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Food Protection Trends

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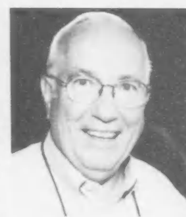

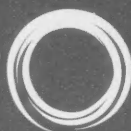

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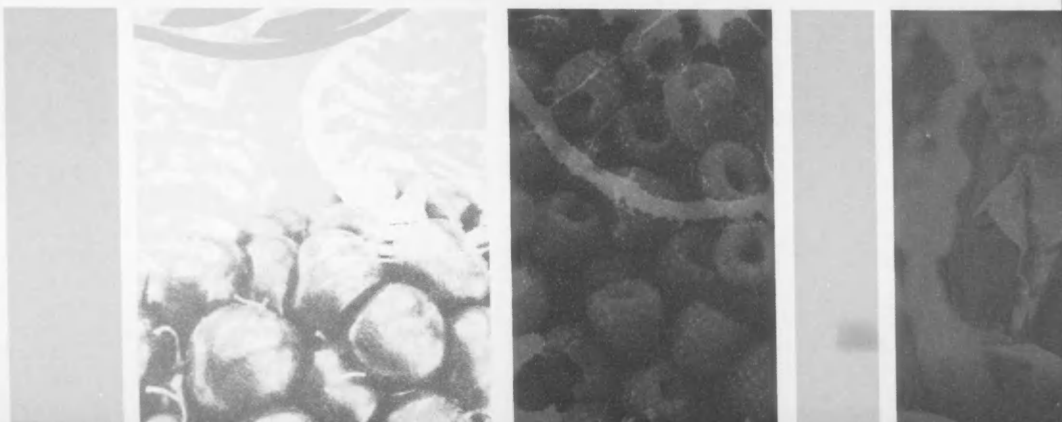

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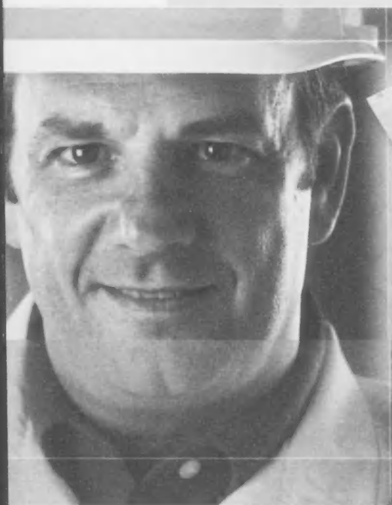

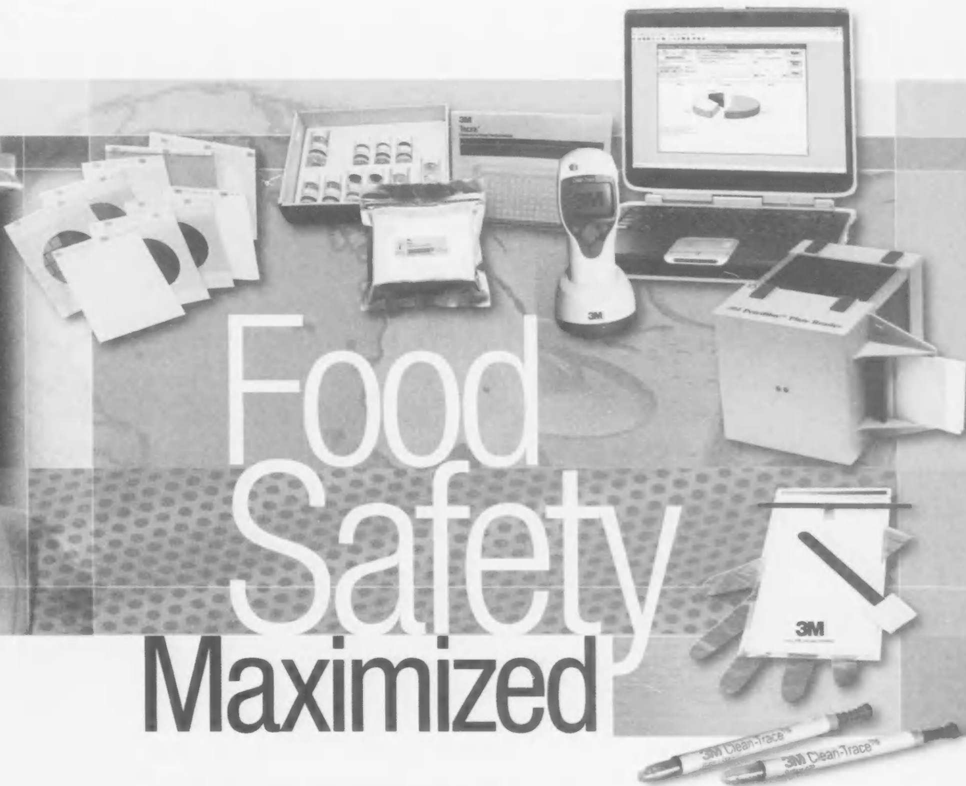

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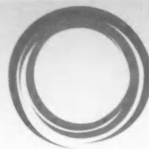

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6200 Aurora Avenue, Suite 200W
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Phone: +1 800.369.6337 • +1 515.276.3344
Fax: +1 515.276.8655
E-mail: info@foodprotection.org
Web site: www.foodprotection.org

FPT JOURNAL STAFF

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

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

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

Pam J. Wanninger: *Proofreader*

INTERNATIONAL ASSOCIATION FOR FOOD PROTECTION STAFF

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

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

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

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

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

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

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

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

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

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

Pam J. Wanninger: *Proofreader*

ADVERTISING

David Larson
Phone: +1 515.440.2810
Fax: +1 515.440.2809
E-mail: dave@larsonent.com

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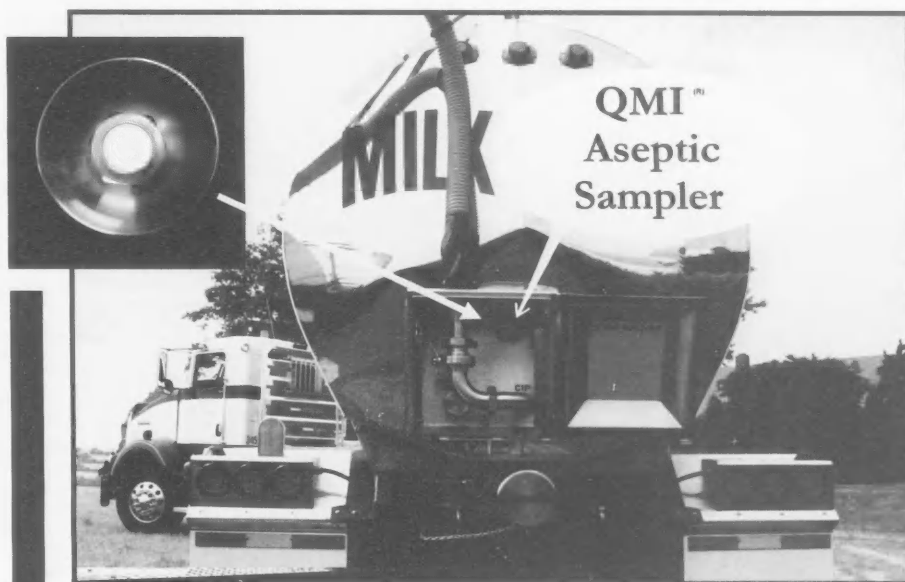

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SECRETARY, Katherine M. J. Swanson, Ph.D., Ecolab, 655 Lone Oak Dr., Eagan, MN 55121-1649, USA; Phone: 651.795.5943; E-mail: katie.swanson@ecolab.com

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AFFILIATE COUNCIL CHAIRPERSON, Dan Erickson, Harold Wainess & Associates, 2460 1st Ave. E., North St. Paul, MN 55109-3243; Phone: 651.779.3700; E-mail: djerickson2460@aol.com

EXECUTIVE DIRECTOR, David W. Tharp, CAE, 6200 Aurora Ave., Suite 200W, Des Moines, IA 50322-2864, USA; Phone: 515.276.3344; E-mail: dtharp@foodprotection.org

SCIENTIFIC EDITOR

David A. Golden, Ph.D., University of Tennessee, Dept. of Food Science and Technology, 2605 River Dr., Knoxville, TN 37996-4591, USA; Phone: 865.974.7247; E-mail: david.golden@tennessee.edu

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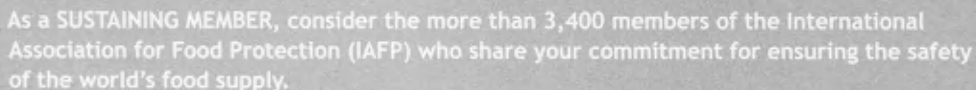

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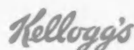

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PRESIDENT

"Do you have a colleague in mind that is worthy of an award?"

Greetings to all! I hope everyone had a wonderful holiday season. I had the opportunity to spend an entire week away from work. I spent the time with my family, with my boys, Max and Jack. Each day we did something different; a movie one day, roller skating another, we took the train to downtown Chicago another day and went to the Shedd Aquarium. And one day we went to Chuck E. Cheese's (CEC). For those of you not familiar with CEC, it is pizzeria/ arcade with a huge mouse (Chuck E. Cheese) welcoming and entertaining everyone. In true arcade fashion there are hundreds of games and even more children running around (it's very loud!). I think it is safe to say that most, if not all, children in the United States have been to CEC as either the host or a guest at a party there, or will be before their 6th birthday! The venue motto is, "Where a kid can be a kid!" The children eat pizza for about 60 seconds and then spend the rest of the time playing loud arcade games. Quite a few of the games reward the player with tickets; the higher your score, the more tickets the game pays you back. These tickets can then be traded in for "valuable" prizes. Subsequently, even as young children, we are taught that if we do well at something, there is a chance that we will be rewarded. I found this to be quite coincidental as I was considering what the topic of this month's column would be. I had decided months ago that the February column would be about awards, rewards, and incentives. There is a quote by Former U. S. President, Ronald Reagan that I typically try to keep in mind as I go about my daily work; "There's no limit to what a man can do or where he can go if he doesn't mind who gets the credit." This philosophy promotes the concept of team and of coming together for a common cause and consensus. In my experience, it is this notion that makes industry, academia, and governments successful. Equally vital to success are awards and incentives. Acknowledgment of one's performance is essential to an individual's sense of worth and value. There are numerous versions of employee satisfaction or employee engagement surveys that companies and institutions use to gage or measure success. The number one result of most of these surveys is that many employees feel their accomplishments are not recognized and rewarded appropriately. This has been the top survey response for numerous years past and continues to be so. It seems to be one of those things that we simply accept. Maybe we think it is bigger than us and that we can't change it. But really, how hard is it to say thank you to someone? How hard is it to send a note acknowledging a colleague's hard work, especially when they have gone above and beyond the call of duty? Do you have a colleague in mind that is worthy of an award? If yes, you are in luck! IAFP has 13 association awards available that recognize the effort and energy put forth by your coworkers, colleagues, company, student or professor. Of the 13 awards available, one is specifically an industry award for an outstanding company (the Black Pearl), 3 are for an individual, group or organization (Food Safety Innovation Award, GMA Food Safety Award, and the Frozen Food Foundation Freezing Research Award), and 9 are specifically for individuals (Fellow Award, Honorary Life Membership Award, Harry Haverland Citation Award, International Leadership Award, Maurice Weber Laboratorian Award, Larry Beuchat Young Researcher Award, Sanitarian Award, Harold Barnum Industry Award, and the Elmer Marth Educator Award). And, you don't have to choose between one or more deserving person, you may make multiple nominations. The general guidelines for nominating are clear and simple:

- Persons nominated for individual awards must be current IAFP Members (if they are not, encourage them to become a member; $50 base membership).
- Black Pearl Award nominees must be companies employing current IAFP members.
- GMA Food Safety Award and Frozen Food Foundation

Research Award (new in 2010!) do not have to be IAFP members.

- Previous award winners are not eligible for the same award.
- Executive Board Members and Awards Selection Committee Members are not eligible for nomination.

For further information and a detailed criteria description for each of the 13 awards and nomination forms go to www.foodprotection.org.

Here is the really important piece of information; all nominations must be received at the IAFP office by **February 16, 2010.** I realized that February 16th is in 15 days or less. But I urge you to take the time to nominate one of your colleagues right now. It doesn't take 15 days! It takes one person to initiate the idea, the nomination. Most of the nominations require examples of criteria fulfillment and 2–3 letters of recommendation. If you feel your nominee is worthy, it is likely you can easily identify 2 or 3 other people to write letters and help you pull the nomination together. There are so many out there in our profession scattered throughout industry, academia and government that are so worthy of recognition. There are so many out there that go above and beyond the call of duty to keep our global food supply safe on a daily basis.

You might agree with everything I have said, but might think that you don't have the time or that someone else will do it. But year after year what is so surprising and so disappointing is that some of these awards are not given out. Not because there are not worthy recipients, but because nobody was nominated. Nobody took the time to help give someone the one basic thing we all want, recognition. Do it, do it now!!

In closing I would like to mention that along with the recognition, each award comes with an inscribed plaque and most also include an Honorarium! My boys were extremely satisfied with the "valuable" award they received in return for their efforts in the arcade; a Chuck E. Cheese gumball machine. Just think how proud and satisfied your colleague will be with their recognition and award!

As always, feel free to contact me at anytime at VLewandowski@kraft.com.

ISOPOL XVII

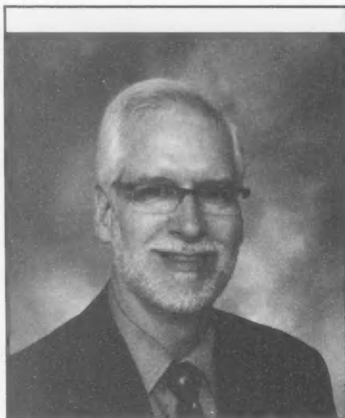
International Symposium on Problems of Listeriosis

May 5 - 8th, 2010

Alfândega Congress Centre, Porto, Portugal

CATÓLICA

"COMMENTARY"
FROM THE EXECUTIVE DIRECTOR



By DAVID W. THARP, CAE
EXECUTIVE DIRECTOR

"Thanks to each member of the Program Committee for your help"

February is stacking up to be a very busy month for IAFP. The Program Committee meets at the beginning of the month; the Dubai conference takes place toward the end of the month; and all this while preparations for three IAFP meetings and symposia are underway – the European Symposium, IAFP 2010 and the International Symposium. Let's take a look at each of these projects in more detail.

By the time this column is read, the Program Committee will have met in Anaheim to review submitted abstracts for IAFP 2010's technical and poster presentations. In addition to making decisions on more than 500 abstracts, the Program Committee finalizes scheduling for symposia, technical presentations and poster sessions during its two-day meeting. We are fortunate to have dedicated professionals serving on the Program Committee under the direction of Faye Feldstein, Chair for 2010. In addition to the time contributed at the meeting, Committee members also must give of their personal time to review the abstracts prior to the meeting and many times, they also help to follow up with symposia organizers when "fine-tuning" is needed on specific sessions. It is an honor to be selected to serve on the Program Committee as there are many IAFP Members who would like to serve in this capacity. We are glad to know those selected accept the responsibility and are willing to dedicate themselves to IAFP in this way. Thanks to each member of the Program Committee for your help in providing excellence in programming for IAFP 2010 for all attendees to enjoy!

On the staff side, a number of Annual Meeting related functions also take place in February. First, the work of the Program Committee must be digested and assembled to make up the program for IAFP 2010. Once this is completed, it is posted on our Web site and developed into our promotional brochure for mailing. Registration opens at the beginning of February, so these systems must be tested and ready for use. Efforts also continue to develop sponsorships and sign up exhibitors. At present, the exhibit space is over 50% sold and sponsorship monies are far ahead of last year's totals. All of our indicators are pointing to a very successful Annual Meeting at IAFP 2010!

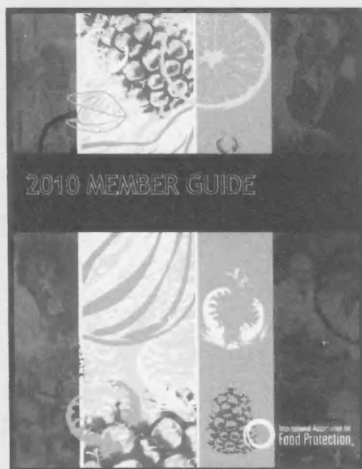
One meeting where we have offered support for three years now is the Dubai International Food Safety Conference (DIFSC). It has been a pleasure for IAFP to be involved with this high-quality, well-organized meeting that takes place each February in Dubai. This year, conference organizers have extended a half-price registration fee to IAFP Members. DIFSC provides IAFP with an avenue to reach food safety professionals in the Middle East, Asia and Africa. We have seen an increased interest in IAFP from the region since our participation in Dubai and we look forward to continuing this special relationship.

IAFP has two additional conferences that are well into the planning process. First is the European Symposium on Food Safety that will be held in Dublin, Ireland over the dates of 9–11 June this year. Registration is now open for this event and program information is available at the IAFP Web site. The Organizing Committee worked long hours over the past few months to develop the program content. In addition, technical papers can be submitted for consideration in either poster or oral presentation formats this year. For more information on submitting papers, please visit our Web site.

The other IAFP conference in process is the Second Latin America Symposium on Food Safety to be held in Bogota, Colombia in September.

This conference is considered our "International" symposium and follows symposia held in Brazil (2008) and Korea (2009). With this symposium, and those preceding it, we look to an IAFP Affiliate to take responsibility for organizing the program, registration and all conference details. The Colombian Association of Food Science & Technology is our Affiliate in Colombia and is heading up the conference planning. IAFP assists with program content, speaker invitations and onsite presentations. This series provides an excellent opportunity for IAFP to expand its network of food safety professionals around the world. With the help of the local host, IAFP can become more well-known to conference participants.

So, as you can see, February is a very busy month for IAFP. We continue to plan ahead for each of the conferences where food safety professionals have come to count on us. We hope to see you at one or more of the IAFP conferences during this year!



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Reduction of *Escherichia coli* O157:H7 in Fresh Spinach Using Bovamine® Meat Cultures as a Post–harvest Intervention and Its Impact on Sensory Properties

SARA E. GRAGG, J.C. BROOKS and MINDY M. BRASHEARS*
Texas Tech University, Dept. of Animal and Food Sciences, Box 42141, Lubbock, TX 79409–2141, USA

ABSTRACT

To determine the inhibitory actions of lactic acid bacteria (LAB) toward *E. coli* O157:H7 in spinach, fresh spinach was inoculated with a 1×10^6 CFU/ml target population of the pathogen and then treated either with sterile distilled water or a four-strain LAB cocktail (2.0×10^8 CFU/ml). Both treatments were stored at 7°C for 24 h and then compared to an inoculated control to determine pathogen reductions. Reductions achieved by water alone and LAB were significant at 0.88 log CFU/g ($P < 0.0001$) and 1.03 log CFU/g ($P < 0.0001$) respectively, in comparison to the control sampie. The improved reduction achieved by LAB over water was significant ($P = 0.0363$), indicating that LAB was the most effective intervention in the study. A triangle test was implemented to determine if LAB results in a difference in the sensory properties of fresh spinach when compared to water-treated spinach. Two spinach samples were rinsed with water and considered identical. The third spinach sample was rinsed with the LAB cocktail at a target concentration of 2.0×10^8 CFU/ml. A total of 40 panelists participated in the study and 16 correctly identified the LAB spinach as being the one odd sample. A total of 18 and 20 samples should be identified correctly as the odd sample in order to be statistically significant at the levels of 0.05 and 0.01, respectively. These results indicate that a significant difference does not exist ($\alpha = 0.05$ and 0.01) when LAB is applied to fresh spinach, making it an acceptable intervention from the standpoint of consumer acceptance.

A peer-reviewed article

*Author for correspondence: Phone: 806.742.2805; Fax: 806.742.3788
E-mail: mindy.brashears@ttu.edu

INTRODUCTION

Escherichia coli O157:H7 is a virulent pathogen that has been associated with produce in 21% of the foodborne outbreaks that occurred between 1982 and 2002 *(2)*. While *E. coli* O157:H7 is often associated with raw or undercooked ground beef *(15)* awareness of the potential for fresh fruit and vegetable consumption to cause illnesses from this pathogen has increased in recent years *(7, 8)*. In the mid-1990s, fresh produce was recognized as a vector for foodborne illness caused by *E. coli* O157:H7 *(7)*.

Because of the nature of its production, spinach is vulnerable to pathogenic contamination at every step in the production process. According to Warriner et al. *(21)*, post-harvest handling is believed to be the primary source of contamination. However, the same study also identified soil, water and harvest equipment as factors that may lead to the contamination of spinach plants during the growing process. As a result, it is necessary that spinach safety is emphasized throughout the entire production process.

Because fresh spinach production lacks a thermal kill step, reliance is placed on post-harvest wash interventions to control microbial populations. Up to 90% of spinach processors utilize sodium hypochlorite (chlorine) washes as the primary barrier against pathogenic contamination *(3)*. While chlorine is known to be an effective antimicrobial agent, numerous factors affect the efficacy of chlorine applied to fresh spinach, including water temperature, pH and contact time *(16)*. In general, it is understood that the ability of chlorine to inactivate microorganisms present on the surface of spinach leaves is not exceptional *(13)*. Warriner et al. *(21)* stated that the efficacy of chlorine is capable of reducing total microbial populations by no more than 2 logs. Beuchat *(4)* discovered that 200 parts per million (ppm) chlorinated water and deionized water were equally efficacious at killing, removing or inactivating *E. coli* O157:H7 on the surface of lettuce leaves. Lang et al. *(11)* observed reductions of *E. coli* O157:H7 on lettuce leaves of only 1.10 logs in comparison to the control after treatment with 200 ppm chlorine. These minimal reductions, in combination with the lack of a thermal processing step, indicate the need for additional interventions to be developed.

The use of lactic acid bacteria (LAB) as an intervention to control microbial growth in the food industry is not a new strategy. There are multiple properties associated with bacteria belonging to the LAB family that prove to be lethal to other bacteria, including some pathogens. Metabolism of LAB results in the production of bactericidal compounds, including hydrogen peroxide, bacteriocins, carbon dioxide and organic acids *(9, 17, 18)*. Production of organic acids, including lactic, propionic and acetic acid, induce lethal effects by acting on the cytoplasmic membrane of the bacterial cell *(9)*. Additionally, the creation of an acidic environment that is considered unfavorable for pathogenic growth aids in the control of *E. coli* O157:H7 *(9)*. The effects of such compounds on the sensory characteristics of fresh spinach are unknown, and consumer acceptance must be determined before LAB can be implemented as a post-harvest intervention in spinach production.

Lactic acid bacteria have been successfully utilized to control *E. coli* O157:H7, and other pathogens in raw meat products *(9)*, in cooked meat products *(1)* and in cattle *(5, 22, 23)*. These studies report that the use of NP51, alone or in combination with other LAB, has been effective in controlling the pathogen. Therefore, LAB may be an effective intervention for the spinach industry as well.

The overall objective of this study was to determine if Bovamine® Meat Cultures, a commercially produced LAB product, can be effectively implemented as a post-harvest intervention to reduce levels of *E. coli* O157:H7 in fresh spinach and to determine if the application of Bovamine® Meat Cultures to fresh spinach resulted in a statistical difference in sensory characteristics between treated and control spinach.

MATERIALS AND METHODS

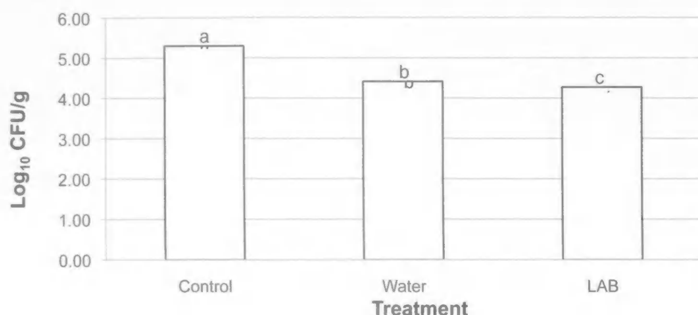
A cocktail mixture of four *E. coli* O157:H7 strains was used: A4 966, A5 528, A1 920 and 966. All strains were isolated from cattle and are maintained in the stock culture collection at Texas Tech University. The cocktail was prepared by making frozen concentrated cultures of each culture as described by Brashears et al. *(6)*. Briefly, one vial from each strain was obtained from the -80°C stock culture. A sterile loop was used to add the strains to separate tubes of brain heart infusion broth (BHI) (EMD, Gibbstown, NJ). The strains were incubated overnight at 37°C, transferred into fresh BHI tubes and incubated an additional night at 37°C. The concentration of each strain was determined to be at the appropriate numbers by plating on tryptic soy agar (TSA) (EMD, Gibbstown, NJ) and incubating for 24 hours at 37°C. All four strains were then transferred to fresh BHI and allowed to grow at 37°C overnight before being centrifuged for 10 minutes at 4,000 × g. The pellet was resuspended in BHI containing 10% glycerol and all four strains were then combined in equal portions to create the four-strain cocktail. The cocktail was then stored as a frozen culture at -80°C in 1-ml portions at a concentration of 1.0×10^9 CFU/ml in the Texas Tech University inventory.

Bovamine® Meat Cultures used in this study were obtained from Nutrition Physiology Corporation (Guymon, OK). This commercially available LAB product is comprised of four LAB strains: *Lactobacillus acidophilus* (NP 51), *Lactobacillus cristpatus* (NP 35), *Pediococcus acidilactici* (NP 3) and *Lactobacillus lactis* subsp. *lactis* (NP 7) *(19)*. Isolates NP 51 and NP 35 were originally isolated from cattle, while NP 3 was isolated from cooked hot dogs and NP 7 from alfalfa sprouts *(19)*. The culture was commercially prepared and packaged in 10-g portions in a freeze-dried form prior to shipping to Texas Tech University.

Pathogen reduction study

Fresh bagged baby spinach was obtained from a local grocery store and weighed into a sterile poultry rinsate bag (VWR, West Chester, PA) to ensure that total weight was approximately 500 g. The four-strain cocktail of *E. coli* O157:H7 was diluted 1:1000 in buffered peptone water (BPW) (OXOID, Basingstoke, Hampshire, England) to obtain a final concentration of 1.0×10^6 CFU/ml and an inoculum volume of 5 L. The pre-weighed spinach was submerged in the inoculum and allowed to soak for 20 minutes to facilitate attachment. Using a sterile tongs, the inoculated spinach was spread evenly across sterile drying racks in a biological hood (Fisher Hamilton model #54L925, Two Rivers, WI) and allowed to dry for one hour. A LAB

FIGURE 1. Composite least squares means *E. coli* O157:H7 levels in each spinach treatment held at a target temperature of 7°C for 24 hours



[a,b,c] indicates treatments that differ ($P < 0.05$).

[1] LAB is repressentative of the Bovamine® Meat Cultures lactic acid bacteria treatment.

wash with a concentration of 2.0×10^8 CFU/ml was prepared by combining 5 g of freeze-dried Bovamine® Meat Culture with 495 ml of sterile distilled water. The concentration of LAB was determined by making serial dilutions in buffered peptone water and plating on Lactobacilli MRS Agar (MRS) (EMD, Gibbstown, NJ). The MRS agar plates were incubated at 37°C for 24 to 48 hours. A control wash consisting of 500 ml of sterile distilled water was also prepared. Upon completion of drying, 100 g of the dry, inoculated spinach was added to the LAB rinse and 100 g to the control water rinse in sterile poultry rinsate bags. The bags were agitated for 1 minute at 230 rpm on an automatic orbital shaker (KS 260 Basic, IKA, Wilmington, NC). A third set of 100 g of dry, inoculated spinach was placed directly into a sterile Whirl-Pak (Nasco, Fort Atkinson, WI) bag to serve as the background control for this experiment. Following agitation, both rinse treatments were allowed to soak during the 0, 5 and 10 minute sampling time points. After 10 minutes, each rinse was drained in a sterile colander and transferred to sterile Whirl-Pak bags, using sterile tongs. All samples were stored at 7°C between sampling intervals.

From each rinse and the background control, 10 g of spinach was collected at 0, 5 and 10 minutes and at 1, 4, 8 and 24 hours. The exact sample weight was recorded and used to determine colony forming units (CFU) on a per gram basis. At each time point, the sampled spinach was stomached (Seward Model 400, Bohemia, NY) with 90 ml of buffered peptone water at 230 rpm for 2 minutes. Homogenized samples were serially diluted and quantitatively analyzed for *Escherichia coli* O157:H7, using a Neo-Grid™ Method (Neogen, Lansing, MI). Neo-Grid™ filters were placed on CHROMagar (CHROMagar, Paris, France) containing tellurite at a level of 2.5 mg/L. Tellurite was added to reduce the interference from other bacteria. CHROMagar plates were incubated at 37°C for 24 ± 2 hours. Mauve colonies were counted as presumptive positive for *E. coli* O157:H7 and agglutinated at random for confirmation, by use of a latex agglutination kit (Remel, Lenexa, KS).

This study was classified as a complete randomized block design. The Statistical Analysis System (SAS) software was used to analyze the data. All data were subjected to the PROC MIXED and PROC UNIVARIATE commands. The Least Squares (LS) means obtained from SAS were used to identify statistically significant differences between each individual treatment and the control. Additionally, the LS means of the water and LAB washes were compared to identify if one treatment was significantly more effective than the other. The Shapiro-Wilk value provided by the PROC UNIVARIATE procedure was used to determine normality of the data. The experimental procedure was replicated a total of three times.

Sensory study

Fresh bagged baby spinach was obtained from a local grocery store. All bags were combined to minimize the effects of natural variability and randomize the product. The combined spinach was then divided into three samples. One sample was rinsed with Bovamine® Meat Culture at a concentration of 2.0×10^8 CFU/ml. The remaining two samples were rinsed with tap water and considered to be identical. All 3 samples were drained in separate colanders and distributed into sample cups labeled with their respective three-digit sample number. The samples were placed on a tray, covered with aluminum foil and held in the refrigerator at 4°C before serving to panelists.

Forty consumer panelists were chosen at random to participate in the sensory study. All panelists were presented with the three samples simultaneously in a triangle test. They were instructed to evaluate each sample from left to right and identify the one sample they perceived to be different. The order in which the samples were presented to the panelists was randomized in order to decrease bias. Panelists were provided with a cracker, water and expectorant cup to clear their palate between samples. An answer sheet was supplied and panelists were encouraged to include comments.

Statistical significance of sensory data was evaluated using published statistical tables *(14)*. These tables were utilized to determine if statistically significant differences existed in the sensory characteristics of spinach treated with lactic acid producing-bacteria by comparing the number of responses identifying the correct "odd" sample to alpha values of 0.05 and 0.01. Additionally, the number of discriminators was calculated using methods described by Lawless and Heymann *(12)*. Discriminators are defined as those individuals who saw the true difference and selected the correct "odd" sample. It is speculated that the remainder of participants who selected the LAB sample merely guessed and were not able to perceive the true difference.

RESULTS

Pathogen reduction study

No interactions were detected among the treatments in this study. With both treatments, the total num-

TABLE 1. Summary of triangle test sensory data to determine statistical significance between tap water–treated fresh spinach and fresh spinach treated with Bovamine® Meat Cultures at an α–level of 0.05 and 0.01

α–Level	Correct Responses Required	Correct Responses	Decision	Interpretation
0.05	18[a]	16 < 18	Accept Null	No Detectable Difference
0.01	20[a]	16 < 20	Accept Null	No Detectable Difference

[a]Reject the assumption of "no difference" if the number of correct responses is greater than or equal to the tabled value.

bers of *E. coli* O157 declined over the 24 hour sampling period. *E. coli* O157:H7 populations recovered from the control maintained fairly consistent levels at just above 5 log CFU/g throughout the entire 24 hour study.

Because there were no time by treatment interactions, Fig. 1 represents the LS means of all data points composited for each treatment. As illustrated by this figure, both water ($P < 0.0001$) and LAB ($P < 0.0001$) resulted in significant reductions in comparison to the control. Water reduced *E. coli* O157:H7 numbers by 0.88 log CFU/g, while LAB was successful at reducing it by 1.03 log CFU/g (Fig. 1). The improved reduction of LAB was significantly different from that of water ($P = 0.0363$). This indicates that LAB was significantly more effective than water at reducing *E. coli* O157:H7 populations on baby spinach leaves when the composite LS means of each treatment were compared over the 24 hour sampling period.

Sensory study

Of the 40 panelists, 40% *(16)* correctly selected the LAB spinach as being the one "odd" sample. For a population of 40 panelists, the numbers of correct responses required for statistical significance at the $\alpha = 0.05$ and $\alpha = 0.01$ were 18 and 20, respectively. These values were determined using an equation outlined in Table T8 of the third edition of *Sensory Evaluation Techniques (14)*. The null hypothesis for this triangle test states that no difference exists between the control spinach and the spinach treated with lactic acid bacteria. Therefore, because the 16 correct responses obtained is less than the required responses of 18 and 20, there was no statistical significance and the null hypothesis was accepted at the $\alpha = 0.05$ and $\alpha = 0.01$ levels. These results are summarized in Table 1. Calculations to determine the number of discriminators estimated that 4 (10%) panelists perceived the true difference and selected the LAB sample as a result. These results suggest that a mere 25% (4 out of 16) of panelists who selected the LAB spinach truly detected a difference in the sensory properties of fresh spinach treated with Bovamine® Meat Cultures.

DISCUSSION

While little research has been conducted evaluating the effectiveness of LAB as an intervention for fresh spinach, the use of LAB in ground beef has been investigated. Smith et al. *(19)* utilized the same combined cultures included in Bovamine® Meat Cultures as an intervention to reduce the presence of *E. coli* O157:H7 in ground beef. The cultures were added to ground beef at a level of 10^9 CFU/g and stored at 5°C for 14 days. The combined cultures significantly reduced *E. coli* O157:H7 levels by 2.0 logs and 3.0 log cycles after 3 and 5 days of storage, respectively.

Given the proven effectiveness of these LAB cultures in other food products, Bovamine® Meat Cultures may have great potential for application in the spinach industry, as well. The LAB treated spinach was evaluated for a mere 24 hours and resulted in reductions of 1.55 log CFU/g compared to the control at the 24 hour sampling time (data not shown). Because LAB have the potential to produce inhibitory products over time, it is possible that longer exposure times could result in additional reductions in the spinach, making the present 24 hour study preliminary in nature. Additionally, these cultures may be an effective pre-harvest intervention to be applied to the crops prior to harvest. Furthermore, if the LAB-treated spinach had been held at 7°C for longer than 24 hours, perhaps the population of *E. coli* O157:H7 would have continued to decline in comparison to the control spinach and ultimately achieved reductions similar to those found by Smith et al. *(19)* in ground beef. Additionally, differences in the nutrient availability of the two products may play a role in the effectiveness of Bovamine® Meat Cultures. Meat is a nutrient dense environment with a high water activity *(10)*, while the surface of spinach leaves has low water availability and is rather nutrient poor in comparison to the internal surfaces of the plant *(20)*. A high level of nutrients and available water present in the food matrix will improve the metabolic activity of LAB and the resultant production of antimicrobial compounds will also increase.

Before application to the spinach, the LAB concentration was determined to be 7.5 $\log_{10}$ CFU/ml (3.0×10^7 CFU/ml) (data not shown). This value is the mean concentration of all three replications and is nearly 1 log CFU/ml less than the target concentration of 8.3 $\log_{10}$ CFU/ml (2.0×10^8 CFU/ml). This may be the result of adding the Bovamine® Meat Cultures to sterile distilled water.

Because solutes have been removed from distilled water, the osmotic pressure is greater outside the LAB cell relative to inside the cell. As a result, water will diffuse into the cell, potentially causing lysis.

Given that the LAB treatment was only applied as a rinse and at one concentration (2.0×10^8 CFU/ml), perhaps an improvement in performance could be achieved with a different application method or concentration level. For example, the implementation of a spray intervention may result in differing levels of success. Additionally, the Bovamine® Meat Cultures may be capable of the same degree of reduction in *E. coli* O157:H7 populations at concentrations lower than 2.0×10^8 CFU/ml. These items must be addressed before a definitive conclusion can be drawn about the effectiveness of LAB as a post-harvest intervention in the production of fresh spinach. The present study does not support LAB as an effective post-harvest intervention for fresh spinach. However, the results obtained do provide a foundation for future investigations.

Sensory results on the spinach were also similar to those of previous reports, including a 2002 study conducted by Amézquita and Brashears *(1)* which evaluated the effects of LAB on ready-to-eat meat products. They also executed a triangle test to determine whether an isolate *Pediococcus acidilactici* resulted in a significant difference between LAB treated and control frankfurters. Triangle tests were conducted on the frankfurters 9 times throughout the 56-day storage period. The number of correct responses obtained during each test was less than the number required for statistical significance. Therefore, they concluded that the application of *P. acidiliactici* did not result in a significant difference between treated and control frankfurters. Their findings support the results of the current spinach study, in which we did not have significant sensory changes in the product after the application of the cultures.

The lack of statistical significance obtained with this triangle test supports the use of LAB as a post-harvest intervention in the production of fresh spinach, from a consumer acceptance standpoint. The results of this study indicate that there is great potential for future research. As a result of metabolism and fermentative activities, LAB produce multiple by-products that have the potential to adversely affect the sensory properties of fresh spinach, particularly during shelf-life. For this reason, it is necessary to evaluate sensory changes throughout the shelf-life to determine if the production of metabolites over time will result in a statistically significant difference and decrease the consumer acceptance of product treated with Bovamine® Meat Culture.

ACKNOWLEDGMENTS

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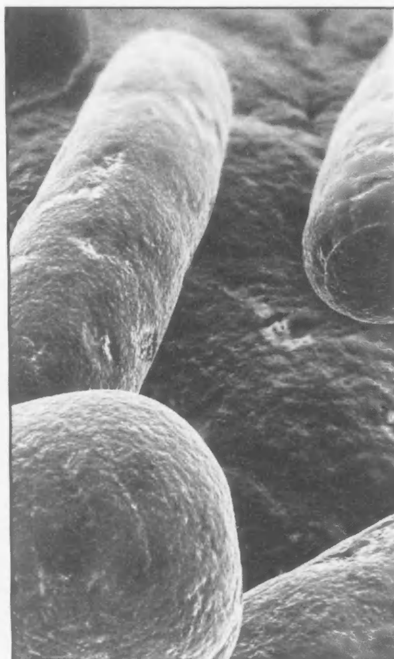

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Background Factors Affecting the Implementation of Food Safety Management Systems

BRITA BALL,[1*] ANNE WILCOCK[2] and MAY AUNG[2]
[1]Dept. of Food Science and [2]Dept. of Marketing and Consumer Studies, University of Guelph, Guelph, Ontario N1G 2W1, Canada

ABSTRACT

Why don't workers follow Hazard Analysis Critical Control Point (HACCP) guidelines? Socio-psychological models have been used to describe factors that influence the implementation of food safety management systems (FSMSs) in food processing facilities. The theory of planned behavior posits that perceived control over one's own behavior, one's attitude and the influence of others are antecedents of behavioral intention and/or behavior.

The objectives of this study were to identify background factors that influence food safety behaviors of production workers in small and medium sized meat processing facilities and examine how these factors are applicable to the theory of planned behavior. Using a qualitative approach, the researchers conducted 13 in-depth interviews at five meat plants and two focus group interviews with representatives of government and industry agencies. These interviews generated 219 single-spaced pages of verbatim transcripts, which were analyzed by use of NVivo 7 software.

Ten themes found in the data relate to elements in the theory of planned behavior that were demonstrated to be applicable to a meat processing establishment. Confirmation of factors having the strongest influence on production workers in meat plants may assist in developing targeted interventions that improve the implementation of FSMSs in the meat and other food processing sectors.

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*Author for correspondence: Phone: +1 519.824.4120 ext. 52087; Fax: +1 519.824.6631
Email: bball@uoguelph.ca

INTRODUCTION

Numerous studies have identified barriers to implementing HACCP in small and medium sized food processing plants *(8, 13, 15)*. Some researchers suggest that factors such as lack of knowledge and/or resources are the main barriers *(4, 10, 14, 20, 21)*.

Several researchers have used socio-psychological models to describe factors that influence the implementation of food safety behaviors in commercial settings *(2, 3, 7, 11, 12, 18, 19)*. Some of these studies applied rigorous analyses and so are able to predict or explain behavior. Predictive power enables interventions to be targeted to the right people, while explanatory power provides information about appropriate types of interventions *(23)*.

Clayton and Griffith *(7)* determined that the theory of planned behavior *(1)* is useful for explaining hand hygiene practices of caterers. Hinsz et al. *(12)* showed that the theory is strongly supported as a way to explain self-reported food safety behaviors of workers in a meat processing plant. According to the theory of planned behavior *(1)*, several elements can be used to predict and understand the intentions and behaviors of individuals: attitude toward the behavior, subjective norms and perceived control over the behavior. Additional elements may be identified *(1)*. Hinsz et al. *(12)* found that adding work routines improved the

TABLE 1. Profiles of in-depth interviewees

Interviewee code	Job/Position	Experience in food industry (yrs)	Employment at current plant (yrs)
SrMgr/Owner-1	Co-owner	> 20	> 20
SrMgr/Owner-2	Co-owner	> 20	> 20
SrMgr/Owner-3	Co-owner	> 20	1–5
SrMgr/Owner-4	Co-owner	> 20	> 20
SrMgr/Owner-5	General manager	1–5	1–5
FSC-1	Food safety coordinator	16–20	1–5
FSC-2	Food safety coordinator	6–10	1–5
FSC-3	Food safety coordinator	6–10	1–5
FSC-4	Food safety coordinator	1–5	1–5
Prod-1	Production worker	> 20	1-5
Prod-2	Production worker	> 20	< 1
Prod-3	Production worker	11–15	11–15
Prod-4	Production worker	6–10	1–5

TABLE 2. Profiles of focus group interviewees

Interviewee code	Job/Position	Experience in food industry (yrs)	Employment at food plants (yrs)
FGrp1-Int1	Government food safety specialist	1–5	< 1
FGrp1-Int2	Government food safety specialist	6–10	6–10
FGrp1-Int3	Government food safety policy analyst	6–10	1–5
FGrp1-Int4	Government food safety policy analyst	6–10	< 1
FGrp1-Int5	Government food safety policy analyst	1–5	< 1
FGrp2-Int1	Industry association technical director[*]	> 20	> 20
FGrp2-Int2	Industry association executive director[*]	> 20	<1
FGrp2-Int3	Industry association executive director[†‡]	11–15	<1

[*]Ontario Independent Meat Processors; [†]Alliance of Ontario Food Processors; [‡]Ontario Food Processors Association

prediction of intentions and general self-reported food safety behaviors of meat plant workers.

Knowing the antecedents to the elements in the Hinsz model *(12)* may assist in developing targeted interventions to improve food safety behaviors in meat plants. The objective of this study is to describe background factors influencing production workers in meat processing establishments with respect to the implementation of food safety management systems (FSMSs).

METHODS

Using a qualitative approach, we conducted 13 in-depth interviews with personnel in five small to medium sized meat processing plants (Table 1). According to McCracken *(17)*, eight in-depth interviews are sufficient to generate ideas and assumptions common to a culture.

Additionally, two focus group interviews were held with representatives of the Ontario Ministry of Agriculture, Food and Rural Affairs (FGrp1) and in-

TABLE 3. Profiles of meat establishments

Food safety management system	Inspection jurisdiction	Number of workers in production	Number of workers in company
HACCP certified	Ontario	30–99	30–99
HACCP implemented	Ontario	30–99	30–99
HACCP implemented	Canada	< 10	10–29
Working toward GMP certification	Municipal	< 10	10–29
No written system	Municipal	< 10	30–99

dustry associations (FGrp2) (Table 2). Focus groups with three to five participants are suitable when participants are very knowledgeable about or are experienced with the topic being discussed *(6, 16)*.

Businesses were selected purposively on the basis of the stage of FSMS implementation (from no written program to HACCP certified by a third-party audit), as well as inspection jurisdiction — municipal, provincial and federal. All establishments had fewer than 100 employees (Table 3). Although all businesses were known to be members of the industry association, the Ontario Independent Meat Processors, it was unknown at the time of selection that representatives of several plants were directly associated with the Board of Directors.

In-depth interviews

In-depth interviews allow the exploration of a topic with respondents *(17)*. Using a semi-structured format, interviews of 30 to 60 minutes duration were held at the plants. An interview guide containing a series of open-ended questions for three personnel types was developed to cover themes related to *production systems*, *organization characteristics* and *employee characteristics*, as suggested by van der Wende *(24)*.

The interview questions for the senior managers/owners (SrMgrs/Owners) and food safety coordinators (FSCs) were pretested by a manager/former food safety coordinator of a meat plant as well as by two food safety specialists with the Ontario government. The interview questions for production employees were pretested by a former meat plant line-employee. The pretesting resulted in minor wording changes and a reordering of some questions.

Plant personnel selection was purposive. The researchers requested interviews with owners/senior managers, food safety/quality assurance coordinators or managers, and food safety or production personnel responsible for monitoring and recording FSMS information. Individuals were selected by plant management. In one plant, the senior manager/owner was responsible for food safety and worked directly in production; he indicated that he could provide the information and declined the request for employees to participate.

Focus group interviews

Focus groups are useful in a number of ways, from stimulating new ideas and creative concepts to generating feedback on specific products, programs, services, and institutions through specific discussions *(22)*. For this study, focus group interviews followed in-depth interviews with the intention of further confirming and clarifying themes identified through the in-depth interviews.

Focus group interviews, each lasting about one hour, were held in industry and government agency boardrooms. A focus group guide provided the framework for discussion *(5, 9)*. The guide had two questions: *What do you believe are indicators of success in companies that have been successful at implementing some kind of food safety management system?* and *What do you believe are the main factors that affect, positively or negatively, the implementation of food safety management systems on the plant floor?* The questions allowed a focus on any aspects that were considered relevant.

Accompanying the first question was a probing question to clarify participants' ideas about indicators of success. Accompanying the second were probing questions related to production systems, as well as organization and employee characteristics. The probes were used as needed to ensure that discussion covered the categories described by van der Wende *(24)*. The focus group guide was reviewed by a qualitative specialist and revised slightly prior to use.

Data analysis

The audio-recorded interviews generated 219 pages of single-spaced verbatim transcripts. In-depth interviews accounted for 189 pages of transcripts, while focus group interviews provided 30 pages. Repetitions, filler words and hesitations were eliminated from the transcriptions, as they did not add value to the context. The transcripts were verified by a second party. Contradictions within plants were noted immediately following in-depth interviews.

A content analysis of the transcribed data was conducted with NVivo 7 software to identify patterns and themes. The researchers read and reflected on the content of the transcripts. Words and phrases in the transcripts were highlighted and coded under different headings, or "themes." Because the data were collected using questions specific to production systems, employees and the organization, three themes for content analysis were pre-determined. However, new pat-

terns and themes identified from the data were added; thus the analysis was both deductive and inductive *(5)*. Themes/subthemes were then considered in relation to the food safety behavior model of Hinsz et al. *(12)*.

Using multiple data collection methods and data sources helps to increase the dependability of the data by allowing triangulation *(5)*. In-depth interviewees in different positions and from different organizations provided some triangulation. This was strengthened by two focus group interviews, each with representatives of different agencies.

RESULTS

Themes identified in this study were found to be supported by various respondents from both in-depth interviews and focus group interviews. Ten themes emerging from the data relate to the four factors shown by Hinsz et al. to be predictive of worker intention and self-reported food safety behavior *(12)*. These themes and their sub-themes describe factors that facilitate or inhibit successful implementation of FSMSs.

Theme 1: Conscientiousness

Work ethic

All senior managers/owners identified a positive attitude toward work in general as important when asked about hiring new employees. One identified willingness to work as one of the most important factors affecting food safety.

"[G]ood people who care… It's a hard job [working in the meat industry] and people do not have that ambition anymore. So, good people." [SrMgr/Owner-1]

Company/Customer focus

Plant employees appeared to have neutral to positive attitudes toward following FSMSs, with some looking beyond their job tasks.

"[I]t's not just a job… because we know the customers really well, and I think that [it] all boils down to us being a smaller plant. So maybe you take a little more care because you know these people." [FSC-1]

Theme 2: Adaptability/willingness to change

Several employees and focus group interviewees thought newer employees were more willing and able to adapt to FSMSs than those who had been in the industry for some time. This is supported by others who suggest that full commitment of all employees to the FSMS may not be possible.

"There will always be employees that don't believe in the procedures … our most trained and most ambitious employee, because he was trained old school, will laugh at a lot of things that we try [to] enforce… There are different levels of buying into the program." [SrMgr/Owner-3]

Theme 3: Work unit factors

Influence of peers

Regardless of one's own attitude toward food safety behavior, the influence of co-workers may make a difference in whether one follows FSMSs. The influence may be positive or negative and may affect the individual's attitude.

"[Y]ou get the training and you know that's all the official, those are all the official rules. Then you talk to the employees and then you get the inside scoop… really, how is it [done] on a day to day basis?" [FGrp1-Int1]

Monitoring by food safety personnel

Food safety coordinators were responsible for reminding production workers to complete records and "making sure that people understand what they are looking for, so I guess training and if I see something wrong, like I walk through twice a day or whenever I am downstairs, I see something and I address it right away." [FSC-3]

Influence of supervisory personnel

Enforcement/Reinforcement. Most senior managers/owners indicated that employees need to be supervised to ensure they are doing their jobs. Several interviewees spoke of the importance of supervisors providing job related feedback regarding FSMSs.

"It goes both ways. If it's good it's good, and if it's bad that's good too sometimes. It makes you aware of what you are doing wrong. Sometimes you get a little lazy, just like anybody else in any job. So you get feedback whether it's good or bad…" [Prod-1]

Personal support. Production workers agreed that feedback on their job roles is valuable. Several employees indicated that there are other ways superiors can have a positive influence on workers.

"Make them feel welcome and know that they have more than just this [job]. They have a personal life … if they know that you are interested in more than just their work life, that you care, well I am going to give a little extra." [Prod-2]

Financial incentives. As a form of exchange, supervisors may also influence the remuneration that employees receive for their work. Focus group interviewees thought financial incentives were an important motivator for following FSMSs. One production worker said, "bonuses are good". However, this was contradicted by several employees who said bonuses were not appreciated. Moreover, production workers suggested they are motivated by time off with pay, regular raises but not bonuses, and positive verbal reinforcement for doing a good job.

"[Y]ou shouldn't be rewarded for food safety… You *have* to do that." [Prod-2]

Theme 4: Senior manager commitment to food safety

For a fully operational FSMS, having workers and supervisors buy into the programs is not enough for implementation to occur. Several interviewees and focus group participants identified management commitment to the FSMS as being important. This commitment may be expressed in different ways.

"Commitment from upper management is also [important]…. Not only from funding but also from their actions, personal actions and so on." [FSC-2]

The senior managers/owners concurred.

"You start at the top and you get the managers involved and you get them to buy into it, and then you kind of let loose there and you support them. You're out in the plant and you see someone without a hair net and you say, 'Has your manager told you that you need to 'wear a hair net?'" [SrMgr/Owner-4]

… by us giving them positive reinforcement and by us stressing to them that this is very important, and them

buying into the system. And when they buy into the system, then we all win." [SrMgr/Owner-5]

One food safety coordinator identified that senior manager(s)/owner(s) as well as production workers were not diligent in following FSMS rules and some production employees had negative attitudes about the FSMS. This was in contrast to the responses from the two other interviewees at that plant.

Theme 5: Workplace atmosphere

Open communication

Several employees spoke of being able to communicate openly with supervisors and senior managers at their establishments. Open two-way communication was reported to encourage workers to share information and contribute ideas for improvement to the FSMS and the workplace.

"It is an open door, employees are never, they can all come up, feel free to say their ideas, good or bad and vice versa. There is always a lot of communication going on back and forth, which is really good..." [FSC-1]

Teamwork

Some plant personnel indicated that everyone is responsible for food safety. A few spoke of the importance of working cooperatively for food safety and other initiatives.

"[W]e kind of just all work together like that. It's a team. That's basically what it is, but that is the biggest thing. You have to work as a team because you all have to get the job done." [Prod-3]

Theme 6: Training

Workers need skills and knowledge to be able to follow FSMSs effectively. All the plant personnel thought they were adequately prepared to do their jobs. Production workers and food safety coordinators indicated that training was primarily done in-house and included hands-on training. For new employees in one plant,

"... a day or a week before they start, I do an orientation with them and I go through their GMPs [Good Manufacturing Practices] in the areas that apply to them... then the rest of the training [takes place] wherever they are going. Like if you are in the box room, you get hands on training there for two weeks, or longer if needed..." [FSC-3]

Furthermore, training is a continuing process:

"Well, they always come and make sure that I know what I am doing and I always ask. It's not just a 20 minute training thing. It's an ongoing training." [Prod-1]

Theme 7: Firm's production system factors

Product characteristics

Having objective measures of product characteristics makes it easier for workers to ensure that products meet food safety specifications.

"And now we are watching the pH, because before, with the [previous owner], we used to just know by feel that summer sausage, when it gets to its low pH, you tell by the feel, that it just becomes rubbery. But now we actually check for the pH because it has to be below 5.3 and there is a certain number of degree hours." [Prod-4]

Process characteristics

Automation. Several respondents indicated that automated systems can eliminate variation in the production process. Computerization may reduce the amount of manual record keeping. However, as part of the FSMS at one plant, the temperature of each batch of cooked product is manually verified to ensure product is fully cooked.

Productivity. One focus group participant indicated that a FSMS supports production; however, production inefficiencies may cause problems with follow-through.

"If you don't have good productivity in a plant then you can't expect to be able to do all of the other things that support the production, like a food safety program. Because if your productivity stinks, everybody is behind the eight-ball and they are scrambling." [FGrp2-Int1]

Equipment and facilities

Functional equipment. According to SrMgr/Owner-1, "Very good equipment" is one of the most significant factors affecting the quality and safety of products. One focus group interviewee identified equipment maintenance as influencing worker behavior.

"If the equipment is not maintained properly... you can't expect the workers to do the job that you're asking them to do." [FGrp2-Int1]

Suitable facilities. The building and facilities may also have an influence: the meat plant where FGrp1-Int1 previously worked had to install additional sinks to enable production employees to wash their hands and return to work from breaks in a timely manner.

Sometimes problems arise because busy production workers have limited work space. As one food safety coordinator said,

"... because we have a lot of different activities in such close quarters, it is so easy to contaminate something. Like you have processing going on in the back, you are dealing with nitrates and brines and phosphates and that is right next door to where we deal with fresh stuff..." [FSC-4]

Theme 8: Firm's production priorities

Perceived or real time constraints may contribute to a sense of urgency about accomplishing work tasks and thereby reduce the likelihood that workers will follow all procedures required by the FSMS:

"We're the biggest sources of contamination here. We constantly move. We're always in a hurry. We're always rushed. We're always trying to get things done." [FSC-4]

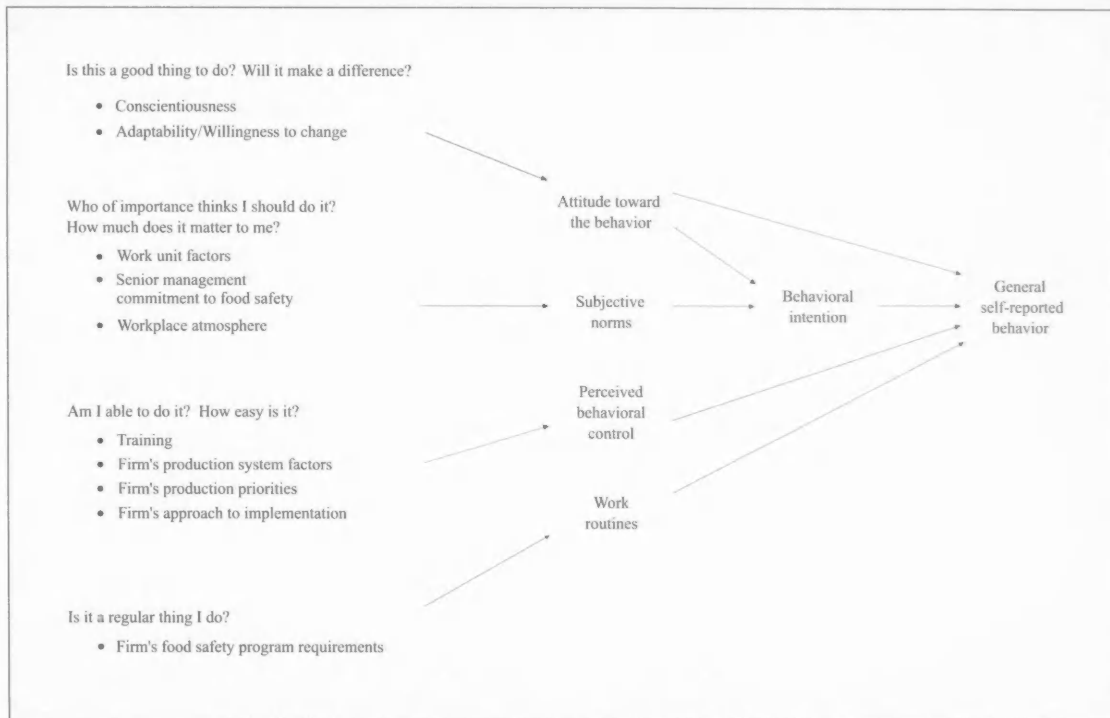
Theme 9: Firm's approach to FSMS implementation

Gradual introduction

There is evidence of employee resistance to implementing HACCP in some plants. In one plant, resistance was thought to be overcome by introducing HACCP gradually. According to one food safety coordinator.

"The staff has been wonderful in switching over in their record keeping.

FIGURE 1. Background factors that influence elements predictive of employee intention and food safety behaviors



We have been very lucky. We haven't had any big issues. Everybody is just—and I think because it's so gradual, it did not all happen in one day—that everyone has been very good. It's been a gradual thing." [FSC-1]

Coordination of records

Another aspect that may improve implementation of FSMSs is the extent to which food safety record keeping can be coordinated with or used for other purposes. A focus group participant also spoke about how integrating records streamlined work tasks at a plant.

"...the records that were designed for food safety were also incorporated into production records. So a lot of that job was done for them, as an example, so it made everybody's job easier." [FGrp2-Int2]

Employee input into changes

Some employees do not perceive themselves as being involved in developing the FSMS at their plants even though they indicated they were asked for input about job tasks. Nonetheless, at establishments with written FSMS, documentation is continually updated and workers are asked for their input. As an example:

"As we go along, I am learning more about it and I change things as we go and how we operate. That is based on input from the plant, the employees, the staff. We have had two audits and a couple of things didn't jive with the way [the consultants] wrote the book, with the way we actually do the [program]. So we have changed it then." [FSC-3]

Theme 10: Firm's food safety program requirements

Good Manufacturing Practices (GMPs)

In one plant, the biggest issue in implementing the FSMS requirements, which are primarily GMPs covering general personnel, premises and production/process controls, is...

"Getting the [workers] to abide by them. Habits are hard to break, so [the program] is sometimes a reminder." [FSC-3]

Standard operating procedures (SOPs)

Interviewees identified Standard Operating Procedures (SOPs), including Sanitation Standard Operating Procedures (SSOPs), as an important aspect of FSMSs. By providing workers with specific directions, SOPs ensure process consistency and reduce the risk of errors that could impact product safety.

"[Y]ou make your fresh sausage in the first part of the day and from there you maybe move on to your kielbasas [which may contain nitrate/nitrite]... so there is just a procedure list on how you do things throughout the day." [SrMgr/Owner-2]

Record keeping

Required monitoring procedures at one plant ensured that product did not exceed critical limits and highlighted the value of record keeping to the production worker.

"...as soon as you check it, then you write it down. Because before, someone could say, 'I think I checked it.' But you are never positive if you did unless you write it down right away on the sheet of paper." [Prod-4]

DISCUSSION

Ten themes arising from the data support the four elements—attitude,

subjective norms, perceived behavioral control and work routines—that Hinsz et al. *(12)* identified as predicting behavioral intention and/or food safety behavior. Expanding on the Hinsz model, the authors propose a descriptive model (Fig. 1), in which we show:

- Worker conscientiousness and adaptability/willingness to change as primarily related to attitude toward food safety behavior
- Worker's work unit influences, senior management commitment to food safety and workplace atmosphere as contributing to subjective norms
- Training of workers, and the firm's production system factors, production priorities and approach to FSMS implementation as related to perceived behavioral control
- Firm's food safety program requirements as influencing work routines

According to Ajzen *(1)*, to encourage people to change a specific behavior, one needs to examine the predictive elements of that behavior. Interventions for behavior change need to focus on the factors that influence an individual's behavioral, normative and control beliefs. Furthermore, an intervention has two stages. In the first, the focus is on changing the beliefs and motivating a change in behavior. The second step is to facilitate implementation of the desired behavior by creating favorable conditions for it to occur *(1)*.

The themes emerging from our data may be viewed as background factors. Thus, we categorized the themes according to the four predictive elements that Hinsz et al. *(12)* identified. We asked one to two questions for each element (i.e. attitude, subjective norms, perceived behavioral control and work routines) to help determine under which of the themes the data best fit.

Is this a good thing for me to do? Will it make a difference?

An individual's attitude toward a behavior is a function of the person's belief about his/her behavior and expectations that the specific behavior will make a difference to an outcome *(1, 7, 12)*.

The data suggest that a general willingness to work and do required job tasks, even as the requirements change, are seen as desirable traits in employees. Individuals themselves must also see value in this.

Some employees believe the outcomes of their work tasks make a difference to the company and/or its customers. It is not clear whether the expected outcome relates to safe food production, continuing employment, other outcomes and/or a combination of these.

Our data suggest that it is not necessary for workers to have positive attitudes toward food safety behaviors to engage in those behaviors. It is conceivable that such employees evaluate the outcome of the behavior in terms of continuing employment rather than food safety.

If employees do not believe the food safety behavior makes a difference in the product and/or if there are no repercussions for not following the FSMS, the strength of the behavioral beliefs may be low.

Who of importance thinks I should do it? How much does it matter to me?

Social influences contribute to subjective norms that are a function of normative beliefs and motivation to comply. Normative beliefs are an individual's beliefs about who approves or disapproves, or engages or does not engage in, the behavior *(1)*. Social pressure is generally greater when most referents with motivating influence think the individual ought to perform, or avoid, a specific behavior. A referent's level of influence may also affect an individual's motivation to comply with expectations *(1)*.

Several social influences emerged from the data. Peers/co-workers were suggested as being highly influential and, depending on their attitudes, may influence a worker to perform or not perform food safety behaviors. Clayton and Griffith *(7)* report that caterers were more motivated to comply with co-workers' ideas than with wishes of bosses, customers or environmental health officers.

Food safety personnel may have some influence because of their monitoring and training roles; however, in plants where they lack authority to correct noncompliance, a production worker's motivation to comply may not be strong.

Supervision and reinforcement of desired behaviors, whether by lead hands, managers or other supervisory personnel, help workers understand that following FSMS guidelines is important. Nonetheless, production workers who receive personal support and/or other benefits from their supervisors may have greater motivation to comply with behavioral expectations, whether food safety related or not, than those who do not receive them. In small plants, senior managers/owners may function as supervisory personnel.

Commitment of senior managers/owners to the FSMS has a normative influence in several ways. Senior managers/owners apply social pressure by engaging in food safety behaviors, directing managers to ensure compliance, supporting managers in their efforts to ensure compliance by subordinates and supporting food safety personnel in their efforts, among other actions. Direct or indirect demonstration by senior managers/owners that it is not necessary to perform food safety behaviors may threaten the implementation of a FSMS, as it reduces the motivation for others to comply.

In a workplace where open communication and cooperation are perceived to be part of the culture, it is expected that social pressure would support the continuation of whatever food safety behaviors have become accepted. The sharing of information and working as a team may motivate workers to support or undermine a FSMS.

Am I able to do it? How easy is it?

Perceived behavioral control is a function of an individual's perception about his/her ability to engage in the behavior and how easy the behavior is to perform. Control beliefs involve perception of both control and opportunity *(1)*.

Relevant skills and/or knowledge form the basis of workers' control beliefs that they are capable of performing food safety related tasks. Nonetheless, resources and opportunities that emerged from the data identify factors that may facilitate or interfere with an individual's ability to apply the skills and/or knowledge.

Production system factors related to products and processes that allow objective measures in decision-making make it simpler for workers to do their jobs well. Simplifying the production process may make job tasks easier and help ensure that procedures are followed. Automated processes reduce repetitive tasks

and guesswork. Well-maintained equipment can also influence worker behavior because the sense of control that workers have over food safety behaviors can be negatively affected by equipment failure. Adequate facilities may enable workers to follow FSMSs efficiently and effectively, reduce expectations of difficulty, and thereby increase perceived control over food safety behaviors.

In the Clayton and Griffith study *(7)*, control beliefs include external barriers that workers believe would prevent them from carrying out food safety behaviors. Two of these control beliefs—lack of resources and equipment, and poor design of workplace—support our theme "equipment and facilities."

Efficient systems and adequate physical resources need to be accompanied by sufficient time and personnel so that workers perceive they have the opportunity to meet production targets while following the FSMS.

Workers may perceive greater control and fewer obstacles with a new FSMS if it is implemented gradually, allowing them time to adapt to procedures. Coordinating records with other functions and/or streamlining them may simplify record keeping. Furthermore, workers who provide input into continuous improvement efforts that affect them may perceive they have greater control than those who are not invited to contribute.

Is it a regular thing I do?

Hinsz et al. *(12)* demonstrated that work routines predict self-reported food safety behavior. Included in the numerous components of a FSMS are various procedures that are followed on a regular and/or frequent basis. In some situations, regular procedures may become habitual and be performed without conscious effort *(1)*. In others that require specific thought and action, such as GMP or critical control point monitoring, the routinely performed food safety behaviors were said to become "part of the job".

APPLICATION

Hinsz et al. *(12)* found the four predictive elements of intention and food safety behavior (i.e. attitude, subjective norms, perceived behavioral control and work routines) to be statistically correlated. According to Ajzen *(1)*, background factors may also be correlated or act as background factors to more than one predictor.

The proposed model (Fig. 1) shows each theme from the data (acting as a background factor) to relate to only one predictor. However, it may be that these themes/background factors relate to more than one of the predictors identified by Hinsz et al. *(12)*.

Knowledge of the background factors that contribute to workers' various beliefs about food safety and FSMSs will enable the development and testing of interventions that target the relevant beliefs. Additionally, identification of potential obstacles is necessary so they may be removed, thereby enabling individuals to increase the actual and/or perceived control over their food safety behaviors.

SUMMARY

Worker food safety behavior is influenced by numerous factors. The themes emerging from the data in this qualitative study support the Hinsz model *(12)* and have been used to describe background factors related to worker attitudes toward food safety behavior, subjective norms (social influences), perceived behavioral control and work routines.

More themes relate to perceived behavioral control than to other factors. However, because of the strong correlation that Hinsz et al. *(12)* found among their four predictive factors, the strength of each and the qualitative nature of this study, the number of themes should not be used to assess the strength of influence on behavior.

While the Hinsz model *(12)* may be useful for predicting intention and food safety behaviors in meat plants, further research is needed to confirm background factors that influence the predictors and identify those with the strongest influence on food safety behaviors.

Knowing which of the background factors has/have the strongest influence will assist with the development of targeted interventions to improve the implementation of FSMSs.

Limitations. Plant personnel interviewed in this study were selected by management; this may have introduced a positive bias. Additional bias may be present because of a connection between some interviewees and the meat industry association. Occasional interruptions in some plant interview settings may have influenced responses. Although invited for the government focus group interview, meat inspection/audit staff did not participate. A previous work relationship between the moderator and some focus group participants may have contributed to a bias. Additional in-depth and focus group interviews would have provided supplementary data and enabled stronger triangulation. For example, interviews at additional plants of various sizes, inspection jurisdictions and/or management system types would have strengthened triangulation. Furthermore, food safety consultants, meat inspectors or auditors, and public health officers may have provided different information.

This study focused on small and medium-sized establishments in south-central Ontario. Workers at these plants were not unionized. Representatives from larger and/or unionized establishments or from plants in other regions or provinces may have provided different perspectives.

Although the transferability of the findings (comparable to generalizability in quantitative research) has not been fully assessed, the study provides a basis for comparing these interpretations with findings of research conducted in other meat plant settings and food sectors.

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IAFP's Fifth European Symposium on Food Safety

ABSTRACTS

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Poster Session 1 – Thursday, 8 October

P1-01 A New "Next Day" Method for Detection of *Listeria monocytogenes* in Food

Jean-Michel Pradel, Damien Cote, Vincent Remy, Jean-Louis Pittet, and PASCAL MONTES, bioMérieux, Chemin de l'Orme, Marcy L'Etoile, 69280, France

Introduction: Detection of *Listeria monocytogenes* in foods with traditional methods is time-consuming, taking up to five days to obtain a negative result.

Rationale and Objectives: The objective of this study was to determine the performance of a new immunoassay method, VIDAS *Listeria monocytogenes* Xpress (LMX), for the next day detection of *Listeria monocytogenes* in food samples.

Methods: The detection method, is associated with a specifically formulated LMX broth containing optimized concentrations of selective agents to inhibit competitive bacteria. For the food study, samples were culturally enriched for a total of 26 h in LMX broth, before testing in the VIDAS instrument. Positive results were confirmed by streaking enrichment broths onto selective chromogenic agar. The new method was compared to ISO 11290-1 reference method.

Results: the detection limit, established with 50 *L. monocytogenes* strains was found to be between 2.103 and 3.105 CFU/ml in LMX broth. No cross reaction was observed with 30 potentially interfering strains at the growth level reached in a non selective medium.

The food study included 370 food products, 238 meat, 87 dairy and 45 seafood products. 153 samples were confirmed positive by one of the methods, 23 by the immunoassay only, 17 by the cultural method and 113 by both methods.

Sensitivity was respectively 88.9% for the immunoassay and 85.0% for the reference method. Difference observed between the two methods was not statistically significant. Agreement between the two methods was 89.2%. As all positive results were confirmed after subculture, the test specificity was 100%.

Conclusions: This study demonstrated that the VIDAS LMX method is comparable to the ISO 11290-1 method for the recovery of *Listeria monocytogenes* in meat, dairy and seafood products. It provides a very rapid, sensitive and convenient method allowing a presumptive result within 27 h of sample set up.

P1-02 Evaluation of Two New Alternative Methods for the Detection of *Campylobacter* spp. in Food and Environmental Samples

Arlette Darbon, Eliane Desmaris, Daniel Baroux, Laboratoire Départemental d'Analyses de l'Ain, Rue Henri de Boissieu, 01060 Bourg-En-Bresse France

Introduction: *Campylobacter* spp. are the most frequent cause of acute intestinal infections in developed countries. Human campylobacteriosis can be reduced by better control of foodborne contamination.

Rationale and Objectives: This study compares the performance and ease of use of two new alternative methods for detection of *Campylobacter* spp. with the reference method NF EN ISO 10272-1. Forty-five samples (twenty-five food matrices (including twenty-two poultry meats), eight production environment and twelve breeding environment) were analyzed. For these two tested methods a 1/10 dilution of samples is performed in the new ready to use medium: CampyFood Broth (CFB) (bioMérieux). CFB is incubated 44–52 h at 41.5°C under microaerophilic conditions using an innovative Combibag system.

For the simplified conventional detection method, CFB isolation is carried out on the optimized formulation CampyFood Agar (CFA) (bioMérieux). CFA is incubated for 48 h at 41.5°C under microaerophilic conditions. Typical colonies of presumed *Campylobacter* (deep-red (burgundy) to orange-red) are confirmed by respiratory type, oxydase testing, and microscopic morphology.

For the VIDAS CAM protocol, 1–2 ml of the CFB enrichment is heated at 95–100°C for 15 min and 500 µl then transferred to a VIDAS CAM strip for testing. VIDAS CAM positive samples are streaked onto CFA. Typical colonies are confirmed by the same procedure used for the simplified detection method.

Results and Findings:

- Sensitivity: Globally, sixteen true positive samples were detected with the reference method NF-EN-ISO 10272-1, twenty-six with the simplified conventional detection method, and twenty-seven with the VIDAS CAM protocol.
- Specificity: No significant statistical difference was shown between the three methods.

Conclusions: These results demonstrate that the two alternative methods have higher recovery for *Campylobacter* spp. compared to the NF EN ISO 10272-1 method. The new bioMérieux alternative methods for detection of *Campylobacter* spp. significantly improve ease of use, time to result, and laboratory throughput.

P1-03 Application of an Automated MPN System for Enumeration of Bacterial Counts on Food Contact Surfaces

Peter Paulsen, A. Aydin, W.R. El Ghareeb, and G. Devulder, bioMérieux, Vienna, 1210, Austria

Introduction: The microbiological examination of food-contact surfaces is a recognized tool to assess the efficacy of cleaning and disinfection in food plants. Commonly tested indicators are total viable count (TVC) and *Enterobacteriaceae*. Neutralizing agents can be used to prevent "false-negative" results due to the antibacterial activity of residues.

Rational: The application of an automated MPN system (TEMPO®) for enumeration of bacteria for testing of the cleaning and disinfection efficacy of food contact surfaces was studied. In a first trial, 5 neutralizing agents [Eugon LT100, Difco neutralizing buffer; ISO 18593 buffer; mod. Letheen broth; commercial swab with neutralizer (Quantiswab, Coban)] were tested for possible interferences on the enumeration of selected bacterial strains (*E. coli* ATCC25922; *Lb.plantarum* DSM20174; *St. aureus* ATCC25923; *C. freundii* NCTC9750; *B. cereus* NCTC7464) by the automated MPN system and cultural ISO or BAM methods. Then, 40 surfaces (stainless steel=22, plastic=15, other=3) in 5 different food premises were tested by the MPN system (TVC, *E. coli*, coliforms, *St. aureus*, Lactic acid bacteria) and cultural reference methods.

Results: As there was no significant difference in the enumation of cultures between the different neutralizing agents, the commercial swab kit (Quantiswab) was chosen for surface sampling. For the 40 surface samples, results by the automated MPN method agreed well with those obtained by cultural methods. For results in the detection range, average differences were 0.06 and 0.12 log for TVC (n=22) and *Enterobacteriaceae* (n=6), respectively. For coliforms, similar results were obtained. For *E. coli*, 38 samples were below detection range, and differences for the remaining two samples were 0.5 and 0.7 log.

Conclusions: Results obtained for cleaned and disinfected food contact surfaces did not differ significantly from those obtained by reference methods. Depending on the microbiological parameter, results were obtained 24–48 earlier by the MPN system than by reference methods.

P1-04 Use of a Novel Device to Enable Irradiation of Fresh Cantaloupes by Electron Beam Irradiation

MARY PIA CUERVO, Daniela Rodrigues-Silva, Joseph E. Maxim and Alejandro Castillo, Texas A&M University, Animal Science Department-2471, 308 Kleberg, TAMU, College Station, TX 77843, United States

Introduction: Cantaloupes have been associated with numerous *Salmonella* outbreaks. Different studies have addressed the development of methods for cantaloupe disinfection, and their results seem to indicate a limited effectiveness of sanitizing rinses at reducing pathogens. Irradiation may be a solution, although the appropriate treatment conditions are still not established.

Rational: Due to their unidirectionality, electron beams are considered unsuitable for irradiating foods of irregular shapes. However, we have developed the Maxim Chamber, a new application that benefits from the innate scattering behavior of electrons when impacting a solid mass. Inside the chamber, a metallic mesh promotes infinite electron bounces, creating a cloud of electrons around the target object. When using this device, a uniform dose delivery over irregular shape objects such as rabbit carcasses, was achieved. Inoculated *E. coli* O157:H7 was reduced by > 5 log cycles onto rabbit carcasses. The objective of this work was to further investigate the Maxim Chamber capabilities in delivering dose uniformity and penetration using cantaloupes as a model.

Results: Average doses at the cantaloupe surface and at depths of 1 and 2 cm were 3.13 kGy, 2.27 kGy and 1.42 kGy, respectively. A stack of 6 allanine dosimeters immersed into the flesh showed max/min dose ratios from 1.19 to 1.61 kGy. Average log reduction of *Salmonella* Poona on cantaloupe after irradiation in the Maxim Chamber were > 4.7 and > 4.0 when inoculated on the rind and stem scar, respectively, and 4.7 and 3.9 when inoculated in the flesh at 1 and 2 cm under the surface, respectively.

Conclusions: The Maxim Chamber seems to be an effective tool to uniformly deliver e-beam irradiation to products with spherical shapes. Additionally, the advantage of reducing pathogen subcutaneously is highly remarkable due to current food safety concerns.

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P1-05 Testing for *Salmonella* and *Escherichia coli* O157:H7 from a Single 8-h Enrichment

Xuan Peng, Morgan Wallace, Dawn Fallon, Bridget Andaloro, Lois Fleck, Lihong Wu, Dan Delduco and George Tice, DuPont Qualicon, R&D, Wilmington, DE 19880, United States

Introduction: Introduction: Most *Salmonella* and *E. coli* O157:H7 outbreaks are linked to two food types: fresh produce and beef. Traditional testing protocols call for separate enrichment methods when testing for *Salmonella* versus testing for *E. coli* O157:H7 in these matrices.

Rational: Purpose: The objectives of this study were two-fold; one was to investigate using an established 8-h beef enrichment method with the BAX® system PCR method for detecting *E. coli* O157:H7 in fresh produce, and the other was to evaluate the same enrichment with the same PCR method for detecting *Salmonella* in both beef and produce. Methods: Produce was spiked with *E. coli* O157:H7, and beef and produce were spiked with *Salmonella* at target levels set to yield fractional positive results. Samples were evaluated using the appropriate culture-based reference method and the PCR test kit method following the 8-h enrichment protocol. Twenty spiked and five unspiked samples per food type per method were tested and compared.

Results: Statistical analysis on both *E. coli* O157:H7 and *Salmonella* in all matrices indicated the test method performed as well as or better than the reference method for detecting both *E. coli* O157:H7 and *Salmonella*.

Conclusions: This approach demonstrated that both *Salmonella* and *E. coli* O157:H7 can be detected from the same 8-hour enrichment, which may save food companies cost, time and labor through reductions in sample preparation, media preparation, incubator space and waste streams.

P1-06 Development of a Scorpion™ Probe-based Real-time PCR Assay for Genus *Salmonella*

Daniel DeMarco and Stephen Varkey, DuPont Qualicon, Wilmington, DE 19880, United States

Introduction: The use of PCR-based methods for *Salmonella* spp. detection and monitoring have shown tremendous growth in recent years. One commonly used commercial method, the BAX® system, uses end-point PCR based on melting curve analysis. Although this method features excellent performance characteristics for sensitivity and specificity, it can require nearly 3.5 h to complete the cycling and melt curve analysis.

Purpose: The purpose of this study was to evaluate the use of probe-based Scorpion™ technology with existing primer sequences to develop a faster real-time PCR assay that would maintain performance identical or superior to the current end-point PCR assay. The use of probe detection allows for much more rapid cycling (< 1 h) and eliminated the need for a melt curve analysis. Methods: Studies comparing the sensitivity and inclusivity of the new real-time assay with the current commercial PCR assay were conducted, using both purified DNA and select *Salmonella* spp.

Results: Results using liquid real-time PCR reagents versus the tableted commercial PCR kit reagents showed equivalent sensitivity using both DNA (5 to 50 fg) and cells (~10^4 CFU/mL). Inclusivity using a small panel of 48 diverse *Salmonella* spp. was also identical with both assays, showing 100% detection of the strains tested.

Significance: These results demonstrate the feasibility of developing a novel real-time PCR assay for *Salmonella* spp. that allows for cycling and detection in less than one hour, with the same performance characteristics of an existing well-characterized, commercial assay.

P1-07 Validation of a PCR Assay for Screening *Listeria* spp. in Foods and Environmental Sponges

Morgan Wallace, Bridget Andaloro, George Tice and Joanne Ruebl, DuPont Qualicon, Wilmington, DE 19880, United States

Introduction: Since other *Listeria* species can out-compete *L. monocytogenes* in culture, potentially leading to false negative results for the pathogenic species, some food producers are testing for *Listeria* spp. instead. Well-validated rapid methods for the detection of *Listeria* species as an indicator of possible product adulteration with *L. monocytogenes* are needed because culture-based take four to seven days to deliver a result.

Purpose: This study evaluated the inclusivity, exclusivity and effectiveness of the PCR-based BAX® system approach to screening of artificially introduced *Listeria* in spinach, processed cheese and frankfurters, and naturally occurring *Listeria* in smoked salmon and drain sponges.

Methods: Inclusivity testing was performed at ~1 log over the claimed product sensitivity of 10^5 CFU/mL, while exclusivity testing was performed at 10^8 CFU/mL. For method effectiveness, foods were spiked with *Listeria* at target levels set to yield fractional positive results and were evaluated using the appropriate USDA, FDA or AOAC culture-based method and the PCR test kit method, with twenty spiked and five unspiked samples per food type per method. Frankfurter testing was repeated at an independent laboratory. One food type, smoked salmon, and one environmental sample type, drain sponges, were testing using naturally occurring *Listeria* with twenty paired replicates.

Results: All 50 *Listeria* in the inclusivity panel were found to be reactive, whole the 30 non-*Listeria* strains were non-reactive using the assay. Comparing effectiveness results for PCR and plating, results for the three inoculated sample types demonstrated Chi-square values of 0.1 to 0.46, indicating no significant difference in method performance. For the naturally occurring *Listeria* contamination of salmon and drain samples, Chi-square comparison of PCR and reference culture methods demonstrated values of 1.26 and 0.10, also indicative of indistinguishable method performance.

Significance: This data indicates that this PCR method for the detection of *Listeria* is as effective as culture-based methods whole providing significant time savings.

P1-08 Exposure Assessment to *Cronobacter sakazakii* in Powder Infant Formula in Ireland

ARIANNA MUSSIDA and Francis Butler, University College Dublin, School of Agriculture, Food Science and Veterinary Medicine, Biosystems Engineering, Belfield, Dublin 4, Ireland

Introduction: *C. sakazakii* represents a significant risk to the health of neonates. Although, the organism natural habitat is currently unknown, PIF has been identified as a source and vehicle of neonatal infection.

Rationale and Objectives: The objective of this study is to consider some statistical aspects, as the probability of accepting and rejecting a lot, considering two surveys carried out in Ireland to detect the contamination of *C. sakazakii* in PIF. The assumptions and the method used to calculate the probability of accepting or rejecting a lot are the ones adopted by WHO risk assessment model for *Enterobacter sakazakii* in powder infant formula. Calculation of rejection rates requires the mean log concentration of *C. sakazakii* across all lots of PIF (CFU/g), which is estimated from C= l n [1- $P > 0$] / S where C is the concentration (per gram), $P > 0$ is the prevalence, and s is the samples size (grams).

Results and Findings: True prevalence is estimated (2.9 and 0.14%) from apparent prevalence using the Bayesian approach based on beta (1, 1) and assuming the microbiological analyses without error, thus considering sensitivity and specificity equal to 1. In this study lots are simulated using the Montecarlo software @Risk and tested against the microbiological criteria established in the EC 2073/2005 (absence in 10 g, 30 samples per unit). The outputs obtained are the probabilities of accepting/rejecting a lot calculated assuming different values for the within and between lot variability. Rejection rates are also presented graphically considering uncertainty distributions around prevalence data.

Conclusions: As Ireland supplies 15% of PIF in the world, monitoring the contamination of the product using an appropriate sampling plan and t he application of microbiological criteria represents an important first step in reducing the risk of contaminating PIF product.

P1-09 Modeling the Concentration of *Salmonella* in Irish Fresh Pork Sausage from Most Probable Number (MPN) Results

Ursula Gonzales-Barron and Francis Butler, University College Dublin, Room 109, UCD Agricuture and Food Science Centre, UCD Belfield, Dublin, Dublin 4, Ireland

Introduction: It has been estimated that 10–30% of foodborne salmonellosis had pork and pork products incriminated as the actual source. In Ireland, a pork product that deserves attention for being a raw comminuted product that is widely consumed is the fresh pork sausage.

Rational: As part of a risk assessment of *Salmonella* in pork sausage, a methodology for modeling the concentration of *Salmonella* (CFU/g) in pork sausage at retail from MPN data was assessed.

Results: From a retail survey study, MPN result triplets were available for each of the sausages (6) from 10 contaminated packs. The conditional probability l(x|?) of observing the tube counts X={xi} given the true *Salmonella* concentration ? was fitted to the MPN triplets for every sausage within a pack. Considering that the sausage production involves meat grinding and thorough mixing with other ingredients, each of the small portions of sausage mix stuffed into casings (and subsequently packed) can be assumed to be Poisson (?) distributed. Thus, to obtain a better estimate of the uncertainty about the true ? (CFU/g) of each contaminated

pack, a posterior distribution f(?|X) was modeled by combining the six l(x|?) functions and a Jeffreys' prior distribution. In order to model the variability of ? in contaminated sausage packs, the uncertainty around the 10 f(?|X) distributions was propagated to a lognormal distribution by calculating its parameters for 10000 Bootstrap samples.

Conclusions: The mean and standard deviation of the lognormal distribution (CFU/g) fitted a normal (4.0389, 0.1039) and a normal (0.6389, 0.0591), respectively, and, in log terms, the initial *Salmonella* concentration of contaminated packs at retail had an expected value of 1.84 log CFU/g with a 95% CI of 1.19–2.30 log CFU/g. This approach provided a more informed second-order distribution of CFU/g than would have been possible by the common practice of fitting directly a distribution to the MPN/g.

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P1-10 Detemination of Microbial Contamination Sources at Sausages Processing Line

NALAN GOKOGLU, Akdeniz University, Akdeniz University Fisheries Faculty, Antalya, 7058, Turkey

Introduction: Effective HACCP systems must be based on accurate baseline data on the levels of contamination at each stage of production. It is important to provide baseline data on the levels of bacterial contamination of sausages at processing line.

Rationale and objectives: This study has been conducted to determine microbial contamination sources during sausage processing. Minced meat, sausage batter, stuffed sausage, cooked sausage, peeled sausage and pasteurized sausage samples have been examined microbiologically. Moreover, spices and ice water used in production, personnel hands and equipment have been examined.

Results: Counts of total aerobic mesophilic bacteria, *Staphylococcus aureus, Escherichia coli,* yeasts and molds in minced meat were found to be 7.02, 3.83, 4.42 and 1.62 log CFU/g respectively. *E. coli* and yeast-mold counts in sausage batter reached 3.99 and 1.72 log CFU/g respectively. Heating for cooking was effective in reducing microbial counts. Total plate (3.93 log CFU/g) and *S. aureus* (1.08 log CFU/g) counts in cooked sausages decreased, *E. coli* and yeast-molds were not detected.

Conclusions: According to the results, raw material and spices have been found as primary contamination sources. Personnel hands and equipments have been found as secondary contamination sources. Microbial counts in personnel hands showed significant correlations with the counts of the samples taken from all processing stages. Microorganism counts determined in overall processing were not at harmful levels for human health and microbial load of final product was within critical limits.

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P1-11 Determination of Polycyclic Aromatic Hydrocarbons Profile in Portuguese Traditional Dry Fermented Sausage

ANA GOMES, Cristina Roseiro and Carlos Santos, Instituto Nacional de Engenharia, Tecnologia e Inovação, Estrada do Paço do Lumiar, 22 (Edificio S), 1649-038 Lisboa, Portugal

Introduction: Over the past years, growing concerns about polycyclic aromatic hydrocarbons (PAH) carcinogenic activity and their presence in food have been reported. Food industries largely use wood smoke due to its preservative and sensorial properties. Nonetheless PAH contamination may occur in meat products exposed to this practice, especially when smoke generation is not controlled.

Rational: The aim of this work was to study the prevalence of the 16 referred PAH by Environmental Protection Agency (EPA), in 9 samples of a portuguese traditionally dried fermented sausage, in regard to ripening time and also the respective PAH diffusion within the product. The analysis was performed by HPLC-UV/Vis-FLD.

Results: The total PAH content (dry matter basis) in the final product was 626.86µg.kg^{-1} prevailing low molecular weight compounds, namely acenaphthene, fluorene and phenanthrene (53.77, 89.23 e 273.68µg.kg^{-1}, respectively). Naphthalene, acenaphthylene, dibenzo[a,h]anthracene, benzo[g,h,i]perylene and indeno[1,2,3-c,d]pyrene were not detected in any sample. In relation to PAH considered as carcinogenics, such as benzo[a] anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene and benzo[a]pyrene (BaP), the higher content was verified for the benzo[a]anthracene reaching 8.07µg.kg^{-1}. BaP did never exceed 1.60µg.kg^{-1} (fresh weight, FW) which is below the 5.0µg.kg^{-1} (FW) limit established by European Commission for meat and meat products (Regulation (EC) Nº 1881/2006 of 19 December 2006). PAH migration from products surface to internal layers was observed. Total PAH content reached 3883.89µg.kg^{-1} on the outer layers in comparison to 1092.72µg.kg^{-1} detected in the inner ones.

Conclusions: Our results show that, despite of BaP content being in agreement with the legal limit, all samples revealed PAH contamination that could be minimized by the optimization of the smoking process.

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P1-12 Novel Sample Preparation Solutions for Highly Sensitive and Accurate Detection of Foodborne Pathogens from Complex Food Matrices

Lily Wong, Paolo Vatta, Priya Balachandran, Robert S. Tebbs, Maxim G. Brevnov, Manohar R. Furtado, and OLGA V. PETRAUSKENE, Applied Biosystems, 850 Lincoln Centre Drive, Foster City, CA 94404, United States

Introduction: Detection of low levels of pathogenic microorganisms in food is often difficult due to the complexity of food matrices. A successful sample prep method should have a simple workflow, give high recovery, and be able to efficiently remove inhibitors that would otherwise interfere with detection.

Rationale and Objectives: We have developed two separate sample preparation procedures that enable sensitive detection of foodborne pathogens using real-time PCR. Each of these novel sample preparation methods allows separate detection of 1 CFU of *Salmonella* spp., *Listeria* spp., or *Escherichia coli* O157:H7 following enrichment in a variety of food matrices.

Results and Findings: Foods from a variety of categories were addressed with the sample preparation procedures including chocolate, shrimp, and chicken wings for *Salmonella* spp. detection; ice cream, brie cheese, chocolate and milk for *Listeria* spp. detection; and ground beef for *E. coli* O157:H7 detection. Following enrichment, samples were prepared by either of two methods: (1) total DNA capture method using magnetic beads or (2) clarification spin column. The samples were assayed using specific real-time PCR assays run under fast conditions (<1 h). An internal positive control was included in the assays to assess inhibition.

Two sample preparation methods were validated for detection of *Salmonella* spp., *Listeria* spp. and *E. coli* O157:H7. Both methods were efficient at detecting 1–3 CFU of each pathogen in all food matrices. The results from the total DNA capture method correlated with results from the column clarification method. The consistent signal from the internal positive control indicated that both methods adequately removed inhibitors.

Conclusions: The novel sample preparation described here are highly efficient when used in conjunction with FAST real-time PCR detection. The methods are robust enough to allow for time-to-result in as short as 8 h, as in the case of *E. coli* O157:H7 detection. The DNA capture method is adaptable to high-throughput automation. The advantage of the column clarification method is a simplified workflow.

P1-13 Validation of a New TaqMan® Real-time PCR Method for the Detection of *Salmonella enterica* in a Variety of Food Samples Using a Single 18-h Enrichment Protocol

Neil S. Thompson, Melanie Patterson, Frederic Bar, Yanxiang Cao, David Favy, Aude Lectard and Neil Whitfield, Applied Biosystems Europe BV, Lingley House, 120 Birchwood Boulevard, Birchwood, Warrington, WA3 7QH, United Kingdom

Introduction: *Salmonella* is one of the largest causes of food-related illnesses worldwide and is associated with a wide variety of matrices. The need for the provision of a reliable rapid method which is sensitive, specific and robust has been identified.

Rational: Numerous methods are available for the detection of *Salmonella* in foods, but often take up to four days to confirm a negative sample. As a result, a reliable rapid method which is sensitive, specific and robust is in demand.

Results: The TaqMan® *Salmonella enterica* detection kit from Applied Biosystems is a genetic-based detection kit using TaqMan® chemistry, offering results after just 18 hours enrichment in Buffered Peptone Water (BPW). The method was certified by AFAQ AFNOR validation according to the ISO 16140 standard, analysing naturally and artificially contaminated raw poultry, raw meat, raw fish, milk, cheese, frozen vegetables, raw egg and pet food amongst others comparing TaqMan® *Salmonella enterica* detection method with the reference method ISO 6579. Positive results were confirmed by performing the ISO 6579 standard. A total of 333 samples were analyzed, 38.1% of which were contaminated naturally. Statistical analysis of the data showed that the relative accuracy of the alternative method was 98.5%, the relative specificity 99.4% and the relative sensitivity 97.4%. During the specificity study all 58 *Salmonella* target strains gave positive results, and all 36 non-target strains gave negative results. Non-target strains are commonly found in food and show no cross reactivity with our detection method. Ten laboratories from 7 countries in Europe participated in the inter-laboratory study, giving comparable results which illustrates that the method is reproducible. The practicability of the method was found to be better than the reference method, requiring less than one day of training for technicians with no experience. Negative results were obtained in less time than the reference method and the software gives permanent traceability.

Conclusions: The validation demonstrated that the TaqMan® *Salmonella enterica* detection kit from Applied Biosystems is not only rapid and easy to use, but also selective and specific, offering the food industry high accuracy and sensitivity.

P1-14 Characterization of Surface Properties and Biofilm Formation of Four *Listeria monocytogenes* Strains

BALÁZS MRÁZ, Gabriella Kiskó, and Csilla Mohács-Farkas, Corvinus University of Budapest, Faculty of Food Science, Department of Microbiology and Biotechnology, H-1118 Budapest, Somlói út 14-16, Hungary

Introduction: *Listeria monocytogenes* is a human pathogen that is implicated in several foodborne disease outbreaks. This bacterium can form biofilm on many food industrial working surfaces. The speed of bacterial attachment depends on the cell surface properties which are af fected by several environmental conditions.

Rationale and Objectives: The aim of this study was to determine the effect of the cultivation conditions of the inoculum (BHI agar slants and BHI broth at 5°C and 37°C) on surface properties of *L. monocytogenes* strains by microbial adhesion to solvents (MATS) and to describe the biofilm formation at 5°C. Stainless steel surfaces in BHI broth and UHT milk media were used for the analysis.

Results and Findings: The cells cultivated on the BHI agar surfaces showed more hydrophilic properties at both temperatures than in the broth cultivated ones. The cells had more pronounced electron donor nature in this case.

The number of attached cells was higher in case of BHI broth inoculated by cell from agar surfaces regardless of the cultivation temperature. The number of attached cells increased by time in all experimental conditions. In case of BHI broth the development of biofilm increased after 48 h while in case of UHT milk media the development of biofilm decreased. However the difference between the initial (24 h) and final (168 h) cell number of biofilms was 1.2–1.5 log irrespectively of the past of cells and the media where the biofilm was developed.

Conclusions: The history of bacterial cells have great effect on the properties of cell surface and therefore affects the attachment to stainless steel surfaces. The media where the biofilm was formed affects the speed of biofilm growth.

P1-15 Differential Expression of Genes in *Listeria monocytogenes* under Thermo-tolerance Inducing, Heat Shock and Prolonged Heat Shock Conditions

RÉKA ÁGOSTON, Palmy R. Jesudhasan, Csilla Mohácsi-Farkas,and Suresh D. Pillai, Corvinus University of Budapest, Faculty of Food Science, Department of Microbiology and Biotechnology, H-1118 Budapest, Somlóiút 14-16, Hungary

Introduction: Recent research has shown that bacterial pathogens can exhibit enhanced survival and virulence especially under sub-lethal heating. Thus, in addition to the issue of pathogen decontamination of foods, the physiological response of foodborne pathogens to stress such as heat stress needs careful examination.

Rational: The underlying hypothesis was that *Listeria monocytogenes* elicits unique transcriptomic responses as part of its overall stress adaptation in response to sub-lethal temperature stress. Microarray analysis was performed to identify the differentially expressed genes during heat stress by comparing the transcriptome of *L. monocytogenes* ATCC 43256 under varying experimental temperature conditions. The four different experimental conditions namely: (i) 37°C (control), (ii) heat shock at 60°C (for 0 minute), (iii) prolonged heat shock at 60°C for 9 min, and (iv) thermo-tolerance inducing treatment at 48°C for 30 minutes followed by exposure to 60°C for 9 min were performed in a calibrated water-bath. The standard operating protocols of The Institute of Genomic Research (TIGR, USA) were followed with slight modifications for cDNA synthesis, labeling, and hybridization.

Results: The transcriptome has very distinct patterns under the three temperature conditions. When *L. monocytogenes* was exposed to: (i) 60°C heat shock conditions, 91 out of 6347 genes were differentially expressed, (ii) 60°C for 9 minutes (prolonged heat shock), 80 out of 6347 genes were differentially expressed, (iii) thermo-tolerance inducing conditions (48°C for 30 minutes prior to 60°C for 9 minutes), 71 out of 6347 genes were differentially expressed.

Conclusions: Overall, the results support the original hypothesis that *Listeria monocytogenes* elicits unique transcriptomic responses as part of its stress adaptive response when exposed to sub-lethal temperature stresses. Since temperature is one of the key stressors that is widely employed in the food industry as a "hurdle" to prevent microbial growth or eliminate microbial populations, these results highlight the critical importance of understanding how *L. monocytogenes* responds to varying temperature ranges.

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P1-16 Effect of NaCl and pH Stresses in *Listeria monocytogenes*

GABRIELLA KISKÓ, Réka Ágoston, Edit Pocklán, Quang Nguyen Duc and Csilla Mohácsi-Farkas, Corvinus University of Budapest, Faculty of Food Science, Department of Microbiology and Biotechnology, Budapest

Introduction: Number of human outbreaks caused by *Listeria monocytogenes* has increased over the last few years. This bacterial pathogen is capable of growing in a wide range of environmental conditions and capable of surviving a variety of food processing conditions or capable of contaminating processed foods. Understanding the stress adaptive responses of *Listeria monocytogenes* that allow it to withstand environmental stresses (especially pH and NaCl) can help in developing effective food processing techniques to produce safe food.

Rational: In this study, seven *L. monocytogenes* strains of different origins (culture collection, dairy isolates, meat isolates) were examined. The organisms' stress response and adaptation to pH and NaCl stresses were examined in broth media using different combinations of pH and NaCl. The results were evaluated using Response Surface Method (RSM) and analysis of variance.

Results: The results showed that only few of the tested pH and NaCl combinations inhibited the growth of this pathogen at optimal growth temperature conditions. These results point out that the studied *L. monocytogenes* strains have the ability to survive pH and NaCl stresses. There were differences in the resistance even among strains from similar origins. Though there were differences in the inhibitory NaCl concentrations, there was no significant difference in the pH range that was effective at inhibiting the strains. Sodium chloride had a significant effect on growth, pH 4 was effective at inhibiting the growth of the pathogen.

Conclusions: There is a need for a comprehensive study to verify these results, using more strains from different origins (especially with extreme salt and acid tolerant strains) to determine an applicable pH-NaCl combination for the food industry. After an examination in Modell-broth media, there is a need for studies in foods with a possibility of growth of *Listeria monocytogenes* causing a potential risk for human health.

P1-17 ceeramTools Molecular Detection Systems for Foodborne Viruses Detection

FABIENNE LOISY-HAMON, Angélique Fourrier, Denis Bidot, and Benoît Lebeau, ceeram, La Chapelle sur Erdre, 44700, France

Introduction: Foodborne viral infections are a common source of gastrointestinal disease. The proportion of outbreaks attributed to viral agents, predominantly noroviruses, increased regularly every year.

Rational: To meet the needs for the food industries in term of viral risk control, the commercial solutions, ceeramTools molecular detection systems, were developed. The targeted human enteric viruses were norovirus genogroup I and II, hepatitis A and E, rotavirus, enterovirus, astrovirus, adenovirus 40/41, sapovirus, aïchi virus.

Results: One step real time RT-PCR was developed for each viruses. The sensitivity was tested with other human enteric viruses and potential food pathogens. Amplification conditions and reaction mixes were optimized to obtain a high sensitivity with a very easy protocol. A robustness study was performed for each kit. Internal controls, positive and negative controls were developed for each target. The developed methods were then tested on artificially and naturally contaminated matrices (shellfish, fruits, vegetables). Finally, the different ceeramTools molecular detection systems were evaluated by different reference laboratories. Using the ceeramTools kits, a high specificity was observed for each virus. A sensitivity of 1 to 10 genome copies for each virus was observed at a confidence level superior to 95%. Thanks to internal control, negative and positive controls including in the kits, reliable results are obtained in less than 2 h 30 min. The ceeramTools kits were adaptative to different thermocyclors. Using our concentration and extraction methods, positive results were obtained on artificially contaminated matrices, even at low contamination level. Results obtained on naturally contaminated shellfish during winter 2008–09 using the ceeramTools molecular detection systems will be presented.

Conclusions: Associated with our extraction protocols, the different ceeramTools molecular detection systems allow a rapid detection, identification of foodborne viruses for different types of food in 24 to 48 h depending of the urgency. This constitutes a real advance in food safety control and public health protection.

P1-18 Flow Cytometry Detection of *Escherichia coli* O157:H7 Stressed by Chemical and Physical Treatments

ALICIA SUBIRES, Josep Yuste, and Marta Capellas. CER Planta de Tecnologia dels Aliments (XaRTA, XIT), Departament de Ciència Animal i dels Aliments, Facultat de Veterinària, Universitat Autònoma de Barcelona, 08193 Bellaterra, Barcelona, Spain

Introduction: Food processing and preservation treatments can render injured microorganisms which are not detected by conventional plate count procedures. Flow cytometry combined with bacterial viability stains allow detection and quantification of injured cells.

Rational: The objective of this study was to test flow cytometry and fluorescent dyes SYTO9 and propidium iodide (PI) as a method to identify live, injured and dead *Escherichia coli* O157:H7, in potassium citrate buffer suspension, exposed to chemical (sodium benzoate, vinegar, sodium hypochlorite) and physical (freezing,

refrigeration, heat and high isostatic pressure) stresses. The technique was compared to plate counting on nonselective medium: tryptic soy agar with yeast extract (TSAYE); and selective media: TSAYE with sodium chloride (TSAYE+NaCl) and sorbitol MacConkey agar (SMAC).

Results: While *E. coli* O157:H7 counts declined from 7.0 to ca. 6.0 log CFU/ml with sodium benzoate (0.1%, 42 h) and vinegar (to reach pH 4.0, 42 h), the organism was totally inactivated by sodium hypochlorite (150 ppm free chlorine, 30 s before sample processing). Heat (68°C, 15 s) caused a ca. 3.5-CFU/ml reduction, whereas high pressure (400 MPa, 2 min, 20°C) decreased counts by 3.0 log CFU/ml. In general, counts on selective media were similar to those on TSAYE, except for the pressure-treated sample, whose counts on TSAYE+NaCl and SMAC were, respectively, ca. 1.5 and 1 log CFU/ml lower than those on TSAYE, which suggests a large injured cell population that agrees with flow cytometry results. SYTO9-PI staining enabled good separation and identification of live, injured and dead bacteria; and gave counts (determined by means of a calibrated microsphere suspension) higher than those estimated by plate counting.

Conclusions: Flow cytometry can improve the knowledge about physiological state of pathogenic bacteria after food processing and preservation treatments.

P1-19 Evaluation of a Rapid Two-day Isolation Method for *Salmonella* Using Oxoid ONE Broth–*Salmonella* and Brilliance *Salmonella* Agar

Jeff J. Koziczkowski, Dorn L. Clark, Roy P Radcliff, Christine Hilbert, Jonathan Cloke and ALASTAIR THOMAS, Oxoid, Wade Road, Basingstoke, RG24 8PW, United Kingdom

Introduction: *Salmonella* is a Gram-negative, rod-shaped, motile bacterium with a widespread occurrence in animals, especially poultry and swine. Additional sources of this organism include raw meat, raw poultry, and raw seafood, to name only a few. Detection is critical as *Salmonella* is the most frequently reported cause of food borne illness (within the USA, 40,000-50,000 cases are reported annually) and the infectious dose can be as low as 1–10 CFU/g. This study evaluated the Oxoid *Salmonella* rapid culture method which combines Oxoid ONE Broth-*Salmonella* and Brilliance™ *Salmonella* Agar in a simple protocol, for the detection of *Salmonella* in food within 2 days.

Rational: 25 g samples of minced beef, minced chicken, lettuce, shrimp and shell eggs were inoculated with *Salmonella* serovars at a level of ~1 CFU/25 g. Samples were then enriched in Oxoid ONE Broth-*Salmonella* at 42°C for 16–24 h before plating a 10 µl loop full onto Brilliance *Salmonella* Agar and incubating at 37°C for 24–26 h. The Oxoid *Salmonella* rapid culture method was compared to either the USDA or FDA established protocols depending on the food matrix. The specificity of the methods was evaluated using multiple *Salmonella* serovars (n = 100) or closely related bacterial species (n = 30).

Results: When selected foods were inoculated with *Salmonella* serovars at a level of ~1 CFU/25 g there was no difference in sensitivity between the Oxoid *Salmonella* rapid culture method and the reference methods. When specificity was evaluated 96/100 *Salmonella* serovars were identified using this method and 29/30 of the non-*Salmonella* showed no growth or atypical growth.

Conclusions: Enriching samples using ONE Broth-*Salmonella* and plating on Brilliance *Salmonella* Agar reduced time to detection to as little as 38 h, compared to the FDA and USDA reference methods which took 4 days. Identification of presumptive positive colonies on Brilliance *Salmonella* Agar can be conducted rapidly using the Oxoid *Salmonella* Latex kit, to give a confirmed result in 2 days.

P1-20 An Improved Medium for the Enumeration of Coagulase-Positive Staphylococci from Foods: Oxoid Brilliance™ Staph 24 Agar

Mark Gibson, Kim Kirby and JONATHAN M. CLOKE, Oxoid, Wade Road, Basingstoke, Rg24 8PW, United Kingdom

Introduction: Contamination of foods both pre- and post-production with coagulase positive staphylococci (CPS) is a potential cause of serious food poisoning. Although Baird-Parker Agar with Egg Yolk and Tellurite (BPA) is traditionally the most commonly used medium for the enumeration of CPS from foodstuffs according to ISO 6888-1, the 48 h incubation period and highly variable colony morphology of typical and atypical isolates are widely seen as disadvantages. Oxoid Brilliance Staph 24 Agar, a new chromogenic medium for the enumeration of CPS within 24 h was evaluated as an alternative to BPA.

Rational: Eighty routine food samples covering cooked vegetables, sweets and chocolate, powdered flavourings, meat sauce and cheeses were analysed. Samples were prepared and decimally diluted according to the laboratories standard method before spreading 0.25 ml of 10-1 dilutions over single plates of Acumedia BPA and Brilliance Staph 24 Agar. Inoculated BPA was incubated at 37 ± 1°C for 48 ± 2 h. Brilliance Staph 24 Agar was incubated at 37 ± 1°C for 24 ± 2 h. Typical and atypical colonies on BPA and presumptive positive (blue) colonies on Brilliance Staph 24 Agar were sub-cultured onto Plate Count Agar (37 ± 1°C for 24 ± 2 h) before confirming CPS by the tube coagulase test.

Results: Seventy-four of the food samples were negative for CPS with BPA. Typical colonies were identified from the remaining six samples. These isolates were shown to be coagulase-negative organisms. A single colony of presumptive growth was recorded from one sample with Brilliance Staph 24 Agar, which was identified as a coagulase-negative organism.

Conclusions: Brilliance Staph 24 Agar proved to be a suitable alternative to BPA for the enumeration of coagulase-positive staphylococci within 24 h. It resulted in significantly fewer presumptive positive isolates compared to BPA, which required confirmation, and accurate results were available within 24 hours.

P1-21 ISO16140 Expert Laboratory Evaluation of a Novel Medium for the Enumeration of Coagulase-positive Staphylococci

Mieke Uyttendaele, Anja DeLoy-Hendrickx, Dirk Berkvens, Niko Speybroeck and JONATHAN M. CLOKE, Oxoid, Wade Road, Basingstoke, RG24 8PW, United Kingdom

Introduction: Oxoid Brilliance™ Staph 24 Agar is a new chromogenic medium for the enumeration of coagulase-positive staphylococci (CPS) from foods within 24 hours. Traditionally, Baird-Parker Agar supplemented with Egg Yolk and Tellurite (BPA) has been used for enumerating CPS. Isolates on BPA are often difficult to interpret because of the presence of both typical and atypical colonies of staphylococci, which both require confirmation.

Rational: Brilliance Staph 24 Agar was evaluated against BPA for the enumeration of CPS from the five identified food categories detailed in ISO16140:2003. Testing was performed according to the method detailed in ISO6888-1:1999, with the exception of Brilliance Staph 24 Agar which was incubated at 37°C for 24 h. The Expert laboratory evaluation was conducted in full accordance of the quantitative methods validation section of ISO16140:2003.

Results: Brilliance Staph 24 Agar showed good equivalence to BPA with dairy, meat, sea-food, bakery products and composite/ready to eat food samples. Equivalence of the media was not shown with CPS from sugar snap peas. Results for inclusivity, limit of detection and quantification limit (LOD=2, LOQ=4) were equivalent for the reference and alternative method. Exclusivity testing of Brilliance Staph 24 Agar showed it was more specific than BPA, with no false positive results (0/48) compared to BPA, where 13/48 non-CPS gave typical/atypical colonies. Statistical analysis demonstrated that Brilliance Staph 24 Agar showed excellent linearity and accuracy. Linear regression analysis (GMFR and OLS2) demonstrated that the relative accuracy of the reference and alternative method was equivalent (R=0.999) for all food categories, giving an overall regression of (y=0.9918 + 0.0335).

Conclusions: Brilliance Staph 24 Agar proved to be a suitable alternative to Baird-Parker Agar with the five food groups analysed during the Expert lab phase of the ISO16140 validation. Brilliance Staph 24 Agar showed greater specificity than Baird-Parker Agar and gave results within 24 h.

P1-22 Evaluation of a Novel Medium for the Enumeration of Thermotolerant *Campylobacter* spp.

Wilma Jacobs-Reitsma, Wendy van Overbeek, El Bouw, Hilko van der Voet, Jonathan Cloke and ANNETTE WHISTANCE, Oxoid, Wade Road, Basingstoke, RG24 8PW, United Kingdom

Introduction: Traditional media for the enumeration of thermotolerant *Campylobacter* spp. often lack specificity and individual colonies are difficult to count, due to the swarming nature of campylobacters and the presence of blood and charcoal in the media. Oxoid Brilliance™ CampyCount Agar is a novel defined medium for the direct enumeration of *Campylobacter* spp. which was evaluated as the first part of an ISO16140:2003 validation of the medium. Colonies of *Campylobacter* spp. grow as distinct dark red colonies against a clear background.

Rational: Brilliance CampyCount Agar was evaluated against modified Charcoal Cefoperazone Desoxycholate Agar (mCCDA) for the enumeration of thermotolerant *Campylobacter* spp. from poultry samples, according to the method detailed in ISO10272-2:2006. Both media were incubated at 41.5°C for 40–48 h in a microaerobic atmosphere. The evaluation was conducted in accordance with the quantitative methods validation section of ISO16140:2003. In addition to the confirmation requirements of ISO10272-2, presumptive colonies on Brilliance CampyCount Agar were confirmed using the Oxoid Dryspot Campylobacter Latex kit and O.B.I.S Campy test.

Results: Brilliance CampyCount Agar was shown to have comparable performance to the reference method (mCCDA) in terms of inclusivity, exclusivity and to limits of detection and quantification (LOD=3.3, So=0.309). Statistical analysis of the linearity, in accordance with ISO16140 showed no statistically significant evidence of lack of fit (P = 0.56). Linear regression analysis (GMFR) showed that the relative accuracy of the reference and alternative methods was equivalent (R=0.82, y=-0.22+1.09).

Conclusions: Brilliance CampyCount Agar was shown to be comparable in performance to mCCDA. Colonies of *Campylobacter* spp. were easier to enumerate as they were distinct dark red colonies on a clear background. The Oxoid Dryspot Campylobacter Latex kit and O.B.I.S Campy tests were found to be accurate methods for the confirmation of presumptive growth on Brilliance CampyCount Agar.

P1-23 Advancing Access to Global Food Safety Research Information: The Research Projects Database

TARA M. SMITH, Yvette Alonso, Joyce Merkel, and Kristina Brandriff, USDA Food Safety Research Information Office, 10301 Baltimore Ave., Beltsville, MD 20705, United States

Introduction: The Food Safety Research Projects Database (http://fsrio.nal.usda.gov/advsearch.php) was created by the Food Safety Research Information Office (FSRIO) at the USDA National Agricultural Library (NAL) (http://www.nal.usda.gov/). The FSRIO program is a collaborative project with the USDA Agricultural Research Service.

Rational: FSRIO's vision is to provide a publicly accessible and searchable database that showcases food safety research projects funded by both United States and International government agencies, as well as educational institutions and other private or non-government organizations. The information provided by this database can assist in the assessment of food safety research trends, identification of research gaps and avoidance of unnecessary duplication, as well as provide a valuable tool to the food safety community and policymakers.

Results: The Food Safety Research Projects Database currently provides access to more than 4,000 food safety research projects, and is the largest searchable collection of research conducted among government agencies. The projects are organized by food safety categories, including risk assessment, on-farm food safety, food defense, and sanitation and pathogen control, which capture the broad concept of the research data and are indexed with key terminology from the NAL Thesaurus (controlled vocabulary) developed by experts. These features result in faster access to the information.

Conclusions: The Research Projects Database uses both cutting edge technology and library resources to leverage access to the breadth of food safety information. Future efforts will focus on expanding collaborations with both International and U.S. agencies, further enhancing the collection and establishing it as the central place to access global food safety research initiatives.

P1-24 WITHDRAWN

P1-25 Evaluation of a New Swab-based Test for *Salmonella* on Food Contact Surfaces

DOUGLAS J. SHEDDEN, Medical Wire & Equipment, Leafield Industrial Estate, Corsham, SN13 9RT, United Kingdom

Introduction: *Salmonella* remains a significant cause of foodborne illness around the world, and food manufacturers must take measures to control its presence of within production areas. Traditional methods of surveillance require samples being sent for laboratory testing, and can take several days for results to be reported, by which time the food product may have been consumed.

Rationale and Objectives: The *Salmonella* Detection Transwab (SDT) is a self-contained swab-based kit for the detection of *Salmonella* on food contact surfaces. The kit consists of a premoistened swab, together with a tube of red *Salmonella* Detection Gel. The swab is used to sample the test surface, then placed into the tube of red gel and incubated at 37°C (a small portable incubator would be suitable). *Salmonella* is confirmed within 24 hours by the development of a black colouring around the swab, eventually spreading through the whole gel. Early development of the black colour is clearly seen at the tip of the conical base of the tube, and can allow detection of *Salmonella* in less than one day.

This study was designed to show the performance of the device, firstly by challenging with known dilutions of *Salmonella* Enteritidis, *Salmonella* Typhimurium, and also *Citrobacter freundii*, an organism which gives false positive reactions in some *Salmonella* media. In addition, known amounts of *Salmonella* Enteritidis, *Salmonella* Typhimurium, and also *Citrobacter freundii*, together with various other species of bacteria were spread onto food grade stainless steel plates, before sampling with the swab.

Results and Findings: In both experiments *Salmonella* was clearly detectable by the presence of a black colour in the gel at both 24 and 48 hours, while there was no change with other species, including *Citrobacter*.

Conclusions: It is concluded that SDT could offer a suitable method for the detection of *Salmonella* in food production facilities.

P1-26 Comparison of a Self-contained *Listeria* Detection Test against USDA and ISO Reference Methods

DOUGLAS J. SHEDDEN, Medical Wire & Equipment, Leafield Industrial Estate, Corsham, SN13 9RT, United Kingdom

Introduction: *Listeria monocytogenes* is a life-threatening foodborne pathogen that causes much illness and many deaths (up to 500 annually in United States). It is important for food manufacturers to have effective control measures in place, including measures for testing food contact surfaces.

Rationale and Objectives: The present study was designed to measure the effectiveness of the *Listeria* Isolation Transwab, a self-contained swab-based test kit that can be used on site, and to compare its performance with two traditional reference methods (USDA and ISO).

The *Listeria* Isolation Transwab (LIT) includes a dry swab, together with a tube of straw coloured gel medium. The swab is rubbed across a test surface, inserted into the gel and incubated at 37°C for 24–48 hours. Blackening of the medium indicates a positive result due to aesculin hydrolysis. Both the reference methods require primary and secondary enrichment stages in the laboratory before a final result is obtained.

For this study, a number of organisms known to hydrolyse aseculin were used. Suspensions of each organisms at different dilutions were used to inoculate either the LIT, swabs which were tested according to the two reference methods.

Results and Findings: LIT showed equivalent sensitivity to the two reference methods for *Listeria monocytogenes*, with a minimum detection level of 15 CFU per swab. Other *Listeria* species were also detectable at low levels. In contrast false reactions were only detectable for very high levels of other aesculin hydrolysers, such as *Enterobacter aerogenes* (over 43000 CFU).

Conclusions: From the study, LIT appears to be capable of alerting users to the presence of low levels of *Listeria monocytogenes*.

P1-27 Prevalence of *Salmonella* spp. in Porcine and Bovine Raw Meat and By-products in Southern Germany

C. MEYER, S. Thiel and A. Stolle, LMU-Munich, Faculty of Veterinary Medicine, Institute of Food Hygiene, Schoenleutnerstr. 8, 85764 Oberschleißheim, Germany

Introduction: Salmonellosis is, after campylobacteriosis the second main cause of bacterial human enteritis in Germany. *Salmonella* spp. is known to colonize the gastrointestinal tract of animals without producing any clinical or pathologic-anatomic signs. Therefore, carcasses of asymptomatic animals can be contaminated with *Salmonella* spp. at the time of slaughter. Contaminated raw or undercooked meat is considered an important factor in transmitting this foodborne pathogen. Thus, this study was undertaken to contribute to the understanding of the actual risk potential of raw meat and by-products originating from pigs and cattle. A further aim was to find out if a seasonality could be observed.

Rational: From March 2008 to January 2009, a total of 4172 beef and pork raw meat samples and by-products were tested qualitatively for *Salmonella* spp. using the VIDAS system. Positive samples were confirmed by isolation of the agent with cultural methods. The samples, composed of 1368 beef and 2804 pork samples, were obtained from seven different slaughterhouses in Southern Germany.

Results: The overall prevalence of *Salmonella* spp. in pork and beef was 1.1% and 0.1%, respectively. The highest contamination rate of porcine samples was found in tongues and livers with 5.0% and 4.5%, respectively. The prevalence of *Salmonella* spp. in pork carcasses amounted to 1.1%, while no *Salmonella* spp. could be found in porcine kidneys and lungs. As for the bovine samples, *Salmonella* spp. were isolated only from tongues at a rate of 2.2%. With the exception of May, June and July, positive porcine samples were detected all over the year, observing a slight seasonal increase in the colder months. From bovine samples *Salmonella* spp. were isolated only in June.

Conclusions: Although the *Salmonella* spp. prevalence found in this study was relatively low compared to previous surveys, the risk of transmitting this pathogen cannot be neglected in terms of preventing foodborne zoonoses.

P1-28 Comparison Study to Demonstrate the Equivalence of the SimPlate Total *Campylobacter*-CI Method to the Reference Culture Method for the Enumeration of Total *Campylobacter jejuni* and *Campylobacter coli* in Food

Philip T. Feldsine, Mandeep Kaur and Andrew H. Lienau, BioControl Systems Inc., Bellevue, WA 98005–4356, USA

Introduction: The SimPlate for Campylobacter Color Indicator (C-CI) method allows for the quantitation of total *Campylobacter jejuni* and *Campylobacter coli* in poultry meat and poultry meat rinses after 48 to 52 h of incubation in a microaerophilic environment.

Purpose: A study was undertaken to compare the SimPlate C-CI method to the reference culture method for the quantitation of total *Campylobacter jejuni* and *Campylobacter coli*.

Methods: Target *Campylobacter* and non-target microorganisms were tested for inclusivity and exclusivity by the SimPlate method. 37 strains of *C. jejuni* and *C. coli* were enriched in Bolton broth, diluted and plated onto SimPlate devices and 3 selective agar plates (Abeyta-Hunt-Bark (AHB) agar, Campy CEFEX agar and Line agar). Finally, a field trial comparison of the performance of the SimPlate C-CI method to the Campy CEFEX method was performed. Lab personnel at 3 poultry processing plants analyzed 168 BPW carcass rinse samples with both methods.

Results: There was good correlation for the quantitation of *Campylobacter* from all three plating methods to the SimPlate method; only 2 strains for AHB and 1 strain for Line agar demonstrated greater than 0.5 log difference between both methods. For exclusivity, the C-CI method detected none of the 27 non-target organisms tested. Regression analysis of the results from the field trial comparison showed a correlation of 0.96.

Significance: These results indicate that the SimPlate C-CI method and the reference culture method are comparable for enumeration of *Campylobacter jejuni* and *Campylobacter coli* in poultry meat and poultry meat rinses.

P1-29 Detection of Shiga Toxin-producing *Escherichia coli* (STEC) with the Assurance GDS for STEC Assay

Philip T. Feldsine, Markus T. Jucker, Andrew H. Lienau and David E. Kerr, BioControl Systems Inc., Bellevue, WA, 98005–4356, USA

Introduction: Recent reports of illnesses caused by foodborne non-O157:H7 Shiga Toxin-producing *Escherichia coli* (STEC) have led to increased awareness of their threat to public safety.

Purpose: A rapid screening assay has been developed to detect *E. coli* STEC isolates with the following O-serotypes: O26, O45, O103, O111, O121, O145.

Methods: Immunomagnetic beads are employed to specifically isolate and concentrate bacteria that express these O-antigens during a sample preparation step. DNA from the samples is then amplified and identified using primers and probes directed against conserved, specific, virulence-associated DNA sequence targets in these bacteria.

Results: The assay was able to detect 30/31 *E. coli* strains that expressed one of the O-antigens in question. The one undetected strain did not contain either the *stx*1 or *stx*2 gene and is not considered a STEC. An additional 40 bacteria, including 15 *E. coli* strains that express different O-antigens, were not detected.

Significance: The data show that the combination of an immunomagnetic sample preparation step and a specific DNA amplification-detection step yield a screening assay specific and sensitive for the top 6 *E. coli* STEC strains known to cause human disease.

P1-30 Development and Validation of a Real-time PCR Assay for Detection of *Mycobacterium avium* subsp. *paraturberculosis* from a Range of Dairy Matrices

JOHN DONAGHY, Jane Johnston, Anne Fisher, and Michael Rowe, Agri-Food and Biosciences Institute (AFBI), Food Microbiology Branch, AFESD, Newforge Lane, Belfast, Ireland

Introduction: *Mycobacterium avium* subsp. *paratuberculosis* (Map) has concerned the dairy industry by reports of its possible association with Crohn's disease in humans. The 'gold standard' for Map detection remains isolation in culture, however, due to its slow growth rate efforts have been made to use quantitative PCR methods to detect Map in dairy products, particularly milk.

Rational: A key factor in the development of a PCR assay for the detection of Map from dairy matrices is the use of an effective method to recover Map from the matrix and subsequently extract DNA from the cells. The objective of this study was to develop and assess the potential of real time PCR assays coupled with a standardized magnetic bead-based Map DNA extraction method, to quantify Map in a range of dairy products including milk, yogurt and a range of cheeses.

Results: Map DNA extracted from homogenized cheese and milk samples using the Adiapure® kit (Adiagene, France) was subjected to two independent TaqMan®-based real time PCR assays targeting different gene sequences. The IS900 based real time assay was more sensitive (approx. 10-fold) than the assay targeting the F57 sequence, detecting < 4 CFU ml^{-1} in artificially contaminated milk and < 30 CFU g^{-1} in spiked cheese and milk powder samples. In an EU organized dairy products ring trial, involving 12 laboratories, average sensitivities of the prescribed Adiapure/IS900 TaqMan®-based qPCR method across a range of artificially contaminated dairy matrices were 85–100%. Specificities for all matrices were in the range 95–100%.

Conclusions: The real time PCR assay combined with the Adiapure Map-DNA extraction kit represents a reproducible, sensitive and convenient method for detection of Map DNA from a range of raw and pasteurized dairy products. Its robustness has been confirmed through a ring trial within the FP6 EU ParaTBTools project.

Acknowledgments: This work was funded as part of the EU FP6 ParaTBTools project – FOOD – CT-2006–023106.

P1-31 A Method for the Laboratory-scale Manufacture of UK Semi-Hard and Hard Type Cheeses from Milk Contaminated with *Mycobacterium bovis*

RICHARD FORGRAVE, John Donaghy, and Michael Rowe, Queen's University Belfast, School of Biological Sciences, Newforge Lane, Belfast, Ireland

Introduction: Although the UK has established control and monitoring mechanisms for tuberculosis in cattle the prevalence of tuberculosis amongst dairy herds continues to increase. Concomitantly there is a growing market for artisanal cheeses produced from raw milk. The absence of a pasteurisation process removes a major barrier to possible *Mycobacterium bovis* contamination of raw milk cheeses. A link between *M. bovis* zoonotic infections and the consumption of raw milk and related products has been established.

Rational: Currently a lack of data exists regarding the survival kinetics of *M. bovis* during the manufacture, ripening and storage of raw milk cheeses. To address this knowledge gap it was essential to devise a protocol for the production of semi-hard (Caerphilly) and hard cheese (Cheddar). The cheesemaking procedure must satisfy stringent health and safety criteria regarding manipulation of Hazard Group 3 organisms and produce on a laboratory-scale cheese comparable with commercial products.

Results: The devised procedure mimics the cutting and stacking of curd, traditionally used to develop the characteristic texture of cheddar cheese. Equipment developed facilitates the application of constant, measurable and reproducible pressure during pressing. All cheesemaking manipulations can be conducted within the confines of a Class I safety cabinet. Containment measures allow for the safe collection of whey and subsequent disposal. Cheddar and Caerphilly cheeses prepared from raw milk artificially contaminated with M. bovis have been produced and *M. bovis* has been enumerated on selective media post manufacture.

Conclusions: This procedure allows the investigation of *M. bovis* survival kinetics in raw milk cheeses. Furthermore the technique could be used with other Hazard Group 2 & 3 pathogens and adaptation is possible for production of alternative cheese types. As a result this protocol is a tool for the production of microbiologically contaminated cheese which can facilitate investigation of food protection relating to cheese.

Acknowledgments: The authors acknowledge funding received for this project from the Food Standards Agency (UK).

P1-32 Qualitative Methods for the Detection of *Listeria monocytogenes* and Other *Listeria* Species – Strategies for Comparison Studies

MARIJA ZUNABOVIC, Wolfgang Kneifel, University of Natural Resources and Applied Life Science, Vienna, 1190, Austria

Introduction: Current approved methods allow the detection of the food pathogen *L. monocytogenes* from various food matrices. For the detection three general procedures can be described: (1) direct plating on selective media (2) immediate selective enrichment (3) pre-enrichment steps. Of course the choice of the "ideal" method for specific purpose is dependent on different parameters (e.g., number and stage of microorganisms, inhibitory aspects of the media, incubation time and conditions). On the other hand the treatment of samples for efficient detecting of especially low levels and inhomogeneous spreading of microorganisms is also essential.

Rational: The preparation and design for the comparison of qualitative methods based on different methodologies for detection of the emerging food pathogen *Listeria monocytogenes* and other *Listeria* species is described. The matrices were naturally contaminated and sampled in different food factories (seafood, cabbage, ready-to-eat food) and therefore reflect the real situation.

Results: This protocol was successfully applied for comparison studies with VIDAS® LDUO (bioMérieux), IQ-Check® *Listeria* (Biorad), and BAX® *Listeria* PCR (DuPont) run in parallel with the reference method according to ISO 11290:1. It allows the evaluation of these methods by the use of current parameters as specifity, sensitivity, false-positive and false-negative rate for alternative methods.

Conclusions: For estimating the prevalence of *Listeria* spp. and *Listeria monocytogenes* e.g., in neuralgic areas in the food production and in food products it is essential to combine methodologies for an effective detection. The problem of obtaining a representative sample of food or environment is persistent due to uneven spread of contamination. Comparison studies with alternative methods are difficult to perform because they rely on different detection principles (e.g., monoclonal antibodies, virulence genes, enzymes, and ribosome) and the sensitivity is rising with upcoming new methods. Even though the analyzing time and information content about the presence of *Listeria* can be fulfilled with the use of alternative methods.

P1-33 Environmental Monitoring for Noroviruses in UK Food Outlets

Niamh M. Murphy, Chris I. Gallimore, Jacqueline Xerry, Juliet Adigwe, Jim J. Gray, and Susanne B. Surman-Lee, Health Protection Agency, Food, Water and Environmental Network - London Laboratory, 61 Colindale Ave., London, NW9 5EQ, United Kingdom

Introduction: Noroviruses are the commonest cause of acute gastroenteritis outbreaks world-wide. Norovirus outbreaks are frequently associated with semi-closed or closed institutions such as hospitals, and homes for the elderly. However, outbreaks have also been associated with eating establishments, cruise ships, a concert hall and schools.

Rational: A proposed route of transmission is cross-contamination from hard surfaces such as fridge door handles to food samples. This study investigated the potential cross-contamination of toilet to food contact surfaces in food businesses. Environmental swabs were taken from to sites within toilet facilities in food outlets (e.g., toilet flush handle, toilet door handle, wash basin taps) and kitchens (e.g,. fridge door handles and other food preparation sites). Nucleic acid was extracted using the guanidinium thiocynate method. Norovirus RNA was identified using real-time PCR, genotyped by PCR and sequencing.

Results: Norovirus was detected in 40/193 (20%) swabs including: 10 refrigerator door handle, 3 food preparation sites, 7 toilet door handles, 12 wash hand basin taps and 8 toilet flush handles. Norovirus was typed as genogroup II (GII) in 39/40 and 1/40 genogroup I (GI). Strains were further differentiated as GII-4 (17.5%), GII-3 (7.5%), GII-UT (Untyped) (72.5%) and GI-4 (2.5%). The seven GII-4 strains were variant typed, with 2/7 v2 strains, 4/7 v6 and 1/7 was vUC (variant unclassified).

Conclusions: The findings indicated that food businesses without a HACCP in place, poor food safety management were more likely to have norovirus present and that environmental swabbing is an effective means of monitoring during outbreak investigations.

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P1-34 Development of Mathematical Model to Predict the Outgrowth of *Listeria monocytogenes* in Ready-to-Eat Food Products

SAURABH KUMAR, Taco Wijtzes, An Vermeulen, Frank Devlieghere, Willem Hommes, Diana Visser, Edwin W. Bontenbal, Purac Biochem BV, Arkelsedijk 46, Gorinchem, 4200 AA, The Netherlands

Introduction: EU regulations state that the food industry can use predictive models to document that outgrowth of *Listeria monocytogenes* in RTE foods is controlled (EC 2073/2005). The Codex Alimentarius Commission recently agreed on similar criteria. The development of reliable models, based on challenge studies in food products using outbreak strains therefore continues to be important.

Rational: The objective of this study are to: (1) Develop a mathematical model for *Listeria monocytogenes* that predicts its potential for growth in food products as a function of temperature, pH, water activity and the concentration of organic acids and their salts. (2) Demonstrate the efficacy of lactic acid, acetic acid and their salts against *Listeria monocytogenes* and spoilage microorganisms in food products.

Results: The model shows that the addition of lactic acid, acetic acid or their salts to food products significantly retards the outgrowth of *Listeria monocytogenes*. Addition of 0.75% PURASAL Powder S98 to a Carbonara type of pasta sauce (pH 5.6, moisture 80%, a_w 0.986) was simulated at 95% confidence level. At 7°C, for the treated sample, the time for 2 log growth for *Listeria monocytogenes* was increased from 3 days to 8 days compared to that of control. The developed model describes the data very well, including independent challenge studies, and generally gives fail safe predictions.

Conclusions: The developed model gives reliable predictions of the potential for outgrowth of *Listeria monocytogenes* in RTE foods. This model can be used by food processors to evaluate how they can control *Listeria monocytogenes* by addition of lactic acid, acetic acid or their salts to their formulations, and by adequate temperature control.

P1-35 The Inhibitory Effect of the Lactoperoxidase System on the Survival of *Campylobacter jejuni* in Pasteurized Skimmed Milk Incubated Aerobically at 25°C

MARYAM AL SALLAQI, S. Park and M. Adams, The University of Surrey, Faculty of Health and Medical Sciences, Guildford, Surrey, GU2 7XH, United Kingdom

Introduction: Campylobacter jejuni and *Campylobacter coli* are the most common bacteria isolated in animals and humans suffering from diarrhea. These organisms can also be found in animals which are clinically healthy. The most common alimentary sources of *Campylobacter* infection include undercooked meat, especially chicken, contaminated water and unpasteurized or raw milk.

Rational: The effects of storage temperature on the survival of *C. jejuni* were examined in pasteurized and UHT skimmed milk. It was found that, *C. jejuni* NCTC 11168 survived for more than 5 days at 4°C in both UHT and pasteurized milk. At 25°C it survived for 3 days in UHT milk but was not detectable after 6 h in pasteurized milk. *C. jejuni* was found to die at the same rate in pasteurized milk that had been filter sterilized to remove the residual micro-flora. This result indicates that the antimicrobial effect was not due to the natural flora but to a natural component in the milk.

Results: The inhibitory action of pasteurized milk was prevented by boiling and by addition of 1 mM of sodium meta-bisulphite (an inhibitor of lactoperoxidase) suggesting that lactoperoxidase in the pasteurized milk was responsible. This was confirmed by restoration of the inhibitory effect in UHT milk by addition of components of the lactoperoxidase system.

Conclusions: A similar effect was not seen with other pathogens such as *Salmonella*, *Listeria monocytogenes* and *E. coli* O157 indicating the unique sensitivity of *Campylobacter* to the lactoperoxidase system.

P1-36 Rapid Isolation and Detection of *Salmonella* Serovars from Pre-enriched Pooled Food Samples Using an Automated PATHATRIX Re-circulating IMS (RIMS) Coupled to, Real-time PCR and Selective Agar Plating

John Murray, Nicole Prentice, Katarzyna Brzegowa, Paul Benton, Brooke Houston , Michael F. Scott, Christine M. Aleski, Marcie Van Wart, and ADRIAN PARTON, Matrix MicroScience, Lynx Business Park, Fordham Road, Newmarket, CB87NY, United Kingdom

Introduction: Re-circulating Immuno-magnetic Separation (RIMS) is well established as a robust and versatile approach to pathogen isolation from food and environmental samples; combining straightforward analysis of large samples and removal of potential PCR inhibitory compounds with the ability to detect initially low levels of target pathogens.

Methods: A range of food samples including peanut butter, confectionary and cocoa products, fresh produce, tomatoes, almonds and milk powders of various sample sizes (25 g–1875 g) were inoculated individually at low level, (1–10 CFU/sample), with a range of *Salmonella* serovars. Samples were pre-enriched for 8–18 h as appropriate to sample size and food type. After pre-enrichment, identical duplicate pooled samples were created; consisting of single aliquots from inoculated samples and 4–9 aliquots from uninoculated samples. Pooled samples were processed in parallel using a novel automated RIMS device alongside manual RIMS. Recovered Pathatrix beads were analyzed using real time PCR and selective agar plating as the *Salmonella* detection methodologies.

Results: The detection of a range of *Salmonella* serovars from wide variety of pooled food samples using Pathatrix RIMS linked to agar plates and/or real time PCR was achieved. There was 100% correlation between the recovery and detection of target organisms by the automated and manual RIMS systems. For peanut butter a detection level of 1–10 CFU in 1875 g for all *Salmonella* serovars tested was achieved in less than 24 h.

Conclusions: The study showed that it is feasible to fully automate the Pathatrix RIMS procedure for use in a wide variety of food types, with no loss of bead recovery or target pathogen capture functionality. This RIMS method provides the capability to quickly identify sources of *Salmonella* contamination in both routine food pathogen surveillance regimes or in outbreak scenarios.

P1-37 Rapid Detection and Serotyping of *Salmonella* Isolates

Ron van Santen, FRANCOISE DE GOEIJEN, Joost Thijssen and Pieter Vos, DSM, postbox1163, Geleen, 6160 BD, The Netherlands

Introduction: Serotyping is a classification system based on differences in structures on the surfaces of bacteria or other disease-causing agents. Serotyping divides *Salmonella* into more than 2500 different serotypes. *Salmonella* serotyping is an important tool for classification of strains, epidemiological purposes and the id entification of contamination sources. Successful *Salmonella* reduction programs within the food industry rely largely on information about the serotypes encountered in the production chain.

Rationale and Objectives: Traditional serotyping, according to the Kauffmann-White scheme (KW), makes use of a range of antisera, directed against the antigens present on the cell surface of the *Salmonella*. The combination of antigens present determines the serotype. Correct execution of the technique requires a lot of experience and it is a time and resource consuming activity.

Results and Findings: The PremiTest *Salmonella* is a rapid and robust alternative for traditional serotyping. The technique combines multiplex PCR and subsequent simultaneous detection of the PCR products using a micro array. The PremiTest *Salmonella* uses multiple DNA markers to detect the presence of *Salmonella* and identify the serotype. Currently, 94 serotypes are being identified by the test, based on the genetic pattern generated (genovar). Serotypes not recognized by the test yield other, reproducible genovar scores. These genovar scores may be associated with specific serotypes lateron, but already at this stage allow tracking and tracing of the contamination.

The complete procedure can be executed within 7 hours, enabling a serotype result within one working day after isolation. The test is being used by a range of laboratories, including reference laboratories, and yields reproducible results after a 2-day training.

The test has proven to be independent of the culture media used and is capable of typing rough *Salmonella* strains (in contrast to KW). The process to obtain external certificates is in progress: The last part for the OIE-validation is completed and the certificate is expected end 2009. The protocol for joint AOAC & MicroVal validation is being finalized.

The PremiTest *Salmonella* has been designed for food processors, as routine use. However, the set-up of the test enables the inclusion of specific DNA markers. In this way, more detailed knowledge on specific serotypes or characteristics (such as antibiotic resistance and the DT104) can be obtained.

Conclusions: The PremiTest *Salmonella* is a good tool for official labs to get fast and reliable serotyping and the best routine tool for the food industry for serotyping *Salmonella* isolates. It is inevitable in surveillance and outbreak-related studies.

Poster Session 2 – Friday, 9 October

P2-01 Stability of Calibration Function (Standards) in Nucleic Acid-based Food-pathogen Detection

BARBARA ROEDER, Karin Frühwirth, Martin Wagner, and Peter Rossmanith, Christian

Doppler Laboratory for Molecular Food Analytics, University of Veterinary Medicine, Veterinärplatz 1, Vienna, 1210, Austria

Introduction: Results of real-time PCR depend on a calibration function when using the Ct-method for quantification and the accuracy of this standard is all-important. Long-term storage of standards is saving cost and time, avoiding laborious production on a daily basis in routine application. Nevertheless, aqueous solutions of DNA are prone to degradation during storage.

Rational: The aim of this study was the determination of the causative parameter of DNA-standard degradation and the underlying mechanism impairing the amplification reaction during real-time PCR. Real-time PCR assays targeting the *prf*A gene of *Listeria* and the *fim*A gene of *Salmonella* have been used to investigate the influence of long-term storage (>100 d), the GC-value, shear forces, DNA target length, chemical reactions within the storage buffer, glycerolstorage, subsequent thaw and freeze cycles, and the influence of remaining cellular enzymes after isolation, at -20°C, ± 0°C, and 4°C. Tests were performed for initial low and high DNA target numbers.

Results: The stability of DNA-standards is influenced by shearing of long DNA fragments (bacterial genomes) if the standard is frozen. Short fragments (~100 bp) are not influenced by shearing during long-term storage or by subsequent thaw and freeze cycles. Depurination of the DNA and following mismatches on the primer attachment sites are biasing real-time PCR results if DNA is stored at 4°C or with glycerol. This effect is increased by primary amines such as Tris or by Mg-ions as included in the PCR buffer. By finally testing the resulting benchmark treatment for DNA-standard storage a deviation of 0.2 Ct-values was obtained by real-time PCR after 100 days storage in H_2O containing 50% glycerol.

Conclusions: Preservation of DNA-standards in 50% glycerol in ddH_2O enables long-termstorage for real-time PCR. Depurination and shearing of the DNA are avoided, thus providing reliable results using the Ct-method for quantification.

P2-02 Application of a Novel Single Bacterial Cell Manipulation Technique

BARBARA ROEDER, Martin Wagner, and Peter Rossmanith, Christian Doppler Laboratory for Molecular Food Analytics, University of Veterinary Medicine, Veterinärplatz 1, Vienna, 1210, Austria

Introduction: Highly diluted suspensions of bacterial cells are distributed according to Poisson-distribution. Quantitative microbiological methods (Most propable number MPN) are based on this prerequisite. Nevertheless, predictions on the growth performance of single bacterial cells are not possible due to these statistical effects. A new method avoiding these influences was developed which enables the physical manipulation of single bacterial cells. Based on this method the investigation of autonomous growth of low bacterial cell inocula (< 10) was performed.

Rational: The purpose of this study was to evaluate the growth performance of single bacterial cells without the influence of statistics within dilution series. Furthermore the necessity of chemical and physical cell to cell interactions for bacterial growth was investigated. *Listeria monocytogenes* EGDe bacteria from the lag-phase, the mid-exponential phase, and the stationary phase were used to produce single cell inocula with the newly developed single bacterial cell manipulation technique (SBCM). Growth in tryptone soy broth with 0.6% yeast was evaluated after 24 hours at 37°C or 42°C by measurement of optical density and selective- and non selective plating.

Results: For 110 manipulated single cells growth was detectable in 79 samples (71.5%) with a final optical density of 1.21 × 10^9 CFU/ml (± 9.07%). In 31 samples (28.5%) growth was not detectable. The live/dead ratio of the initial culture was 20.9% (± 20.6%) as obtained by live/dead staining. These results show a good correlation of live/dead ratios before and after the SBCM indicating the ability of autonomous growth.

Conclusions: These data suggest that the investigated single bacterial cells are able to multiply independently under optimal conditions.

P2-03 *Micrococcus roseus* and *Serratia marcescens* as Coloured Bacterial Indicators: A Simple Strategy during Design and Development of a New Method for Sample Pre-treatment

PETER ROSSMANITH, Karin Frühwirth, Beate Süß, Erich Schopf and Martin Wagner, Dept. of Veterinary Public Health and Food Science, University of Veterinary Medicine, Veterinärplatz 1, Vienna, 1210, Austria

Introduction: In the present study, chromogenic (red) bacteria were used to simulate actual target bacteria during setup and optimisation of an isolation process of bacteria, designed for food samples.

Rational: Isolation of bacteria from food in the context of molecular biological detection of food pathogens is a multistep process. Development of such a separation method requires continuous monitoring of the location of the presumable targets in the sample tubes. Therefore, red-coloured pigmented bacteria were used as substitutes for the actual target bacteria, during the establishment of a new sample preparation technique. Visibility of the pigmented bacteria within the complex sample matrices served to allocate bacterial content during the various steps necessary for finalisation of the method protocol. Prior to application, the chromogenic bacteria *Micrococcus roseus* and *Serratia marcescens* were confirmed to withstand the physical (e.g., centrifugal forces) and chemical (e.g., lysis buffer composition) conditions required during establishment of the new technique.

Results: The suitability of these model bacteria to substitute for the actual target pathogens (*Salmonella enterica* subsp. *enterica* serovar Typhimurium and *Listeria monocytogenes*) was assured by testing the physical properties of the model bacteria with respect to the proposed separation methods.

Conclusions: The use of these pigmented bacteria as substitutes for actual colourless target bacteria during design and development of a bacterial isolation method is a simple and inexpensive application. The presumptive bacterial targets can be allocated simply by visualisation of their bright red colour silhouetted against the background sample matrix. Application of coloured bacterial indicators saves a huge amount of time and resources, as the proof of principle of new methods is possible in rapid succession.

P2-04 Statistical Data Analysis of Real-time PCR Results Derived from Single Copy Amplification

PETER ROSSMANITH and Martin Wagner, Christian Doppler Laboratory for Molecular Food Analytics, University of Veterinary Medicine, Veterinärplatz 1, Vienna, 1210, Austria

Introduction: The validation of real-time PCR systems and above all the proof of the detection limit of this method is a frequently and intensively discussed topic. We present a statistical method for the accurate determination of DNA amounts < 10 target molecules using real-time PCR. The implication of this method is the possibility of distinct validation of real-time PCR assays and the generation of absolute DNA standards needed for quantification with this enzymatic method in routine diagnostics.

Rational: The purpose of this study was to evaluate a novel validation tool for real-time PCR assays based on the theoretical possibility of the amplification of one single DNA target. The ability to detect such low DNA target concentrations reliable by real-time PCR should be clearly demonstrated. Consequent a validation method based on this pre-requisites should be established which allows the absolute evaluation of real-time PCR assays. Real-time PCR was carried out by targeting a 274 bp fragment of the prfA gene of *L. monocytogenes*. Fit of the empirical data to the theoretical predictions was tested using the Kolomogorow – Smirnov (K-S) test using the SPSS 14.0 statistical software package.

Results: The ability of the prfA real-time PCR assay to detect reliable one target molecule could be clearly demonstrated (pavg.=0.52). The coherence of the results of samples containing < 10 target molecules and samples containing DNA amounts within the range of fluorescent measurement could be clearly demonstrated. The evidence for the accuracy of the newly developed validation-method was shown both statistically and with direct demonstration. The explicit determination of assays with a detection limit of one copy and assays with such a limit of three copies is exemplary demonstrated. We also demonstrate that real-time PCR at best starts from the first cycle with certain efficiency and proceeds with this efficiency until saturation of the reaction.

Conclusions: The results show that an absolute validation of real-time PCR assays is possible. The Ct - values of certain initial target amounts are fixed in dependence of the efficiency of the reaction. An absolute determination of DNA amounts is possible independent of conventional measurement methods. The validation tool also allows on-line monitoring of real-time PCR results in routine diagnosis.

P2-05 The Application of Ionic Liquids for Separation and Concentration of Foodborne Pathogens from Food for Subsequent Molecular or Cultural Quantification Methods

PATRICK MESTER, Barbara Röder, Eva Mayrl, Stephan Hühn, Martin Wagner, and Peter Rossmanith, Christian Doppler Laboratory for Molecular Food Analytics, University of Veterinary Medicine, Veterinärplatz 1, Vienna, 1210, Austria

Introduction: Due to the implementation of critical pathogen levels, direct quantification of food-borne pathogens from food is going to become standard in food risk analysis. Until now major challenges for biomolecular detection and quantification (such as real-time PCR) of foodborne pathogens are heterogeneous food matrices and large sample quantities. Therefore a major research topic is the development of sample treatment methods prior to subsequent molecular detection and quantification methods, which allow the separation of the target organisms from the sample matrix. Because of their unique physicochemical properties, ionic liquids offer a promising new approach contrary to classical microbiology.

Rational: The purpose of this study was the development of a new sample treatment method for quantification of foodborne pathogens enabling subsequently both molecular and cultural methods for detection and characterization. Several buffer compositions including ionic liquids were tested for their ability dissolving various edibles, without affecting the bacterial target cells. The toxicity of these buffers towards *Listeria monocytogenes* and *Salmonella enterica* serovar Typhimurium were investigated. Quantification of both pathogens from artificially contaminated food samples was quadripartite carried out by either real-time PCR targeting the prfA-gene for *L. monocytogenes*, the fimA-gene for *S.* Typhimurium or selective plating methods, respectively.

Results: The application of 1-ethyl-3-methylimidazolium thiocyanate to the lysis buffer system enabled the quantifiable isolation of *S.* Typhimurium and *L. monocytogenes* from different artificial contaminated foodstuffs with decreasing inoculums ranging between 10^5 to 10^2 cells. Recovery for *S.* Typhimurium on selective agar plates varied between 45% (RSD 6%) out of 6.25 g egg and 36% (RSD 19%) out of 6.25 g ice-cream. *L. monocytogenes* was recovered with 67% (RSD 26%) from 12.5 ml milk and for both pathogens real-time PCR quantification resulted in higher (1.5–2 fold) bacterial equivalent counts in comparison with CFU determination.

Conclusions: Application of ionic liquids permits the separation of food-borne bacterial pathogens from the food of interest for subsequent quantification both with real-time PCR and culture methods. Quantitative results can be obtained within one working day using the new buffer system.

P2-06 Food Safety through a Community of Practice in eXtension

JEAN WEESE and Kristin Woods, Auburn University, 218 H Duncan Hall, Auburn, AL 36849, United States

Introduction: The eXtension Food Safety Community of Practice is unlike any other search engine or information-based website. It's a space where university content providers can gather and produce new educational and information resources on wide-ranging topics. Because it's available to students, researchers, clinicians, professors, as well as the general public, at any time from any Internet connection, eXtension Food Safety Community of Practice helps solve real-life problems in real time. Food Safety is only one of many Communities of Practice that have been established through extension.

Rationale: The Food Safety Community of Practice is set up to supply research based Food Safety information to individuals throughout the food chain, from the food grower to the consumer. The Community of Practice is not limited by walls or state and national boundaries but can supply the best information from the top scientist in the field.

Objectives: To bring together food scientists from across the county to deliver research based information to individuals all over the world. The Objective is to bring together food scientists from across the county to deliver research based information to individuals all over the world.

Results and Findings: The Food Safety Community of Practice is made up of food scientists from all over the United States. The Food Safety Community of Practice was started by a group of food scientist in the Southern Region of the United States. The core leadership is made up of Ph.D. food scientists from 5 states. There are at present almost 50 members that participate in answering questions and supplying content to the site. We are actively recruiting more members to participate in the site to supply content. The eXtension website has been recognized by federal granting agencies as a method to bring content to the end user.

Conclusions: Food Safety Community of Practice (CoP) is a newly formed group within eXtension. We plan to bring in new participants and form smaller working groups to work to provide food safety content in their specialty area. The groups that we have established to work within at the present are: Consumers, Producers, Processors, and Food Service Workers. More groups may be added as interest and expertise is added to the CoP.

P2-07 Predictive Modeling of Deoxynivalenol Content in Dutch Winter Wheat

EELCO FRANZ, Seth-Oscar trmp Hajo, Rijgersberg Ine van der Fels-Klerx, RIKILT – Institute of Food Safety, Wageningen University & Research Centre, P.O. Box 230, Wageningen, 6700 AE, The Netherlands

Introduction: Wheat derived feed and food products can be contaminated with mycotoxins produced as a secondary metabolite by a variety of fungi, in particular Fusarium species, causing a potential risk to human and animal health. Deoxynivalenol (DON) is the most implicated mycotoxin associated with Fusarium head blight (FHB) in wheat. Forecasting models for the DON content in wheat at harvest can assist decisions on disease management but can also be useful tools for control authorities and industry to limit potential feed and food safety problems.

Rationale and Objectives: The objective of the current study was to develop a quantitative predictive model for DON content in Dutch winter wheat based on geographic, agronomic and climatic variables.

From 2001 to 2007 winter wheat samples for DON analysis were taken at harvest from in total 264 fields throughout the Netherlands. Geographic, agronomic (resistance, fungicides)and climatic variables (for 48 days period around heading) were recorded for each field. After a univariate pre-selection of variables, multiple regression models were constructed (excluding year) and the model with best set of explanatory set of variables was chosen.

Results and Findings: The best performing predictive model used average 24 days pre- and post-heading climatic variables, heading date, region, variety resistance level, and fungicide use ($P < 0.0001$, R_2 model = 0.59). The predicted DON level increased with higher average temperature, increased precipitation and higher relative humidity, but decreased with increased number of hours with temperature above 25°C. Model evaluation showed little bias and high consistency indicating good statistical performance. In 92.8% of the cases (n = 264) the model predicted correctly whether the concentration of DON was lower or higher than the maximum level of 1250 μg/kg (1.1% false positives, 6.1% false negatives).

Conclusions: We developed a statistically good performing forecasting model for DON in Dutch winter wheat, including agronomic, geographical and climatic variables. We observed a strong regional effect on the levels of DON, which could not be explained by differences in the recorded agronomic and climatic variables. It is suggested that future model improvement might be realized by indentifying and quantifying the mechanism underlying the region effect.

Acknowledgments: This work was financed by the Food and Consumer Product Safety Authority (VWA). The authors thank Don Jansen, Huub Schepers and Harro Spits (Plant Science Group, Wageningen UR) for their contributions.

P2-08 Quantitative Microbial Risk Assessment for *Escherichia coli* O157:H7, *Salmonella* and *L. monocytogenes* in Leafy Green Vegetables Consumed at Salad Bars

EELCO FRANZ, Seth-Oscar trmp Hajo, Rijgersberg Ine van der Fels-Klerx, RIKILT – Institute of Food Safety, Wageningen University & Research Centre, P.O. Box 230, Wageningen, 6700 AE, The Netherlands

Introduction: Fresh vegetables play an important role in a healthy diet. However, most produce is grown in a natural environment and is therefore vulnerable to contamination with pathogens from multiple sources. In Europe and US both the consumption of fresh vegetables and the number of foodborne disease outbreaks associated with the consumption of fresh produce have recently increased. Several outbreaks of foodborne illness have been associated with consumption from salad bars.

Rationale and Objectives: Temperature is one of the most important environmental parameters from both the food quality and food safety point of view. Respecting the chilled chain is of particular impor tance for fresh produce because of the absence of thermal treatment prior to consumption.

The purpose of this study was to conduct a quantitative microbial risk assessment for *E. coli* O157:H7, *Salmonella* or *L. monocytogenes* infection from consumption of leafy green vegetables based salad from salad bars in the Netherlands. Pathogen growth was modeled in Aladin (Agro Logistics Analysis and Design INstrument), using time-temperature profiles in the chilled supply chain and one particular restaurant with salad-bar. A second-order Monte Carlo risk assessment model was constructed (using @Risk) in order to estimate the public health effects.

Results and Findings: The temperature in the cold-chain was well controlled below 5°C. Growth of *E. coli* O157:H7 and *Salmonella* was minimal (+17% and +15%, resp.). Growth of *L. monocytogenes* was considerably more profound (+194%). Based on first order Monte Carlo simulations, the average number of cases per year in the Netherlands associated the consumption leafy green based salads from salad bars was 166, 187 and 0.3, for *E. coli* O157:H7, *Salmonella* or *L. monocytogenes*, respectively. The range of average number of annual cases as estimated by second order Monte Carlo simulation (with prevalence and number of visitors as uncertain variables) was 42-551 for *E. coli* O157:H7, 81-281 for *Salmonella* and 0.1–0.9 for *L. monocytogenes*

Conclusions: This study presented a successful integration of modelling pathogen growth in the supply chain of fresh leafy vegetables destined for restaurant salad bars. We conclude that the temperature in the cold-chain was fairly well controlled and that growth of *E. coli* O157:H7 and *Salmonella* was minimal. Growth of *L. monocytogenes* was considerably more profound but due its low virulence not considered problematic. The estimated number of annual cases were considered reasonable in relation to epidemiological data and in proportion to an earlier risk assessment considering the entire consumption of fresh vegetables.

Acknowledgments: This study was financed by the Dutch Ministry of Agriculture, Nature and Food Quality.

P2-09 Consumer Attitudes and Risk Perceptions Associated with Preparation and Storage of Powdered Formula Milk in the Home: Implications for Microbiological Safety and Education

ELIZABETH C. REDMOND and Christopher J. Griffith, University of Wales Institute Cardiff, Food Industry Centre, Western Ave., Cardiff, CF52YB, United Kingdom

Introduction: The risk to infants from powdered infant formula(PIF) milk has received increased attention in recent years due to possible contamination with pathogens such as Enterobacter sakazakii and *Salmonella*. Recommended procedures to safely prepare and use PIF in the home are available to parents; however implementation may be influenced by parental attitudes and risk-related perceptions. For health communication strategies to be effective it is important for them to be relevant. Related psychological constructs need to be identified and addressed.

Rational: This study aimed to determine parents attitudes and perceptions of risk, control and responsibility associated with preparation and storage of PIF in the home. To achieve this, structured face-to-face interviews with 200 parents were undertaken in England and Wales using a Computer-Assisted-Personal-Interviewing technique. Quota controls on age and socioeconomic-grading were applied; the sample was representative of parents who feed their infant(s) with PIF at least once-a-day.

Results: Results indicated attitudes and risk perceptions that may impede implementation of safe preparation and storage behaviours. Sixty-nine percent of parents believed PIF is sterile and the majority were unaware of the association of PIF with *E. sakazakii* and/or *Salmonella* (83%). Ninety-percent of parents believed there was a very-low-risk of infant illness after feeding reconstituted PIF they had prepared; risk of illness was perceived to be greater if feeds were made-up by 'other parents', day-nursery staff and hospital staff. The majority (97%) of parents believed they had full-responsibility and full-control of hygiene and safety when preparing PIF for their infant; smaller proportions of parents (44–73%) believed that 'other-parents', day-nursery staff and hospital staff had the same level of responsibility (63–82%) and control (44–73%).

Conclusions: Findings suggest consumer judgements of 'optimistic-bias' and the 'illusion-of-control' could be a factor in the adoption of appropriate hygiene practices. Data collected will help development of targeted information and messages that address microbial risks of domestic preparation and storage of PIF.

P2-10 Use of Powdered Infant Formula in UK Day Nurseries: Implications for Microbial Safety

ELIZABETH C. REDMOND and Christopher J. Griffith, University of Wales Institute Cardiff, Food Industry Centre, Western Ave., Cardiff, CF52YB, United Kingdom

Introduction: Over the past few decades the need for non-maternal childcare has risen as increasing numbers of mothers with infants aged

Rational: This study aimed to understand day nursery nurse (DNN) knowledge, attitudes and behaviours relating to infant feeding with PIF in UK day nurseries. Data from DNN was obtained using focus group discussions across the UK (n = 4) and self-complete postal questionnaires, administered to 10% of UK nurseries with infants aged.

Results: Findings indicated that methods DNN (n = 334) reportedly use to handle, prepare and feed PIF are variable within and between day nurseries. Ninety-five percent of DNN reported feeding PIF according to parent instructions, even if such practices were believed to be inappropriate. Common practices included (44%) feeding PIF reconstituted by parents and brought to the nursery for use throughout the day (up to 10hours) and (53%) prepared feeds in the nursery using measured PIF, bottle with measured, pre-boiled water provided by the parents. Both practices are contrary to current safety recommendations which indicate it is best to make-up PIF fresh for each feed, using boiled water >70°C. Many DNN believed PIF is a sterile product 'I think it is sterile' and up to 95%DNN lacked of knowledge and awareness of microbiological issues, such as the association between *E. sakazakii/Salmonella* and PIF. The majority of DNN reported they had never received training about the microbiological risks associated with PIF.

Conclusions: Findings from this study will help the development of targeted information and national policies that address the microbial risks of preparation and storage of PIF in day nurseries.

P2-11 Applicability of the DHPLC (Denaturing High Performance Liquid Chromatography) Methodology for Fresh Dairy Products Analysis

THOMAS CARTON, Sophie Le Fresne, Joël Crociani, Françoise Le Vacon, Silliker, 21 rue La Noue Bras de Fer, Nantes, 44200, France

Introduction: In the last years, major progress in microbiology analyses has been made thanks to the development of new genomic technologies and especially culture independent detection methods, like DHPLC (Denaturing High Performance Liquid Chromatography). Based on the physical properties of the bacterial DNA sequences, the DHPLC analysis leads to a profile, also named fingerprint, which is a picture of the bacterial community

Rational: The present work describes the DHPLC analysis results of some fresh dairy products: 1 yogurt and 2 probiotics dairy products (still defined as 'yogurt' in some countries). The obtained fingerprints have been compared to those of *Streptococcus thermophilus*, *Lactobacillus delbruckii* subsp. *Bulgaricus*, *L. casei* and *Bifidobacterium animalis*, isolated from the same products

Results: After sampling, DNA extraction and 16s rRNA gene amplification, amplicons were analyzed with DHPLC. Two different parameter sets were determined: one for the general (and "opened") analysis of the total bacteria population of the products and one for the focusing analysis of the *Bifidobacterium* phyla. The general analysis gives a fingerprint where appears all the flora as determined with culture. The specific analysis provides a screening method for close *Bifidobacterium* species: *longum, animalis, breve, infantis* and *catenulatum.*

Conclusions: DHPLC analysis provides short turn-around-time reliable results with high-throughput capability for the screening of fresh dairy products. By means of an automated fingerprint fraction collection, DHPLC can be used to describe a microbial population including fraction collection and subsequent sequencing identification of the bacteria, and/or compare its components based on the only comparative analysis of their fingerprints. The latter methodology is applicable for microbial quality product screening using a previously validated gold standard fingerprint from the characteristic native flora of the tested products

Acknowledgments: Thanks to Transgenomic Inc. for technical help on DHPLC analysis.

P2-12 Effective Control of Quantitative Food Microbiology Process Variation Using Statistical Process Control Charting (SPCC)

STEFANO COLOMBO, Michele Smoot, Peter Lowe and David Evanson, Silliker Group Corporate, via Alcaini, Bergamo, I-24123, Italy

Introduction: SPCC for quantitative food microbiology is relatively new. Typically, control samples contained high levels of variable target microorganisms from overnight enrichments offering minimal understanding of process variations. Today, SPCC with standardized reference cultures containing stable low levels of microorganisms is used to provide objective evidence of testing process control within the expected variation for a given analysis.

Rational: SPCC data over three years from a US laboratory network were compared and multiple quantitative analyses method variations established. In 2008 the same reference culture material and related SPCC were expanded to the global network in 15 countries. The current work presents expected variation for common quantitative analyses and reviews worldwide network inter-laboratory SPCC data used to drive laboratory process improvement.

Results: Original upper and lower control limits (UCL, LCL) values suggested that some US laboratories had higher variation when compared within the network. Variation was reduced over three years by as much as 30% as demonstrated by the UCL-LCL average differences. *Enterobacteriaceae*, coliforms and *E. coli* showed significant improvement. A smaller variation decrease was observed in other analyses indicating that the method variation was inherent and not as a result of external sources. UCL-LCL average differences comparison from the global network data showed small variations and equivalent performances of methods applied, ranging for instance from 0.67+/-0.23 to 0.57+/-013 (APC), from 1.01+/-0.38 to 0.81+/-0.23 (staphylococci), and from 1.13+/-0.47 to 0.87+/-0.19 (coliforms / *E. coli*), in log CFU/g +/-sd, for Europe & Asia-Pacific to North America, respectively.

Conclusions: Standardized control samples SPCC data provide objective evidence of controlled operation within the expected variation for a given analysis. Comparing laboratory network variation on a worldwide basis proved consistency and reliability of process and results. Food microbiology laboratories should demonstrate controlled testing process before releasing results.

P2-13 Effect of Post-incubation Half Fraser Enrichment Broth Refrigeration on *Listeria monocytogenes* Detection

Christophe Poulain, Bertrand Bremaud, Joel Crociani, Christiane Hoareau, CHRISTOPHE DUFOUR, Silliker SaS, Immeuble le Mercury, 1 rue de la Croix des Maheux, CERGY PONTOISE, F-95032, France

Introduction: *L. monocytogenes* presence is of major concern in ready-to-eat food products which, due to their nature, require immediate testing upon reception at the laboratory. Food samples arriving on Friday and needing

Listeria analysis imply continuation of testing operations throughout the weekend which can be sometimes problematic for the laboratory organization. ISO 7218:2007 quotes that "unless otherwise stated, the incubated enrichment broths may only be refrigerated after evaluation of the impact of refrigeration on the results and only if clearly stipulated in the test report". The present study illustrates the preliminary evaluation of weekend post-incubation enrichment broth refrigeration impact on the detection of *Listeria monocytogenes*.

Rational: Results obtained in the Silliker laboratories of France between October 2008 and May 2009 with the AFNOR-validated *Listeria monocytogenes* detection method (BIO 12/14-04/05) using a 24 h enrichment in half Fraser broth and isolation on Ottaviani-Agosti agar have been evaluated. A 36 h post-incubation refrigeration was systematically applied to all half Fraser broths of samples prepared on Fridays. Broths of samples processed on any other week day were not refrigerated after incubation. Rates of confirmed positive samples were then compared between samples with and samples without broth refrigeration.

Results: In the defined period, 2,614 samples were tested in total on Mondays, and 15,641 in total on Thursdays. 12,781 tests were performed in total on Saturdays. Monday confirmed positive samples were 147, Thursday confirmed positive samples were 511, and Saturday confirmed positive samples were 531. Positive rate of confirmed *Listeria monocytogenes* was thus 5.6%, 3.3%, and 4.2 % respectively. The applied statistical model (parametric comparison of 2 proportions) showed a statistical difference (5% risk) between Monday and Thursday samples, but no underestimation due to 36 h refrigeration applied to the half Fraser enrichment broth of the Saturday samples.

Conclusions: The preliminary comparison of a significant number of *L. monocytogenes* tests performed with or without a 36 h post-incubation refrigeration of the half Fraser broth, has shown no negative impact of the refrigeration on the recovery rate and confirmation of positive samples.

P2-14 Evaluation of a New TEMPO Method for Enumerating Yeast and Mold in Food Products Compared to ISO 21527 Method

GRÉGORY DEVULDER, Remy Deschomets, Anita Fourneron, Geraldine Ramage, Florence Gorse, bioMérieux, Chemin de l'Orme, Marcy L'Etoile, 69280, France

Introduction: Yeast and Mold (YM) enumeration in food is useful in evaluating its quality and the degree of deterioration. It is often an essential component in microbiological quality assurance programs. In this study, we compared the TEMPO automated method for the enumeration of YM to the ISO 21527: Dichloran rose bengal chloramphenicol (DRBC) or Dichloran 18% glycerol agar (DG18) media depending on the food product A_w.

Rational: TEMPO YM enumeration is based on the well known Most Probable Number (MPN) procedure. The method uses a selective dehydrated culture medium and an enumeration card for the automatic determination of the MPN. This method provides a final result in 3 days at 25°C compared to 5 days for the reference methods. For comparative purposes, more than 400 naturally contaminated products were tested. These products represented a wide range of food categories and environmental samples. A combination of regression analyses, difference Log_{10} distributions and T-tests at the 5% level were used to analyse the data and compare performances. In parallel, the comparison of results before and after confirmation was performed on 30 food products to test the specificity of this media.

Results: This automated method showed similar performances to the ISO method with good agreement on the whole data. Regression analysis and T-test show a slight negative bias due to a better selectivity of TEMPO YM, demonstrated by the complementary tests performed on DRBC.

Conclusions: The results suggest that both tested methods are equivalent for enumerating yeast and mold. The automated method offers food laboratories a rapid alternative for YM enumeration with a time to result of only 3 days compared to 5 days for FDA-BAM.

P2-15 Microbiological Monitoring of Ready-to-Eat Food at the Point of Sale

JOANA SANTOS, Miguel Bento Alves, Carla Ramos, Orlando Morais and Paulo Fernandes, ESTG-IPVC, Avenida do Atlântico, Viana do Castelo, 4900-348, Portugal

Introduction: The microbiological quality evaluation is quite important since microbiological hazards continue to be one of the biggest threats to food safety. The interpretation of the results is often a difficult aspect of the food examination process, although using the guidelines suggested by PHLS, UK , this process is manageable and consistent. Checking the compliance with existing regulations is often insufficient and food processors need to verify and validate the efficacy of their food safety systems for that, statistical data of food microbiological analysis could be a useful tool.

Rationale and Objectives: The purpose of this study was to determine the extent to which ready-to-eat meals were contaminated with aerobic bacteria, hygiene indicator bacteria and potential foodborne pathogens at the point of sale.

Results and Findings: To study the microbial flora of the 700 samples of ready-to-eat meals, the following analysis were performed in an accredited laboratory according the NP EN ISO/IEC 17025:2005: Assay Analytical Method
Enumeration of *Bacillus cereus* ISO 7932:1993
Enumeration of *Escherichia coli* ISO 16649-2:2001
Enumeration of Microorganisms at 30 Â°C ISO 4833:2003
Enumeration of *Enterobacteriaceae* ISO 21528-1:2004
Enumeration of Staphylococci Coagulase positive ISO 6888-1:1999
Detection for *Salmonella* spp. ISO 6579:2002
Enumeration of *Listeria monocytogenes* ISO 11290-2:1998

Conclusions: The results obtained were compared with the guidelines for microbiological quality suggested by Public Health Laboratory Services (PHLS) for Ready-to-eat Food (Gilbert et al., 2000). According to these guidelines, the 700 samples were classified in different categories on the basis of their aerobic colony count, according to the type of the food and the processing it was received. Results were statistically analysed in respect to the type of food and usual contamination.

P2-16 Information Technologies to Support Verification in Food Safety Systems

CARLOS BRANDÃO, Cláudia Viegas, Fernando Santos, Manuela Guerra, Pedro Moita, ESHTE, Av. Conde de Barcelona, 2760-510, Portugal

Introduction: The European Union and other International Organizations have issued several regulations concerning food safety in order to assure food safety of foods and protect the consumer. This has become a fundamental requirement for hotel and catering operators since the approval of the EC Regulation 852/2004.

This regulation lays down general rules for business operators on the hygiene of foodstuffs, through the implementation of procedures based on the HACCP principles.

Studies have shown that implementation of food safety systems has not been very effective, manuals and records are not usually customized, and business operators produce a large volume of paper documents that are difficult to manage and easy to fabricate.

In most cases operators have poor knowledge of procedures and how to control food operations.
As so, we consider has highly important the use of IT technologies to manage and facilitate the control of food safety operations.

Rationale and Objectives: The purpose was to develop an application to automate and manage different tasks related to food safety procedures in hotel and catering facilities.

Results and Findings: The software is composed by different modules that are organized in a relational database, allowing for the validations of CCPs, suppliers control, staff training records and other everyday jobs and controls.

As a database software, it also allows facilitated search of information and building reports. It is also possible to be connected to a network, linked to international and official organizations and therefore send and receive relevant food safety real-time data.

Conclusions: IT simplifies the way procedures and data recording are made. The generated data is more reliable and it is much harder to alter and fabricate information, and much easier to share and access.

We consider this application to be a valuable asset to all intervenient through the food chain: 1. Producers record easily a more reliable information; 2. Consumers have higher assurance on the safety of foods they eat; 3. Official organizations have real-time information and the possibility to easily send rapids alerts concerning food safety.

P2-17 Traceability in the Mexican Dairy Processing Sector

EMA MALDONADO-SIMAN, Carla S. Godinez-Gonzalez, José A. Cadena-Meneses, Agustin Ruiz-Flores, Gilberto Aranda-Osorio, Universidad Autonoma Chapingo, Posgrado en Producción Animal/ Posgrado en Ciencias y Tecnología Agroalimentaria, Km. 38.5 Carretera México-Texcoco, 56230 Texcoco, Edo. De Mexico, Mexico

Introduction: Traceability has become one increasingly important component of food safety systems within the agri-food system.

Rational: The primary objective of a food traceability system is to generate the ability to identify speedily, and remove from distribution, food which may present a public safety risk. Thus, this study examines traceability in the Mexican dairy processing industry to understand the drivers behind the implementation of product traceability, motivations; challenges faced the industry, and the impacts of traceability system on company performance.

Results: Fieldwork was carried out as a structured questionnaire to the Mexican dairy processing sector. The final survey of 33 processing facilities across Jalisco State in Mexico generated a 69.7% response rate (23 questionnaires). The 85.5% of the firms sold their production within Jalisco State and Mexico City, 14.3% to the rest of the country, and 42.9% exported to the USA, Guatemala and Nicaragua. Around 71.4% of respondents produced only one type of dairy product. The 42.9% of the plants were operating HACCP, 57.0% operated ISO standards, and 42.9% had other food-safety control systems. The 85.7% of the respondents had implemented system of product traceability. Most important motivations for adopting traceability were related with legal responsibility, regulatory requirements, position in current markets and risks/worries of product recalls. Problems were most commonly associated with supplier and customer support and lack of ability to manufacture new products. Impacts reported to product traceability were related to regulatory requirements, enterprises' name perceived by commercial customers, and product recalls/withdrawals.

Conclusions: The study provided the first information in the implementation of product traceability systems in the Mexican dairy processing sector. The results suggest a range of motivating factors. Economic and marketable reasons could be of importance to implement a system of product traceability.

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P2-18 Selection of Strains for Use in Microbiological Challenge Testing to Support Chilled Food Risk Assessments

MOIRA D. JOHNSTON, Jane Carey, Paul Barrett, Laura J Price, Nick B. Johnson and Jorie L. van Zanten, Unilever R&D, Safety & Environmental Assurance Centre, Colworth Science Park, Sharnbrook, Bedfordshire, MK44 1LQ, United Kingdom

Introduction: Sales of chilled foods have been increasing to meet consumer demands for high quality foods that are less heavily processed, contain lower levels of preservatives and require minimal preparation time. Many chilled foods do not have intrinsic properties that will control growth of bacterial pathogens. Their safety is dependant on controlling the initial contamination in raw materials, the possible reduction of pathogens (e.g., by heat treatment) and ensuring that any hazards present are not able to reach levels of concern by the end of the shelf-life at relevant chilled storage temperatures.

Rationale and Objectives: To assess the safety of a product and/or process, microbiological challenge testing is frequently required, often complimentary to the use of predictive models or sometimes to validate/build such models. Challenge tests involve inoculating a product with appropriate pathogens or spoilage microorganisms and assessing their growth, survival or death under conditions that are relevant to the specific product/process. Microorganisms are usually inoculated as "cocktails", which comprise several strains of the organism mixed in equal numbers to take some account of variability between strains. The objective of the current study was to define safety cocktails of specific pathogens for use in chilled food challenge testing.

Results and Findings: Laboratory studies identified relevant strains that grew under the harshest conditions of low temperature/aw/pH, as well as considering other factors (e.g., heat resistance, growth in the presence of preservatives/modified atmospheres). The Bioscreen microbiological analyser was found to be a useful rapid technique for monitoring growth in aerobic conditions.

Conclusions: Safety cocktails of *Bacillus* spp., *Listeria monocytogenes* and non-proteolytic *Clostridium botulinum* were defined that could be used for challenge testing of chilled foods. An approach was established that could be applied to other food categories.

P2-19 Improved Food Safety Knowledge Obtained by a Simplified Health Information Model

INGELA MARGARETHA MARKLINDER, Fanny Jacobsson, Marielle Enroth and Margaretha Nydahl, Uppsala University, Dept. of Food, Nutrition and Dietetics, Box 560, Uppsala, SE-751 22, Sweden

Introduction: As part of the project CHANCE, taking place in Austria, Germany, Latvia, Romania, Sweden and United Kingdom (Lifelong Learning Programme of European Union 2007–2009) it was shown that the informants (n = 202) feel uncertain about food handling. The present intervention was exemplified as a communication tool to improve knowledge and to make social change. In a single meeting, education programs about fruit and vegetable and food safety, respectively, were individually self-administered via computers following discussions in small groups. The outcome was measured through questionnaires, before, immediately after and three weeks after the implementation. The number of participants was 92 (21 to 81+) living or working in the urban area Eriksberg, Uppsala municipality, Sweden. Analysis of data was quantitatively processed using Microsoft Office Excel 2007; McNemans test, SPSS Version 16.0.

Rational: The objective of this intervention was to use a simplified health information model in order to measure improvement of food safety knowledge among consumers and to see if changed behaviour could be reported.

Results: With focus on food safety the result illustrates a statistical significant improvement in knowledge according to the meaning of the expression cross contamination and the recommended storage temperature for smoked salmon and raw minced meat. However, no behavioural change was reported.

Conclusions: This simplified health information program could be a useful tool to improve knowledge about food safety among consumers. For behavioural change the model must be developed. Experiences from this study further illustrates the difficulty to get people interested in participating even though the information is offered in the nearby surrounding.

Acknowledgments: We would like to thank all the consumers participating in the present study.

P2-20 Use of the Qualified Presumption of Safety (QPS) Concept to Prioritise and Harmonise Risk Assessment of Biological Agents within the European Food Safety Authority (EFSA)

RENATA LEUSCHNER, Marta Hugas, Tobin Robinson, and Christophe N'Guyen, Biological Hazards (BIOHAZ), Emerging Risks Units, EFSA, Parma, Italy

Introduction: EFSA is requested to assess the safety of a broad range of microorganisms in the context of notifications for market authorisation as sources of food and feed additives, enzymes and plant protection products.

Rational and Objectives: The QPS concept was developed by EFSA for its own use to provide a generic safety assessment approach applicable across EFSA's scientific Panels, for all approvals related to the intentional addition or use of microorganisms in the food chain. Unambiguously defined taxonomic groups of biological agents are assessed for potential safety concerns based on a sufficient body of knowledge that covers also the field of application for which an authorisation is sought. Identified safety concerns or gaps in the body of knowledge could be reflected as 'qualifications' of a QPS status as an alternative to an exclusion from it.

Results and Findings: The list of QPS microorganisms is updated annually. The latest revision[3] lists several species from the genera of *Bifidobacterium*, *Lactobacillus*, *Leuconostoc* and *Pediococcus*. *Lactococcus lactis*, *Propionibacterium freudenreichii*, *Streptococcus thermophilus* and *Corynebacterium glutamicum* are included. *C. glutamicum* has as 'qualification' that the QPS status applies only when the species is used for production purposes. The yeast species *Pichia angusta*, *P. anomala*, *P. jardinii*, *P. pastoris* received a similar 'qualification'. *Debaromyces hansenii*, *Hanseniaspora uvarum*, *Kluyveromyces lactis*, *K. marxianus*, *Saccharomyces bayanus*, *S. cerevisiae*, *S. pastorianus*, *Schizosaccharomyces pombe* and *Xanthophyllomyces dendrorhous* have QPS status. Some *Bacillus* species are included with 'qualifications' of absence of food poisoning toxins, surfactant activity and enterotoxic activity.

Conclusions: The QPS approach is currently mainly applied by EFSA's scientific Panel on additives and products of substances used in animal feed (FEEDAP) however it is expected that as a consequence of recent regulatory initiatives the concept will gain increasing importance for EFSA.

Acknowledgments: The QPS working group members and the members of the Panel on biological hazards (BIOHAZ) which are acknowledged in the [3]EFSA 2008 Opinion: The maintenance of the list of QPS microorganisms intentionally added to food or feed - Scientific Opinion of the Panel on Biological Hazards (Question number: EFSA-Q-2008-006). The EFSA Journal, 2008, 923, 1 – 48.

http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753812_1211902221481.htm

P2-21 Food Surface Decontamination Using Non-thermal Plasma

ANTJE FRÖHLING, Matthias Baier, Jörg Ehlbeck, Dietrich Knorr, and Oliver Schlüter, Leibniz Institute for Agricultural Engineering Potsdam, Dept. of Horticultural Engineering, Max-Eyth-Allee 100, D-14469 Potsdam, Germany

Introduction: Special treatments are required to reduce microbial contaminations and to guarantee optimal quality of heat-sensitive products such as fruits and vegetables. Non-thermal plasma is a promising tool for the decontamination of food surfaces due to the various reactive species in the plasma and their associated antimicrobial effects.

Rationale and Objective: The objective of this study was to evaluate the effects of non-thermal plasma on the inactivation of human pathogenic bacteria using flow cytometric techniques.

Results and Findings: E. coli and *L. innocua* on a polysaccharide gel were treated with non-thermal plasma at operating powers of 10 to 40 W which was generated in an rf-driven atmospheric plasma jet. The inactivation of the bacteria were recorded by conventional plate count methods with an detection limit of 10^2 ml^{-1} and by flow cytometry measuring 10,000 cells per sample. Each treatment was performed in triplicate. An energy input of 20 W resulted in a 7 log-cycles reduction (initial count: 10^8 CFU ml^{-1}) after 4 min treatment for both *L. innocua* and *E. coli*. A 10 W plasma treatment led to minor damaging effects (log-cycle reduction < 2) of either tested organisms while a complete inactivation was determined when applying 40 W and 90 s treatment time (*L. innocua*)

or 120 s (*E. coli*). Flow cytometric analyses of bacteria cells after plasma treatment at 20 W showed increased membrane permeability with increasing treatment time. The number of slightly permeabilized cells with esterase activity remains almost constant at 15% during the treatment, and the number of cells with intact cell membrane and esterase activity decreased by 70% for both bacteria after 4 min of plasma treatment.

Conclusions: Non-thermal atmospheric pressure plasma inactivates both gram-negative and gram-positive bacteria at temperatures below 40°C. A plasma jet array can be designed enhancing the industrial applicability in food processing.

P2-22 The Efficacy of Mitigation Strategies to Reduce the Norovirus Intake Evaluated by a Risk Assessment Approach

LEEN BAERT, Liesbeth Jacxsens, and Mieke Uyttendaele, Ghent University, coupure Links 653, Ghent, 9000, Belgium

Introduction: A risk assessment approach was used to determine the norovirus intake and probability of infection (PI) after the application of decontamination procedures or mild heat treatments on respectively lettuce or raspberries. Therefore, two cases were elaborated to address this issue. The first case represents a worst case scenario as it was assumed that lettuce crops were irrigated with non-disinfected secondary treated effluent. The second case represented a foodhandler introducing viruses onto raspberries during harvesting. The reduction of the viral intake after mildly heating raspberries was assessed (1).

Results and Findings: The application of 200 mg/L NaOCl to treat lettuce, that was irrigated with water containing 2.3 PFU/L (C1), decreased the PI with a factor 7 compared to the washing of lettuce with tap water (case 1). The application of 250 mg/L PAA even reduced the PI to 0%. The use of NaOCl or PAA to treat lettuce, that was exposed to a higher viral load C2 (130 PFU/L), decreased the PI although the PI could not be reduced to 0%.

Accordingly, mild heat treatments (75°C 15 s or 65°C 30 s) in case 2 were more effective in decreasing the PI when raspberries were exposed to a lower viral concentration C1 (2.5×10^4 genomic copies/g) in comparison with the exposure of raspberries to a higher viral load (C2 = 3.0×10^8 genomic copies/g).

Conclusions: Decontamination procedures or mild heat treatments can be useful to lower the viral intake on respectively lettuce or raspberries having an initial low viral contamination level. From the comparison of case 1 and 2, the PI is considerably higher in foodhandler-involved viral contamination of foods compared to irrigation water as a vehicle for viral transmission to foods.

(1) Baert, L. (2009). Molecular detection of, and strategies to reduce Norovirus load or infectivity in foods. Ph.D. dissertation, Faculty of Bioscience Engineering, Ghent University, Ghent.

P2-23 A Selection Tool for Application of the Most Appropriate Microbial Method of Analysis

VICKY JASSON, Liesbeth Jacxsens, Andreja Rajkovic, and Mieke Uyttendaele, Ghent University, Coupure Links 653, Ghent, 9000, Belgium

Introduction: According to the MAS-protocol appropriate methods for sampling and analyses of pathogens and other microorganisms need to be selected (1). Reference methods for microbial analysis are the internationally agreed ISO standards. However, nowadays numerous and diverse alternative methods for microbiological analysis of foods are currently brought to the market by various suppliers in a variety of formats as a result of recent developments, particularly in the field of biotechnology, microelectronics and related software development, which also can be used. Due to an overload of rapid methods and/or formats on the market, food producers have difficulties in deciding which method is best fit for their purpose in their particular context.

Results and Findings: A decision tree was made that support the selection of the most appropriate method for microbial analysis. The decision tree is based on a techno-managerial point of view and takes into account the context of the analysis, the performance characteristics of the method, the operational requirements etc.

Conclusions: The selection tool helps the end user of the method to obtain a systematic insight into all relevant factors, beyond the inherent performance characteristics of the method, to be taking into account for selection of a method for microbial analysis. In this way this tool helps to select the method which is best fit for purpose for a particular situation.

1. Jacxsens, L., J. Kussaga, P. A. Luning, M. Van der Spiegel, and M. Uyttendaele. 2009. A microbial assessment scheme to support microbial performance measurements of food safety management systems, p. In press. International Journal of Food Microbiology.

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P2-24 Validation of a Norovirus Detection Methodology in Soft Red Fruits

AMBROOS STALS, Leen Baert, Els Van Coillie and Mieke Uyttendaele, Ghent University, coupure Links 653, Ghent, 9000, Belgium; Institute for Agricultural and Fisheries Research, Technology and Food Unit, Brusselsesteenweg 370, 9090 Melle, Belgium

Introductin: Noroviruses (NoVs) are recognized as one of the most important causes of (foodborne) non-bacteriological gastroenteritis worldwide. Despite these facts, a standardized assay to detect NoV in different food types is still not available.

Rational: In the current study, the robustness of a suggested NoV detection methodology was examined on different soft red fruits.

Results: Ten grams of different food products were inoculated with diluted GI and/or GII NoV stool samples. Virus/RNA extraction was performed as described by Baert et al (2008). A multiplex real-time RT-PCR assay described by Stals et al. (2009) was used for detection of NoV GI, NoV GII and MNV-1 of which the latter served as full process control. MNV-1 ssRNA was added used as reverse transcription control and MNV-1 plasmid DNA was used as real-time PCR internal amplification control. GI NoVs were recovered from deep-frozen raspberry crum samples with efficiencies of 28.11 ± 7.82% and 20.09 ± 9.40% (high and low concentrated inoculation). GII inoculations were recovered with efficiencies of 13.82 ± 6.23% and 7.57 ± 3.79% (high and low concentrated inoculation).

Conclusions: Results show that the recovery of (genomic material of) GI and GII NoVs from different soft red food products is influenced by the concentration of GI/GII NoVs present on the food sample and the fruit/matrix type. Further validation of the developed method on different food matrices remains necessary, but this assay seems to have perspectives for detection of human GI/GII NoVs in food samples.

P2-25 Simulation Modelling and Risk Assessment as Tools to Identify the Impact of Climate Change on Microbiological Food Safety – The Case Study of Fresh Produce Supply Chain

Liesbeth Jacxsens, Luning, P., J. van der Vorst, F. Devlieghere, R. Leemans, and M. Uyttendaele, Ghent University, coupure Links 653, Ghent, 9000, Belgium

Introduction: The current quality assurance and control tools and methods to prevent and/or to control microbiological risks associated with fresh produce are challenged due to the following pressures upon the food supply chain, i.e., changing consumption patterns, globalization and climate change. It demonstrates the need for scientific research and development of new and/or improved tools, techniques and practices to adapt the current risk management systems.

Rational: A conceptual research approach is presented to analyse the complexity of the climate change and globalization challenge on the fresh produce supply chain taken as a case study. The factors which affect the vulnerability of the fresh produce chain demand a multidisciplinary research approach. The proposed knowledge-based modelling system is believed to be a most appropriate way to identify problems and to offer solutions to monitor and prevent microbiologicalal food safety risks during all phases of food production and supply.

Results: To explore the potential impact of climate change and globalization, baseline information can be obtained by surveillance and performance measurement of implemented food safety management systems. Simulation of climate change scenarios and the logistic chain of fresh produce, along with mathematical models to optimize packaging technology to maintain quality and safety of fresh produce are tools to provide insights in the complex dynamic ecosystem. They are the basis for elaboration of risk assessment studies to scientifically support management options and decisions to new microbiological threats related to globalization and climate change in the fresh produce supply chain.

Conclusions: This research concept as such will contribute to develop strategies in order to guarantee the (microbiological) food safety of fresh produce on the long term.

Acknowledgments: This conceptual research approach will be undertaken in an EU FP7 project Veg-i-Trade coordinated by Mieke Uyttendaele. The Veg-i-Trade project responds to a call by of DG Research of the European Commission and addresses the elaboration of research activities to identify impacts of anticipated climate change and globalisation globalization on food safety, microbiological and chemical hazards, of fresh produce and derived food products. The authors wish to thank all the members of the Veg-i-Trade consortium.

P2-26 Potential Use of Fourier Transform Infrared Spectroscopy (FT-IR) to Assess Pork Spoilage

Olga Papadopoulou, Efstathios Panagou, Constantinos Mallidis, and CHRYSOULA TASSOU, National Agricultural Research Foundation, Institute of Technology of Agricultural Products, Sofokli Venizelou 1, 141 23 Lycovrissi, Athens, Greece

Introduction: Quality is a subjective and sometimes elusive term. Freshness of meat muscles is generally considered the most important contributor to quality. It is therefore crucial to have valid methods to monitor freshness and quality. Indeed, methods should be valid for application by industry and consumers in order to

obtain reliable information on freshness status when merchandizing and purchasing products. Fourier Transform Infrared (FT-IR) spectroscopy is a rapid, non-destructive analytical technique with considerable potential for application in the food and related industries. FT-IR has been tested for several muscle food analyses and recent studies on meat tissues, stored at ambient temperature, correlate microbial spoilage of meat with biochemical changes within the meat substrate.

Rational: Minced pork meat was stored aerobically at five different temperatures (0, 5, 10, 15 and 20°C) and the microbiological analysis (Total Viable Counts, lactic acid bacteria, pseudomonads, *Enterobacteriaceae*) was performed in parallel with FT-IR analysis, pH measurements and sensory analysis. The spectral data collected from FT-IR were subjected to principal component analysis (PCA) to investigate differences between samples and thus reduce the size of the data set. A second PCA with the selected variables (wavenumbers) revealed the principal components (PCs) that significantly contributed to the variance of the data set. These PCs were further subjected to factorial discriminant analysis (FDA) in order to predict the quality of a sample that was pre-characterized as Fresh (F), Semifresh (SF) or Spoiled (S) from the sensory analysis. A corresponding procedure was followed in order to qualitatively predict the storage temperature of a sample.

Results: The FDA exhibited a correct classification of >96% of samples regarding their spoilage status (F, SF, S) and 90% regarding their storage temperature. These data revealed a good correlation between sensory detection of spoilage status and that of chemical metabolites according to storage temperature, as detected from FT-IR. On the other hand, sensory evaluation of spoilage was not always correlated with the same microbial load at the time of the early sensorial detection of spoilage (meat characterized as SF) which was increased with temperature.

Conclusions: Results show that Fourier Transform Infrared (FT-IR) spectroscopy is a rapid, non-destructive analytical technique with considerable potential for application in the food and related industries.

Acknowledgments: The project is funded from SYMBIOSIS-EU (Contract No. 211638).

P2-27 Food Safety and Epidemiological Relevance of Procedures in Cleaning and Disinfection at Household Level

Telma Basto, CARLOS BRANDÃO, Susana Marcelino, Manuela Guerra and Claudia Viegas, Department of Food Science - Laboratory of Food Microbiology, Estoril Higher Institute for Tourism and Hotel Management, Av. Condes de Barcelona, 2769-510 Estoril, Portugal

Introduction: Food borne diseases at household level are considerably frequent, and in many situations associated to cross-contaminations, and deficient hygiene pratices

Rational: This study aimed to undertake a survey to assess the degree of compliance with good hygiene practices at home, and to evaluate the feacal contamination in refrigerators, cleaning sponges and kitchen counters.

Results: Regarding the survey the main evidences are the following: out of the 30 inquires, 62% used a cloth to clean and 49% cleaned only it with detergents; 48% discarded the sponge once a month; 90% washed the dishes with detergents without desinfectant; 63% usually cleaned the refrigerator, 33% desinfected it and finally, 42% did so once a month. Of the 90 analysis carried out in the three refrigeratours zones, *Escherichia coli* was detected in 3%, and always in the meat storage zone. *Enterobacteriaceae* were found in 20% of the samples. Considering the analysis of the 30 kitchen surfaces (100 cm^2) *Enterobacteriaceae* were detected in 63% of the samples and *Escherichia coli* in 10% of them. Regarding the analysis of the 30 sponges, *Enterobacteriaceae* were found in 93% of the samples and *Escherichia coli* in 47%.

Conclusions: The sponges are sources of contamination, and a specific factor that can relate the incidence of food borne diseases at home by cross-contamination. The kitchen counters are also sources of contamination, once they contact directly with ready to eat foods. The cleaning procedures of the refrigerators are frequently made without the use of disinfectants, which is a factor that can allow the microbiological survival, and also bio film formation. Considering the analysis of the 30 kitchen surfaces (100 cm^2) *Enterobacteriaceae* were detected in 63% of the samples and *Escherichia coli* in 10% of them.

P2-28 Development of Artisan Chocolate Confectionery: Microbiological Safety and Chemical and Sensory Stability

CARLOS BRANDÃO, Rogério Soares, and Manuela Guerra, Department of Food Science – Laboratory of Food Microbiology, Estoril Higher Institute for Tourism and Hotel Management, Av. Condes de Barcelona, 2769-510 Estoril, Portugal

Introduction: Chocolate confectionery is a product consisting of either chocolate mass or a nucleus containing several fillings covered with a chocolate layer. The demand for these products and specially artisan confectionary chocolates is growing in Portugal. Gourmet and chocolate shops are expanding offering new formulas of these products.

Rational: Considering that sometimes chocolate confectionaries are kept for long periods of time, it's essential to assure the microbiological safety of these products and also its stability in terms of chemical and sensorial characteristics, once these are directly related to their acceptance by consumers. The objective of this study was to assess the safety of a new fill dark chocolate confectionary formula, and its chemical and sensorial stability for a four month period, as influenced by the addition of sorbitol to the filling and the storage temperature (18ºC and 25ºC).

Results: Two series of chocolate confectionery samples filled with a vanilla flavoured cream were prepared, one having sorbitol in its formula. After microbiological sampling, both series were divided in two parts and one of each stored at 18ºC and 25ºC. Once a month, for four months, microbiological analyses were performed (total mesophilic counts, *Bacillus cereus*, total coliforms, *Escherichia coli*, *Clostridium*, *Staphylococcus aureus*, *Salmonella* and *Listeria* spp., moulds and yeasts). Also quality parameters of each series kept at both temperatures were assessed – chemical characteristics (pH and a_w) and sensory characteristics (descriptive analysis and triangular test carried out using a panel of 7 to 10 judges half-trained).

Conclusions: Two assays have already been undertaken. By the end of the experiment (September) which started in June 2009, results of the effect of sorbitol and temperature in the developed chocolate confectionery's shelf life are expected and also which product will have a greater potential from a market point of view.

Acknowledgments: Authors acknowledge technical assistance of Catia Morgado.

P2-29 Occurrence and Expression of Toxin Genes in *Clostridium perfringens* Isolates from Healthy Swine

Elbieta Kukier, KRZYSZTOF KWIATEK, and Magdalena Goldsztejn, National Veterinary Research Institute, Pulawy, OT, 24-100, Poland

Introduction: Prevention of food animal diseases is important issue among many elements in animal food production chain. *Clostridium perfringens* is the most important animal pathogen among anaerobic sporulating bacteria responsible for enterotoxemia of many warm-blooded animals. The production of the major toxins is a base for classification into one of the five toxotypes (A – E). Toxin production ability and their level of production decide about pathogenicity these bacteria. Not less important than activity of genes is immune decreasing of animals, which may lead to disease.

Rationale and Objectives: Taking into account that pathogenicity of *C. perfringens* is conditioned by presence and activity of toxin genes the study were undertaken for assessment of toxin genes occurrence and expression of most often detected toxin genes.

There were detected toxin genes of *C. perfringens* isolates from faeces of healthy swine by multiplex polymerase chain reaction. The second step of study was expression checking of alpha and beta2 toxin by reverse transcriptase PCR on the base of mRNA presence.

Results and Findings: Between 354 analyzed isolates suspected of belonging to C. perfringens species, 305 strains were confirmed. Toxin type and its subtype identification revealed that 51.1% of the isolates belong to type A, 48.8 isolates belong to type A subtype beta2. Enterotoxic strains (positive for cpe gene) were detected in 0.6% strains. Additionally, both isolates possessed cpb2 gene. Analysis of isolates (n = 31) for cpa and cpb2 toxin gene expression shows that 71% of isolates expressed both genes and 29% of isolates only cpa gene. *Conclusions*: Similar to results of other studies there were noted dominance of isolates type A and among them almost half strains possessed cpb2 gene. Relative low percentage of isolates with enterotoxin gene in our study may be, according to some authors, sufficient reservoir of this gene, taking into account a panmictic nature of *C. perfringens* genus.

Acknowledgments: This work was supported by The Ministry of Science and Higher Education research program number R1202302.

P2-30 Roche Lightcycler TaqMan® Methods for Quantification of Genetically Modified Maize and Soybean

ZBIGNIEW SIERADZKI and Krzysztof Kwiatek, National Veterinary Research Institute, Pulawy, 24-100, Poland

Introduction: Real-Time PCR is the most common technique used for the quantification of genetically modified organisms (GMO) in food and feed analyses.

Rationale and Objectives: The objective was to validate the TaqMan Real-Time PCR procedures for the quantification of genetically modified maize (MON810, Bt11, Bt176 and T2 5) and soybean (GTS 40-3-2) at the capillary Roche LightCycler 2.0. The amplification of reference genes: hmg (MON810, Bt11), zSSIIb (Bt176), adh1 (T25), lectin (soybean) and construct- (Bt176, GTS 40-3-2) or event-specific (MON810, Bt11, T25) GM DNA fragments were done.

Results and Findings: The dynamic range of all methods was satisfactory for GMO analyses but limited by low CRM GMO content.

The trueness of the genes copies quantification was in the range ±25% of true value.
The reaction efficiency reached the lower value 89.6% for Bt11 transgene, and the higher value 99.0% for Bt11 hmg reference gene. For other methods the efficiencies for both reference gene and transgene were very similar. The linearity of reaction was very high, R_2 > 0.999.

The limit of detection and limit of quantification was 0.06% for GM maize MON810, Bt11 and Bt176, and 0.05% for T25 event. As regards GM soybean LOD was 0.025%, LOQ was 0.075%. Analyses of CRM maize and soybean samples showed that there is no significant difference between the mean measured value and the certified value. The uncertainty for the quantification of GM maize for all 4 GM event were below or equal ±25%, as regards GM soybean it was ±33% (≤5% GMO content) or ±14% (≥5% GMO content). The last phase of validation proved that robustness of all methods was acceptable.

Conclusions: The results showed that all reactions, optimised for capillary thermocycler, are suitable for the quantification of genetically modified maize and soybean.

P2-31 The Use of Fully Stable Isotope Labeled Mycotoxins as Internal Standards for Mycotoxin Analysis with LC-MS/MS

Georg Mitterer, Markus Kainz, Martin Freudenschuss, Georg Häubl and Rudolf Krska, ROMER LABS Division Holding GmbH, Technopark 1, 3430 Tulln, A-3430 Austria

Nowadays, so called LC-MS/MS multitoxin analysis methods allow the simultaneous determination of up to 100 toxins. However, interferences from matrix components can lead to so called matrix effects that cause variations of the ionization efficiency of the analytes in the sample compared to pure standard calibrants, which results in an under- or overestimation of the actual concentration. This is a clear limitation of multi-toxin methods using a mass spectrometer as detector for the determination of mycotoxins.

There are several approaches to overcome these matrix-induced signal suppression or enhancement effects. The application of matrix-matched standards is a common strategy in LC-MS/MS approaches to counteract the adverse effect of co-eluting matrix components on accuracy. However, matrix-matched calibrations are quite laborious and sometimes, depending on the matrix of interest, not applicable due to the lack of a blank sample or large variation between individual samples of the same matrix. An alternative method is the addition of internal standards (IS) to the sample to overcome matrix effects. IS behave similar to the analyte and can therefore correct for recovery losses during the sample preparation process and for ion suppression effects in the MS source. Stable isotope-labeled analogs of natural mycotoxins provide the best IS for these toxins. However, it should be noted that deuterated compounds still run the risk of H/D exchange in protic solvents and retention time shifts relative to the natural toxin. Moreover, partially labeled toxins frequently contain considerable amounts of "lighter" isomers, leading to mass peaks that interfere with natural toxin isotopes. Therefore, fully 13C-substituted compounds can be regarded as the best standard for quantification by LC-MS/MS based methods.

In our work, we demonstrate the use of fully isotope labeled mycotoxin IS to correct for fluctuations that may occur during extraction, clean-up and ionization of the sample in LC-MS/MS methods.

P2-32 Validation Results of New Test Kits for Food Allergens – AgraQuant® Allergen ELISA Test Kit

Elisabeth Halbmayr, Alexandra Molinelli, Donna Houchins, and Michael Zheng, ROMER LABS Division Holding GmbH, Technopark 1, 3430 Tulln, A-3430 Austria

Food Allergy, typically an immune system response to a protein present in food that the body mistakenly believes is harmful, represents an important health problem in modern society. Cross-contamination during the production process may occur so that residues of food allergens in different products may be present. Worldwide labeling regulations lead to more accurateness for food manufacturers, although hidden allergens continue to be the largest single cause of global product recalls. With the aim of preventing health hazards by food allergy, Romer Labs® offers AgraQuant® Allergen ELISA Test Kits to sensitively detect food allergens in a wide range of processed foods and raw materials.

The AgraQuant® Allergen Test Kits are sandwich enzyme-linked immunosorbent assays (ELISA). Food allergen proteins, extracted from food products with an extraction buffer, bind to specific polyclonal antibodies pre-coated on the surface of a microwell. After a washing step an enzyme-conjugated antibody binds to captured specific food allergen proteins. The applied enzyme substrate develops a blue color. The reaction is then stopped by adding an acidic stopping solution, turning the color into yellow. Using a microwell reader the color intensity is determined and is directly proportional to the concentration of the food allergen in the sample.

AgraQuant® Peanut and AgraQuant® Hazelnut have quantitation ranges of 1-40 ppm and detection limits of 0.1 ppm peanut and 0.3 ppm hazelnut. The quantitation range of AgraQuant® Gluten is 4–120 ppm gluten and limit of detection was determined to be 0.6 ppm gluten. AgraQuant® Soy has a quantitation range of 40–1000 ppb and a limit of detection of 16 ppb. AgraQuant® Almond and AgraQuant® Egg white have quantitation ranges of 0.4–10 ppm and detection limits of 0.2 and 0.05 ppm. Extensive validation studies indicated low detection limits, good accuracy, precision and recovery of the Test Kits.

P2-33 Multiplex PCR Method for Detection of Pecan and Brazil Nuts Allergens in Food Products

ZORA HUBALKOVA and Eva Rencova, Veterinary Research Institute Brno, v.v.i., Hudcova 70, 621 00 Brno, Czech Republic

Introduction: Residues of nut allergens in food products may cause severe allergy in a part of population. European legislation (2003/89/EC) requires labelling of food products with respect to the contents of pecans (*Carya illinoiesis*) and Brazil nuts (*Bertholletia excelsa*).

Rational: The purpose of this study was to develop a multiplex PCR method for simultaneous detection of partial sequence of gene encoding pecan allergen vicilin-like seed storage protein (72 bp) and partial sequence of gene encoding Brazil nut allergen 2S albumin (173 bp) in food matrixes. The specificity of designed primer pairs was tested on a broad range of food ingredients. Food products with various nut declaration and without nut declaration were investigated for the presence of pecan or Brazil nut residues. Universal plant primers were used for the plant matrixes confirmation in food (123 bp).

Results: Twenty eight samples of food products with various nut labelling and eighteen samples without nut labelling were analyzed using developed PCR method. In analyzed samples neither pecans or Brazil nuts were detected. The detection limit of the PCR method was assessed 100 pg/µl.

Conclusions: The presented PCR method is useful for sensitive and specific detection of pecans and Brazil nuts in food products and could therefore prevent the occurence of allergic reaction in context of early nut residues detection.

Acknowledgments: This work was supported by the Ministry of Agriculture of the Czech Republic (Grants MZe 00027 16202 and QG 60090/2005).

P2-34 Compositional Differences in the Lactic Acid Bacteria Flora of Matured Traditional Greek Graviera Cheese as Affected by the Type of Starter Culture Added to the Milk Post-thermization

JOHN SAMELIS and Athanasia Kakouri, National Agricultural Research Foundation, Dairy Research Institute, Katsikas, 452 21 Ioannina, Greece

Introduction: Traditional Graviera cheese is often produced from thermized milk to control undesirable bacterial contaminants. Since thermization also reduces the desirable lactic acid bacteria (LAB) flora of raw milk, natural undefined or commercially defined mixed LAB starters are utilized.

Rational: This study evaluated effects of the type of starter added to thermized (63°C, 30 s) milk on the numbers and types of LAB dominating in matured Graviera cheese. Eight cheese batches produced either with a natural yogurt-like starter (NS; 4 batches) or with a commercial freeze-dried starter (CS; 4 batches) containing *Streptococcus thermophilus*, *Lactococcus lactis* and leuconostocs were analyzed, and 200 (25/batch) LAB isolates from high dilution agar plates were identified.

Results: Mean populations of total mesophiles (TSAYE; 30°C), mesophilic and thermophilic LAB (MRS; 30 and 45°C), and mesophilic and thermophilic cocci (M-17; 22 and 42°C) in NS-cheeses were 8.7, 8.5, 8.0, 8.1 and 7.8 log CFU/g, respectively, whereas respective populations in CS-cheeses were 8.6, 8.7, 6.6, 8.4 and 8.3 log CFU/g. *Enterococcus faecium* (41%), *E. durans* (35%), *Lactobacillus casei* (9%), *E. faecalis* (8%), *Leuconostoc* (5%) and *Lc. lactis* (2%) were isolated from NS-cheeses. Conversely CS-cheeses contained *L. casei* (46%), *L. plantarum* (17%), *Lc. lactis* (3%) *and S. thermophilus* (3%). *Enterococcus* spp. comprised 31% of LAB isolates from CS-cheeses; 86.2% of them, however, were recovered from MRS plates at 45°C which exclusively contained enterococci at populations ca. 1.5 log lower ($P < 0.05$) than in NS-cheeses.

Conclusions: Replacement of NS with CS suppressed enterococci and favoured mesophilic lactobacilli during maturation. *S. thermophilus* present in both NS and CS, and *Lc. lactis* present in the CS, were overgrown, and *Lactobacillus bulgaricus* isolated from the NS was undetectable, in ripened cheeses. Safety concerns associated with inability of the NS to control *Enterococcus* suggest that concentrated commercial starters should be used in traditional Graviera cheese production.

Acknowledgments: Funding was provided by TRUEFOOD (Traditional United Europe Food), which is an integrated project financed by the European Commission under the 6th RTD Framework (contract FOOD-CT-2006-016264).

P2-35 A New Approach to HACCP for Hospitality: Changing Knowledge, Attitude and Behaviour

JOANNE Z. TAYLOR, University of Salford, 109 Claremont Road, Irlam o'th Heights, Salford, M6 7QF, United Kingdom

Introduction: The purpose of this paper is to demonstrate an evaluation of the effectiveness of a new method of HACCP for the hospitality industry that was developed, piloted and validated by the UK Food Standards Agency (FSA) and the University of Salford between 2002 and 2006.

Rational: To evaluate the impact of a new approach to HACCP, in-depth case studies using psychological interviews and documentary analysis were carried out in a wide range of hospitality businesses in Greater Manchester. The new approach to HACCP was implemented in these businesses, and the research method was replicated at 6 month and 3 year periods to assess change.

Results: The findings show notable improvements in food safety knowledge, attitude and behaviour, and a reduction or elimination of all previously identified barriers to food safety management, as a result of implementing the new approach to HACCP. They also show how they can be maintained over time with minimum external pressure or involvement.

Conclusions: The results of this study support the FAO/WHO guidance to governments on 'evolving methods' of HACCP for SLDBs, and also provide in-depth psychological and practical insights into how this can be achieved and evaluated.

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P2-36 Could LanguaL be Useful for Food Microbiological Risk Assessment?

SILVIA VIEGAS, Margarida Saraiva, Andreia Porto, and Luisa Oliveira, Instituto Nacional de Saude Dr. Ricardo Jorge, Av. Padre Cruz, Lisboa, 1649-016, Portugal

Introduction: Microbiological foodborne diseases are a growing public health problem worldwide. To design public health policies and identify appropriate food safety measures, data on foodborne diseases surveillance and food monitoring systems need to be analysed together. In order to reduce uncertainties in risk assessment, it is very important to improve data quality, particularly regarding food classification and description.

LanguaL (Langua aLimentaria) is a description-classification system that characterizes each food by a set of standard, controlled terms chosen from facets. LanguaL facilitates links to many different food data banks and is currently used in European EuroFIR Composition Databases contributing to coherent data exchange. EFSA's zoonoses reporting system classifies foods according its risk level by hazard.

Rationale and Objectives: To assess LanguaL suitability for food microbiological risk assessment. Foods related to foodborne diseases reported by Portugal in 2008, were classified by LanguaL. EFSA and LanguaL classifications were compared.

Results and Findings: Major contributory factors to microbiological risk like temperature misuse, raw material, are related to Langual facets F. EXTENT OF HEAT TREATMENT, G. COOKING METHOD and J. PRESERVATION METHOD. Also, facets C. PART OF PLANT OR ANIMAL, E. PHYSICAL STATE, SHAPE OR FORM, H. TREATMENT APPLIED, K. PACKING MEDIUM and M. CONTAINER OR WRAPPING, R. GEOGRAPHIC PLACES AND REGIONS and Z. ADJUNCT CHARACTERISTICS OF FOOD describe food aspects that may be important to risk. The term "canteen" lacks in Preparation establishment descriptor of facet Z.

Conclusions: Results suggest that LanguaL may be adequate for microbiological risk assessment and could facilitate screening emergent problems, because it does not have risk oriented classification limitations. Furthermore, the use of the same Food Description System for composition, consumption and contaminant occurrence databases would allow data combination among networks improving food safety and food security at global level.

2010-2011 Secretary Election

MARIA TERESA DESTRO

DONALD W. SCHAFFNER

The following page contains biographical information for the 2010–2011 Secretary Candidates. This information is provided to help you make your selection of the next IAFP Secretary.

Members with valid E-mail addresses will receive election notices and a unique personal identification number via E-mail from IAFP's election service provider. Members without E-mail addresses, or invalid E-mail addresses, will be sent their unique personal identification number via postal service. Voting will take place on a Web site hosted by Survey & Ballot Systems (SBS), an independent, external organization who is conducting the IAFP election. Safeguards are in place to insure each Member votes only once.

The election Web site will be open from January 28 to March 16. Election results will be reported directly from SBS to the IAFP Teller who will report directly to President Vickie Lewandowski. Watch for the election results on the IAFP Web site in April and also in the April *IAFP Report* and the May issue of *Food Protection Trends*.

If you have questions about the election process, contact David W. Tharp, CAE, Executive Director at +1 800.369.6337; +1 515.276.3344 or E-mail: dtharp@foodprotection. org.

DR. MARIA TERESA DESTRO

São Paulo, Brazil

Dr. Maria Teresa Destro is an Associate Professor of Food Microbiology in the Department of Food and Experimental Nutrition at the University of São Paulo (USP), Brazil. She earned a B.Sc. in Biological Sciences at the University of São Carlos. Her first professional experience was at an animal pre-mix production company. She later joined the Food Technology Institute (ITAL). At ITAL, she discovered the importance and beauty of food microbiology. After moving to a pharmaceutical research company, she found that food microbiology was her main interest and passion, and subsequently enrolled in the M.Sc. Program in Food Technology at the University of Campinas (UNICAMP) where she began the first studies in Brazil of *Listeria* contamination problems in food.

While pursuing her M.Sc., Dr. Destro began teaching Food Hygiene at the Catholic University of Campinas. She joined the Food Department at USP in 1989, first as a teaching assistant, and then promoted to assistant professor and lecturer in 1990. Dr. Destro obtained her Ph.D. in Food Science at USP in 1995, after developing part of her *Listeria* research under the supervision of Dr. Jeff Farber in Canada. She spent the year 2000 working as a Research Fellow in the Food Science Department of the University of Nottingham, England. In 2006 she received her *Livre Docencia* and was promoted to Associate Professor.

As a professor at USP, Dr. Destro dedicates her time to three areas: teaching, research and extension. Her responsibilities as a professor are teaching food microbiology to undergraduates and studies on Gram-positive foodborne pathogens to graduate students. She also delivers regular courses at several universities in Brazil and in other South American countries. To date she has supervised several graduate students; 11 M.Sc. and 10 Ph.D. candidates.

Dr. Destro's research areas of interest are foodborne pathogens, with a special interest in *Listeria monocytogenes*, from detection and control to the influence of processing conditions on the virulence of the pathogen. She has served as lead investigator and collaborator in several multi-institutional projects addressing food safety and microbial risk assessment.

Dr. Destro has fostered extension and outreach activities by helping micro and small food producers implement GMP, HACCP programs, and by training private and official laboratory staff in *Listeria* detection and enumeration. As an FAO certified HACCP instructor, she has delivered courses all over Brazil and trained over 500 food processors and government employees. She has served on several Brazilian Government committees and works at the international level with FAO, ILSI North America and PAHO.

Dr. Destro joined IAFP in 1994 and has attended the association's annual meetings since 1999. She has served as Member, Vice-Chair and Chair of the *Journal of Food Protection* Management Committee (2000–2008); and Vice-Chair and Chair of the Awards Committee (2007–2008). As Affiliate Council Secretary and then Affiliate Council Chair (2005–2007), she had the opportunity to join the IAFP Executive Board as the first non-North American member of the Board. Maria Teresa currently serves as a member of the IAFP Program Committee (2008–2011) and on the Meat and Poultry Safety and Quality PDG. Dr. Destro was responsible, together with Dr. Mariza Landgraf, for the establishment of the Brazil Association for Food Protection, the first IAFP Affiliate organization in South America. She has also acted as an ambassador for IAFP in different Latin America countries, always committed to spreading the IAFP objective: advancing food safety worldwide.

In addition to IAFP, Dr. Destro has been very active in Brazilian scientific associations. She served as treasurer of the Brazilian Society of Microbiology; Director of Courses for the Brazilian Society for Food Science and Technology, and president of the Brazil Association for Food Protection.

DR. DONALD W. SCHAFFNER

New Brunswick, New Jersey

Dr. Donald W. Schaffner is Extension Specialist in Food Science and Professor at Rutgers University. He also serves as the Director of the Center for Advanced Food Technology. His research interests include quantitative microbial risk assessment and predictive food microbiology. Dr. Schaffner has authored more than 100 peer-reviewed publications, book chapters and abstracts. He has been the recipient of more than $5 million in grants and contracts, largely in the form of competitive national grants. Dr. Schaffner has educated thousands of Food Industry professionals through numerous short courses and workshops in the United States and more than a dozen countries around the world.

Dr. Schaffner was awarded the IAFP Elmer Marth Educator Award in 2009 for outstanding service to the public and IAFP in the area food safety and food protection education. He also received the Sustained Research and Impact Award in 2008 from the Rutgers School of Environmental and Biological Sciences and NJ Agricultural Experiment Station in recognition of research and scholarship that has provided significant contributions to his profession, and contributions that have had direct measurable impact on the communities he serves.

Dr. Schaffner has served on a variety of national and international expert committees. He served on the US National Academy of Sciences Standing Committee on Use of Public Health Data in FSIS Food Safety Programs and the Committee to Review the Use of Scientific Criteria and Performance Standards for Safe Food. He chaired two expert workshops on microbial risk assessment for the World Health Organization (WHO) and Food and Agriculture Organization (FAO) of the United Nations. Expert reports offering guidelines for Microbial Exposure Assessment and Risk Characterization arising from those two workshops were recently published by FAO/WHO. He also served on a number of Institute of Food Technologist (IFT) expert panels working on projects for FDA including: Development and implementation of a risk-ranking framework to evaluate potential high threat microbiological agents, toxins, and chemicals in food; evaluation and definition of potentially hazardous foods; and quantification of the destruction kinetic of alternative processing technologies. Dr. Schaffner also served two terms on the US National Advisory Committee on Microbial Criteria for Foods (NACMCF), co-authoring documents on Parameters for Determining Inoculated Pack/Challenge Study Protocols and Consumer Guidelines for the Safe Cooking of Poultry Products.

Dr. Schaffner is active in several scientific associations including IAFP, IFT, Society for Risk Analysis (SRA), American Society for Microbiology (ASM), and Conference for Food Protection (CFP). Dr. Schaffner is an Editor for the *ASM Journal, Applied and Environmental Microbiology*, and serves on CFP, Council III – Science and Technology.

His recent service to IAFP includes membership on the *Journal of Food Protection* Editorial Board, IAFP Foundation Committee, Program Committee, Organizing Committee for IAFP's Second European Symposium on Food Safety, GMA Food Safety Award Jury and Nominating Committee. He currently serves as Vice Chairman for the IAFP Membership Committee.

Dr. Schaffner holds a B.S. in Food Science from Cornell University and a M.S. and Ph.D. in Food Science and Technology from the University of Georgia.

IAFP ASIA PACIFIC SYMPOSIUM ON FOOD SAFETY HIGHLIGHTS

November 11–13, 2009
Seoul, South Korea

Over the dates of November 11–13, 2009, IAFP and the Korean Association of Food Protection held the Asia Pacific Symposium on Food Safety in Seoul, Korea. Along with the Korean Food and Drug Administration and the Korean Society of Food Hygiene and Safety, a number of other agencies and companies supported this, the first IAFP led effort in the region.

The first day was reserved for two workshops; one on quantitative modeling for microbial risk assessment presented by Vijay Juneja and Thomas Oscar from USDA; the second was on the topic of principles and application of real-time PCR and was taught by Kwang-Won Hong, Yong-Suk Nam and Taiwan Koo. Both were well attended and the information exchanged was valuable to attendees. The following two days were a combination of plenary sessions, concurrent sessions, poster presentations and time to visit with exhibitors.

Well over 350 attendees enjoyed 65 oral presentations and close to 200 poster presentations. Many of the presentations were

delivered by IAFP Members from Korea and from around the globe, making the Asia Pacific Symposium truly an international event. First day plenary session presentations were delivered by Richard Linton, Purdue University; Yong Ho Park, Seoul National University; and Angelika Tritscher, World Health Organization. Dr. Linton presented a talk titled, "Global Issues in Food Safety: The Present and Future Perspectives"; Dr. Park presented, "Control and Management of Microbial Contamination in Food Products: International Tendency", and Dr. Tritscher delivered, "Food Safety and Risk Assessment from the International Perspective."

The second symposium day also began with plenary session presentations as follows: Dr. Wilhelm Holzapfel from Handong Global University in Korea talked on "Microbial Food Safety in the EU" and Dr. Kazuki Kanazawa from Kobe University in Japan presented "The Exact Safety of Biofunctional Asian Ethnic Foods." Korea ILSI (International Life Sciences Institute) also organized a session on Threshold and Food Safety Risk Assessment involving colleagues from China, India, Japan, Singapore, Korea and the United States.

The results of the symposium show that it was a success in every way. Organization of the program by the Korean Affiliate was excellent as were the conference materials. Comments received from attendees were all very positive. We look forward to the next opportunity to work together with the Korean Affiliate in producing another Asia Pacific Symposium on Food Safety.

Turkish Food Safety Association, 1st Food Safety Congress Highlights

December 4, 2009
Istanbul, Turkey

The 1st Food Safety Congress was held in Istanbul, Turkey on December 4, 2009. It was organized by the Turkish Food Safety Association (TFSA), an IAFP Affiliate organization. More than 650 attendees were present to be welcomed by Samim Saner, TFSA President and David Tharp, IAFP Executive Director who replaced Vickie Lewandowski, IAFP President due to Vickie's work responsibilities. The Turkey Minister of Agriculture and Rural Affairs, Mr. Mehmet Mehdi Eker also welcomed attendees and gave a presentation on the current status of food safety in Turkey.

The auditorium was full when keynote presentations were delivered by Dr. Chris Griffith, consultant from the United Kingdom and Dr. Bernd van der Meulen from Wageningen University in The Netherlands. Dr. Griffith spoke on "Do Countries Get the Food Poisoning They Deserve?" and Dr. van der Meulen's talk was on "Food Law and Legislation in Europe." This was followed by a panel discussion on Food Safety and Public Health in Turkey, chaired by Mr. Saner.

After the lunch break, parallel sessions were presented on a variety of subjects including: 1.) Animal Production and Food Safety, 2.) Food Safety in Retail, 3.) Agricultural Production and Food Safety, 4.) Food Safety and Turkey's Accession into the EU, 5.) Packaging and Food Safety, and 6.) Food Safety and Tourism. More than 50 presentations were delivered during the one-day event with speakers mostly from Turkey, but also from Europe and the United States.

Lunch was held in the foyer where twenty-five supporting companies displayed their latest products and technologies. A reception for congress attendees was also held in the same area upon conclusion of the day's presentations.

The congress reached its aim by approaching the session topics from a scientific point of view and by bringing together parties from government, industry and academia to discuss "food safety" on a solution-based platform. The speakers, with their intense knowledge and experience made the utmost contribution in the realization of the congress' aim. This event was so successful that the 2nd Food Safety Congress is already being planned for December of 2010, also to be held in Istanbul. Organizers expect to expand the program to two-days in order to serve an increased number of attendees.

NEW MEMBERS

CANADA

Jason M. Cheddie
World Trade Group
Toronto, Ontario

Ghislain Dufresne
Fish Consulting (Training & Development)
Longueuil, Quebec

Musarrat Jahan
University of Manitoba
Winnipeg, Manitoba

Kavitha Palaniappan
University of Manitoba
Winnipeg, Manitoba

Ian Young
University of Guelph
Guelph, Ontario

CHINA

Wei Cao
China Agricultural University
Beijing

DENMARK

Jorgen J. Leisner
Copenhagen

FRANCE

Herve Prevost
ENITIAA
Nantes

MEXICO

Javier Arzate Cabrera
Universidad Del Claustro De Sor Juana
Mexico City

NEW ZEALAND

Michael J. Donkin
Fonterra
Palmerston North, Manawatu

Nicola J. Dymond
Food Safety First Ltd.
New Plymouth

PORTUGAL

Antonio A. Lourenco
Instituto Superior de Agronomia, UTL
Lisboa

UNITED KINGDOM

Emma L. Snary
Veterinary Laboratories Agency Weybridge
Addlestone, Surrey

UNITED STATES

ARKANSAS

Marty Green
De Wafelbakkers
North Little Rock

CALIFORNIA

Brian Banerdt
Univar USA, Inc.
Fresno

Lisa A. Benjamin
Western Institute of Food Safety and Security
Davis

Keith Refsnider
Driscoll Strawberry Associates, Inc.
Watsonville

DELAWARE

Adam Leaphart
Strategic Diagnostics, Inc.
Newark

Joan M. Stevens
Agilent Technologies, Inc.
Wilmington

DISTRICT OF COLUMBIA

Shanker P. Reddy
USDA-FSIS
Washington

FLORIDA

John Gurrisi
DARDEN Restaurants, Inc.
Orlando

Masi Rajabi
ABC Research Corp.
Gainesville

GEORGIA

Arthur P. Liang
CDC
Atlanta

Steven A. Lyon
Chick-fil-a, Inc.
Atlanta

ILLINOIS

Sam Saltzman
All American Chemical
Rosemont

INDIANA

Valentina Trinetta
Penn State University
West Lafayette

Kelli Whiting
Marion County Health Dept.
Indianapolis

IOWA

Alan M. Schultz
Rochester Midland Corp.
Spirit Lake

KANSAS

Robert E. Hanson
Hanson Tech
Overland Park

Jerry W. Rich
Smith, Brown & Jones LLC
Wichita

MARYLAND

Azadeh Khojasteh
Elkridge

NEW MEMBERS

MASSACHUSETTS

Florence E. Feeherry
Natick Soldier R,D, & E Center
Natick

MICHIGAN

Kanika Bhargava
Detroit

MINNESOTA

Leo Jacques
AMPI
New Ulm

MISSOURI

Staci L. DeGeer
MARS Petcare
Kansas City

Steven S. DeHaven, II
MARS Petcare
Kansas City

Norman V. Morrow
MARS Petcare
Kansas City

Lindsey S. Spedding
MARS Petcare
Kansas City

NEBRASKA

Nageswara R. Korasapati
University of Nebraska – Lincoln
Lincoln

NEW JERSEY

Robert Hudson
TraceGains, Inc.
Mountain Lakes

Kevin Lorcheim
Clordisys Solutions, Inc.
Lebanon

Gabriel K. Mootian
Rutgers University
New Brunswick

Wen-Hsuan Wu
Rutgers University
Sayreville

NEW YORK

Ruth E. Riner
Upstate Niagara Cooperative, Inc.
Batavia

Carol D. Savvas
Diversified Search Odgers Berndtson
New York

NORTH CAROLINA

Ryan E. Harrolle
Outback Steakhouse
Cary

OHIO

Hossein Daryaei
The Ohio State University
Columbus

Barbara B. Kowalcyk
University of Cincinnati
Maineville

Christian P. Thomas
Summer Garden Food Mfg.
Boardman

Zhi Wang
International Fiber Corp.
Urbana

OREGON

Bruce D. Harris
RDO-Calbee Foods
Boardman

PENNSYLVANIA

Gulbanu Kaptan
Carnegie Mellon University
Pittsburgh

Kim Morrison
Appeeling Fruit, Inc.
Dauberville

TEXAS

Melinda Hayman
Food Safety Net Services
San Antonio

WISCONSIN

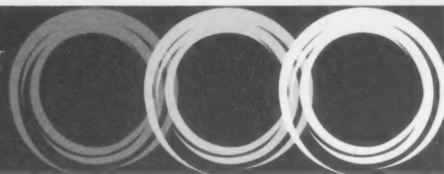
Stacy L. Street
JohnsonDiversey
Oak Creek

NEW SUSTAINING MEMBERS

De Wafelbakkers
Ed Hansberry
North Little Rock, AR

Hardy Diagnostics
Chris Catani
Santa Maria, CA

WHAT'S HAPPENING IN FOOD SAFETY



NSF International Certified for Sport™ Program Announces Support for USDA's "Supplement Safety Now" Campaign

NSF International, a not-for-profit public health and safety organization that tests and certifies dietary supplements, has announced full support for the United States Anti-Doping Agency (USADA) "Supplement Safety Now" campaign.

This campaign will create increased awareness around this important public health issue and help safeguard consumers from taking steroids and other illegal or controlled substances in products that are marketed as "safe and legal" dietary supplements.

"To be clear, products containing steroids and steroid precursors are not supplements, they are Illegal drugs masquerading as dietary supplements," said Dr. Lori Bestervelt, senior vice president and chief scientific officer for NSF International. "These dangerous and illegal products pose a significant public health risk and more stringent enforcement and independent surveillance is needed to better safeguard consumers."

Recent reports and FDA warnings regarding steroid contamination in products sold as supplements in the US continue to emphasize the need for testing and certification of dietary supplements and nutritional products to ensure they do not contain steroids and other banned substances and contaminants.

NSF International has been working on solutions that address this public health issue for nearly a decade, working in concert with sports organizations, anti-doping agencies and supplement manufacturers to develop certification programs that evaluate dietary supplements for steroids and other prohibited substances as well as other contaminants. regarding the safe manufacture of dietary supplements. NSF developed a Dietary Supplement Certification program based on this standard that tests products for contaminants and heavy metals, verifies that what's on the label is in the bottle and audits manufacturing facilities to ensure they operate using Good Manufacturing Practices (GMPs).

Since 2004, NSF has partnered with sporting organizations to test and certify dietary supplements and sports nutritional products to ensure they are also free of athletic banned substances. Major League Baseball (MLB), the MLB Player's Association, the National Football League (NFL), the NFL Player's Association, Professional Golfers Association of America (PGA), Ladies Professional Golf Association (LPGA), and the Canadian Centre for Ethical Sports (CCES) have all chosen NSF to help verify the products their athletes use are safe and free of banned substances. More information about NSF's Certified for Sport program is available at www.NSFsport.com.

3-A SSI Introduces New 'Buyer Beware' Resource

3-A Sanitary Standards, Inc. (3-A SSI) announces a new online resource to help processors, consumers, equipment specifiers and others identify equipment sellers that make false or misleading claims of conforming to the sanitary design or fabrication criteria of 3-A Symbol authorization. The new resource, 'Buyer Beware: False or Misleading Claims', lists companies and marketing web sites that feature misleading or false information about the sanitary design of products used widely in dairy and other food processing applications.

Today literally hundreds of sellers market food processing equipment online or through B2B web sites, and many state claims such as 'meets '3-A,' 'conforms to 3-A standards', or the equipment may include '3-A' in a model name or designation. Such references suggest the equipment meets the criteria for 3-A Symbol authorization. Unless the supplier is an authorized 3-A Symbol holder, the buyer is solely responsible for verifying whether the equipment meets the desired (and expected) sanitary design and fabrication criteria.

According to 3-A SSI Executive Director Tim Rugh, "All equipment is not created equal and even if it were, wouldn't you want to verify it? Processors around the world know and trust the 3-A Symbol and that's why they demand it for their food processing equipment. All equipment displaying the 3-A Symbol or making a claim of 3-A Symbol authorization must pass a comprehensive, independent Third Party Verification (TPV) inspection to assure it meets the sanitary design criteria in a 3-A Sanitary Standard."

"3-A SSI quickly found many unsupported statements of conformance to 3-A Sanitary Standards, 3-A Certification, or authorization to use the 3-A Symbol, including some products such as 'sanitary butterfly valves', for which no 3-A Sanitary Standard exists. Unfortunately,

the number of suspect or misleading claims made online and the legal expense for obtaining prompt corrections are beyond the resources of 3-A SSI," Rugh said.

To assist processors, buyers or specifiers, 3-A SSI now provides a list of the entities it has contacted to request the removal of the 3-A Symbol or correction of false or misleading claims. The new resource is available on the 3-A SSI web site at www.3-a.org <http://www.3-a.org/> under 'The 3-A Symbol' or go directly to: http://www.3-a.org/symbol/ buyer_beware.html. 3-A SSI will update the listings periodically.

3-A SSI encourages those searching for food processing equipment that meets stringent criteria for sanitary design and fabrication to verify the equipment maintains authorization to display the 3-A Symbol. See the current list of authorized 3-A Symbol holders at: http://www. 3-a.org/symbol/3-a_symbol-holders.pdf.

Land O' Frost Vice President of Research John Butts Honored with American Meat Institute Foundation Scientific Achievement Award

John Butts, Ph.D., vice president of research at Land O' Frost, was honored with the American Meat Institute Foundation (AMIF) Scientific Achievement Award. The award was presented during AMI's International Meat, Poultry & Seafood Convention & Exposition, part of Worldwide Food Expo, Oct. 28–31, in Chicago, IL.

Mr. Butts has been instrumental in promoting food safety efforts for all meat and poultry companies by embracing the philosophy that food safety should be a non-competitive issue. At every turn, Mr. Butts can be counted upon to share the benefit of his knowledge and experience. His development of the "Seek and Destroy" program of sanitation, equipment design and maintenance put him at the forefront of food safety in the industry.

Additionally, he introduced a pasteurization step and a one-way product process through the plant in the 1980s and implemented one of the first plant HACCP programs in the 1990s. Mr. Butts also co-authored AMI's *Listeria* Prevention and Control Program and is a regular and well-respected instructor.

Mr. Butts has worked tirelessly on several AMI committees, serving as chairman of the Scientific Affairs Committee from 2001 to 2003. His scientific contributions to the industry are significant and he continues to lead training to ensure the promotion of food safety within the industry.

"John's scientific achievements extend well beyond his own resume and company," said AMI President and CEO J. Patrick Boyle. "His efforts have had a profound effect on all members of our industry and their products. Those who know him marvel at his microbiological knowledge and his scientific generosity."

The American Meat Institute Foundation is a non-profit research, education and information foundation established by the American Meat Institute to study ways the meat and poultry industry can produce better, safer products and operate more efficiently.

AMI represents the interests of packers and processors of beef, pork, lamb, veal and turkey products and their suppliers throughout North America. Together, AMI's members produce 95 percent of the beef, pork, lamb and veal products and 70 percent of the turkey products in the United States. The Institute provides legislative, regulatory, public relations, technical, scientific and educational services to the meat and poultry packing and processing industry.

New Food Safety Report Released from the National Restaurant Association

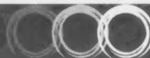
Poor personal hygiene is a leading cause of foodborne illness. That's why every food handler on every shift needs to understand the importance of proper personal hygiene practices. Download the free report, "The Safe Path to Success," from the National Restaurant Association. This is the report our industry is reading today, because it can help every operation recognize and avoid common barriers to food safety. Go to www.Serv.Safe.com/safereport to download the new white paper.

FMI Presents Award of Excellence to Food Industry Association Executives President Barbara McConnell

Food Marketing Institute (FMI) recognized Barbara McConnell, president of the Food Industry Association Executives (FIAE) with an award of excellence for her leadership in promoting the food industry through the strength of state associations. FMI President and Chief Executive Officer Leslie G. Sarasin presented the award to Ms. McConnell at FIAE's annual convention.

"Barbara has worked tirelessly to make sure the state associations are kept up-to-date and are well-informed about the industry's most pressing issues," said Ms. Sarasin. "She is an extremely popular and effective leader on behalf of the food industry."

Ms. McConnell has spent her lifetime helping others both in the private sector and through public service. She served two terms in the New Jersey State Assembly. She was the director of the New Jersey Division of Tax Appeals and was the first woman appointed to serve as



the Secretary of Commerce and Economic Development for New Jersey.

She also has a long-standing commitment to helping women. During her time in the Assembly, Ms. McConnell worked on legislation to protect women against domestic violence and served as president of the board of the Hunterdon County Women's Crisis Services.

She combined her political skill and knowledge of the food industry in 1981 when she was named president and CEO of the New Jersey Food Council (NJFC). Ms. McConnell and her staff were successful in winning more than 100 legislative and regulatory battles important to New Jersey grocers.

Ms. McConnell was named president of FIAE in 1995 and is credited with growing its membership, resources, services and credibility.

Her leadership on behalf of the industry has not gone unnoticed. She was the first recipient of FMI's Donald H. McManus Association Executive Award for her extraordinary leadership in public affairs. "Barbara knows that our customers are the reason for everything we do," said Ms. Sarasin. "She stands up for consumers and our industry and is well deserving of this award."

Lee Blakely Receives 2009 American Dairy Products Institute Award of Merit

Lee Blakely has enjoyed a long, multi-faceted dairy career, which has spanned an unusually wide range of responsibilities in fields of teaching, manufacturing, quality assurance and marketing. Over the course of his career, Lee has contributed in many diverse ways to the advancement of the American Dairy Industry.

Lee's successful career in the dairy industry was built on an impressive foundation of academic achievement. He received his B.S. in food technology from the University of Georgia in 1962. He subsequently earned M.S. and Ph.D. in food science at Michigan State University, concluding his studies there in 1968.

After receiving his doctorate, Lee began teaching future dairy industry managers starting some 40 years ago as an assistant professor at the University of Wisconsin-River Falls, followed by a move to the well-regarded dairy science program at Texas Tech University in Lubbock, Texas.

After four years of teaching, the dairy industry called and Lee joined Dairyman's Cooperative Creamery Association in 1973 as Senior VP of Manufacturing. It was a prescient move as California was quickly emerging as a major milk producing state. A DCCA merger with Land O' Lakes in 1999 resulted in Lee assuming a new role as VP of Quality Assurance for LOL. In 2002, he was tapped as the chief technical officer for Cheese & Protein International LLC, which was eventually acquired by Saputo and reorganized as Saputo Cheese & Protein.

Lee retired in the fall of 2008, although he remains active in the dairy business taking on various consulting assignments from Land O' Lakes and other industry clients.

In addition to his long and distinguished dairy career, Lee has had a very active relationship with American Dairy Products Institute. He attended his first American Dry Milk Institute Annual Meeting in 1973. His record of service to ADPI to includes active roles on the ADPI's Technical Committee, Board of Directors and Executive Committee. Lee served as for eight years as an officer of ADPI, culminating in his term as president during the years of 1999–2001.

Lee has also served on numerous dairy industry scientific and research advisory committees. He is currently serving on the 3-A Sanitary Standards Board of Directors, where his extensive technical knowledge and practical experience plays a key role in developing dairy and food equipments standards and sanitation codes which protect consumable dairy products from contamination, safeguard consumers and contribute to the strong safety record of the dairy industry.

DPC® Elects New Board and Honorary Life Members at the 2009 Annual Meeting

The Dairy Practices Council® held its annual meeting in Latham, NY, November 4–6, 2009.

There were members from Canada and 24 states in attendance. The International Milk Haulers Association held their Board Meeting in conjunction with the DPC meeting.

Longtime member and past DPC Executive Vice President Terry Musson was honored by the Board and membership with Honorary Life Membership. Mr. Musson also received a special award for his eleven year service as DPC executive vice president.

New Board Members were elected: Michael Schutz, Purdue University was elected president, replacing outgoing president Don Breiner. Rebecca Piston, HP Hood, LLC was elected vice president. Patrick Healy, milk market administrator, was elected to the Board to replace the position vacated by Kelly Wedding. The remainder of the DPC Board are: Ellen Fitzgibbons, MA Dept. of Public Health; Chris Thompson, KY Division of Regulatory Services; Greg Leach, Losurdo Foods; Neil Bendixen, Dairy Marketing Services; Meikel Brewster, Charm Sciences, Inc.; Lloyd Kinzel, Food and Drug Administration; Chuck

Boeneke, Louisiana State University; Robert Peters, University of Maryland and, Joseph Zulovich, University of Missouri.

The president appointed one new task force director with the Executive Board consent. Dan Scruton, VT Agency of Agriculture, Food, and Markets was appointed director of the Small Ruminants Task Force VI, replacing outgoing Director, Lynne Hinckley.

The remainder of the DPC Task Force directors are: Task Force I, Robert Graves, The Pennsylvania State University; Task Force II, John Partridge, University of Michigan, Task Force III, Nancy Carey, Cornell University, Task Force IV, Philip Wolff, USDA, and Task Force V, Miles Beard, IBA Inc.

The Dairy Practices Council is a nonprofit organization of education, industry and regulatory personnel concerned with milk quality, sanitation, and regulatory uniformity.

For further information about The Dairy Practices Council visit http://www.dairypc.org.

Appointment of Michael Jackson as New President and CEO of National Grocers Association

Food Marketing Institute President and Chief Executive Officer Leslie G. Sarasin issued the following statement on the appointment of Michael Jackson as the new president and CEO of the National Grocers Association:

"On behalf of the staff and members of Food Marketing Institute, it is my pleasure to extend warm congratulations to Mike on his appointment as president and CEO of the National Grocers Association. Given his impressive industry background and expertise, he will be a tremendous asset to the association representation for the industry. I look forward to working with Mike to continue to enhance the ways our associations work together to advance the issues, interests and concerns of our great industry that serves Americans and provides for families in cities and towns across the country."

Key Technology Appoints Randy Unterseher as Senior Director of Marketing

In this new position, Mr. Unterseher is responsible for leading worldwide marketing activities for Key's automated inspection and sorting systems, specialized conveying, and processing equipment.

"Randy is ideally suited to take the lead in marketing. He has extensive experience with our equipment and our customers as well as with sales and marketing. He fully understands our value proposition and how to effectively communicate that to our industry," noted David Camp, president and CEO of Key Technology.

Mr. Unterseher has been with Key Technology for 19 years. For the past 5 years, he has been director of sales operations. Previously, he was sales engineering manager and prior to that, product marketing manager for Specialized Conveying Systems. He holds a bachelor's degree in business administration from Walla Walla University and earned his MBA in e-business from the University of Phoenix.

"I'm excited to take on this important position at Key as part of the executive management team. The company already has a terrific reputation as an innovative industry leader with top-quality equipment and services. My goals are to continue building this premium brand and grow market awareness in developing regions that require processing solutions and automation," noted Mr. Unterseher. "Agribusiness, food safety, and food quality impact everyone's daily lives, which is an important reason for taking on this new strategic role at Key."

Henk Hoogendoorn Appointed National Sales Manager

Bosch Packaging Technology, Inc., one of the leading suppliers of packaging and processing technology, in the food, pharmaceutical, and confectionery industries, has appointed Henk Hoogendoorn to national sales manager, Vertical Form Fill Seal. In this role he is responsible for sales strategy development and implementation for vertical packaging machinery with Bosch sales representatives and agents throughout North America.

Mr. Hoogendoorn brings over 20 years of international sales management experience in packaging and automation technology. His career has included positions in sales, marketing, new business development and product portfolio management in the packaging, plastics and processing industries. "This position was created to increase our sales focus and coordination for the important VFFS market in North America," said Mike Wilcox, director of sales & marketing, Bosch Packaging Technology, Inc. "Hoogendoorn's strong background and experience will provide direction in meeting customer expectations and input for technical directions for Bosch VFFS products."

METTLER TOLEDO

Automated Density Measurements for Accurate Results

METTLER TOLEDO is pleased to introduce the PSU-DE Density Meter Sampling Unit. This compact automation unit allows the measuring cell to be thoroughly cleaned and dried, and ensures that possible measurement errors are automatically detected.

Most digital density meters only give accurate measuring results if the measuring cell is free of air bubbles, contamination or residual cleaning liquids. Often, the accuracy of measurements depends on the skill and care of the user. Potential sources of error are not always obvious, even for experienced users. The PSU-DE helps to overcome such problems: METTLER TOLEDO DE density meters equipped with this automation unit can automatically detect measurement errors caused by the above factors and warn the operator accordingly.

The PSU-DE Sampling Unit can be installed in all METTLER TOLEDO DE series density meters. The key advantage of the PSU-DE is its separate pumping system: a peristaltic pump is dedicated to sampling and cleaning, and a diaphragm pump is used for drying. Samples for measurement can be taken directly from different types of containers such as beakers, sampling bottles or vials. "The new PSU-DE autosampling unit enhances the METTLER TOLEDO density line even further," states Market Manager, Wallace Harvey. "The separate sampling and drying pumps make the PSU-DE an extremely robust unit and the measurements extremely reliable."

METTLER TOLEDO
614.438.4936
Columbus, OH
www.mt.com

The Next Generation in Syringe Pumps from KD Scientific

The Legato 200 Series offers unparalleled ease of use through the high resolution color touch screen user interface. The full touch screen interface enables the user to quickly create configurations and recall them for easy use. The intuitive run screen combines multiple parameters simultaneously with internationally recognized graphic Icons which allow the Legato 200 series to provide a new level of intuitive syringe pump operation.

Three basic models ensure the right pump for your application: Infuse only, Infuse and Withdraw and Push Pull.

Each of these pumps is available in a programmable version for maximum flexibility and capability.

Each of the basic models work with one syringe or two and can be reconfigured in the field to use with multiple syringes.

The Legato Series optimizes laboratory bench space. For limited laboratory space the Legato 200 Series can be placed on its side to reduce the footprint by 4 Times. The footprint is only 3.5 in x 9.75 in. The display also tilts with the change to allow the user to operate the pump vertically.

KD Scientific designs, manufactures and sells a range of quality fluidics equipment used by research laboratory markets worldwide.

KD Scientific syringe pumps are an economical solution to delivering precise and smooth flow in research, pilot plants and production applications. They are recognized worldwide for quality, accuracy and reliability. A broad line of syringe pumps are offered: from a simple one syringe infuse only, to a programmable multi-syringe infuse/withdrawal pump.

KD Scientific
508.429.6809
Holliston, MA
www.kdscientific.com

Eriez® 5-Star Service Center Maintains Magnetic Strength of Wet Drum Separators with Repairs and Upgrades

Restoring older Wet Drum Separators to their previous magnetic strength can now be handled through Eriez' 5-Star Service Center. The Center is located in Lake City, PA and is staffed with trained service technicians to expertly handle even the toughest service projects.

There are two distinct applications for Wet Drum Magnetic Separators. One application is the recovery of magnetite or ferro-

Be sure to mention, "I read about it in *Food Protection Trends*"!

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

silicon in a heavy media process. The other is the concentration and recovery of magnetite from iron ore. Over time, Wet Drum Separators used in harsh industrial environments lose their magnetic efficiency, but it can be restored with proper maintenance.

To keep the magnetic power at an optimum level, the Eriez 5-Star Service Center now offers a comprehensive maintenance program for Wet Drum Separators. Portions of the maintenance program include:

- Perform a visual inspection of shell, hubs, bearings and shaft end
- Remove hubs to inspect the magnetic element for damage
- Upgrade magnetic element and replace shell, if necessary
- Test the wet drum separator and ship back to customer

"Our team is ready to do whatever it takes to address customers' issues and limit costly downtime of their Wet Drums," said Jim Lasko, Eriez 5-Star service center manager. "We utilize original OEM parts, remanufacture equipment to original specifications and offer 'as new' warranties."

Eriez also has service technicians available for in-house repairs and routine maintenance checks. "We understand that sending the equipment to our 5-Star Service Center is not always a viable option, so Eriez will come to you, even on short notice," said Dave Hansen, Eriez customer service manager.

Besides Wet Drum Separators, the 5-Star Service Center upgrades and maintains other Eriez equipment, including Eddy Currents, Suspended Electromagnets, Scrap Drums, Vibratory Feeders, Lift Magnets and Metal Detectors.

Eriez
888.300.ERIEZ (3743)
Erie, PA
www.eriez.com

Assurance GDS™ 20 Hour Method for *Salmonella* Validated as an AOAC Official Method of Analysis for *Salmonella*

BioControl Systems, Inc., has announced that after collaborative study by 15 different independent industry laboratories Assurance GDS™ for *Salmonella* was approved by AOAC International as an Official Method of Analysis (2009.03) for the detection of *Salmonella* in meats, poultry, poultry rinse, seafood, dairy products, fruits and vegetables, egg, pasta, peanut butter and environmental surfaces.

Assurance GDS for *Salmonella* is a DNA-based detection method incorporating multiple layers of specificity including Immunomagnetic separation (IMS), highly specific primers, and a patented probe system to provide improved accuracy. Results are available in as few as 20 hours. "With increasing emphasis being placed on process control as a means of improving operational efficiency and food safety, fast and accurate *Salmonella* detection methods validated for both food and environmental samples can offer food processors a significant advantage," states Anita Kressner, vice president of global sales and marketing. In addition to increased speed and accuracy, Assurance GDS for *Salmonella* is easy to use, requiring only a single enrichment media for most foods. The faster results and streamlined enrichment requirements make Assurance GDS for *Salmonella* an efficient and cost effective method, according to Geoff Bright, group product manager.

"The 18 hour, 1-step enrichment in Buffered Peptone Water for most samples allows laboratories to start samples as late as 5 pm and still have results available by the following morning, allowing for faster release of product or implementation of corrective actions," says Mr. Bright.

Assurance GDS for *Salmonella* has also been approved by Health Canada and the Canadian Food Inspection Agency, Certified by AFNOR in accordance with the ISO 16410 standard for validation of alternative methods and certified by AOAC Research Institute as a Performance Tested Method.

In addition to *Salmonella*, the Assurance GDS platform includes assays for *E coli* O157:H7, Shiga Toxin Genes, *Listeria* spp., *Listeria monocytogenes*, and *Enterobacter sakazakii.*

BioControl has been a recognized leader in the development of innovative rapid microbiological tests for the food industry since 1985. We offer an extensive line of proprietary, rapid tests for pathogen detection, quality control, and hygiene monitoring.

BioControl Systems, Inc.
425.603.1123
Bellevue, WA
www.biocontrolsys.com

Calibration Guide Now Available from Dickson

Quality managers and others responsible for maintaining the integrity of temperature and/or humidity chart recorders or data loggers can now download a comprehensive guide to all aspects of instrument calibration at http://

Be sure to mention, "I read about it in *Food Protection Trends*"!

www.dicksondata.com/calibration/calibration_order.php.

Chapters of this online guide include:

- Explanations of why calibrations are required
- Review of calibration methods to choose from
- A step-by-step guide to developing calibration schedules
- "Before" Data considerations
- Best fit applications for 1-point, 3-point and custom point calibrations
- Glossary of calibration terms
- Optional Calibration Club registration

Chris Sorensen, Dickson vice president sales and marketing explains, "All instruments lose accuracy over time due to normal usage and the environmental conditions to which they are exposed. Periodic NIST certified calibrations maintain the accuracy of your instrument throughout its life. This guide is designed to make it very easy for users of chart recorders and data loggers to navigate the many choices in calibration approaches to find the one that is best-matched to their application requirements."

Dickson Company
800.757.3747
Addison, IL
www.dicksondata.com

PetroOXY Oxidation Stability Tester for Shelf-life Testing of Foods, Flavors and Fragrances

The PetroOXY Rapid Oxidation Stability tester from Petrotest Instruments provides manufacturers and others with a powerful new tool for monitoring and control of oxidation stability (aging) of oils, fats, greases and other products, such as proprietary antioxidant and shelf-life additives used by food, fragrance and cosmetic industry.

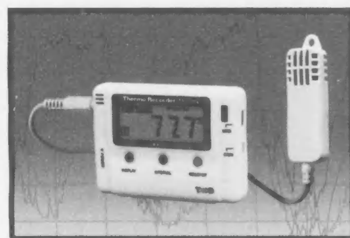
Among the key features of the new tester are substantially faster test times, compared with traditional testing methods as well as clear and easily understood test results. The tester offers excellent repeatability and reproducibility of results along with simple handling procedures, small sample sizes, improved user safety, automatic operation, and simple cleaning procedures. The user-friendly PetroOXY is ideal for fast and simple stability spot checks as well as routine monitoring of products.

The compact PetroOXY features a small hermetically sealed test chamber in which a 5 ml sample is combined with oxygen at a pressure of 700 kPa (approx. 7 bar) and heated to a temperature of 140°C. These test conditions initiate a very fast aging process, which is measured by a pressure drop within the chamber. The time needed to achieve a fixed pressure drop is directly related to the oxidation stability of the sample. Test times can be reduced by elevating the test temperature. Other parameters of pressure and temperature can be set individually.

AMETEK Petrolab Company
918.459.7170
Broken Arrow, OK
www.petrolab.com

New Wide Range Temperature and Humidity Logger from TandD Corporation

TandD Corporation has introduced its new TR-77Ui Data Logger.



TandD Corporation

This versatile unit features a wide range from 0 to 99% relative humidity along with an expanded temperature range from -30° to +80°C.

This compact, lightweight unit is approximately 2" × 3" and operates on one AA battery.

The relative humidity accuracy is ±2.5%, uncalibrated and provides a fast response of 20s Humidity Time Constant.

The sturdy Probe has a 1 meter cable which can be increased up to 10 meters from the Logger with optional extensions.

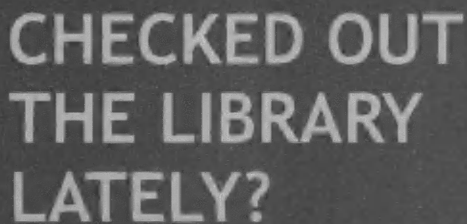
The TR-77Ui has a large data capacity which can store up to 8,000 readings times 2 channels for a total of 16,000 readings in one-time or endless recording mode.

Simply by connecting to a computer via a USB port, the recorded data can be quickly downloaded with the easy-to-use software. The TR-77Ui also features an IrDA Port for Wireless Downloading of data.

A unique feature is the built-in adjustment function which allows the user to enter calibration factors directly into the Logger eliminating the need to adjust readings after they are downloaded.

TandD Corporation
518.669.9227
Saratoga Springs, NY
www.tandd.com

Be sure to mention, "I read about it in *Food Protection Trends*"!



THE IAFP
AUDIOVISUAL
LIBRARY,
THAT IS.

A free benefit to Association Members, the library offers 136 educational DVD and video titles on dairy, environmental, and food safety training. Plan your next course, or just sit back and learn.

Go to www.foodprotection.org
for a complete library listing.

IAFP 2010 Activities

SATURDAY, JULY 31

COMMITTEE MEETINGS
3:00 p.m. - 4:30 p.m.

WELCOME RECEPTION
5:00 p.m. - 6:30 p.m.
Sponsored by Eurofins Scientific

SUNDAY, AUGUST 1

COMMITTEE MEETINGS
7:00 a.m. - 5:30 p.m.

STUDENT LUNCHEON (ticket required)
12:00 p.m. - 1:30 p.m.

EDITORIAL BOARD RECEPTION (by invitation)
4:30 p.m. - 5:30 p.m.

OPENING SESSION AND IVAN PARKIN LECTURE
6:00 p.m. - 7:30 p.m.

CHEESE AND WINE RECEPTION
7:30 p.m. - 9:30 p.m.
Sponsored by Kraft Foods

IAFP JOB FAIR
Sunday, August 1 through Wednesday, August 4

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

MONDAY, AUGUST 2

COMMITTEE AND PDG CHAIRPERSON BREAKFAST (by invitation)
7:00 a.m. - 9:00 a.m.

EXHIBIT HALL LUNCH
12:00 p.m. - 1:00 p.m.
Sponsored by Johnson Diversey

EXHIBIT HALL RECEPTION
5:00 p.m. - 6:00 p.m.
Sponsored by DuPont Qualicon

TUESDAY, AUGUST 3

EXHIBIT HALL LUNCH
12:00 p.m. - 1:00 p.m.
Sponsored by DNV

BUSINESS MEETING
12:15 p.m. - 1:00 p.m.

EXHIBIT HALL RECEPTION
5:00 p.m. - 6:00 p.m.
Sponsored by 3M Food Safety

PRESIDENT'S RECEPTION (by invitation)
6:00 p.m. - 7:00 p.m.

WEDNESDAY, AUGUST 4

JOHN H. SILLIKER LECTURE
4:00 p.m. - 4:45 p.m.

AWARDS RECEPTION AND BANQUET
6:00 p.m. - 9:30 p.m.

TOURS

IAFP has partnered with Southern California Gray Line to offer daily sightseeing tours to all major Southern California attractions. Specialty tours include LA/Hollywood and San Diego/Tijuana city tours, OC beaches, shopping excursions, movie stars' homes and Catalina Island. Book your tours now at www.graylineanaheim.com with your special IAFP discount coupon available under 'Special Promotions.' Or visit the IAFP Registration Desk once you arrive in Anaheim to arrange your tours.

IAFP 2010 General Information

REGISTER ONLINE

Coming soon, register online at www.foodprotection.org.

REGISTRATION

Register to attend the world's leading food safety conference. Full Registration includes:

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

GUEST REGISTRATION

Guest registration includes:

- Welcome Reception
- Ivan Parkin Lecture
- Cheese and Wine Reception
- Exhibit Hall Admittance
- Exhibit Hall Lunch (Mon. & Tues.)
- Exhibit Hall Reception (Mon. & Tues.)

Please note that Guest registration applies to those individuals who are not employed in the food safety arena.

PRESENTATION HOURS

Sunday, Aug. 1

Opening Session	6:00 p.m. – 7:30 p.m.

Monday, Aug. 2

Symposia & Technical Sessions	8:30 a.m. – 5:00 p.m.

Tuesday, Aug. 3

Symposia & Technical Sessions	8:30 a.m. – 5:00 p.m.

Wednesday, Aug. 4

Symposia & Technical Sessions	8:30 a.m. – 3:30 p.m.
Closing Session	4:00 p.m. – 4:45 p.m.

FOUNDATION GOLF TOURNAMENT

Saturday, July 31

Golf Tournament

To be determined

EVENING EVENTS

Sunday, Aug. 1

Opening Session	6:00 p.m. – 7:30 p.m.
Cheese and Wine Reception *Sponsored by Kraft Foods*	7:30 p.m. – 9:30 p.m.

Monday, Aug. 2

Exhibit Hall Reception *Sponsored by DuPont Qualicon*	5:00 p.m. – 6:00 p.m.

Tuesday, Aug. 3

Exhibit Hall Reception *Sponsored by 3M Food Safety*	5:00 p.m. – 6:00 p.m.

Wednesday, Aug. 4

Awards Banquet Reception	6:00 p.m. – 7:00 p.m.
Awards Banquet	7:00 p.m.– 9:30 p.m.

SPECIAL EVENTS

NFPA Alumni and Friends Reception

To be determined

EXHIBIT HOURS

Sunday, Aug. 1	7:30 p.m. – 9:30 p.m.
Monday, Aug. 2	10:00 a.m. – 6:00 p.m.
Tuesday, Aug. 3	10:00 a.m. – 6:00 p.m.

HOTEL INFORMATION

Hotel reservations can be made online at www.foodprotection.org. The IAFP Annual Meeting Sessions, Exhibits and Events will take place at the Anaheim Convention Center.

Hilton Anaheim $149.00 per night

CANCELLATION POLICY

Registration fees, less a $50 administration fee and any applicable bank charges, will be refunded for written cancellations received by July 16, 2010. No refunds will be made after July 16, 2010 however, the registration may be transferred to a colleague with written notification. Refunds will be processed after August 9, 2010.

Event and extra tickets purchased are nonrefundable.

International Association for Food Protection.

6200 Aurora Avenue, Suite 200W
Des Moines, IA 50322-2864, USA
Phone: +1 800.369.6337 • +1 515.276.3344
Fax: +1 515.276.8655
E-mail: info@foodprotection.org
Web site: www.foodprotection.org

IAFP 2010 Registration Form

3 Ways to Register

ONLINE	FAX	MAIL
www.foodprotection.org	+1 515.276.8655	6200 Aurora Ave., Suite 200W Des Moines, IA 50322-2864, USA

Member Number: ____________

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

Employer Title

Mailing Address (Please specify: ❐ Home ❐ Work)

City State/Province Country Postal/Zip Code

Telephone Fax E-mail

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

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

PAYMENT MUST BE RECEIVED BY JULY 6, 2010 TO AVOID LATE REGISTRATION FEES

REGISTRATION FEES	MEMBERS	NONMEMBERS	TOTAL
Registration	$ 445 ($ 495 late)	$ 665 ($ 715 late)	______
Association Student Member	$ 80 ($ 90 late)	Not Available	______
Retired Association Member	$ 80 ($ 90 late)	Not Available	______
One Day Registration* ❐ Mon. ❐ Tues. ❐ Wed.	$ 240 ($ 265 late)	$ 370 ($ 395 late)	______
Guest* (Name): ______	$ 60 ($ 60 late)	$ 60 ($ 60 late)	______
Children 15 & Over* (Names): ______	$ 25 ($ 25 late)	$ 25 ($ 25 late)	______
Children 14 & Under* (Names): ______	FREE	FREE	______
*Awards Banquet not included			
Additional Awards Banquet Ticket – Wednesday, 8/4	$ 55 ($ 65 late)	$ 55 ($ 65 late)	______
Student Luncheon – Sunday, 8/1	$ 10 ($ 15 late)		______
FOUNDATION GOLF TOURNAMENT			
To be determined – Saturday, 7/31			
SPECIAL EVENTS			
NFPA Alumni and Friends Reception			
ABSTRACTS			
Annual Meeting Abstracts (citable publication to be distributed in Anaheim)	$ 30	$ 30	______
PRE-MEETING WORKSHOPS			
Workshop 1			
Workshop 2			
Workshop 3			

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

❐ **Check Enclosed**

TOTAL AMOUNT ENCLOSED $ ____________
US FUNDS on US BANK

Refunds subject to cancellation policy

CREDIT CARD # ______________________

CARD ID #* ____________ EXP. DATE ____________

SIGNATURE ______________________

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

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

COMING EVENTS

MARCH

- **1–3, AFFI Frozen Food Convention,** Manchester Grand Hyatt, San Diego, CA. For more information, go to http://www.affi.com
- **2–3, Better Process Cheese School,** Madison, WI. For more information, go to http://fri.wisc.edu.
- **5, Global Food Safety Standards – Overview and Comparison of HACCP-based Standards Course,** Calgary, Alberta, Canada. For more information, call 800.374.3818 or go to http://training.us.saiglobal.com/course/promotion.aspx?id=a0c2000000074FdAAI.
- **8–9, 2010 Lean and Six Sigma Conference,** Pointe Hilton Tapatio Cliffs Hotel, Phoenix, AZ. For more information, call 800.248.1946 or go to www.asq.org.
- **8–9, Implementing the BRC Food Standard,** Greensboro, NC. For more information, go to www.ecosure.com/EcoSure%20Supply%20Chain.asp.
- **14–17, FMI Asset Protection Conference,** Ritz-Carlton Hotel, Dallas, TX. For more information, call Aileen Dullaghan Munster at 202.220.0704 or go to www.fmi.org.
- **17–19, Idaho Environmental Health Association Annual Education Conference,** Boise State University, Boise, ID. For more information, go to www.ieha.wildapricot.org.
- **23–26, 2010 Food Safety Education Conference, Advancements in Food Safety Education: *Trends, Tools and Technologies*,** Hyatt Regency Atlanta, Atlanta, GA. For more information, go to www.fsis.usda.gov/Atlanta2010.
- **24, Metropolitan Association for Food Protection Evening Seminar,** Newark Airport Holiday Inn, Newark, NJ. For more information, call 800.248.1946 or go to www.asq.org.
- **24–26, Michigan Environmental Health Association Annual Education Conference,** Doubletree Hotel, Bay City-Riverfront, Bay City, MI. For more information, go to www.meha.net.
- **29–30, BRC Internal Auditor Training Course,** Toronto, Ontario, Canada. For more information, call 800.374.3818 or go to http://training.us.saiglobal.com/course/promotion.aspx?id=a0c2000000074Fh.
- **31–April 2, Missouri Milk, Food and Environmental Health Association Annual Educational Conference,** Stoney Creek Inn, Columbia, MO. For more information, call Steve Sikes at 636.797.3737 or E-mail: sikess@lpha.mopublic.org.

APRIL

- **7–8, Upper Midwest Dairy Industry Assocation with Iowa Association for Food Protection Spring Meetings,** April 7 at Holiday Inn South, in Rochester, MN; April 8 at Holiday Inn in Alexandria, MN. For more information, contact Dale Heintz at 507.951.0756 or E-mail daheintz@landolakes.com.
- **9–14, Conference for Food Protection 2010 Biennial Meeting,** Providence, RI. For more information, call 916.645.2439 or go to www.foodprotect.org.
- **12–13, Advanced HACCP Training,** Eagan MN. For more information,go to www.ecosure.com/EcoSure%20Supply%20Chain.asp.
- **12–14, 2010 Food Safety Summit,** Washington, D.C. For more information, go to www.foodsafetysummit.com.
- **14–15, Implementing SQF 2000 Systems,** Eagan MN. For more information, go to www.ecosure.com/EcoSure%20Supply%20Chain.asp.
- **18–21, TAPPI 2010 PLACE Conference,** Albuquerque, New Mexico. For more information, call 800.332.8686 or go to www.tappi.org.
- **22, Ontario Food Protection Association Spring Meeting,** Mississauga Convention Center, Mississauga, Ontario. For more information, E-mail: info@ofpa.on.ca or go to www.ofpa.on.ca.
- **25–27, ADPI/ABI Annual Conference,** Hyatt Regency, Chicago, IL. For more information, go to www.adpi.org.

MAY

- **5, Carolinas Association for Food Protection Annual Meeting,** North Carolina Research Campus, Kannapolis, NC. For more information, contact Steve Tracey at smtracey@foodlion.com.
- **5, Florida Association for Food Protection Annual Educational Conference,** International Plaza Resort and Spa, Orlando, FL. For more information, contact Zeb Blanton at 407.618.4893 or go to www.fafp.net.
- **5–8, ISOPOL XVII International Symposium on Problems of Listeriosis,** Alfandega Congress Centre, Porto, Portugal. For more information, go to www.esb.ucp.pt/isopol2010.
- **6, Metropolitan Association for Food Protection Spring Seminar,** Rutgers University, Cook College Campus, New Brunswick, NJ. For more information, contact Carol Schwar at 908.475.7960; E-mail: cschwar@co.warren.nj.us.
- **6–7, Associated Illinois Milk, Food and Environmental Sanitarians Spring Conference,** Eastland Suites, Bloomington, Il. For more information, contact Steve DiVencenzo at Steve.DiVencenzo@illinois.gov.
- **6–8, High-throughput Methods for Detecting Foodborne Pathogens Workshop,** York College, Jamaica, NY. For more information, go to www.york.cuny.edu/conted/fdaworkshops/2008-fda-workshop/preliminary-program.

COMING EVENTS

- **11–13, FMI 2010,** Mandalay Bay Convention Center, Las Vegas, NV. For more information, go to www.fmi.org/events.
- **17–21, 3-A 2010 Education Program and Annual Meeting,** Wyndham Milwaukee Airport Hotel and Convention Center, Milwaukee, WI. For more information, go to www.3-a.org.
- **23–27, 110th General Meeting of the American Society for Microbiology,** San Diego Convention Center, San Diego, CA. For more information, go to www.gm.asm.org.

JUNE

- **6–9, NEHA Annual Educational Conference,** Albuquerque, New Mexico. For more information, go to http://www.neha.org.
- **8–10, 2nd International MoniQA Conference,** Krakow, Poland. For more information, go to http://krakow.moniqa.org.
- **9–11, IAFP's Sixth European Symposium on Food Safety,** University College Dublin, Dublin, Ireland. For more information, go to www.foodprotection.org.
- **18–20, Food Processing Suppliers Association Annual Conference,** Chicago, IL. For more information, call 703.761.2600 or go to www.fpsa.org.
- **19–23, AFDO 114th Annual Educational Conference,** Sheraton Waterside Hotel, Norfolk, VA. For more information, contact Leigh Ann Stambaugh at 717.757.2888 or go to www.afdo.org.

JULY

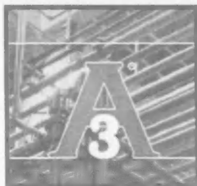
- **14–16, NACCHO Annual Meeting,** Marriott Memphis Downtown, Memphis Cook Convention Center, Memphis, TN. For more information, go to www.naccho.org.
- **18–20, FPSA Process Expo – 2010,** McCormick Place, Chicago, IL. For more information, call 703.761.2600 or go www.fpsa.org.

IAFP UPCOMING MEETINGS

AUGUST 1-4, 2010
Anaheim, California

JULY 31-AUGUST 1, 2011
Milwaukee, Wisconsin

JULY 22-25, 2012
Providence, Rhode Island



Search, Order, Download 3-A Sanitary Standards

Get the latest 3-A Sanitary Standards and 3-A Accepted Practices and see how the 3-A Symbol program benefits equipment manufacturers, food and dairy processors and product sanitarians.

Order online at www.3-a.org

ADVERTISING INDEX

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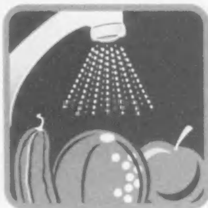
Quality Management, Inc 61

Clean.

As experts continue to recommend we add more fruits and vegetables to a healthy diet, it becomes increasingly important that consumers know how to handle produce safely to reduce the risk of illness.

be food safe.



clean

rinse fruits & vegetables

- **WASH** hands with warm water and soap for at least 20 seconds before and after handling produce.
- **RINSE** fruits and vegetables under running tap water.
- **RUB** firm-skin produce (or scrub with clean brush) under running tap water.
- **BLOT** dry with a clean cloth towel or paper towel.

Brought to you by (logo or store name)

Partnership for Food Safety Education

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