.," in Markham, Canada. The studies were performed between 1994 and 2007 with a common purpose: to determine the safe endpoint cooking temperature for raw whole poultry.

Canadian Turkey Marketing Agency

A study was commissioned in 1994 by CTMA to determine a safe endpoint cooking temperature for raw stuffed and unstuffed whole turkey. In this study, whole turkeys separated into four weight classes, ranging in weight from 4 kg to 10 kg, were inoculated with *S.* Typhimurium NAL+ (Table 1). The skin was inoculated with the target inocula, which ranged from 10^3 to 10^4 CFU/cm^2 (Table 1). The stuffing was prepared as recommended by the manufacturer, using 1 part commercial dry stuffing to 1.5 parts water, so as to have the lowest moisture content to ensure a slow heat transfer and to mimic potential in-home cooking conditions. After preparation, the stuffing was subsequently inoculated with *S.* Typhimurium NAL+ at a concentration of 10^2 to 10^3 CFU/g (Table 1). The turkeys were cooked in one of four commercially available consumer type ovens to one of three specific endpoint temperatures, i.e., 76.7°C, 79.4°C and 82.2°C (Table 1). All treatments were repeated for each weight class in each oven. The endpoint temperature

TABLE 1. Summary of materials and methods for the three poultry studies analyzed in this review

Study	Inoculum	Inoculation	Cooking	Sampling	Birds in study	Final internal temperature tested
CTMA 1994	S. Typhimurium NAL+	Placed in an autoclave bag with inoculum for 5 min and then dried for 5 min Inoculation: 10^2 to 10^3 CFU/g in stuffing; 10^3 to 10^4 CFU/cm^2 on skin Inoculum not equilibrated overnight	Temperature measured in inner thigh Standing time 15 min after cooking	Skin samples taken from turkey sides; 1 from thigh 1 from breast 3 stuffing samples Followed modified HC procedure MFHPB-20	30 stuffed turkeys Weight class 4 kg, 5.5 kg 6.5 kg and and 10 kg	Stuffed turkeys cooked to: 76°C, 79.4°C 82°C
CFC 2000	S. Typhimurium (ATCC # 13311) S. Senftenberg (ATCC # 43845)	Injected 1/8" following a previously established protocol *(7)*; deep into thigh, wing breast, oyster at target 10^7 CFU/site Stuffing inoculated at 1.1×10^7 and 6.0×10^7 *Salmonella*/g chicken Chicken equilibrated at 4°C for 24 h (not the stuffing)	Temperature measured in thigh, wing, breast, and oyster but away from inoculation site Waited until all probes reached the desired end-point temp Allowed to stand for 15 min At least 5 chickens tested at each temperature	Followed modified HC procedures MFHPB-20 and MFLP-49 (replaced by MFHPB-24, 2001)	25 unstuffed whole chickens 20 stuffed chickens Weight approx. 2 kg	Stuffed and whole chickens cooked to 73.9°C, 76.7°C, 79.4°C and 82.2°C
HC 2003–2007	S. Typhimurium PT104 S. Heidelberg S. Enteritidis PT4 S. Senftenberg 775W	Target inoculum of 10^7 CFU was swabbed on the chicken Chicken equilibrated for 24 h at 4°C	2 probes/breast 1 probe/thigh 1 probe/in oven 1 probe/in roasting pan Waited until all probes reached desired end point temperature Allowed to stand for 10 min; chicken tested in triplicate	Carcass rinse and enrichment of chickens Followed modified HC procedure MFHPB-20	54 whole unstuffed chickens Weight approx. 1.5 kg	73.9°C, 76.7°C 79.4°C, 82.2°C 85°C, 87°C

TABLE 2. Canadian Turkey Marketing Agency's study of *Salmonella* spp. survival from stuffed raw whole turkeys of four different weight classes cooked to three different endpoint temperatures

	Temperatures tested		
CTMA	76.7°C	79.4°C	82.2°C
Stuffed Turkeys	3/12[a,b]	3/8[a,b]	0/10[a]

[a]Total number of *Salmonella*-positive turkeys out of total number of turkeys tested.

[b]*Salmonella* isolated from turkeys at 76.7 and 79.4°C were isolated only from the stuffing.

was recorded at the inner thigh muscle close to the hip joint of the turkey. After the required endpoint temperature was reached in the thigh muscle, the cooked turkey was subjected to a hold time of 15 min before sampling for *Salmonella*. Two skin samples, one from the breast and one from the thigh, consisting of an area of 10 cm^2 and, where applicable, three stuffing samples of undetermined weight from different points of the turkey cavity, were tested for the presence/absence of *Salmonella*, using a modified Health Canada method MFHPB-20 *(19)*.

Chicken Farmers of Canada

The CFC study performed between 1999 and 2000 examined safe endpoint temperatures for raw whole unstuffed and stuffed broiler chickens weighing between 1.5 and 2 kg. A cocktail of *S.* Typhimurium (ATCC #13311) and *S.* Senftenberg (ATCC #43845) was used to inoculate whole broilers. The target inoculum was 10^7 CFU/inoculation site and 10^7 CFU/g in the stuffing (Table 1). The whole and stuffed chickens were inoculated following previously published guidelines *(7)*, at a depth of 1/8" at four locations, i.e., the breast, thigh, wing and oyster (two small round pieces of dark meat, on the back of the poultry near the thigh). Care was taken to inoculate both the fat and lean portions of the chicken.

Additionally, for the stuffed chickens, the stuffing was inoculated (Table 1). Inoculated birds were stored at 4°C for 24 h to mimic storage conditions in a typical household. During cooking, the temperature of all chickens was monitored in the uninoculated wing, thigh and breast; in the stuffed chicken, an additional location (in the center of the stuffing) was monitored. The stuffing mixture was prepared according to manufacturer's instructions, with one part commercial dry stuffing mix and 1.5 parts water, so as to have a low moisture content and mimic possible cooking conditions with a slow heat transfer. The chickens were cooked to the following endpoint temperatures: 73.9°C, 76.7°C, 79.4°C and 82.2°C (Table 1). At least five chickens of similar size were cooked to each endpoint temperature in three different consumer type ovens (Table 1). After the endpoint temperature was reached at each of the monitored endpoints, the chickens were removed from the oven and allowed to stand for 15 min. Injected sites were aseptically removed with a sterile scalpel and placed in cold-buffered peptone at a 1/10 dilution to stop the cooking process. Stuffing was removed and allowed to cool to stop the cooking, and all the test samples were tested for the presence/absence of *Salmonella*, using the Health Canada cultural methods MFHPB-20 and MFLP-49 (replaced by MFHPB-24 2001) *(5, 19)*.

Health Canada

To expand upon the data from the two previously mentioned studies, Health Canada initiated another investigation through a contract with Silliker Laboratories between 2003 and 2007, to determine a microbiologically safe endpoint cooking temperature for raw whole broiler chickens. In this investigation, a cocktail of four *Salmonella* strains consisting of *S.* Typhimurium (PT104), *S.* Senftenberg (775W), *S.* Heidelberg, and *S.* Enteritidis, was used for the inoculation. The inoculum cocktail of 10^7 salmonellae per whole chicken was prepared by suspending 0.1 ml of each of the four *Salmonella* cultures (10^8 cells/ml) in 3.6 ml of sterile peptone water. The cell suspension was swabbed over the surface of the chicken. The inoculated chickens were stored at 4°C for 24 h. The temperature of the chicken was measured by using thermocouples. The thermocouples were calibrated weekly in boiling and ice water. Two probes were positioned in each chicken breast, one probe in each thigh, one probe in the oven beside the roasting pan, and one probe attached to the rack, between the roasting pan and the chicken. Triplicate inoculated chickens were subjected to each of six-endpoint temperatures i.e., 73.9°C, 76.7°C, 79.4°C, 82.2°C, 85°C, 87°C, in three different consumer-type ovens. To confirm the heat resistance of *S.* Senftenberg used in the study, 9 inoculated chickens cooked to 68°C were used as a positive control, to verify that *S.* Senftenberg could survive at this temperature. Once all the probes had reached the desired endpoint temperature, the chickens were removed from the oven and allowed to stand for 10 min before sampling. The chickens were tested for *Salmonella*, using the Health Canada culture method MFHPB-20 *(19)*. Presumptive *Salmonella* isolates were confirmed serologically with polyvalent and single grouping somatic (O) and flagellar (H) antisera (Difco, Becton Dickinson, Sparks, MD, and PRO-LAB Diagnostics, Austin, TX). Appropriate positive and negative controls were included in each experimental trial.

RESULTS AND DISCUSSION

The studies examined in this manuscript used various poultry types, *Salmonella* serovars and final temperatures to determine a recommended endpoint internal temperature that consumers could use to safely cook their raw whole unstuffed and stuffed poultry. Commissioned by three different organizations, all three studies were performed at Silliker Canada Co. in Markham, following similar protocols so as to minimize concern over procedural uniformity and allow direct comparison of the results. In total, 8 different consumer type ovens were used in these studies; the same oven was used twice, once in the Chicken Farmers of Canada study and once in the

TABLE 3. Chicken Farmers of Canada's study of *Salmonella* recovery from stuffed and unstuffed raw whole chickens weighing between 1.5 and 2.0 kg, cooked to four different inoculated endpoint temperatures

	Temperature tested				*Salmonella* serovar isolates	Location(s) where *Salmonella* were isolated
CFC	73.9°C	76.7°C	79.4°C	82.2°C		
Stuffed Chicken	0/5[a]	3/5	0/5	0/5	S. Senftenberg	[c]stuffing; [c]stuffing; [c]stuffing + wing + thigh
Whole Chicken	2/5	0/8	1/5	1/7	S. Senftenberg	[b]breast + wing; [b]wing + oyster [d]breast; [e]wing

[a]Total number of *Salmonella*-positive chicken out of total number of chickens tested.

[b]*Salmonella* isolated at 73.9°C.

[c]*Salmonella* isolated at 76.7°C.

[d]*Salmonella* isolated at 79.4°C.

[e]*Salmonella* isolated at 82.2°C.

TABLE 4. Health Canada's study of *Salmonella* survival from inoculated unstuffed raw whole chickens weighing between 1.5 and 2.0 kg, cooked to six different endpoint temperatures

	Temperature tested							*Salmonella* serovar(s) isolated
	68°C	73.9°C	76.7°C	79.4°C	82.2°C	85°C	87°C	
Unstuffed whole chicken	9/9[a]	3/9	3/9	2/9	0/9	0/9	0/9	[b]S. Senftenberg [b]S. Typhimurium

[a]Total number of *Salmonella*-positive chicken out of total number of chickens tested.

[b]*Salmonella* isolated at 73.9, 76.7 and 79.4°C.

Health Canada study. The final endpoint temperatures in all three studies were between 73.9°C and 82.2°C. Temperatures common to all the studies were 76.7°C, 79.4°C and 82.2°C (Table 1), while the CFC and HC studies also used the lower temperature of 73.9°C and the HC study used the higher temperatures of 85°C and 87°C (for which raw data was unavailable). The studies used equivalent methods to test poultry for the presence/absence of *Salmonella* at each temperature, but did not attempt to quantify the surviving bacteria.

In the CTMA study, *Salmonella* was not recovered from the skin of the turkeys cooked to any of the endpoint temperatures, indicating that the skin was cooked thoroughly (Table 2). However, six inoculated stuffed turkeys of three different weights (5.5, 6.5 and 10.0 kg) contained *Salmonella* in the stuffing after cooking, i.e., three at 79.4°C and three at 76.7°C (Table 2).

In the Chicken Farmers of Canada study, *S.* Senftenberg was isolated from whole chicken at all test temperatures, with the exception of 76.7°C (Table 3). In stuffed chickens, *Salmonella* were recovered only at 76.7°C and not at any other temperature (Table 3). It is difficult to understand why *Salmonella* were not isolated in whole unstuffed chickens at 76.7°C, while they were recovered at the higher temperatures of 79.4°C and 82.2°C.

The Health Canada study was done with the purpose of expanding upon the data that had been generated by the CFC study and through a duplication of test temperatures, to possibly explain why

TABLE 5. Aggregate results from three poultry studies examining the survival of *Salmonella* on inoculated stuffed and unstuffed whole poultry cooked to various endpoint temperatures

Endpoint cooking temperature rounded to the nearest whole number (°C)	Inoculum contained *S.* Senftenberg	Number of poultry tested	Number of poultry with *Salmonella* survivors	Percentage with *Salmonella* survivors	Percentage (total) of survivors
68[a]	Yes	9	9	100%	100%
74	Yes	19	5	26%	26%
77	Yes	22	6	27%	27%
	No	12	3	25%	
79	Yes	19	3	16%	22%
	No	8	3	38%	
82	Yes	21	1	5%	3%
	No	10	0	0%	
85	Yes	9	0	0%	0%
87	Yes	9	0	0%	0%

[a]S. Senftenberg was the only inoculum used.

positives were obtained at 79.4°C and 82.2°C but not at 76.7°C (Table 4). In the Health Canada study, only whole unstuffed broiler chickens were tested. *Salmonella* Senftenberg and *S.* Typhimurium were isolated at all temperatures except 82.2°C, 85°C and 87°C (Table 4).

The cooking times required to reach a set endpoint temperature differed considerably. Temperature probes at different locations in the same bird, for example, reached the set point at different times. Similarly, cooking times differed between individual poultry in the same class and cooked in the same oven. Factors most likely contributing to the variability both between and within individual poultry include differences in shapes, proportions of white and dark meat and fat distribution. Furthermore, the position of the poultry in the cooking pans could have impacted the rate of cooking in various regions of the poultry. Previous Health Canada studies (HC unpublished data), indicate that the side of the poultry closest to the edge of the metal cooking pan in which it had been placed, has a tendency to cook faster and to a higher temperature than the side further from the pan, likely because of the heat conduction by the pan. Alternatively, the variability in the times to reach endpoint temperatures could have resulted from inconsistent placement of temperature probes with respect to position and depth in the bird. In the CFC and HC studies, improper probe placement was addressed by repositioning the probe in the muscle as needed, when temperature spikes were observed.

Apart from duplicating the depth, having to reproduce the exact location of the probe in various muscle groups provided additional challenges. The CTMA study used endpoint temperature measurements from the thigh, but these readings were generally inconsistent, as consistent positioning of the probes into the thigh muscle was found to be very difficult to perform, even by experienced personnel. This finding was also confirmed in the CFC study, which reported that the endpoint temperature was consistently higher in the thigh muscle than in the rest of the chicken. The higher thigh temperatures may have been due to the pooling of liquid fat in the area. All three studies pointed to the observation that in order to record representative muscle temperatures, the poultry breast was the optimum placement for a temperature probe. The breast is the thickest part of a bird's body and therefore requires the longest time to reach the desired endpoint temperature, ensuring that other parts have reached the required temperature. Furthermore, the breast provides temperature readings that are close to that of the wing, which was found to be the slowest heating part in these studies.

Different poultry parts were found to cook at different rates. For 68% of the poultry, the wing was the slowest to reach the desired endpoint temperature under study. In fact, in the CFC study, the one *Salmonella* isolated (out of 31 birds) from poultry cooked to 82.2°C was found in the wing. It is possible that due to biological differences between the wings or poultry placement in the pan, the inoculated wing did not reach the same internal temperature as the uninoculated wing (which contained the temperature probe). In addition, improper probe placement (close to the bone or a fat pocket which conduct heat more readily than muscle) may have resulted in higher and inaccurate readings.

The slowest rate of temperature increase occurred in the stuffing of stuffed poultry. This was likely due to the stuffing's low moisture content, a factor that hinders good heat transfer, suggesting that heat transfer is less efficient between

chicken meat and stuffing than in chicken meat itself. Since stuffing is the slowest part to cook in stuffed poultry, consumers should monitor the temperature of the stuffing as well as that of the bird. Because of inefficient heat transfer between stuffing and poultry meat, Health Canada recommends that stuffing be cooked separately and that the temperature be monitored independently, in order to prevent cross-contamination with *Salmonella*.

Salmonella Senftenberg was the most heat resistant of the *Salmonella* species used (Table 3). Research has shown that *S.* Senftenberg 775W (used in CFC and HC study) is about 30 times more heat resistant than *S.* Typhimurium *(17)* and 10 times more resistant than other *Salmonella* species *(20)*. *Salmonella* Senftenberg is not frequently isolated from poultry; in fact, a recent study found *S.* Senftenberg to be present in only 6% of the non-clinical (routine flock and slaughter surveillance) *Salmonella* chicken isolates. However, the same study identified this species as the top *Salmonella* serovar isolated in turkeys, i.e., it comprised 36% and 16% of the clinical and non-clinical *Salmonella* turkey isolates, respectively *(6)*. *Salmonella* Senftenberg was isolated from one of the chickens cooked to 82°C in the CFC study (about 3% of the total chickens cooked to 82°C) (Table 5). It is possible that the very high inoculum level (10^7 CFU/site), combined with the injection 1/8" deep into the muscle, provided additional protection to the already heat-resistant organism. This situation is not likely to be representative of a typical household, where *Salmonella* would be present on the surface of the poultry and in lower numbers.

In all three studies, the different ovens tested required different final endpoint temperatures to achieve *Salmonella*-negative results in cooked poultry. In the CFC study, for example, the survival of *S.* Senftenberg at 82.2°C occurred in oven #1, an oven from which a positive result was also obtained at a temperature of 79.4°C, whereas none of the three other ovens yielded positive results at either temperature. In total, 4/7 of the *Salmonella* positive chickens in the CFC study were cooked in oven 1. In the HC study, *S.* Typhimurium and *S.* Senftenberg were consistently isolated from oven 1 (a different oven from oven 1 in the CFC study) at temperatures up to 79.4°C, whereas in no other ovens were *Salmonella* detected after an internal temperature of 73.9°C was reached. In the Health Canada study, oven 1 was the oldest oven, having been manufactured in 1990, and, according to the results, it required higher endpoint temperatures to achieve total kill (82.2°C for oven 1, compared with 73.9°C for the other two ovens). The other variables between the ovens were self cleaning vs. non-self cleaning, digital vs. hand dials, and variation in the width/amplitude of the heating profile, all of which could have accounted for the differences observed between the ovens.

In both the CFC and HC studies, significant differences were observed in the time required to reach a given endpoint temperature for poultry of similar size. For example, within a single oven, in the HC study, in one trial it took a chicken 109 min to reach 76.7°C, while in a different trial only 80 min were needed for a chicken of a similar size to reach 79.4°C in the same oven. These results could be attributed either to inconsistent performances of individual ovens or to probes not being placed in the exact same locations/depths in each bird.

In all three studies, the inactivation of *Salmonella* in poultry was dependent on the amount of cooking time the poultry spent in the oven, as well as the final endpoint temperature and weight class. The cook times for *Salmonella*-positive turkeys to reach the required endpoint temperature were 29 to 89 min less than for *Salmonella*-negative turkeys. This difference may have been due to variations in turkey structure, oven heating or probe placement. The time/temperature data from the CTMA and the CFC study showed that all the turkeys and chickens from which *Salmonella* was isolated were heavier, had lower stuffing temperatures, and required a shorter cook time to reach the desired endpoint temperature. However, even with all these considerations, there was only 1 positive out of 31 when raw whole poultry was cooked to an endpoint temperature of 82.2°C.

In the CTMA and the CFC studies, when *Salmonella* was isolated from a stuffed poultry, it was always present in the stuffing. However, in none of the stuffed poultry was any *Salmonella* isolated from the stuffing or the body when the internal temperature of the turkey or chicken had reached 82.2°C.

All three studies ensured a thorough and even cooking of the poultry by introducing a 10–15 min "hold/resting time" after cooking. It was observed that the hold time contributed to the total microbial inactivation (data not shown). During this time, the temperature of the poultry itself, as well as the stuffing, continued to increase at a steady rate before tapering off, thus ensuring more even cooking and the elimination of cold spots.

Based on these studies, Health Canada recommends a target endpoint cooking temperature of 82°C, as measured in the thickest part of the breast, for cooking raw whole stuffed and unstuffed poultry. Although tested in conventional ovens, this temperature recommendation also applies to convection ovens, although increased air circulation, may decrease the poultry cooking time in convection ovens. No significant difference in organism lethality should be observed when poultry is cooked to an endpoint temperature of 82°C, regardless of the shorter cooking time. In the three studies, only one out of 31 birds cooked to 82°C was positive for *Salmonella*. The strain isolated, *S.* Senftenberg 775W, is a heat-resistant strain, and the inoculum was injected at a higher level than would be normally expected (1/8" deep into the muscle), likely providing the bacterium additional heat protection. This situation is also not representative of a typical household, in which the majority of *Salmonella* would be present on the surface of the poultry. Therefore, the recommendation of 82°C still satisfies the requirement for a conservative margin of safety. Furthermore, the oven (oven 1 in CFC study) used to cook the bird from which *Salmonella* was recovered, had a lower wattage but a shorter cooking time than the other ovens used in the study.

CONCLUSIONS

The Health Canada recommended endpoint temperature of 82°C is different from some provincial and industry recommendations, most notably the USDA recommendation of 74°C *(22)*. The data from the present three studies show that at the final endpoint temperatures of 74°C, 77°C and 79°C, *Salmonella*, including *S.* Senftenberg, were recovered. A previous study performed for the USDA found *S.* Senftenberg in the stuffing of 25% of turkeys cooked to 82°C *(13)*. However, another study

found that an endpoint temperature of 74°C, with a hold time of less than 10 min for both chicken and turkey, could achieve a 7-log reduction of *Salmonella*, although *S.* Senftenberg was not included *(11)*. In conclusion, this study demonstrated that 82°C is a safe endpoint temperature to use when cooking raw whole poultry.

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Dry Heat Thermal Inactivation of *Listeria innocua* on Deli Slicer Components

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ABSTRACT

A thermal kill step was evaluated as a method of obtaining an additional margin of safety for retail deli meat slicers following cleaning and sanitizing. Retail deli slicers were cut into coupons or marked off in grids, cleaned and sanitized. *Listeria innocua*, an established thermal-resistant *Listeria* species, was inoculated at 10^7 CFU/cm^2. The inoculated components or stainless steel coupons were placed in a dry heat oven at 66°C or 80°C and sampled at 0.5, 1, 3 and 15 h. There was no statistically significant difference in survival between the stainless steel and the cast aluminum portions of the slicer. At 66°C, there was an initial drop of approximately 1.5 log CFU after 30 min of treatment, but recovery of *L. innocua* remained at more than 4 log CFU even after 15 h. When temperatures were increased to 80°C, the decrease was over 4 log, but the thermal treatment times (15 h) were longer than an overnight treatment that might be considered practical for a retail deli. From these results, it appears that dry thermal treatments at temperature of 80°C and times up to 15 h are not sufficient to produce a 5-log reduction of residual *L. innocua* that may have survived improper cleaning and sanitizing of the deli slicer.

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INTRODUCTION

Listeria monocytogenes causes a rare but potentially fatal disease, listeriosis. The mortality rate from this disease is approximately 28%, particularly in immunocompromised individuals, who are most at risk *(3, 5)*. The economic burden for US citizens for a single case of listeriosis is estimated to be $1,659,143 *(23)*. The prevalence of *L. monocytogenes* in ready-to-eat (RTE) deli meat and poultry products has steadily decreased from 4.61% positive in 1990 to only 0.42% positive in 2008 *(10)*, but the incidence of *L. monocytogenes* infections has not changed substantially in the past 3 years *(3)*.

It has been apparent for many years that meat slicers in retail establishments can harbor large populations of bacteria *(12)* and that these bacteria have the potential to cross contaminate sliced, ready-to-eat foods *(11)*. A few outbreaks of salmonellosis have also been linked to meat slicers *(1, 17)*. Although no cases of listeriosis have been directly linked to meat slicers, slicers have been found to be contaminated with *L. monocytogenes (16)*, and the 2008 listeriosis outbreak in Canada was ultimately traced to the meat slicers in the RTE meat plant *(15)*. In addition, a large study by Gombas and others *(13)* found that prevalence of *L. monocytogenes* was approximately 7 times higher in RTE meats sliced in retail deli as compared to commercially manufactured, sliced and packaged RTE meats. The fact that nearly 75% of consumers purchase deli sliced meats rather than commercially packaged meats *(9)* implies that significant numbers of consumers are exposed to *L. monocytogenes*.

Foegeding and Stanley *(7)* proposed the use of *Listeria innocua* ATCC 33091 as a thermal-processing indicator for *L. monocytogenes* in milk because this organism is 1.3 times more heat resistant than *L. monocytogenes*. Fairchild and Foegeding *(6)* generated a natural mutation of *L. innocua* 33091 that was resistant to rifampin and streptomycin and designated it strain M1. Resistance to these two antibiotics allows this strain to be counted directly on nonselective medium with these antibiotics added, without interference from the normal background microflora present. Murphy and others *(19)* extended this research to poultry and determined the $D_{(67.5°C)}$ in chicken breast meat was 0.35 min for *L. innocua* M1 and 0.29 min for *L. monocytogenes*. *L. innocua* also responds similarly to *L. monocytogenes* to thermal processing, ultraviolet-C light, flash pasteurization, and ionizing radiation on the surface of RTE meats *(8, 24, 25, 26)*. Studies conducted in a food pilot plant setting, using flash pasteurization, have used *L. innocua* cocktails as a nonpathogenic surrogate in place of *L. monocytogenes (18, 20, 21, 24)*.

Dry heat has been used for many years as a means to sterilize materials, especially for such medical commodities as assembled non-disposable syringes, where dry heat can penetrate into the sealed container, in contrast to steam, which cannot be relied upon to reach the interior of the container *(4)*. In 1972, NASA used dry heat sterilization on the Mars landing craft to prevent forward contamination of Mars *(14)*. Commercial manufacturers of RTE meats sometimes place their cleaned and sanitized commercial scale size slicers in their smoke houses at 60 to 80°C overnight in an effort to inactivate any residual *L. monocytogenes* (personal communication, John Butts, May 2009). The objective of this study was to attempt to recreate this treatment, using the existing delicatessen ovens to provide a lethal thermal treatment to destroy *L. innocua* on food contact surfaces. The objective was to mimic the use of bread proofing ovens, in which temperatures do not reach the typical dry heat sterilization temperatures of 160 to 180°C. We also assessed the effectiveness of studying coupons cut from a slicer rather than the entire slicer, as well as the difference in survival of *L. innocua* on the slicer's stainless steel blade versus the cast aluminum guard.

MATERIALS AND METHODS

Bacterial cultures

Listeria innocua M1 resistant to streptomycin (250 mg/L), and rifampicin (50 mg/L), both generated by selective enrichment *(6)*, was originally obtained from Dr. P. M. Foegeding (Department of Food Science, North Carolina State University, Raleigh, NC). Stock cultures were maintained frozen (–80°C). The working culture was started from frozen stock inoculated into tryptic soy broth (Bacto, Becton Dickinson Co., Sparks, MD) supplemented with 0.6% yeast extract (TSBYE) and was incubated at 37°C overnight.

Preparing deli slicer coupons and components

Stainless steel components from the blade of a Hobart heavy duty slicer (Hobart Food Equipment, Australia) were cut into 2 × 2.5 cm coupons, using a Flow Waterjet Cutting System (Flow International Corporation, Kent, WA). This cutting system was used to prevent heat-induced stress, which could cause a change in the physical properties of the stainless steel. From the blade guard of the same slicer, cast aluminum coupons (2 × 2 × 0.5 cm) were cut, using a Milwaukee Heavy-Duty metal cold-cutting metal saw (Brookfield, WI) and a Wellsaw metal-cutting band saw (Wells Manufacturing Corporation, Three Rivers, MI). Coupons were washed thoroughly in Micro 90 cleaning solution (International Products Corp., Burlington, NJ) prepared as per directions of the manufacturer and then rinsed in sterile deionized water. Coupons were sterilized by autoclaving for 15 min at 121°C. In addition, from another slicer, disassembled stainless steel and cast aluminum deli slicer food contact surfaces were marked off into 2 × 2 cm grids, using permanent markers. Gridded areas were serially numbered in a random fashion. Slicer components were wrapped in aluminum foil and autoclaved at 121°C for 15 minutes.

Inoculation of coupons and components

Sterile coupons were laid individually on sterile glass microscope slides and forty microliters (40 µl) of the *L. innocua* culture was pipetted into the middle of each coupon and carefully spread over the area with a sterile inoculation loop. The inoculum was allowed

FIGURE 1. Comparison of recovery of *L. innocua* from stainless steel blade, coupon cut from blade, cast aluminum guard or coupon cut from guard after 3 hours dry heat at 66°C. [a]values are not significantly different by *t* test ($P > 0.05$). Each value is the mean of duplicate samples from six experiments.

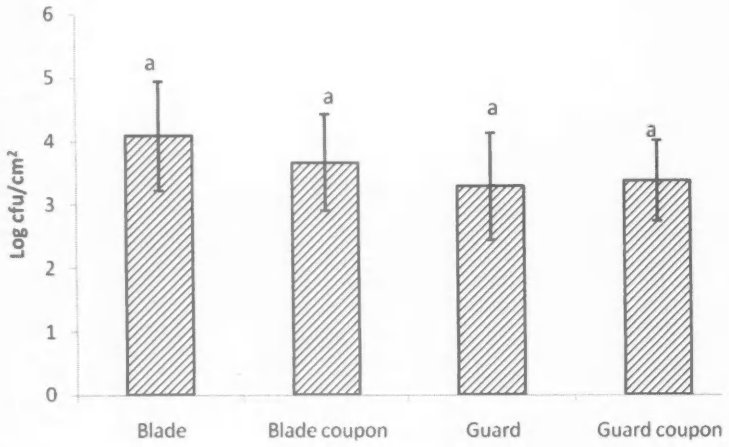
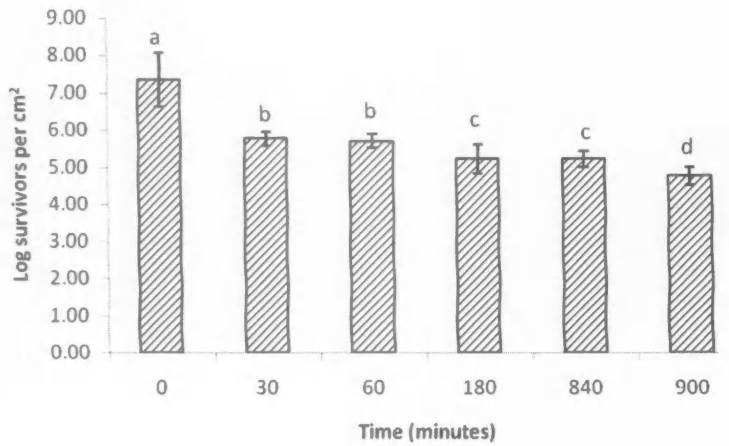


FIGURE 2. Thermal inactivation of *L. innocua* on cast aluminum guard of a deli meat slicer in a dry oven at 66°C for up to 15 h (900 min). [a-d]values with different superscripts are significantly different by *t* test ($P < 0.05$). Each value is the mean of duplicate samples from 3 experiments.



to air dry for 2 h. Forty microliters (40 µl) of the *L. innocua* culture was pipetted into the middle of each 2 × 2 cm gridded area of the components of the slicer, and spread carefully over the gridded area with an inoculation loop, and allowed to air dry for 2 h.

Thermal inactivation

Each deli slicer component was wrapped in Heavy Duty Reynolds Wrap® (Reynolds Kitchens, Richmond, VA) to prevent contamination, and coupons were placed in sterile petri dishes before being placed in a convection oven (Power-O-matic 60, Blue M. Electric Company, Blue Island, IL) at 66°C or 80°C. Components or coupons were sampled at 0.5, 1, 3, and 15 h. Thermocouples (Type J, Iron-Constantan) were placed in thin sleeves and then taped under the aluminum foil right next to each component and to the interior of the oven during runs. Results were logged onto a 21X Micrologger (Campbell Scientific, Inc., Logan, UT).

Sampling after thermal inactivation

After each oven run, gridded areas or coupons were swabbed with sterile cotton-tipped swabs, which were then placed in 10 ml sterile phosphate buffered saline, vortexed, serially diluted, plated on TSAYE agar, and incubated at 37°C for 24 h. Colonies were enumerated and data entered into Microsoft Excel (Microsoft Corporation, Redmond, WA) spreadsheets and analyzed.

Statistical analysis

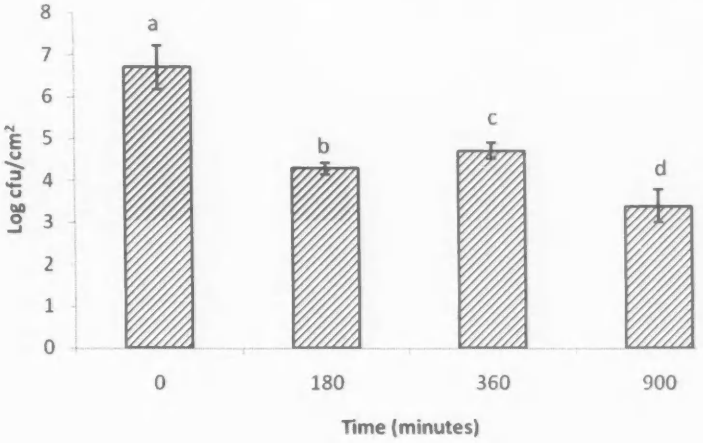
Each experiment was repeated 3 to 6 times. Mean number of colonies per ml (survivors) was converted to log CFU/cm² and means were calculated. Statistical significance of differences was determined by Students *t* test, with significance assigned at $P < 0.05$.

RESULTS AND DISCUSSION

Comparisons of the two different construction materials of the slicer, aluminum and stainless steel, as well as comparison of whole components versus coupons, are shown in Fig. 1. As can be seen, there was no significant difference ($P > 0.05$) in the recovery of *L. innocua* from the different materials, nor was there a difference between results with use of the whole slicer components and the coupons. In contrast, Wilks and others *(27)* found that *L. monocytogenes* survived better on stainless steel than on a copper-base alloy. They detected viable cells on stainless steel after 24 h incubation at room temperature, as opposed to no viable cells on copper, brass, aluminum bronze and silicon bronze after 60 min incubation. Bremer and others *(2)* found that *L. monocytogenes* on stainless steel coupons held at 15°C exhibited a D value of 1.2 days.

Dry heat at 66°C resulted in a small initial drop at 30 minutes, but recovery of *L. innocua* remained at high levels even after 15 h (Fig. 2). Although there were statistically sig-

FIGURE 3. Thermal inactivation of *L. innocua* on cast aluminum guard of a deli meat slicer in a dry oven at 80°C for up to 15 h. [a-d]values with different superscripts are significantly different by *t* test ($P < 0.05$). Each value is the mean of duplicate samples from three experiments.



nificant differences in survivors as time progressed, levels of survivors never declined below 4 logs. Temperature of the oven was increased to 80°C and the experiment was repeated. Results of the second experiment are shown in Fig. 3, where it can be seen that there was recovery of over 3 log CFU/cm² of *L. innocua* survivors. The decrease at 80°C was over 4 log, but the thermal treatment time required to achieve this level of reduction (15 h) is most likely not practical for use in a working delicatessen. However, it should also be noted that the thermal resistance of this *L. innocua* is 1.3 times greater than that of *L. monocytogenes*, so it is possible that this temperature overnight would be sufficient to cause a 5-log reduction of *L. monocytogenes*. Because of the nonlinear nature of the curves obtained, it was not possible to calculate D- and z-values for the slicer materials. We chose a 5-log reduction target because food regulations routinely require that treatments reduce pathogens by this amount in food products. In the case of the deli slicer, it should be noted that we did achieve a reduction of the *L. innocua* in the first three hours of heating that could be adequate, given that levels of residual *L. monocytogenes* on equipment are likely not as high as the levels in the inocula we used.

Rodriguez and others *(22)* found that as *Listeria* biofilms dried on stainless steel, they were more able to transfer *Listeria* to food. Although we did not study *L. innocua* biofilms on these slicers, results of our tests indicate that contaminated slicers subjected to dry heat might be more likely to transfer residual *Listeria* to foods. Although dry heat is economical and could easily be used with typical dry heat ovens found in most delis, it appears that it is not well suited to sterilization of deli slicers. An alternative avenue of exploration would be the use of moist heat applied on the contaminated slicer at similar temperatures as those used in the current study. With moist heat, it is critical for the moisture to penetrate to the contaminated areas, but sterilization is usually achieved over shorter time periods at lower temperatures.

CONCLUSION

Dry thermal treatment at 80°C and times up to 15 h are not sufficient to achieve a 5-log reduction of residual *L. innocua* that may have survived improper cleaning and sanitizing of the deli slicer. However, a three-hour treatment at 80°C produced a 2 or 3 log reduction, which would likely be adequate for a machine that had been cleaned and sanitized prior to heating. Dry thermal heating overnight could provide an extra hurdle for *Listeria* contamination in the worst case scenario of an inadequately cleaned and sanitized slicer.

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NEW MEMBERS

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Tullin

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NEW SUSTAINING MEMBER

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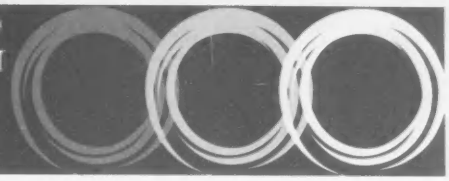
WHAT'S HAPPENING IN FOOD SAFETY



3-A SSI Announces Probationary List Update

3-A Sanitary Standards, Inc. (3-A SSI) announces new public information on the probationary status of a current 3-A Symbol licensee. The new Probationary List was introduced in early 2010 and intended to assist regulatory sanitarians, processors, equipment fabricators, and other interested parties.

The Probationary List was added to other public information on 3-A Symbol holders to disclose information on any licensee that is responsible for a finding of non-conformance to certain provisions of a 3-A Sanitary Standard for which the company holds 3-A Symbol authorization, including the company name and the specific type and model of equipment. According to Tim Rugh, "The Probationary List is not intended to penalize the licensee, but to help inform all concerned parties that the licensee is addressing specific issues it has acknowledged require correction." The licensee remains in this status until a plan for corrective action is completed and verified by third party inspection.

3-A SSI maintains public information on 3-A Symbol licensees at http://www.3-a.org/symbol/holders_list.html, including current and discontinued licensees and the new Probationary List. The public information is important because it shows all equipment conforms to 3-A Sanitary Standards for dairy and food processing equipment and meets provisions of the 3-A Symbol program. 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.

Since 1956, the 3-A Symbol has been used to identify equipment that meets 3-A Sanitary Standards for design and fabrication. 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.

CDC Report Looks at Foods and Foodborne Agents Associated with Outbreaks in the United States

A total of 1,097 foodborne disease outbreaks were reported in 2007 to the Centers for Disease Control and Prevention, according to a CDC analysis. State investigators reported 21,244 illnesses and 18 deaths as a result of these outbreaks. The report also provides the most recent data on how many illnesses were linked to specific types of foods.

"Knowing more about what types of foods and foodborne agents have caused outbreaks can help guide public health and the food industry in developing measures to effectively control and prevent infections and help people stay healthy," said Chris Braden, acting director of the CDC's Division of Foodborne, Waterborne and Environmental Diseases.

Despite health officials' efforts, the cause of an outbreak—either the food or the foodborne agent responsible—often cannot be determined or confirmed. This most commonly is the case when the outbreak is small. Of 1,097 reported outbreaks in 2007, 497 (or 45 percent) confirmed that one foodborne agent was responsible and in an additional 12 outbreaks more than one foodborne agent was responsible. Thus, in more than half of the outbreaks, a foodborne agent was not identified. Norovirus was the most frequently confirmed foodborne agent (39 percent), followed by *Salmonella* (27 percent).

Foodborne disease outbreaks due to norovirus occur most often when infected food handlers do not wash their hands well after using the toilet; outbreaks due to *Salmonella* occur most often when foods are contaminated with animal feces. Contaminated foods are often of animal origin, such as beef, poultry, milk, or eggs. But any food, including vegetables, may become contaminated. Thorough cooking kills *Salmonella*.

The report states that in the 235 outbreaks where one food commodity was identified, the largest number of illnesses listed poultry (691 illnesses), beef (667 illnesses), and leafy vegetables (590 illnesses) as the cause. The CDC tracks 17 food commodity categories. A full listing of the number of illnesses associated with each of the categories is available at www.cdc.gov/outbreaknet/surveillance_data.html.

To prevent foodborne illnesses, CDC recommends that consumers and food handlers appropriately clean, separate, cook and chill foods. For more details, visit www.foodsafety.gov.

The full report, "Surveillance for Foodborne Disease Outbreaks — United States, 2007" appears in the CDC's Morbidity and Mortality Weekly Report, and is available online at www.cdc.gov/mmwr.

Direct access to the Foodborne Outbreak Online Database (FOOD), a searchable database of outbreaks reported to CDC between 1998 and 2007 is available at: http://www.cdc.gov/foodborneoutbreaks/.

FDA New Early Detection System Helps FDA Identify MoreThan 100 Food Safety Problems in First 7 Months

More than 100 food safety reports were submitted by industry to the U.S. Food and Drug Administration's new electronic portal in its first months of operation.

Mandated by Congress, the Reportable Food Registry (the Registry) is a new system that requires manufacturers, processors, packers and distributors to immediately report to the government safety problems with food and animal feed, including pet food, that are likely to result in serious health consequences.

"The FDA's new reporting system has already proven itself an invaluable tool to help prevent contaminated food from reaching the public," said FDA Deputy Commissioner for Foods Michael R. Taylor.

A report summarizing the Registry's first seven months of operation (September 2009 – March 2010) finds that it logged 125 primary reports – initial reports about a safety concern with a food or animal feed (including food ingredients) – and 1,638 subsequent reports from suppliers or recipients of a food or feed for which a primary report had been submitted, from both domestic and foreign sources. These reports help FDA and the food industry locate hazardous foods in the supply chain and prevent them from reaching consumers.

Two notable reports first identified through the Registry prompted the following:

A February 2010 recall of hydrolyzed vegetable protein (HVP), without any report of illness. More than 1,000 industry reports specifically for products containing HVP, resulted in the removal of 177 products from commerce.

A November 2009 recall of products containing sulfites but not labeled as such. More than 100 reports regarding the inadvertent use of an ingredient containing sulfites in two nationally distributed prepared side dishes that were not labeled as containing sulfites resulted in their removal without any reports of illness.

Among the 125 primary reports, *Salmonella* accounted for 37 percent of hazards, undeclared allergens or intolerances accounted for 35 percent, and *Listeria monocytogenes* accounted for 13 percent. Among the 11 different commodity categories involved were: 14 animal feed or pet food, 12 seafood, 11 spices and seasonings, and 10 dairy products. Because the Registry has been operational for only a short period, it is too early to draw inferences concerning patterns of food and feed adulteration.

"Industry is increasingly detecting contamination incidents through its own testing, and FDA access to this information permits us to better target our inspection resources and verify that appropriate corrective measures have been taken," Taylor said. "Ensuring that the American food supply is safe is a top priority of the FDA, and the Reportable Food Registry strengthens our ability to help prevent foodborne illness."

U.S. Foodservice Adopts New GS1 Standards to Improve Food Safety

U.S. Foodservice, a food distributor to restaurants, schools, hotels, healthcare facilities and military installations—is a founding member of the Foodservice GS1 U.S. Standards Initiative and will continue to support it by implementing the Global Data Synchronization Network (GDSN). The implementation of GDSN Data Pool technology will enable the company and its vendors to synchronize product information and price data using standardized Global Location Numbers® and Global Trade Item Numbers.

"We are committed to leveraging these new standards in tandem with our suppliers. The GS1 industry standards will improve food safety and traceability—from 'farm to fork'—and streamline processes, which helps us reduce costs and deliver efficiency to our customers, so they can succeed," said Pat Mulhern, president, Monarch Food Group, U.S. Foodservice. "GS1 ensures one version of product data enabling item data accuracy and more efficient warehouse inventory management."

U.S. Foodservice slected FSE Inc., as its GDSN data pool provider to assist that process.

"FSE has been a great partner to U.S. Foodservice for many years and will play an important role in the success of this project," Mulhern added.

The FDA New Final Rule to Ensure Egg Safety, Reduce *Salmonella* Illnesses Goes into Effect

The U.S. Food and Drug Administration says that as many as 79,000 illnesses and 30 deaths due to consumption of eggs contaminated with the bacterium *Salmonella* Enteritidis may be avoided each year with new food safety requirements for large-scale egg producers.

The new food safety requirements became effective on July 9, 2010, through a rule for egg producers having 50,000 or more laying hens – about 80 percent of production. Among other things, it requires them to adopt preventive measures and to use refrigeration during egg storage and transportation.

Large-scale egg producers who produce shell eggs for human consumption and do not sell all of their eggs directly to consumers must comply with the refrigeration requirements under the rule; this includes producers whose eggs receive treatments such as pasteurization. Similarly, those who transport or hold shell eggs must also comply with the refrigeration requirements by the same effective date.

Egg-associated illness caused by *Salmonella* is a serious public health problem. Infected individuals may suffer mild to severe gastrointestinal illness, short-term or chronic arthritis, or even death. Implementing the preventive measures would reduce the number of *Salmonella* Enteritidis infections from eggs by nearly 60 percent.

Salmonella Enteritidis can be found inside eggs that appear normal. If the eggs are eaten raw or undercooked, the bacterium can cause illness. Eggs in the shell become contaminated on the farm, primarily because of infection in the laying hens.

"Preventing harm to consumers is our first priority. This action will help prevent thousands of serious illnesses from *Salmonella* in eggs," said Margaret A. Hamburg, M.D., commissioner of food and drugs.

The rule requires egg producers with fewer than 50,000 but at least 3,000 laying hens whose shell eggs are not processed with a treatment, such as pasteurization, to comply with the regulation by July 9, 2012.

Producers who sell all their eggs directly to consumers or have less than 3,000 hens are not covered by the rule.

Under the rule, egg producers whose shell eggs are not processed with a treatment, such as pasteurization must:

- Buy chicks and young hens only from suppliers who monitor for *Salmonella* bacteria
- Establish rodent, pest control, and biosecurity measures to prevent spread of bacteria throughout the farm by people and equipment
- Conduct testing in the poultry house for *Salmonella* Enteritidis. If the tests find the bacterium, a representative sample of the eggs must be tested over an eight-week time period (four tests at two-week intervals); if any of the four egg tests is positive, the producer must further process the eggs to destroy the bacteria, or divert the eggs to a non-food use
- Clean and disinfect poultry houses that have tested positive for *Salmonella* Enteritidis
- Refrigerate eggs at 45°F during storage and transportation no later than 36 hours after the eggs are laid (this requirement also applies to egg producers whose eggs receive a treatment, such as pasteurization).

To ensure compliance, egg producers must maintain a written *Salmonella* Enteritidis prevention plan and records documenting their compliance. Egg producers covered by this rule must also register with the FDA. The FDA will develop guidance and enforcement plans to help egg producers comply with the rule.

During the 1990s, the FDA and the U.S. Department of Agriculture implemented a series of post-egg production safety efforts such as refrigeration requirements designed to inhibit the growth of bacteria that may be in an egg. While these steps limited the growth of bacteria, they did not prevent the initial contamination from occurring.

The new rule is part of a coordinated strategy between the FDA and the USDA's Food Safety and Inspection Service (FSIS). The FDA and the FSIS will continue to work closely together to ensure that egg safety measures are consistent, coordinated, and complementary.

In addition to the new safety measures being taken by industry, consumers can reduce their risk of foodborne illness by following safe egg handling practices. The FDA reminds consumers to buy eggs that have been refrigerated, make sure eggs in the carton are clean and not cracked, and cook eggs and foods containing eggs thoroughly.

Allen Sayler New Vice President at Randolph Associates, Inc.

Allen R. Sayler, formerly vice president for regulatory affairs & international standards for the International Dairy Foods Association (IDFA) becomes vice president of food safety, technology & regulatory solutions at Randolph Associates, Inc. (RAI). He will staff the new RAI Washington, D.C. office. Mr. Sayler's dairy career has spanned almost 30 years. Having grown up on a Grade "A" dairy farm, he worked in the civil engineering field, then returned to dairy as a state, FDA and USDA dairy regulator. Allen has spent the last 12 years working for IDFA as an advocate for the dairy processor industry, and assisting members with technical, processing and regulatory solutions.

Mr. Sayler has comprehensive knowledge of dairy production, processing, food safety & quality assurance programs, as well as state and federal regulations, HACCP & SQF systems, product sampling and testing, water and wastewater treatment, and drug residue screening programs. He has extensive experience working on international dairy standards and dairy trade issues.

Mr. Sayler's responsibilities at RAI will include SQF practitioner and advanced dairy & juice HACCP training, as well as GAP analysis of dairy plant food safety, quality and

production efficiency programs. His experience working for state and federal dairy regulatory agencies provides special insight for dairy processors and will expand RAI's offerings into all facets of dairy regulations, both domestic and international.

Domestically, Mr. Sayler is actively involved in the National Conference on Interstate Milk Shipments. At the international level, he has been involved in representing the U.S. dairy industry on various International Dairy Federation's (IDF) Standing Committees, dealing with food additives, dairy product hygiene and environmental standards.

Mr. Sayler has received Group Excellence Awards by both the U.S. Food & Drug Administration and U.S. Department of Agriculture for contributions on animal drug residue strategies, dairy HACCP pilot work and developing an EU Certification program for dairy products.

Allen received the 2009 Harold Barnum Industry Award from the International Association for Food Protection (IAFP) for outstanding contributions to food safety. He currently chairs IAFP's Dairy Quality and Safety Professional Development Group.

NSF International Appoints New General Manager of NSF Shanghai, China Operations

NSF International has appointed Alex Zhang, general manager of NSF's joint venture in China – NSF Shanghai Co., Ltd. NSF Shanghai works with companies that manufacture food equipment, nutritional supplements, and products that come into contact with drinking water by providing testing, auditing, product certification and independent system registration. These services help Chinese companies gain access to international markets by achieving global standards for public health and safety.

The joint venture, approved by the Certification and Accreditation Administration of the People's Republic of China (CNCA), was launched in 2005, and serves as the hub of NSF International's operations in China.

Mr. Zhang will be responsible for NSF Shanghai's joint venture operations, directing NSF International's range of auditing, product certification and registration services.

Mr. Zhang has over 15 years of professional experience, including expertise in launching and growing new businesses in China. His professional experience includes working cooperatively with international and local authorities, such as the State Administration for Industry and Commerce (SAIC), the Commodity Inspection Bureau, and Customs. While serving as Asia-Pacific Operations Leader for General Electric Water & Process Technologies, Mr. Zhang launched the Asia Pacific operations for GE Water Residential & Commercial group in Shanghai. An expert in residential water treatment systems, Mr. Zhang also served as general manager of EcoWater China.

Mr. Zhang's responsibilities will include hiring and training local, experienced staff and developing new business strategies to effectively serve the local market. He also will coordinate with NSF International's 31 global locations, eight of which are located throughout the Asia-Pacific region.

"Alex Zhang has a proven track record in growing business in China, as well as extensive knowledge and expertise in international public health standards and policies," said Lori Bestervelt, Ph.D., senior vice president of NSF International. "His combination of international and local experience will help companies navigate the global marketplace and bridge Western companies to the Chinese market."

Mr. Zhang studied mechanical engineering at the University of Leuven in Belgium and earned master's and bachelor's degrees in applied mechanics from Fudan University in Shanghai, China.

FMI Appoints Rhett Asher Vice President of Industry Relations

The Food Marketing Institute (FMI) has announced the appointment of Rhett Asher as vice president of industry relations.

Mr. Asher will focus on enhancing the capabilities and services of industry relations at FMI, specifically the FMI/GMA Trading Partner Alliance. He will also support other programs such as loss prevention and risk management, technology, and marketing and merchandising.

"Rhett has extensive retail and association management experience that will be very valuable to our members," said FMI president and Chief Executive Officer Leslie G. Sarasin. "He is highly regarded within the industry for his knowledge of loss prevention issues and we are excited to have him join FMI."

Mr. Asher joins FMI from the National Retail Federation where he served as vice president of loss prevention. He served in a similar capacity at the Retail Industry Leaders Association from 2003 to 2006. Previously, Mr. Asher held management positions at Ross Stores, Inc., Modell's Sporting Goods and Cort Furniture Rental.

Mr. Asher earned a BS in business administration from North Carolina State University.

He currently serves on the Department of Homeland Security Commercial Facilities Sector Coordinating Council, the advisory board of the Loss Prevention Research Council and the advisory committee of the National Association for Shoplifting Prevention.

INDUSTRY PRODUCTS

Sheldon Manufacturing, Inc.

New Ergonomic Anaerobic Chamber from Sheldon Manufacturing

Sheldon Manufacturing, Inc. has announced the release of their new BacBASIC Anaerobic Chamber. The BacBASIC is ideal for environmental and incubation work in microbiology and cell biology applications.

The new SHEL LAB BacBASIC Anaerobic Chamber is designed with the clinical/research laboratory scientist in mind by providing bare-handed access for delicate procedures without compromising the required desired hypoxic atmosphere.

The new ergonomically designed Quick-Entry Glove-Less arm ports provides maximum reach and comfort.

The BacBASIC chamber is 32.5" wide, 19.5" deep and 22" high providing storage capacity for up to 150 petri dishes. The user-friendly LCD control panel offers a temperature range from ambient to 45°C.

For complete specifications on the BacBASIC Environmental Work Station, go to http://www.shellab.com/store/lab-products/bacBasic.

Sheldon Manufacturing, Inc.
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Life Technologies Introduces Test for Rapid Detection of *E. coli*

Life Technologies, a provider of innovative life science solutions, announced at the International Association for Food Protection Annual Meeting the launch of the MicroSEQ® *E. coli* O157:H7 assay, designed to detect the deadly strain of *Escherichia coli*, using the company's industry-leading real-time PCR technology. Life Technologies also announced that the assay has secured Performance Tested Methods℠ certification from the AOAC Research Institute for detection of *E. coli* O157:H7. The new product will enable more effective monitoring of the food supply for contamination and help ensure food safety.

E. coli O157:H7 can cause severe illness, even death and has been responsible for significant outbreaks of food poisoning across the globe. Culture-based assays, long considered the gold standard for pathogen detection, can take up to five days to yield results. The MicroSEQ *E. coli* O157:H7 detection assay is highly specific and sensitive and can be run in as little as eight hours.

"Food companies and food testing organizations are seeking validated tools to help safeguard the public from organisms such as *E. coli* O157:H7," said Dr. Sharon Brunelle, technical consultant, AOAC Research Institute. "Life Technologies has demonstrated that the Micro SEQ *E. coli* O157:H7 Detection Kit performs as well or better than the ISO and USDA reference methods for a variety of foods, earning Performance Tested Methods certification from the AOAC Research Institute."

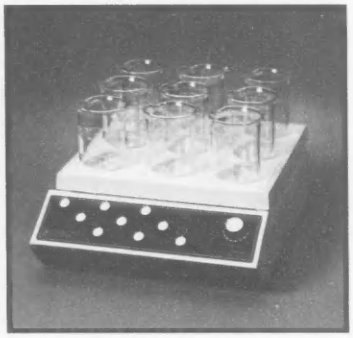
The AOAC Research Institute focuses on the development, use, and harmonization of validated analytical methods and its validation is important for food safety. The certification of the MicroSEQ *E. coli* O157:H7 detection assay means that the assay meets the stringent pathogen detection requirements of many companies and testing organizations responsible for safeguarding food supplies.

"Food contamination is a serious issue, one that can unfortunately have life-threatening repercussions," said Brian Kim, general manager responsible for food protection solutions at Life Technologies. "With the introduction of the MicroSEQ *E. coli* O157:H7 assay, Life Technologies is adding to the arsenal of tools available to authorities to help ensure a safe and reliable global food supply."

The assay is part of a growing portfolio of MicroSEQ kits designed to detect pathogens that contaminate the food supply, including the MicroSEQ *Salmonella* spp. Detection Kit, the MicroSEQ *Listeria monocytogenes* Detection Kit and the Micro SEQ *Listeria* spp. Detection Kit.

Life Technologies
+1 760.603.7200
Carlsbad, CA
www.lifetechnologies.com

INDUSTRY PRODUCTS



Torrey Pines Scientific, Inc.

Torrey Pines Scientific New Hot Plates and Stirrers with up to Nine Positions!

Torrey Pines Scientific, Inc. announces its new line of multi-position analog stirring hot plates and stirrers featuring 5 or 9 stirrers.

The large 12" (30.48 cm) square ceramic heater tops have a temperature range to 450°C.

The 5-position stirring units can stir 5-800 ml beakers, and the 9-position units can stir 9-500 ml beakers of aqueous solutions with a stirring range from 100 to 1500 rpm.

The units can support more than 50 pounds (22.6 kg) on the plate surface, and they are designed to keep spills out of the chassis. All controls are mounted well in front of the heater surface to protect against accidental burns.

The units are available in 100VAC/ 50Hz, 115VAC/60Hz, 220VAC/60Hz and 230VAC/50Hz. They are fused for safety and are supplied with user's manual and detachable line cord for the country of use. All units are UL, CSA and CE or equivalent rated.

Torrey Pines Scientific, Inc.
+1 866.573.9104
Carlsbad, CA
www.torreypinesscientific.com

U.S. Department of Agriculture and DuPont Collaborate on New Test for Hard to Detect Foodborne Pathogens

DuPont and the U.S. Department of Agriculture have agreed to collaborate on the development of a new test for detecting hard-to-identify strains of toxin-producing *E. coli* that are not currently regulated and have been causing increased instances of food contamination and illness.

DuPont was among the first to develop tests for *E. coli* O157:H7, the type of shiga toxin-producing *E. coli* (STEC) most frequently associated with global food contamination outbreaks. The USDA Food Safety and Inspection Service uses the DuPont™ BAX® System to monitor for this pathogen.

In recent years, other types of STEC have been identified as agents of foodborne illness, and these are a growing concern in the United States, Europe, Japan and food safety agencies worldwide. The Agricultural Research Service of the U.S. Department of Agriculture (USDA ARS) will collaborate with DuPont Qualicon to develop an effective test for the "Big 6" non-O157 STEC pathogens in food, and will also expand the diagnostic tools offered for use in the DuPont™ BAX® System.

"The USDA continually looks for opportunities to collaborate in ways that will expedite research to assist regulatory agencies and move technologies into the marketplace. This collaborative project to develop a discriminating STEC test is a good fit with our mission," said Pina Fratamico, USDA ARS research microbiologist.

"Developing the best science available into applications that meet the needs of the food industry has been our mission for more than a decade," said Marcos Cantharino, global business director – DuPont Qualicon. "Our DNA-based technology is easy to use, rapid and accurate, and provides the food industry with a simple and reliable test system to help assure protection of the global food supply."

The U.S. Centers for Disease Control estimate that non-O157 STEC bacteria are responsible for 36,000 illnesses, 1,000 hospitalizations and 30 deaths annually. The majority of these infections have been associated with six specific serotypes: STEC 026, 045, 0103, O111, O121 and O145.

Food processing companies around the world rely on the BAX® System to detect pathogens or other organisms in raw ingredients, finished products and environmental samples. The automated system uses leading-edge technology, including polymerase chain reaction (PCR) assays, tableted reagents and optimized media to detect *Salmonella, Listeria* species, *Listeria monocytogenes, E. coli* O157:H7, *Enterobacter sakazakii, Campylobacter, Staphylococcus aureus, Vibrio,* and yeast and mold. With certifications and regulatory approvals in the Americas, Asia and Europe, the BAX® system is recognized globally as one of the most advanced pathogen testing systems available to food companies.

DuPont Qualicon
+1 302.695.5300
Wilmington, DE
www.qualicon.com

INDUSTRY PRODUCTS

Mettler Toledo Economic Weighing Solution for Challenging Industrial Environments

Mettler Toldeo introduces the BBA226 stainless steel bench scale–perfect fit for many applications in any industrial environment, with light hose down requirements.

The BBA226 is a robust, rugged and cost-effective multi-functional stainless steel scale. It is designed for a wide range of weighing tasks from out-of-the-box simple straight weighing, to over/under checkweighing, product classifying, and even counting.

The scale features an IP65/IP67 rated stainless steel terminal with a fast stabilization time of less than one second, and a large, high-contrast LED display providing clear readability. The BBA226 features six simple and intuitive to operate keys for easy setup and handling-resulting in minimal operator training. A standard RS232 serial connection allows for required communication to a printer or PC.

The open, sturdy and straightforward platform design allows for effective access to all parts of the construction, providing efficient cleaning and reducing potential for bacterial growth and debris buildup.

The BBA226 is available in capacities ranging from 3 kg/5 lb to 150 kg/250 lb, with weighing platforms in both rectangular and square sizes. The bench scale features a readability of 15,000 d and is NTEP approved for legal-for-trade applications at 5,000 d.

Mettler Toledo
+1 614.438.4936
Columbus, OH
www.mt.com

Cryopak Introduces New Packaging for Phase Change Materials

Cryopak has introduced the H-Series, a new line of re-usable thermal control panels to their line of Phase Change Materials.

"The H-Series are made from HDPE plastic and use a spin welding method of sealing to insure a leak-proof closure," Anthony Alleva, technical services manager, said.

The new panels are designed to maintain dimensional stability when frozen and are available in 3 standard sizes. They are offered in both Phase 5™, which is used for 2°C -8°C applications, and Phase 22™, used for room temperature applications.

Cryopak
+1 888.827.3393
Edison, NJ
www.cryopak.com

Thermo Fisher Scientific Develops New Method to Eliminate High Boiling Matrix Contamination in GC and GC/MS Analyses of Pesticides in Food

Thermo Fisher Scientific Inc., has announced a new method to effectively eliminate invisible high boiling matrices in the analysis of pesticides in food. Incorporating a programmable temperature vaporizing (PTV) injector, the Thermo Scientific TRACE GC Ultra GC/MS analyzer achieves sensitive, fast and reliable analysis of pesticides in low fat food products, significantly enhancing the productivity and efficiency of gas chromatography (GC) and gas chromatography mass spectrometry (GC/MS) systems for analyzing pesticides in food, while eradicating high boiling matrix. The new method is detailed in an application note, entitled "Eliminate Invisible High Boiling Matrix in GC and GC/MS by Using PTV Backflush Injection Technique for Increased Productivity and Reliability," which is available to download via www.thermoscientific.com/ptv.

Pesticide extraction in low-fat food products, such as fruits and vegetables, normally results in high concentrations of lipid components as a matrix of high boiling compounds in the extracts. Once injected into a GC or GC/MS analyzer, high boiling substances accumulate on the analytical column of the system, contaminating it and causing an increasingly high background level. As high boiling compounds cannot be seen, there is no possibility of visual quality control. Bake-out procedures have been traditionally used, but these methods increase time between samples, are inefficient and reduce the column lifetime. An optimum solution would be the separation of the analytes from all high-boiling matrix material directly after injection.

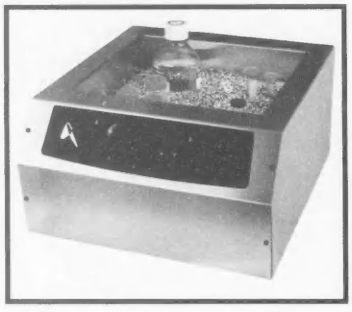
The new application from Thermo Fisher demonstrates that a PTV injector with a pre-column and a carrier gas backflush capability offers a powerful method for separating analytes from high-boiling compounds. Following sample extraction using the QuEChERS technique, a PTV injector was used to inject the extract into the Thermo Scientific TRACE GC Ultra GC/MS analyzer. Pesticides travelled quickly into the system's analytical column whereas

high boilers were kept in the pre-column that was swept backwards concurrently during the analytical run. As a result, the analytes transferred to the column and eluting to the MS source were free from high molecular weight compounds. Experimental results demonstrated that the PTV-GC/MS system can be used for both regular and large volume injections with numerous productivity advantages, including increased sensitivity, time and cost savings, easy maintenance, increased column lifetime and higher robustness of the entire analytical system.

Thermo Fisher Scientific Inc.
+1 800.532.4752
Austin, TX
www.thermoscientific.com/gc

Bead Bath™, a Waterless, Eco-Friendly Laboratory Water Bath from Lab Armor

Lab Armor™ is introducing the new Bead Bath™, a waterless alternative to contamination-prone traditional laboratory water baths. The waterless Bead Bath is designed from the ground up, delivering



Lab Armor

exceptional temperature uniformity while eliminating a major source of contamination in laboratories, water.

The Bead Bath is always on, ready for the next experiment, so scientists don't have to plan around warm-up times. There is also no burn-out risk because there is no water to evaporate. The Bead Bath keeps samples organized, naturally holding vessels in place without the need for racks, floats and bottleneck weights.

Vessels that can be used with the Bead Bath are not limited to water-tight containers. Scientists can safely incubate multi-well plates, petri dishes, and open-top samples at any angle.

Traditional water baths must be routinely monitored, cleaned, refilled and maintained with harmful germicides. The Bead Bath is practically maintenance free, providing scientists with more time for science.

In addition, Lab Armor Beads can be used to replace water in existing water baths, aluminum blocks in dry baths and even ice in ice buckets. These innovative beads can also be used in containers placed in ovens and incubators to replace sample racks.

The Lab Armor Bead Bath's thermal uniformity is: 37°C ± 0.5°C and 65°C ± 1.0°C with a temperature range of 5°C above ambient to 80°C. Lab Armor Beads support a wide temperature range of -100°C to +400°C in laboratory equipment. Lab Armor has a video demonstration available on their Web site which dramatically illustrates the features and benefits of Lab Armor Beads.

Lab Armor, Inc.
800.210.8612
San Antonio, TX
www.LabArmor.com

COMING EVENTS

NOVEMBER

- **2–3, PACK Expo International 2010,** McCormick Place, Chicago, IL. For more information, contact Amy Riemer at 978.475.4441 or go to www.packexpo.com.
- **3–5, Dairy Practices Council Conference,** Ramada Plaza Hotel and Conference Center, Columbus, OH. For more information, go to www.dairypc.org.
- **4–6, Mexico Association for Food Protection Annual Meeting,** Puerto Vallarta, Mexico. For more information, contact Javier Castro Rosas at jcastro@uaeh.edu.mx or capicr@hotmail.com.
- **6–10, American Public Health Association Annual Meeting and Expo,** Denver, CO. For more information, go to www.apha.org/meetings/.
- **8–11, IDF World Dairy Summit,** Auckland, New Zealand. For more information, contact Christian Robert at CRobert@fil-idf.org or go to www.wds2010.com.
- **10–11, China International Food Safety and Quality Conference & Expo,** Shanghai, Longemont Hotel, P.R.C. For more information, go to www.chinafoodsafety.com.
- **10–12, 2010 EFFoST Annual Meeting–Food and Health,** Dublin, Ireland. For more information, go to http://www.effostconference.com.
- **17, Ontario Food Protection Association Fall Conference,** Mississauga Convention Centre, Mississauga, Ontario, Canada. For more information, contact Victoria Rosa at 519.265.4119 or visit info@ofpa.on.ca.
- **18, Alabama Association for Food Protection 2010 Annual Meeting,** Montgomery Marriott Prattville Hotel & Conference Center at Capital Hill, Prattville, AL. For more information, contact G. M. Gallaspy at gm.gallaspy@adph.state.al.us.

DECEMBER

- **9–10, 2nd Food Safety Congress,** Military Museum, Istanbul, Turkey. Organized by the Turkish Food Safety Association. For more information, go to www.ggd.org.tr.

JANUARY

- **12, SfAM Winter Meeting,** Royal Society, Carlton House Terrace, London, England. For more information, go to www.sfam.org.uk.
- **21–26, ILSI Annual Meeting 2011,** Buena Vista Palace Hotel, Lake Buena Vista, FL. For more information, go to www.ilsi.org.
- **26–28, International Poultry Expo,** Georgia World Congress Center, Atlanta, GA. For more information, phone 770.493.9401 or go to www.ipe11.org.
- **31–Feb. 3, National Mastitis Council 49th Annual Meeting,** Hyatt Regency Hotel, Albuquerque, NM. For more information, go to www.nmconline.org.

FEBRUARY

- **16–18, Global Food Safety Conference,** London, UK For more information, go to www.tcgffoodsafety.com.
- **19–23, AFFI Frozen Food Convention,** Hyatt Regency, San Francisco, CA. For more information, go to www.affi.com.

APRIL

- **28–May 4, National Conference on Interstate Milk Shipments Conference,** Sheraton Baltimore City Center, Baltimore, MD. For more information, contact Marlena Bordson at 217.762.2656 or E-mail: ncims.bordson@gmail.com.

IAFP UPCOMING MEETINGS

JULY 31-AUGUST 3, 2011
Milwaukee, Wisconsin

JULY 22-25, 2012
Providence, Rhode Island

JULY 28-31, 2013
Charlotte, North Carolina

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IAFP OFFERS

All Guidelines now available on CD

"Guidelines for the Dairy Industry" from the Dairy Practices Council®

IAFP has agreed with the Dairy Practices Council® to distribute their guidelines. DPC is a non-profit organization of education, industry, and regulatory personnel concerned with milk quality and sanitation. Its membership roster lists individuals and organizations throughout the world. Professionals working through six permanent DPC task forces write DPC guidelines. Prior to distribution, every guideline is peer reviewed and submitted for approval to state regulatory agencies, where exceptions to each state's regulations are noted in the final document. These guidelines represent the state of the knowledge at the time they are written.

The guidelines are renowned for their common sense and useful approach to proper and improved sanitation practices. We think they will be a valuable addition to your professional reference library.

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

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❑ **IAFP Membership** (Member dues are based on a 12-month period and includes the *IAFP Report*)		**$ 55.00**	**$ 55.00**	**$ 55.00**
Optional Benefits:				
❑ *Food Protection Trends*	Add	$ 60.00	$ 75.00	$ 90.00
❑ *Journal of Food Protection*	Add	$150.00	$170.00	$200.00
❑ *Journal of Food Protection* Online	Add	$ 45.00	$ 45.00	$ 45.00
❑ All Optional Benefits – ***BEST VALUE!***	Add	$200.00	$235.00	$280.00
❑ **Student Membership** (Full-time student verification required)		**$ 27.50**	**$ 27.50**	**$ 27.50**
Optional Benefits:				
❑ Student Membership with *FPT*	Add	$ 30.00	$ 45.00	$ 60.00
❑ Student Membership with *JFP*	Add	$ 75.00	$ 95.00	$125.00
❑ Student Membership with *JFP* Online	Add	$ 22.50	$ 22.50	$ 22.50
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Contact the IAFP office for more information on the Sustaining Membership Program.

❑ Check Enclosed ❑ Visa ❑ Mastercard ❑ American Express ❑ Discover

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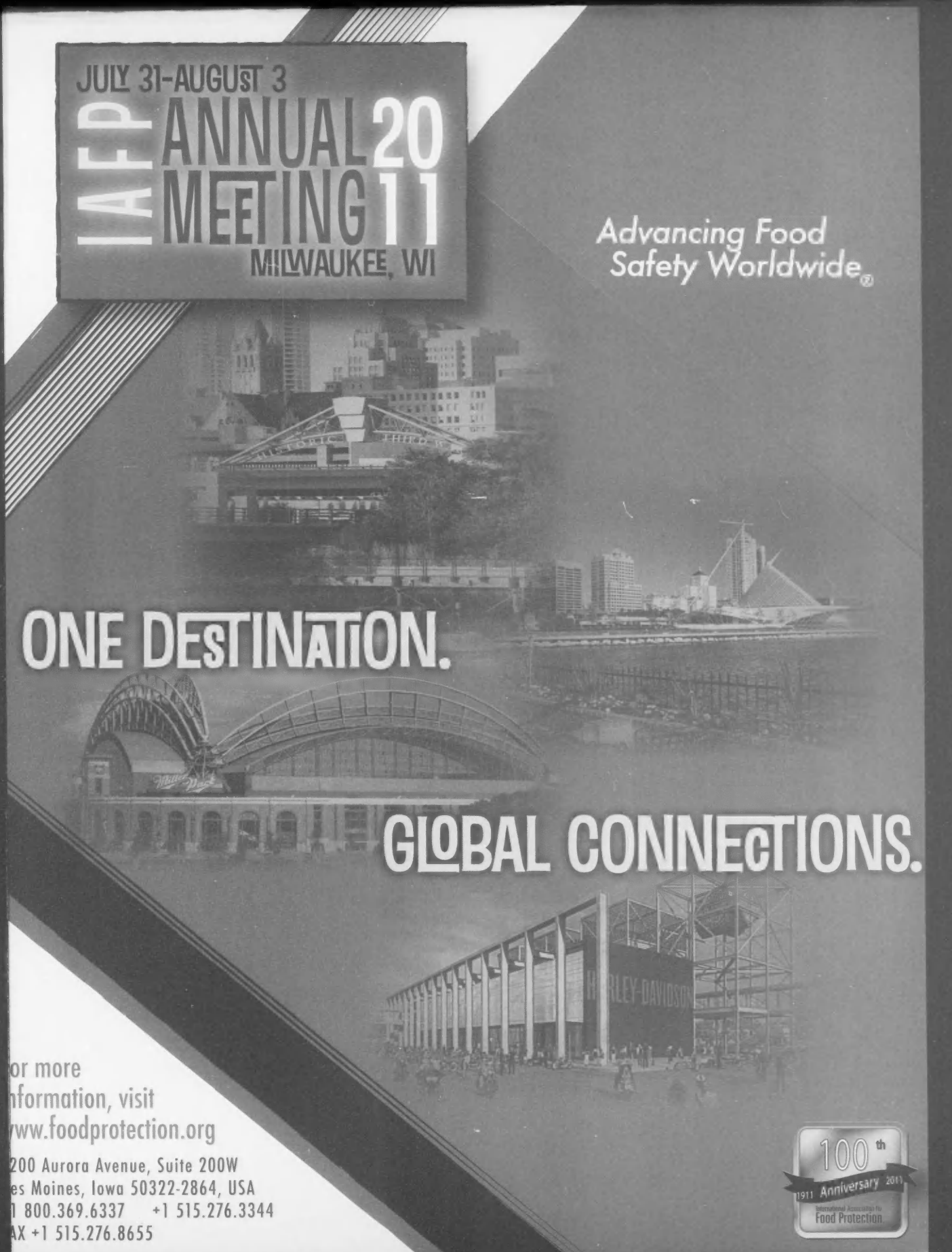
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