VOL. 26, NO. 10
ISSN: 1541-9576
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FOOD PROTECTION TRENDS

SCIENCE AND NEWS FROM THE INTERNATIONAL ASSOCIATION FOR FOOD PROTECTION

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

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

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

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

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

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

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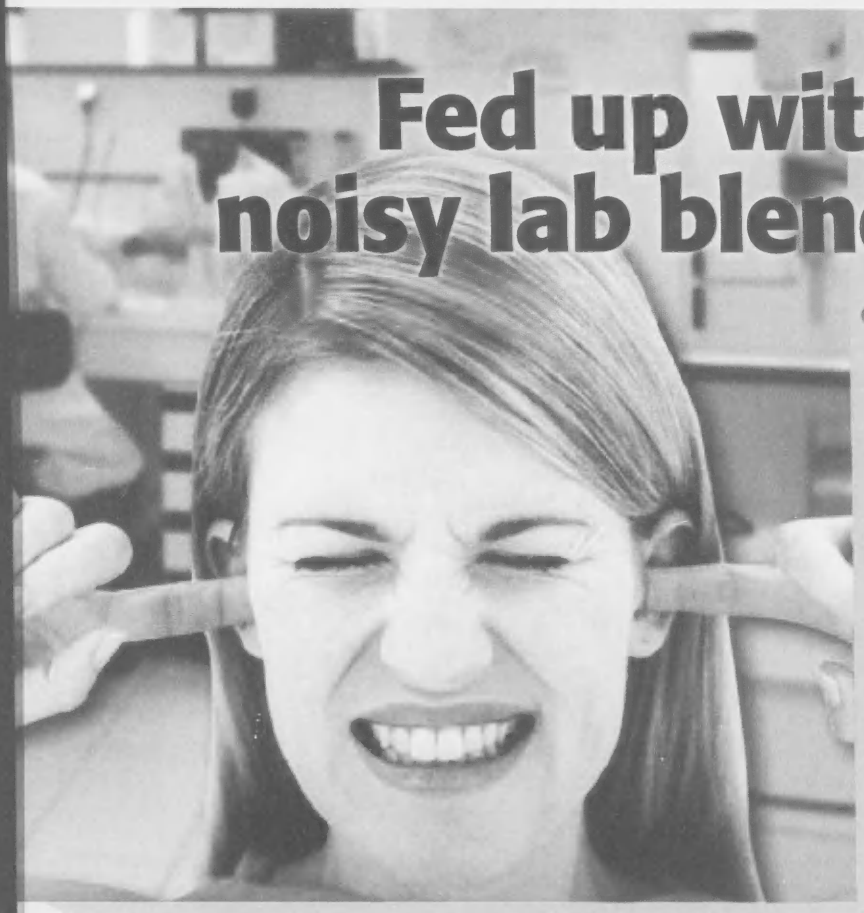
Subscription Rates: ***Food Protection Trends*** is available by subscription for $234.00 US, $249.00 Canada/Mexico, and $264.00 International. Single issues are available for $26.00 US and $35.00 all other countries. All rates include shipping and handling. No cancellations accepted. For more information contact Julie A. Cattanach, Membership Services, International Association for Food Protection.

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

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

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



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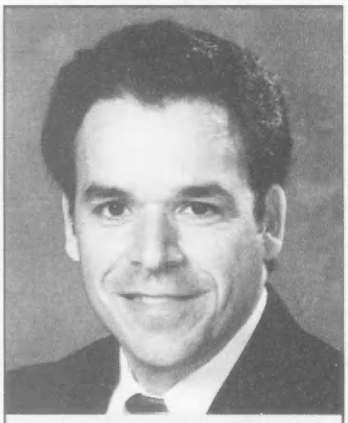
"POINT OF VIEW"

If someone were to ask you to state the one word that best describes today's marketplace, what would your answer be? I suspect that many of you might think of the word *choice*. There are more products and services to choose from. There are more options or features to consider. There are more stores at which to shop. There is more competition, and so on and so on.

Market research in many lines of business has repeatedly shown that, among other things, what consumers really want is choice. Imagine for a moment going into your favorite coffee shop and only being able to order a cup of black coffee – nothing else. You couldn't order your favorite cappuccino, a latte if you were in the mood for one, or an espresso, because they weren't offered on the menu. I doubt that this coffee shop would stay in business very long. Or imagine going into your favorite clothing store and only being able to buy shorts. If you wanted to buy slacks, you couldn't because you were required to first buy shorts. Sounds ridiculous, right?

Now, you might be asking yourself, what in the world does this have to do with the affairs of IAFP? The answer – a lot.

Beginning in January 2007, IAFP is introducing a new restructuring of our annual membership dues and membership categories which will offer new and existing members more *choice*. This new approach, which will offer more flexibility, was agreed to and approved by the Executive Board this past year.



By FRANK YIANNAS
PRESIDENT

"We are interested in offering our members more choice, meeting our members' needs, and making IAFP as inclusive as possible to food safety professionals all over the world"

Here is how the new dues restructure will work. Instead of starting off with a base membership fee that includes a printed version of *Food Protection Trends* and allows you to build on that by adding the *Journal of Food Protection* in print or online, we will offer a wider variety of potential membership options and combinations. You will be able to choose any single publication in your preferred format (print or online) and not be required to subscribe to any particular one. In addition, we are introducing a base membership category that will include a new electronic monthly publication called the *IAFP Report*.

Why the move towards more choice and flexibility? Although there are several reasons, let me summarize two good points below.

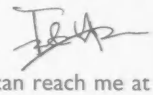
First, by offering greater choice and flexibility in how to become a member, we believe we increase commitment, ownership, and involvement by current and new members. Personal choice is a fundamental desire of the free human spirit and it implies personal control. When a person feels empowered, they are more likely to be fulfilled and engaged. Top-down executive board mandates with limited options on how to become a member are outdated in this modern era of choice. Companies and organizations all over the world know this principle and that is why you see so much choice offered in today's marketplace.

Second, by offering greater choice and flexibility in how to become a member, we enhance our ability to attract additional food safety professionals to IAFP that are not currently members. There are numerous food safety professionals who are members of our many affiliates, but are not members of IAFP. There are also many food safety professionals in other countries who have yet to join. The ability to offer more flexibility and a new base membership category

increases our ability to attract them to IAFP.

Our goal is simple. We are not interested in numbers or simply increasing our membership. However, we are interested in offering our members more choice, meeting our members' needs, and making IAFP as inclusive as possible to food safety professionals all over the world. The more food safety professionals we get from all walks of life to collaborate and work together, the more successful we will be at reducing the global burden of foodborne disease.

By working together, we can make a difference, advance food safety worldwide, and improve the quality of life around the world. Until next month, thanks for reading.



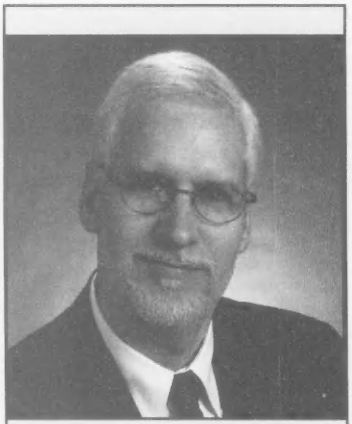
As usual, you can reach me at frank.yiannas@disney.com with questions, comments, or suggestions.

"COMMENTARY"
FROM THE EXECUTIVE DIRECTOR

This month I want to give an update on our planning for the Second European Symposium on Food Safety. The symposium will take place in Barcelona, Spain on November 30 and December 1 and covers the topic of "Innovations in Food Safety Management." It is a comprehensive, one and a half day symposium covering the subject matter.

Speakers from Europe and North America will pry into topic areas of: "Advancement in Risk Analysis and Food Safety Management," "Innovation in Food Products," "Innovation in Microbiological Methods," and "Emerging and Hot Topics in Food Safety" during the symposium. In addition to the presentations, we expect a number of scientific posters to be presented along with a small exhibition from industry suppliers. All in all, this will be a well-rounded program on "Innovations in Food Safety Management."

We invite you to attend this symposium. Everyone is welcome, especially our Members from Europe. The IAFP symposium series is designed to provide timely information for food safety professionals along with establishing a place for IAFP Members to come together outside of North America. These opportunities allow our Members to interact with colleagues who may not already be IAFP Members; to provide them with information about the Association, our publications, and our Annual Meeting; and to encourage them to join the Association and become actively involved.



By DAVID W. THARP, CAE
EXECUTIVE DIRECTOR

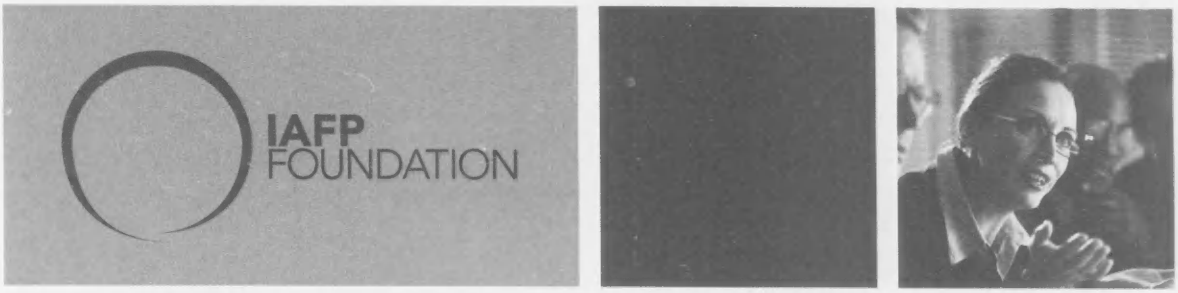
"This is an exciting time in IAFP's history as we become more actively involved outside of North America"

From the interest shown in our First European Symposium on Food Safety held in October of 2005 in Prague, many attendees expressed the desire to hold this event again in the near term. The Executive Board responded by approving the second symposium for Barcelona! We have seen great interest by supporting companies and already have commitments from bioMérieux, DuPont Qualicon, Invitrogen and Lab Ferrer to sponsor and/or exhibit. There are other companies who are considering adding their support. With this support, it is easy to see why IAFP is considering a continued presence in Europe!

We also want to recognize our partners who helped to develop the program. This year, we had assistance from both the World Health Organization and the International Life Sciences Institute–Europe. We appreciate the input and being able to collaborate with representatives from both organizations in preparation for this symposium.

Where does this lead us for the future? Will IAFP continue to hold a European Symposium? Will IAFP begin symposia in other regions of the world? These are questions that the Executive Board will address during its November meeting. This meeting will take place just prior to the Barcelona meeting, but the Board should have preliminary information about the Second European Symposium and be able to address these questions.

This is an exciting time in IAFP's history as we become more actively involved outside of North America. We are prepared to move cautiously forward on a planned course – one that will preserve our Members' investment in IAFP. We look to the future and sharing information around the globe on protecting the world's food supply!



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

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

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

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

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ARTICLES

Food Protection Trends, Vol. 26, No. 10, Pages 714–724

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

International Association for Food Protection

Storage Temperatures Necessary to Maintain Cheese Safety

JAY RUSSELL BISHOP and MARIANNE SMUKOWSKI*
Wisconsin Center for Dairy Research, University of Wisconsin
1605 Linden Drive, Madison, WI 53706-1565, USA

SUMMARY

Available information on bacterial pathogen growth, stasis, and death in cheeses was reviewed and evaluated to determine storage temperatures necessary to maintain product safety. In view of the variety and large volume of cheeses consumed throughout the world, the incidence of foodborne outbreaks associated with cheeses is extremely low. Research revealed that the inherent characteristics of most cheeses create a hostile environment for bacterial pathogens, especially at elevated ripening and storage temperatures. Therefore, it is recommended that the following cheeses, manufactured in the United States with pasteurized or heat treated (≥ 63°C for ≥16 seconds) milk, should be exempt from refrigeration requirements during ripening, storage, shipping, and display: Asiago (medium and old), Cheddar, Colby, Feta, Monterey Jack, Muenster, Parmesan, Pasteurized process, Provolone, Romano, and Swiss/Emmentaler. It must be stressed that the manufacture of these cheeses must be done under the proper conditions of Good Hygiene Practices, Good Manufacturing Practices, and HACCP principles, and according to CFR requirements. In addition, the natural cheeses must include active cultures, and the storage and display temperatures must not exceed 30°C.

INTRODUCTION

Temperature-dependent storage of most foods has three major roles – to allow for curing/ripening of foods that contain added active starter cultures and enzymes, to prevent quality defects, and to control pathogen growth. In making decisions on whether a food requires time/temperature control for safety, the properties of the food itself must be considered *(3)*. The role of temperature-dependent aging and storage is similar for cheese and for other foods, but the targets differ significantly because of unique inherent characteristics of the finished food product.

Transformation of chalky, acid-tasting curd into ductile, full-flavored cheese is accomplished during ripening through the action of milk enzymes, rennet, and various organisms in the cheese, including those in the starter culture. The biochemical changes that occur during cheese ripening are complex and involve fermentation of the carbohydrate; hydrolysis of fats and proteins with subsequent decarboxylation, deamination, and/or hydrogenation; and production of carbonyls, nitrogenous compounds, fatty acids, and sulfur compounds, all of which contribute to the overall body, texture, and flavor of the final product *(63)*. These inherent characteristics also create a hostile environment for pathogens *(25)*. This re-

A peer-reviewed article

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view of scientific information on pathogen death and growth in cheeses at various storage temperatures will determine parameters necessary to ensure safety of cheeses in the marketplace. The United States cheese industry advocates the use of a science-based approach for assessing the risk posed by ready-to-eat foods for possible transmission of pathogens in the food supply *(24)*. Applying HACCP principles enhances the manufacture of safe cheese *(35)*.

In view of the variety and large volume of cheese consumed throughout the world, the incidence of outbreaks of food poisoning and foodborne disease associated with cheese are extremely low *(36)*. Epidemiology studies of cheese-related outbreaks in the United States, Canada, and Europe have found no outbreaks linked to hard Italian varieties, e.g., Parmesan, Romano, and Provolone. Varieties such as Cheddar and Swiss were infrequently involved *(38)*. In general, very few documented illness outbreaks have been linked to consumption of properly ripened hard cheese. Therefore, time/temperature control of hard cheese is primarily needed not for safety reasons, but to maintain the organoleptic quality of cheese *(3)*.

INHERENT CHARACTERISTICS OF SAFE DAIRY FOODS

Numerous researchers have reported bactericidal and/or bacteriostatic effects on pathogenic bacteria in foods because of reduced moisture, low water activity, low pH as the result of organic acid production, salt, heat treatment, competing flora, biochemical metabolites, bacteriocins, and ripening, either singly or as part of hurdle technology *(1, 3, 5, 6, 10, 11, 13, 15, 17, 22, 25, 26, 29, 34, 36, 37, 38, 39, 40, 43, 45, 48, 49, 51, 58, 59, 64, 65, 66, 68, 69, 70, 76)*. Refrigeration cannot be depended upon to reduce the number of pathogens, as it has been proven that *Listeria monocytogenes* (*L. monocytogenes*) and other psychrotrophic pathogens are capable of growth at these temperatures. Therefore, other factors, such as diligence with regard to good hygiene practices by the food industry, must be responsible for the lack of pathogen growth in fermented dairy foods. Results also confirm the low frequency of contamination by *L. monocytogenes* of pasteurized fluid milk products sold in the United States *(24)*.

INHERENT CHARACTERISTICS OF CHEESE

Cheeses are one of the oldest types of prepared foods. Cheesemaking provided human kind with a means of concentrating and preserving milk at a time when refrigeration was unknown and principles of food preservation were vague empirical concepts at best *(52)*.

The vast majority of cheese manufactured in the United States is made from pasteurized or heat-treated milk, which renders the product free of most pathogens *(38, 39, 40)*. The inherent characteristics of cheeses made with starter culture addition provide multiple hurdles that inhibit pathogen growth *(3, 47)*. A multiplicity of practices other than pasteurization or heat-treatment also contribute significantly to the microbiological safety of cheese *(10, 11, 38)*. Some practices, such as milk quality management, lactic culture protocols, pH control, salt addition, and controlled curing conditions, are established technologies *(38)*. Other factors may include natural inhibitory substances (e.g., lysozyme), starter metabolites and fermentation by-products (e.g., nisin), including organic acids (e.g., lactic, acetic, propionic, and formic). Water activity/moisture content imposes additional detrimental effects on foodborne pathogens during the manufacturing and ripening of cheese *(10, 11, 38, 66)*.

During the manufacture of semi-soft, hard, and very hard cheeses, the cheese is subjected to relatively long exposure to ideal incubation temperatures for bacteria. For example, Cheddar and related varieties are maintained at 31–39°C during manufacture and are formed or hooped at temperatures in the 32–37°C range. Many Cheddar-type cheeses are cured or aged at temperatures up to 15.6°C. Swiss cheese is held for a period of 4–8 weeks at a temperature of 22.2–23.3°C to develop the characteristic eyes and flavor. If storage of Cheddar and Swiss cheese at room temperature had any inherent detrimental effect on safety of these cheeses, then neither would be safe to consume *(51)*.

Specifically for *L. monocytogenes*, numerous studies suggest that the composition of cheese, ripening and storage conditions, lactic acid cultures, pH, salt, and moisture concentration influence its survival and growth *(15, 29, 39, 40, 43)*. The fate of *L. monocytogenes* and other foodborne pathogens during cheese ripening is determined by the microbiological, biochemical, and physical properties of the particular cheese *(43, 64)*. Thus, cheese is a very complex system, with the following factors acting simultaneously to determine the behavior of *L. monocytogenes* during ripening: (a) type, amount, and activity of starter culture; (b) pH as determined by concentrations of lactic, acetic, formic, and other acids; (c) presence of hydrogen peroxide, diacetyl, and various antimicrobial agents (Nisin, diplococcin, and other bacteriocins); (d) levels of nutrients, salt, moisture, and oxygen; and (e) the cheese ripening temperature *(64)*.

Fermentation is an age-old food preservation method used to inhibit the growth and survival of pathogenic bacteria *(48)*. Lactic acid bacteria commonly used to produce fermented dairy products are antagonistic to foodborne pathogens and will either inhibit their growth or inactivate them *(5, 13, 36, 59, 66, 70)*. In addition, research has shown that some starter cultures are detrimental to food spoilage organisms as well as various pathogens in these products *(1, 17, 22, 51, 58, 69, 76)*. Responsible for this action are metabolites such as lactic and other acids, diacetyl, hydrogen peroxide, and various antibiotic-like substances produced by lactic acid bacteria, which are probably synergistic *(34, 36, 37, 45, 49, 66)*.

Examples of pathogens that are susceptible to inactivation or growth inhibition by metabolites of lactic acid bacteria include *Salmonella* Typhimurium, enteropathogenic *Escherichia coli*, *Staphylococcus aureus*, and *L. monocytogenes* *(66)*. Growth of *L. monocytogenes* is always inhibited appreciably in lactic acid cultured product when compared to that of the control, no matter how high the final pH of the fermented milk. Even when the final pH dropped only to 5.99, growth of the pathogen was inhibited by 84% relative to the control *(65)*. This suggests that factors other than the hydrogen ion concentration are involved in the inhibition of *L. monocytogenes* by lactic acid bacteria *(65)*. These observations have been documented by other researchers, who noted that lactic cultures inhibited pathogens such as salmonellae and staphylococci, even when pH was controlled at 6.6 *(26)*. Modern lactic culture technology for cheese manufacturers has virtually eliminated *Staphylococcus*-caused outbreaks involving cheese *(40)*. Vigorous starter growth should protect fermented milk products against the growth of pathogens and the formation of staphylococcal enterotoxin *(36)*. Mathew and Ryser *(48)* reported increased injury of healthy *L. monocytogenes* cells during

TABLE 1. Model *L. monocytogenes* exposure of cheese (2001)

	Contamination	Retail	Home storage	Home storage
Cheese	**Frequency**	**Contamination**	**Growth rate**	**Time**
Cheddar	Low	Low	Low	Long
Colby	Low	Low	Low	Long
Feta	Moderate	Moderate	Low	Long
Monterey Jack	Low	Low	Low	Long
Mozzarella	Low	Low	Moderate	Long
Parmesan	Low	Low	Low	Long
Processed	Low	Low	Moderate	Long
Provolone	Low	Low	Low	Long
Swiss	Low	Low	Low	Long

The evaluation revealed that there was a very low risk for listeriosis by Feta cheese, heat-treated natural and process cheeses, and aged cheeses *(77)*.

Obtaining more information from research, industry, and regulatory experience, FDA/USDA *(78)* updated their *L. monocytogenes* risk analysis in 2003 with the following results (Table 2).

fermentation; at the end of the 24-h fermentation period, > 90% of the healthy *L. monocytogenes* cells were injured. Additionally, at the end of the product's shelf life, > 99% of the initial population was injured, and no significant decrease in the percentage of injury was observed. It was also discovered that the presence of *L. monocytogenes* did not adversely affect the growth of the starter culture at any inoculation level *(48)*. Gengeorgis et al. *(25)* demonstrated that non-soft cheeses made with the use of starter cultures and pH values of ≤ 5.5, as well as processed cheeses, will not support growth of *L. monocytogenes* at 4 to 30°C if the cheeses are contaminated from raw foods after the consumers open packages. Rapid acid production is the principal factor responsible for the elimination of pathogens from semi-hard cheese. The use of an effective starter culture is not only critical for preventing growth of pathogens, but also essential for the production of good quality cheese *(6)*. The preservative effect of lactic acid bacteria can be attributed partly to the activation of the lactoperoxidase system and partly to bacteriocins *(4)*.

Temperatures of curd cooking and aging/curing/ripening/storage have an impact on pathogen growth and survival in cheese. In hard cheese types with higher curd cooking temperatures, growth is slight *(68)*. There is considerable evidence showing that certain cheeses do not support growth of pathogens during the aging process and subsequent storage *(11)*. A review of the literature related to the potential for growth of pathogens in hard cheeses that are aged for at least 60 days shows that such growth is not likely to occur because of factors inherent to these cheeses *(31)*. Pathogens that survive the manufacturing process decrease faster at higher storage temperatures *(14)*. The death rate of *Salmonella* in Samsoe cheese was slower at 10–12°C than at 16–20°C *(36)*. It has been concluded that, for traditionally made hard cheeses, time/temperature control for safety is not required *(3)*.

In most cheese varieties, salt concentrations attain levels of 1.6–3.0% of the total weight of the cheese, which would not affect most of the pathogenic bacteria in cheese. But it must be realized that salt is dissolved in the aqueous phase of the cheese only, the actual site of bacterial growth. Given the respective calculated values, salt concentrations in the aqueous phase reach levels of 2.2–6.5% or higher and will, in fact, at least slow down the growth rate of most bacteria and even have a detrimental effect on the more sensitive ones *(68)*.

Where scientific data do not exist, all the inherent characteristics of cheese can serve as criteria in determining potential growth of pathogens by the use of mathematical modeling *(16, 72, 79, 83)*. When two or more of these criteria are combined, the resultant effect is an additional hurdle to the outgrowth of pathogens of concern. It is this effect that makes it possible to store certain cheeses safely beyond either one of the two Food Code criteria for date marking and refrigeration (i.e., 7 days at 5°C or 4 days at 7.2°C). This led the US Food and Drug Administration to issue, on December 15, 1999 *(11)*, a letter suggesting that regulatory agencies use their discretionary authority and defer enforcement action regarding date marking aged hard cheeses. In that letter, FDA granted a formal interpretation to the Food Code that hard and semisoft aged cheeses and pasteurized process cheese, each manufactured according to 21 CFR 133 as specifically cited above and maintained under refrigeration, are exempt from the Food Code's date marking provision related to refrigerated, ready-to-eat, potentially hazardous food. This interpretation has subsequently been incorporated into state statutes, such as Wisconsin's *(2)*. Feta cheese was later added to this exemption list by FDA (in the case of Iowa Dept. Health vs. Shullsburg Creamery).

TABLE 2. Model *L. monocytogenes* exposure of cheese (2003)

	Contamination	Retail	Home storage	Home storage
Cheese	**Frequency**	**Contamination**	**Growth rate**	**Time**
Cheddar	Low	Low	Low	Long
Colby	Low	Low	Low	Long
Feta	Moderate	Moderate	Low	Long
Monterey Jack	Low	Low	Low	Long
Mozzarella	Low	Low	Moderate	Long
Muenster	Moderate	Low	Low	Long
Parmesan	Low	Low	Low	Long

The FDA/USDA evaluation classified cheeses as follows:

Fresh soft – Queso fresco, Queso de Crema, Queso de Puna

Soft unripened (> 50% moisture) – Cottage, cream, Ricotta

Soft ripened (> 50% moisture) – Brie, Camembert, Feta, Mozzarella

Semi-soft (>39–50% moisture) – Blue, Brick, Monterey Jack, Muenster, Provolone

Hard (≤ 39% moisture) – Cheddar, Colby, Parmesan, Processed

SPECIFIC CHEESES AND THEIR INHERENT CHACTERISTICS

Cheeses are typically categorized according to their moisture content:

Soft	≥ 50%
Semi-soft	> 39 – < 50%
Hard	≤ 39% *(4, 22)*

Hard and semi-soft cheeses are the focus of this research review.

Research by Gengeorgis and colleagues *(25)* has yielded results indicative of those obtained by other researchers, which prove death of pathogens in nonsoft cheeses stored at various temperatures. In this study, 49 market cheeses representing 24 varieties were purchased commercially. Cheeses were inoculated with 10^4 cells of *L. monocytogenes* per square cm. The inoculum was a cocktail of 5 strains — Scott A, V7, RM-1, VPH1, VPH2. Inoculated cheeses were stored at 4, 8 and 30°C for up to 36 hours. Certain cheeses (Queso Fresco, Panela Ranchero, Ricotta, Teleme, Brie, Camembert, and Cottage) supported *Listeria* growth in cheese at one of the storage temperatures. Cheeses not supporting growth but causing gradual death at all temperatures included Cotija, cream, blue, Cheddar, Monterey Jack, Swiss, Colby, string, Provolone, Muenster, Feta, and Kasseri with pH values of 4.3–5.6; process cheese (pH 5.7–6.4); and Limburger cheese (pH 7.2). Overall, this study demonstrated that nonsoft cheeses made with the use of starter cultures and at pH values of ≤ 5.6, as well as processed cheeses, will not support growth of *L. monocytogenes* at 4–30°C if contaminated from raw foods (meat, poultry, fish, vegetables) after the opening of the packages by consumers. In all cheeses that caused gradual death (Cotija, cream, Blue, Cheddar, Monterey Jack, Swiss, Colby, Provolone, Muenster, Feta, Kasseri, Process, Limburger), death at 30°C was greater than or equal to death at 4°C.

Asiago (medium and old)

Medium and old Asiago (aged at least 6 months and 12 months, respectively) are hard cheeses with characteristics very similar to those of Parmesan. FDA has previously exempted these cheeses from date-marking *(11)* and stated that hard cheeses aged at least 60 days are not likely to support pathogen growth *(31)*. Bachman and Spahr *(6)* found that Swiss-type hard cheeses are hygienically safe and that the technology used in manufacturing these cheeses does not support growth of pathogens and leads to a more rapid rate of death.

Cheddar

Cheddar is a hard cheese that does not support *L. monocytogenes* growth and that causes gradual death at all temperatures *(25)*. This finding is confirmed by an FDA correspondence *(11)* and also agrees with work by Ryser and Marth *(61)*, who reported that growth of *L. monocytogenes* during Cheddar cheese manufacture appeared to be inhibited by proper acid development resulting from an active starter culture. Behavior of other pathogens during Cheddar manufacture and ripening show similar results. With normal starter activity, inoculated *Staphylococcus aureus* died rapidly *(60)*, as did *Yersinia enterocolitica (67)*. Norholt *(54)* illustrated die-off of *Salmonella* spp. after 2 weeks. Wood et al. *(84)* found that, of 11 vats of *Salmonella*-contaminated Cheddar cheese curd, only 2 remained positive in the finished cheese immediately after manufacture. In 1 and 4 months,

these 2 vats were clear of the inoculated *Salmonella*. This result is supported by studies of Goepfert et al. *(28)* and Hargrove et al. *(32)* in artificially inoculated Cheddar. Both groups found a 75–80% reduction in *Salmonella* after hooping and pressing during manufacture.

Numerous researchers have reported kill of pathogens at higher ripening and storage temperatures. *Salmonella* spp. survived longer when Cheddar cheese was stored at 4.5°C rather than 10°C *(82)*. In general, a low pH and a high ripening temperature result in a higher inactivation rate for pathogenic organisms *(61)*. Using stirred-curd Cheddar cheese, Goepfert et al. *(28)* showed that the number of *S.* Typhimurium decreased by a factor of 10,000 during 10–12 weeks of ripening at 13°C, whereas a similar decrease required 14–16 weeks at 7.5°C. Park et al. *(58)* reported that salmonellae survived during ripening of Cheddar cheese for up to 7 months at 13°C and 10 months at 7°C. Ryser and Marth *(61)* reported an inactivation rate of *L. monocytogenes* 0.9 logs less at 6°C than at 13°C. International Dairy Federation researchers demonstrated that the decrease in numbers of staphylococci in Cheddar was greater at higher temperatures (10°C and 13°C) than at 7°C *(36)*.

Colby

Colby is a hard to semi-soft cheese that does not support *L. monocytogenes* growth and causes gradual death at all temperatures *(25)*, a finding confirmed by an FDA correspondence *(11)*. Various researchers studying the behavior of inoculated pathogens during Colby cheese manufacture and ripening determined that *E. coli* generally decreased over a period of weeks and was not detected after 4–6 weeks *(41)* and that numbers of *Y. enterocolitica* generally decreased over a period of weeks at 3°C *(51)*. Yousef and Marth *(85)* found that, early in storage of Colby cheese, numbers of *Listeria* in the cheese remained relatively constant for a time that depended on the strain used. Numbers of *Listeria* in cheese decreased steadily thereafter at a rate that depended mainly on composition of the cheese. It should be noted that 2 of the 6 lots of cheese manufactured in this study had moisture levels higher than CFR specifications. IDF researchers demonstrated that the decrease in numbers of staphylococci in Colby was greater at the higher temperatures (10°C and 13°C) than at 7°C *(36)*.

Feta

The Greek regulatory standard for Feta cheese stipulates that it cannot contain more than 56% moisture and less than 43% FDM. No standard exists for the amount of salt, but the salting procedure is described in this regulation. Commercial Feta produced in Greece normally contains about 2.5% salt *(75)*. Currently, there is no US standard of identity for Feta, a soft ripened cheese that does not support *L. monocytogenes* growth and that causes gradual death at all temperatures *(25, 55)*. Other experiments have shown that *Listeria* not only failed to grow in Feta but was gradually inactivated in whey and skim milk brine containing 12% salt (NaCl) *(57)*. Papageorgiou and Marth *(55)* observed that the pH value of 2-day old Feta cheese decreased to 4.6, after which the growth of *L. monocytogenes* ceased.

Monterey Jack

Monterey Jack is a hard to semi-soft cheese which does not support *L. monocytogenes* growth and causes gradual death at all temperatures *(25)*. Other than this referenced study, there exists little published research with this cheese. However, it is very similar, with regard to pH, aqueous NaCl, and moisture, to other cheeses that have been heavily studied and proven not to support pathogen growth.

Mozzarella

Mozzarella is a soft to semi-soft cheese that has a manufacturing protocol detrimental to bacteria. Buazzi et al. *(9)* found that the typical cooking of Mozzarella curd at 40°C for 30 min caused a 38% decrease of *L. monocytogenes*, compared to numbers of the pathogen in curd after cutting. Placing of curd in hot water (77°C) and stretching for 3–4 min caused complete demise of the pathogen. The curd temperature during stretching was 58–65°C. In conclusion, no *L. monocytogenes* was found in the cheese at the end of stretching, start of brining, and end of storage. The heat treatment given to the curd freed the product of *L. monocytogenes*, even though the curd initially contained approximately 6.2×10^5 cells of the pathogen per g. Ryser and Marth *(64)* reported that the heat treatment given to Mozzarella cheese curd is clearly sufficient to inactivate small numbers of *L. monocytogenes* that might be present. Villani et al. *(81)* found similar results during manufacture of traditional Mozzarella cheese from buffalo milk.

Stecchini et al. *(71)* addressed the issue of post-process contamination by inoculating the surface and packaging fluid of Mozzarella cheese with *L. monocytogenes* and then storing the product at 5°C for 21 days. Under these conditions, numbers of *L. monocytogenes* increased about 10,000-fold. Mozzarella was implicated in an outbreak of salmonellosis in 1984. Post-processing contamination was thought to have caused the outbreak *(19)*.

Muenster

Muenster is a semi-soft cheese that does not support *L. monocytogenes* growth and causes a gradual death at all temperatures *(25)*. Other than this referenced study, there exists little published research with this cheese. However, it is very similar in pH, aqueous NaCl, and moisture, to other cheeses that have been heavily studied and proven not to support pathogen growth.

Parmesan

Parmesan is a hard cheese ripened at 12.8°C for 10 months, which does not support *L. monocytogenes* growth and which causes gradual death at all temperatures. No outbreaks in the United States have implicated any Italian-type hard cheeses, including Parmesan. This unblemished safety record may reflect conditions during manufacture and curing that inhibit or destroy pathogens *(40)*. Yousef and Marth *(86)* observed that, during Parmesan cheese ripening, numbers of *L. monocytogenes* decreased almost linearly and faster than reported for other hard cheeses. *L. monocytogenes* was not detected in cheese after 2–16 weeks of ripening, depending on the strain of the pathogen and the lot of cheese. Parmesan made in this study was not a favorable medium for survival of *L. monocytogenes*. Decreased viability of the pathogen in Parmesan is probably related to a combination of factors, including (a) action of lipase added to the milk; (b) heat treatment that the curd receives during cheesemaking; and (c) lower moisture content and water activity of the fully ripened cheese.

Parmesan is more acidic than other cheeses, with a much lower water activity that inhibits microbial growth *(35, 44)*. Pathogenic bacteria vary just as widely as the cheeses they contaminate, and their survival characteristics are equally varied. For example, Brie stored under refrigeration will support the growth of *L. monocytogenes*, while Parmesan stored at near-ambient temperature will not *(35)*.

TABLE 3. Summary of data on cheeses reviewed, and compositional calculations *(21, 68, 75)*

Cheese Type	Typical % H_2O	CFR Limit % H_2O	A_w	Typical pH	Typical % NaCl	Typical % Aqueous NaCl	% FDM **	Active Culture	Age at sale (days)	Other inherent characteristics	Pathogen Kill+
Asiago	32-34	35	0.93	5.2-5.5	1.9-2.2	5.75	45	Thermophile	180-365	A/S Temp*	Ah, Cj, Ec, Lm, P, Sa, Sta, Ye
Cheddar	38	39	0.95	5.2	1.7	4.47	52	Mesophile	15-1,000	A/S Temp*	Lm, Sa, Sta, Ye
Colby	39	40	0.95	5.2	1.7	4.36	52	Mesophile	15-80	A/S Temp*	Ec, Lm, Sta, Ye
Feta	53	NA	0.95	4.5	3.0	5.66	29-52	Mesophile	7-90	A/S Temp*	Lm
Monterey Jack	38-42	44		5.25	1.7	4.05-4.47	52	Mesophile	15-150	A/S Temp*	Lm
Mozzarella	45-52	45-52		4.9-5.4	1.6	3.07 – 3.56	52	Thermophile	5-150	Hot water/steam treatment	Lm kill cook/stretch Lm, Sa growth
Muenster	43	46	0.98	5.2	1.8	4.18	52	Thermophile	10-150	A/S Temp*	Lm
Parmesan	31	32	0.92	5.4	2.6	8.38	38	Thermophile	300-600	A/S Temp* Aged ≥300d High temp curd cook Lipase activity	Lm
Process (sliceable)	40		0.92	5.6	2.2	5.50	50	None	14-180	A/S Temp* Heated ≥150°F/≥30 sec	Clb, Ec, Lm, Sa, Sta
Provolone	42.5	45	0.91	5.2	1.8	4.24	45	Thermophile	15-150	A/S Temp*	Lm
Romano	33.5	34	0.92	5.3	2.2	6.57	40	Thermophile	150-180	A/S Temp*	Lm
Swiss / Emmentaler	38	41	0.97	5.6	1.2	3.16	43	Thermophile	61-300	A/S Temp*	Ah, Cj, Ec, Lm, Pa, Sa, Sta, Ye
Brick	43	44		5.3	1.6	3.72	52	Mesophile	7-50	A/S Temp*	Ec, Lm
Blue	43	46	0.97	6.0	2.5	5.82	52	Mesophile	61-240		Lm

* A/S Temp => Increased pathogen kill at elevated aging/storage temperatures.

** %FDM=> Percent fat in dry matter.

+ Ah – *Aeromonas hydrophils*, Cj – *Campylobacter jejuni*, Clb – *Clostridium botulinum*, Ec – *Escherichia coli* O157:H7, Lm – *L. monocytogenes*,

P – *Pseudomonas aeruginosa*, Sa – *Salmonella* sp., Sta – *Staphylococcus aureus*, Ye – *Yersinia enterocolitica*.

Pasteurized Process (21CFR133.169)

Pasteurized process cheese is a soft to semi-soft cheese that does not support *L. monocytogenes* growth and that causes gradual death at all temperatures *(25, 27)*. Pasteurized processed cheese and related products have an excellent safety record in the United States *(39)*. During the past 50 years, very few disease outbreaks have been attributed to contaminated pasteurized process cheese products *(27)*. The combined effects of pH, moisture, and salt in standardized process cheese may inhibit vegetative pathogen growth in a way similar to the mechanism of inhibition for *Clostridium botulinum (73, 74)*. If a pasteurized processed cheese is intended for use at ambient temperature, pH, water activity (a_w), moisture content, and antimicrobials should be appropriately adjusted to inhibit botulinal toxin formation *(3)*. During manufacture, the product is heated for ≥ 30 s at a temperature of ≥ 65.6°C; this is sufficient to eliminate vegetative organisms but not the spores of *Clostridium botulinum*. As a formulated safe product with regard to *C. botulinum*, the combinations of moisture, salt, and pH act as multiple hurdles to inhibit botulinal growth and toxin production *(42, 73)*.

While studying pathogen survival in pasteurized process cheese slices, Glass et al. *(27)* reported that populations of *Salmonella* serotypes and *E. coli* O157:H7 decreased by an average of 1.3 and 2.1 log CFU/g, respectively, by 36 h. *Salmonella* serotypes decreased an additional 0.6 log CFU/g during the remaining 60 h. Populations of *L. monocytogenes* also decreased, although to a lesser extent, exhibiting approximately 0.6 log CFU/g reduction in 96 h. *S. aureus* levels remained relatively constant during the testing period and were below levels that support detectable enterotoxin production. At 30°C, the pasteurized process cheese slices

allowed survival but did not support growth of *S. aureus*, whereas populations of *L. monocytogenes*, *E. coli* O157:H7, and *Salmonella* serotypes decreased during the 96 h storage. Water activity appears to contribute significantly to the inhibition of pathogen growth in these cheese slices. The a_w of the tested formulations (0.92–0.93) was at or below the minimum required for growth of most foodborne pathogens. Although low a_w may inhibit pathogen growth in these formulations, the synergistic effect of moisture, salts, and pH, or another factor such as sorbate, may also contribute to the safety of the product. The results suggest that properly formulated pasteurized process cheese could be exempt from the potentially hazardous food category because it does not support the rapid and progressive growth of pathogens tested. The results of the study suggested that unopened packages of properly formulated pasteurized process cheese can be safely stored unrefrigerated for certain time periods *(53)*. In fact, reducing storage temperatures has been reported to actually enhance survival of *E. coli* O157:H7 in acidified media, apple cider, and mayonnaise *(33, 50, 87)*.

Provolone

Provolone is a semi-soft cheese that does not support *L. monocytogenes* growth and that causes gradual death at all temperatures *(25)*. No outbreaks that implicated any Italian-type cheese, including Provolone *(40)*, have been found in the United States. Other than this referenced study, little published research with this cheese exists. However, with regard to pH, aqueous NaCl, and moisture, it is very similar to other cheeses that have been heavily studied and proven not to support pathogen growth.

Romano

Romano is a hard cheese that does not appear to support *L. monocytogenes* growth. In the United States, no outbreaks have been found that implicated any Italian-type cheeses, including Romano *(40)*. Other than this referenced study, there exists little published research with this cheese. However, it is very similar to other cheeses with regard to pH, aqueous NaCl, and moisture, which have been heavily studied and proven not to support pathogen growth.

Swiss / Emmentaler

Swiss/Emmentaler is a hard to semi-soft cheese that does not support *L. monocytogenes* growth and that causes gradual death at all temperatures *(25)*. This finding is confirmed by an FDA correspondence *(11)*. The ripening temperature of Swiss cheese is comparatively high (22°C). Buazzi et al. *(10)* reported a sharp decrease in numbers of *L. monocytogenes* during brining of Swiss blocks (7°C for 30 h). The population of *L. monocytogenes* continues to decrease during cheese ripening. *Listeria* was not detected after 80, 77, and 66 days of ripening of Swiss cheese made from inoculated milk. Bachmann and Spahr *(6)* discovered none of the inoculated potentially pathogenic bacteria, except for low numbers of *S. aureus*, could be found in the experimental Swiss cheese 1 day after manufacturing. All subsequent determinations showed that the cheese was free from potentially pathogenic bacteria and toxins. Baumgartner et al. *(8)* previously reported the same behavior of *S. aureus* in Emmentaler cheese. Bachmann and Spahr *(6)* also found that even in poor quality cheese that had been inoculated with *E. coli* and was exhibiting early blowing, no *E. coli* could be detected at the end of ripening. Additionally, results showed that 1 week after manufacturing, the inoculated pathogens (*Aeromonas hydrophils, Campylobacter jejuni, E. coli, L. monocytogenes, Pseudomonas aeruginosa, Salmonella* spp., *S. aureus,* and *Y. enterocolitica*) could no longer be detected.

El-Shenawy and Marth *(18)* suggested that production of propionate by eye-forming bacteria may have contributed to the demise of *L. monocytogenes* in Swiss cheese. In other work, < 2,000 ppm of sodium propionate inhibited growth of *L. monocytogenes* at pH 5.0 *(10)*. At pH 5.0 and 3,000 ppm sodium propionate, the *Listeria* population decreased 1,000-fold during 67 days of incubation at 35°C and disappeared after 78 days. A 60-day-old Swiss cheese typically contains 3,750 ppm propionic acid *(46)*. Acetate may also play a major role in inactivating *L. monocytogenes* in Swiss cheese *(10)*; more lactate is fermented to acetate and CO_2 than to propionate *(12)*. The rapid decrease of the redox potential of Swiss cheese probably supports the inhibitory effect on pathogenic bacteria *(54)*.

Generally, manufacturing technology of Swiss cheese does not support the growth of pathogenic bacteria *(6, 10)*. Because of the synergistic effect of active antimicrobial enzyme systems in fresh raw milk, antagonistic starter culture flora, fast acidification, antimicrobial effect of lactic acid, and high curd cooking temperatures, potentially pathogenic bacteria do not survive the manufacturing of Swiss cheese produced under good manufacturing practices. In addition, intense brining and ripening at elevated temperatures for at least 2 months eliminate the occurrence of the tested strains. Pathogens that may survive the manufacturing process decrease faster at higher storage temperatures *(14)*. Swiss cheese appears to pose a very low risk for transmission of foodborne diseases *(40)*.

Brick

Brick is a semi-soft cheese. In studies of the behavior of pathogens during Brick cheese manufacture and ripening, *L. monocytogenes* numbers decreased during 20–22 weeks of curing at 10°C *(67)*, and *E. coli* grew during manufacture and then died off during curing *(23)*.

Blue

Blue is considered a semi-soft cheese that has been proven to not support *L. monocytogenes* growth and that causes gradual death at all temperatures *(25)*. Papageorgiou and Marth *(59)* reported that growth of *L. monocytogenes* ceased when the pH of blue cheese dropped below 5.0. Populations of *L. monocytogenes* decreased significantly ($P \leq 0.005$) during the first 50 days of ripening, by an average of 2.6 logs CFU/g compared to populations of 1-day old cheese. The high salt content in blue cheese is likely the main reason for the lack of growth of *Listeria*. Productions of fatty acids and methyl ketones derived from fatty acids via the beta-oxidation pathway, and their corresponding secondary alcohols, may contribute to the unfavorable environment for *L. monocytogenes (32)*. Blue cheese on the market has a pH >5.0; therefore, conclusive pathogen death is not verified.

Soft / Hispanic

This category includes Queso Blanco, Queso Fresco, Ricotta, Teleme, Brie, Camembert, Panela, Ranchero, cream, and cottage. Gengeorgis et al. *(25)* evaluated the fate of *Listeria* as a post-processing contaminant and found that *Listeria* growth was primarily confined to high-moisture varieties, including Brie, Camembert, Ricotta, and the soft Hispanic cheeses, all of which had a pH ≥ 6.0 and low to moderate levels of salt in the moisture phase. Back et al. *(7)* noted that *L. monocytogenes* survived, and under most conditions multiplied, when inoculated directly into the cheese milk of laboratory-made Camembert cheese.

REGULATORY EVALUATION

In a series of correspondences, in a letter form as an inclusion to the US FDA Program Information Manual on retail Food Safety and in a subsequent correspondence *(11, 31)*, FDA exempted the following cheeses from the date marking mandate within the US Food Code:

Asiago	Limburger
Blue	Monterey Jack
Brick	Muenster
Cheddar	Parmesan
Colby (≤ 40% moisture)	Pasteurized process
Edam	Provolone
Feta	Reggiano
Gorgonzola	Romano
Gouda	Sapsago
Gruyere	Swiss/Emmentaler

In 2001, FDA/USDA *(77)* conducted a risk analysis of foodborne outbreaks of *L. monocytogenes* from ready-to-eat foods (Table 1).

The evaluation revealed that there was a very low risk for listeriosis by Feta cheese, heat-treated natural and process cheeses, and aged cheeses *(77)*.

Obtaining more information from research, industry, and regulatory experience, FDA/USDA *(78)* updated their *L. monocytogenes* risk analysis in 2003 with the following results (Table 2).

Utilizing a cluster analysis of predicted risk that takes into account the relative risk of listeriosis for the total population on a per serving and per annum basis, the following risk categories were developed for cheese:

- High risk – soft unripened cheeses (cottage, cream)
- Moderate risk – fresh soft cheeses (Queso Fresco) soft ripened cheeses (Brie, Camembert, Feta, Mozzarella)semi-soft cheese (Blue, Brick, Monterey Jack)
- Very low risk – hard cheeses (Cheddar, Swiss, Parmesan)
- Process cheeses

FDA/USDA actually decreased the predicted risk of soft ripened and certain semi-soft cheeses to "Moderate" due to increased use of pasteurized or otherwise heat-treated milk, and effective food safety control programs.

The very low risk cheeses have similar characteristics of being subjected to bactericidal treatment, having very low contamination rates, and possessing an inherent characteristic (or two) that either inactivates *L. monocytogenes* (hard cheese) or prevents its growth (process cheese). As can be noted from this review, many more cheeses fit this category than recognized by USDA. The relative risk indices used may not give a clear picture of the range of risk potential that exists. The differential between per-serving risks associated with deli meats (relative risk rank of 1) and hard cheeses (relative risk rank of 23) is almost 10,000,000-fold *(78)*.

CONCLUSIONS

Science-based data presented herein adequately illustrate the fact that most cheeses containing < 50% moisture (or more, in the case of Feta) and active lactic acid starter cultures, along with traditional levels of salt, pH, fat, etc., do not allow the growth of pathogens at temperatures between 4 and 30°C. In fact, in the vast majority of the cheeses, a higher temperature during ripening/aging and storage leads to significant bactericidal activity. A summary of the reviewed science and data is available in Table 3.

Mathematical models were generated using the USDA Pathogen Modeling Program, but given that this system is in nutrient broth, not in a limited moisture solid food (cheese), growth/death curves generated were meaningless. No other models reviewed were found to be appropriate.

RECOMMENDATIONS

For cheeses manufactured in the United States with pasteurized or heat-treated (≥ 63°C for ≥ 16 s) milk, under hygienic conditions outlined in Good Hygienic Practices, Good Manufacturing Practices, and HACCP systems, using active lactic acid cultures, and according to CFR specifications, the following cheese should be considered by regulatory agencies (FDA, USDA, state, local, etc.) exempt from any and all refrigeration requirements for aging, storage, shipping, and retail display, with a maximum temperature of 30°C:

Asiago (medium and old)
Cheddar
Colby
Feta
Monterey Jack
Muenster
Parmesan
Pasteurized process cheese
Provolone
Romano
Swiss / Emmentaler

If this exemption would apply only to pre-packaged cheeses, Parmesan and Romano, and possibly medium and old Asiago — because of their inherent characteristics — would not have to be pre-packaged for this refrigeration exemption. Soft/fresh Asiago, Blue, Brick, cream and Mozzarella require further investigation before a recommendation for exemption could be made.

There is one common thread among all the ripened cheeses evaluated (this would exclude Mozzarella); the curing/ripening/aging step is detrimental to bacterial pathogens, especially at elevated temperatures up to 30°C. Therefore, for safety purposes, refrigerated storage of the cheeses would appear to be unnecessary and possibly counterproductive.

ACKNOWLEDGMENTS

We are grateful to Dr. Kathy Glass of the Food Research Institute for providing valuable input into this paper. We are grateful to Charlie Guan, Kristen Houck and Karen Paulus of the Wisconsin Center for Dairy Research for their assistance.

REFERENCES

1. Ahmed, A. H., M. Moustafa, and T. A. El-Bassiony. 1986. Growth and survival of *Yersinia enterocolitica* in yogurt. J. Food Prot. 49:983–985.
2. Anonymous. 2001. Date marking of potentially hazardous, ready-to-eat foods. Wisconsin Foods Code Fact Sheet # 16, Wisconsin Dept Ag, Trade, Consumer Prot.
3. Anonymous. 2003. Analysis of microbial hazards related to time/temperature control of foods for safety-IFT/FDA Report on Task Order 4. Comprehensive Reviews in Food Science and Food Safety, Volume 2.
4. Asperger, H. 1986. Wirkungen von milchsaeurebakterien auf andere mikroorganismen: Ein uberblick. Oesterr. Milchwirtschaft 41, Beilage 1:1.
5. Babel, F. J. 1977. Antibiosis by lactic culture bacteria. J. Dairy Sci. 60:815–821.
6. Bachmann, H.P., and U. Spahr. 1995. The fate of potentially pathogenic bacteria in Swiss, hard and semi-hard cheeses made from raw milk. J. Dairy Sci. 78(3):476–483.
7. Back, J. P., S. A. Langford, and R. G. Kroll. 1993. Growth of *L. monocytogenes* in Camembert and other soft cheeses at refrigeration temperatures. J. Dairy Res. 60:421–429.

8. Baumgartner, H., P. Kaestli, and P. Weber. 1968. Das verhalten von *Staphylcoccus aureus* in milch und bei der Herstellung von Emmentalerkase. Schweiz Milchzeitung. 94:993.
9. Buazzi, M. H., M. E. Johnson, and E. H. Marth. 1992. Fate of *L. monocytogenes* during the manufacture of Mozzarella cheese. J. Food Prot. 55(2): 80–83.
10. Buazzi, M. M., M. E. Johnson, and E. H. Marth. 1992. Survival of *L monocytogenes* during the manufacture and ripening of Swiss cheese. J. Dairy Sci. 75(2):380–386.
11. Buchanan, R. L., E. L. Harden, and R. D. Beaulieu. 1999. Date marking of cheese. FDA Program Information Manual-Retail Food Safety.
12. Crow, V. 1986. Metabolism of aspartate by *Propionibacterium freudenreichii* subsp. *shermanii*: effect of lactate fermentation. Appl. Environ. Microbiol. 52:359–365.
13. Daly, C., W. E. Sandine, and P. E. Elliker. 1972. Interaction of food starter cultures and food-borne pathogens: *Streptococcus diacetylactis* versus food pathogens. J. Milk Food Technol. 35(6):349–357.
14. Daoism, J. Y., D. W. Warburton, and A. M. Sewell. 1985. *Salmonella* Typhimurium phage-type 10 from Cheddar cheese implicated in a major Canadian foodborne outbreak. J. Food Prot. 48(12):1062–1066.
15. Dominguez, L., J. F. F. Garayzabal, J. A. Vazquez, J. L. Blanco, and G. Suarez. 1987. Fate of *L. monocytogenes* during manufacture and ripening of semi-hard cheese. Lett. Appl. Microbiol. 34:95–100.
16. Duh, Y-H, and D. W. Schaffner. 1993. Modeling the effect of temperature on the growth rate and lag time of *L. innocua* and *L. monocytogenes*. J. Food Prot. 56(3):205–210.
17. Ehlers, J. G., M. Chapparo-Serrano, R. Richter, and C. Vanderzant. 1982. Survival of *Campylobacter fetus* subsp. *jejuni* in Cheddar and cottage cheese. J. Food Prot. 45:1018–1021.
18. El-Shenawy, M. A., and E. H. Marth. 1989. Behavior of *L. monocytogenes* in the presence of sodium propionate. Intern. J. Food Microbiol. 8(1):85–94.
19. Felip, G., and L. Toti. 1984. Food poisoning caused by Gram-negative bacteria in milk products. Microbiol. Aliment. Nutr. 2:251–256.
20. Food and Drug Administration. 2005. Cheese and cheese products. Definitions and standards under the Federal Food, Drug and Cosmetic Act. 21 Code of Federal Regulations 133.
21. Fox, P. F., T. P. Guinee, T. M. Cogan, and P. L. H. McSweeney. 2000. Fundamentals of Cheese Science. Aspen Publishers.
22. Frank, J. F., and E. H. Marth. 1977. Inhibition of enteropathogenic *Escherichia coli* by homofermentative lactic acid bacteria in skim milk. J. Food Prot. 40:749–753.
23. Frank, J. F., E. H. Marth, and N. F. Olson. 1978. Behavior of enteropathogenic *Escherichia coli* during manufacture and ripening of Brick cheese. J. Food Prot. 41:111–115.
24. Frye, C., and C. W. Donnelly. 2005. Comprehensive survey of pasteurized fluid milk produced in the United States reveals a low prevalence of *L. monocytogenes*. J. Food Prot. 68(5):973–979.
25. Gengeorgis, C., M. Carniciu, D. Dutulescu, and T. B. Farver. 1991. Growth and survival of *L. monocytogenes* in market cheeses stored at 4 to 30°C. J. Food Prot. 54 (9):662–668.
26. Gilliland, S. E., and M. L. Speck. 1972. Interactions of food starter cultures and foodborne pathogens: Lactic streptococci versus staphylococci and salmonellae. J. Milk Food Technol. 35(5):307–310.
27. Glass, K. A., K. M. Kaufman, and E. A. Johnson. 1998. Survival of bacterial pathogens in pasteurized process cheese slices stored at 30°C. J. Food Prot. 61(3):290–294.
28. Goepfert, J. M., N. F. Olson, and E. H. Marth. 1968. Behavior of *Salmonella* Typhimurium during manufacture and curing of Cheddar cheese. Appl. Microbiol. 16(6):862–866.
29. Griffiths, M. W. 1989. *L. monocytogenes*: Its importance in the dairy industry. J. Sci. Food Agric. 47:133–158.
30. Gripon, J. C. 1987. Mould-ripened cheeses, pp. 121–149. *In* P. F. Fox (ed.), Cheese: chemistry, physics and microbiology, Vol. 2. Major Cheese Groups. Elsevier Appl. Sci., London.
31. Harden, B. 1999. FDA correspondence, April 5. Subject: Aged Hard Cheeses.
32. Hargrove, R. E., F. E. McDonough, and W. A. Mattingly. 1969. Factors affecting survival of *Salmonella* in Cheddar and Colby cheese. J. Milk Food Technol. 32:480–484.
33. Hathcox, A. K., L. R. Beuchat, and M. P. Doyle. 1995. Death of enterohemorrhagic *E. coli* O157:H7 in real mayonnaise and reduced-calorie mayonnaise dressing as influenced by initial population and storage temperature. Appl. Environ. Microbiol. 61:4172–4177.
34. Hawley, H. B. 1957. Nisin in food technology. I. Food Manuf. 32:370–376.
35. Institute of Food Science and Technology. 2005. Food safety and cheese. IFST: Current Hot Topics, Feb. 2.
36. International Dairy Federation. 1980. Behavior of pathogens in cheese. IDF Bulletin 122.
37. Jay, J. M. 1982. Antimicrobial properties of diacetyl. Appl. Environ. Microbiol. 44:525–532.
38. Johnson, E. A., J. H. Nelson, and M. E. Johnson. 1990. Microbiological safety of cheese made from heat-treated milk, Part I. Executive summary, introduction and history. J. Food Prot. 53(5):441–452.
39. Johnson, E. A., J. H. Nelson, and M. E. Johnson. 1990. Microbiological safety of cheese made from heat-treated milk, Part II. Microbiology. J. Food Prot. 53(6):519–540.
40. Johnson, E. A., J. H. Nelson, and M. E. Johnson. 1990. Microbiological safety of cheese made from heat-treated milk, Part III. Technology, discussion, recommendations, bibliography. J. Food Prot. 53(7): 610–623.
41. Kornacki, J. L., and E. H. Marth. 1982. Fate of nonpathogenic and enteropathogenic *Escherichia coli* during the manufacture of Colby-like cheese. J. Food Prot. 45(4):310–316.
42. Kosikowski, F. V., and V. V. Mistry. 1997. Cheese and Fermented Milk Products. 3rd ed., vol. 1, p. 328–352. FV Kosikowski, Westport, CT.
43. Kovincic, I., I. F. Vujicic, M. Svabic-Vlahovic, M. Vulic, M. Gagoc, and I. V. Wesley. 1991. Survival of *L. monocytogenes* during the manufacture and ripening of Trappist cheese. J. Food Prot. 54(6):418–420.

44. Kozak, J., T. Balmer, R. Byrne, and K. Fisher. 1996. Prevalence of *L. monocytogenes* in foods: Incidence in dairy products. Food Control 7(4/5):215–221.
45. Kozak, W., J. Bardowski, and W. T. Dobrzanski. 1977. Lactostreptins-acid bacteriocins produced by *Lactic streptococci*. J. Dairy Res. 45:247–254.
46. Langsrud, T., and G. W. Reinbold. 1973/1974. Flavor development and microbiology of Swiss cheese – A review. J. Milk Food Technol. 36(12): 593–609.
47. Leistner, X. 1978. Hurdle effect and energy saving. W. K. Downey (ed.) Food Quality and Nutrition. Applied Science Publishers. London.
48. Mathew, F. P., and E. T. Ryser. 2002. Competition of thermally injured *L. monocytogenes* with a mesophilic lactic acid starter culture in milk for various heat treatments. J. Food Prot. 65(4):643–650.
49. Mathot, A. G., E. Beliard, and D. Thuault. 2003. *Streptococcus thermophilus* 580 produces a bacteriocin potentially suitable for inhibition of *Clostridium tyrobutyricum* in hard cheeses. J. Dairy Sci. 86(10): 3068–3074.
50. Miller, L. G., and C. W. Kasper. 1994. *Escherichia coli* O157:H7 acid tolerance and survival in apple cider. J. Food Prot. 57:460–464, erratum 57:645.
51. Moustafa, M. K., A. A. -H Ahmed, and E. H. Marth. 1983. Behavior of virulent *Yersinia enterocolitica* during manufacture and storage of Colby-like cheese. J. Food Prot. 46(4):318–320.
52. Nelson, J. H. 1983. Should cheese be refrigerated? Dairy Food Sanit. 3(10):372–375.
53. Nelson, J. H. 1984. Some regulatory compliance concerns of the cheese industry. J. Dairy Sci. 67:2108–2119.
54. Norholt, M. D., 1984. Growth and inactivation of pathogenic microorganisms during manufacture and storage of fermented dairy products: A review. Neth. Milk Dairy J. 38:135–150.
55. Papageorgiou, D. K., and E. H. Marth. 1989. Fate of *L. monocytogenes* during the manufacture, ripening and storage of Feta cheese. J. Food Prot. 52(2):82–87.
56. Papageorgiou, D. K., and E. H. Marth. 1989. Fate of *L. monocytogenes* during the manufacture and ripening of Blue cheese. J. Food Prot. 52(7): 459–465.
57. Papageorgiou, D. K., and E. H. Marth. 1989. Behavior of *L. monocytogenes* at 4 and 22°C in whey and skim milk containing 6 or 12% NaCl. J. Food Prot. 52(9):625–630.
58. Park, H. S., E. H. Marth, J. M. Goepfert, and N. F. Olson. 1970. The fate of *Salmonella* Typhimurium in the manufacture and ripening of low-acid Cheddar cheese. J. Milk Food Technol. 33:280–284.
59. Reiter, B. 1985. Interaction between immunoglobulins and innate factors such as lysozyme, lactoferrin, lactoperoxidase. J. Schaub (ed.) compos. Physiol. Prop. Human Milk, Proc. Intern. Workshop, Elsevier, Amsterdam pp. 271–284.
60. Reiter, B., B. G. Fewins, T. F. Fryer, and M. E. Sharpe. 1964. Factors affecting the multiplication and survival of coagulase positive *Staphylococci* in Cheddar cheese. J. Dairy Res. 31:261–272.
61. Ryser, E. T., and E. H. Marth. 1987. Behavior of *L. monocytogenes* during the manufacture and ripening of Cheddar cheese. J. Food Prot 50(1):7–13.
62. Ryser, E. T., and E. H. Marth. 1989. Behavior of *L. monocytogenes* during the manufacture and ripening of Brick cheese. J. Dairy Sci. 72(4):838–853.
63. Ryser, E. T., and E. H. Marth. 1991. Incidence and behavior of *L. monocytogenes* in cheese and other fermented dairy products. *L. monocytogenes*, Listeriosis and Food Safety. *L. monocytogenes* in Fermented Dairy Products, pp. 331–404.
64. Ryser, E. T., and E. H. Marth. 1999. Incidence and behavior of *L. monocytogenes* in cheese and other fermented dairy products. *L. monocytogenes*, Listeriosis and food safety, 2nd ed. Revised and expanded. *L. monocytogenes* in Fermented Dairy Products, pp. 411–503.
65. Schaak, M. M., and E. H. Marth. 1988. Behavior of *L monocytogenes* in skim milk during fermentation with mesophilic lactic starter cultures. J. Food Prot. 51(8):600–606.
66. Schaak, M. M., and E. H. Marth. 1988. Interaction between lactic acid bacteria and some foodborne pathogens: A review. Cultured Prod. J. Nov: 14–20.
67. Schiemann, D. 1978. Association of *Yersinia enterocolitica* with the manufacture of cheese and occurrence in pasteurized milk. Appl. Environ. Microbiol. 36:274–277.
68. Spahr, U., and B. Url. 1994. Behaviour of pathogenic bacteria in cheese – A synopsis of experimental data. IDF bulletin 298:2–16.
69. Speck, M. L. 1971. Control of foodborne pathogens by starter cultures. J. Dairy Sci. 55:1019–1022.
70. Stadhouders, J., M. M. Cordes, and A. W. J. van Schouwenberg-van Foeken. 1978. The effect of manufacturing conditions on the development of *Staphylococci* in cheese: their inhibition by starter bacteria. Neth. Milk Dairy J. 32:193–203.
71. Stecchini, M. L., V. Aguili, and I. Sarais. 1995. Behavior of *L. monocytogenes* in Mozzarella cheese in the presence of *Lactococcus lactis*. Intern. J. Food Microbiol. 25(3):301–310.
72. Sutherland, J. P., A. J. Bayliss, and T. A. Roberts. 1994. Predictive modeling of growth of *Staphylococcus aureus*: the effects of temperature, pH and sodium chloride. Intern. J. Food Microbiol. 21:217–236.
73. Tanaka, N., E. Traisman, P. Plantinga, L. Finn, W. Flom, L. Meske, and J. Guggisberg. 1986. Evaluation of factors involved in antibotulinal properties of pasteurized process cheese spreads. J. Food Prot. 49:526–531.
74. ter Steeg, P. F., and HGAM Cuppers. 1995. Growth of proteolytic *Clostridium botulinum* in process cheese products: II. Predictive modeling. J. Food Prot. 58:1108–1110.
75. The Food and Beverage Code 1971. Article 83. Modification, 1987. Newspaper of the Government of the Republic of Greece, Athens, July 3, 1987.
76. Tiwari, N. P., and I. P. Singh. 1964. Survival of pathogens in Dahi. I: Contamination of milk before the preparation of Dahi. Indian J. Dairy Sci. 17:97–101.
77. U.S. Department of Agriculture. 2001. Interpretive Summary: Draft assessment of the relative risk to public health from foodborne *L. monocytogenes* among selected categories of ready-to-eat foods. CFSAN/FDA, FSIS/USDA.
78. U.S. Department of Agriculture. 2003. Interpretive Summary: Quan-

titative assessment of the relative risk to public health from foodborne *L. monocytogenes* among selected categories of ready-to-eat foods. CFSAN/FDA, FSIS/USDA.
79. USDA, ARS, NAA, ERRC, MFSRU Pathogen Modeling Program. PMP 7.0Version number: 1.1.1433.15425. Platform: MS Windows 98, NT4 and newer. Available at: http://www.arserrc.gov/mfs/pathogen.htm
80. Vangtal, A., and E. Hammond. 1986. Relation of the flavors of Swiss cheese to chemical parameters. J. Dairy Sci. 69 (suppl. 1):81 (abstract).
81. Villani, F., O. Pepe, G. Mauriello, G. Moschetti, L. Sannino, and S. Coppola. 1996. Behavior of *L. monocytogenes* during the traditional manufacture of water-buffalo Mozzarella cheese. Lett. Appl. Microbiol. 22:357–360.
82. White, C. H., and E.W. Custer. 1976. Survival of *Salmonella* in Cheddar cheese. J. Milk Food Technol 39(5): 328–331.
83. Wijtzes, T., P. J. McClure, M. H. Zwietering, and T.A. Roberts. 1993. Modeling bacterial growth of *L. monocytogenes* as a function of water activity, pH and temperature. Intern. J. Food Micro 18:139–149.
84. Wood, D. S., D. L. Collins-Thompson, D. M. Irvine, and A. N. Myhr. 1984. Source and persistence of *Salmonella muenster* in naturally contaminated Cheddar cheese. J. Food Prot. 47(1):2–22.
85. Yousef, A. E., and E. H. Marth. 1988. Behavior of *L. monocytogenes* during the manufacture and storage of Colby cheese. J. Food Prot. 51(1): 12–15.
86. Yousef, A. E., and E.H. Marth. 1990. Fate of *L. monocytogenes* during the manufacture and ripening of Parmesan cheese. J. Dairy Sci. 73(12):3351–3356.
87. Zhao, T., M. P. Doyle, and R. E. Besser. 1993. Fate of enterohemorrhagic *Escherichia coli* O157:H7 in apple cider with and without preservatives. Appl. Environ. Microbiol. 59:2526–2530.

Food Protection Trends, Vol. 26, No. 10, Pages 725–728

International Association for Food Protection

Preharvest Control of Yeasts and Molds in Commodities

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SUMMARY

Control of yeasts and molds in commodities involves a multifactorial approach for defining multiple variables. Preharvest scope include varietial (maturity, date, GMO) selection, tillage (time, depth), planting (density, spacing), fertilization (type, amount, timing), irrigation, pesticides, procedures from stalk to storage bin (combines, grain carts, semitrailers, augers and dryers) and transfer devices from initial storage to processing units. Other considerations include operator acuity, organic growing methodologies, growing seasons, heat days, critical rainfalls, late freezes, early frosts, pulse field, electron beam irradiation and broken corn and foreign material (BCFM). Collection of usable data for future modeling that integrates technological advancements with practical applications, necessitates initial multidisciplinary input, continued attention to details and realistic conclusions which can be utilized by personnel throughout the system. A primary consideration for interventions will be economic return for directly involved individuals as well as personal and portfolio investors and representatives from loaning agencies. While milk is a biomaterial that evolved with the intent to nourish growing mammals, most plant biomaterials evolved to assist in avoidance of predators. Cultivating cereal grains under conditions of environmental duress results in elevated levels of polyphenols. Grain compositional characteristics resulting from sustainable (status quo) versus progressive agricultural practices must be reviewed in the context of food safety. Establishing programs to support research and transfer new knowledge must be integral to designing overall management systems. For successful implementation, program recommendations must provide relevant information. Development of regulatory procedures must be based on both scientific and practical considerations to result in relevant impacts.

INTRODUCTION

To deal with mycotoxin problems, there must first be an understanding of the fungi which produce them, their growth parameters and interactions with crops. Mycotoxin control is both fungus specific and crop specific. Control of mycotoxins during growing seasons is a crop management problem. Control during storage is a food technology consideration.

Toxic fungal metabolites, known as mycotoxins, are chemically diverse and occur in a wide variety of substrates, including foodstuffs. Food safety is rapidly rising to a top priority in modulating commodity composition such as control of molds and yeasts. When ingested, mycotoxins have the potential to impair human and animal health, as well as predisposition to infectious diseases and reducing production efficiency, thereby resulting in economic losses in livestock.

Improvements in cereal grain variety and biotechnology, as well as advances in production management, have resulted in reduced insect damage, more timely harvest and a decrease in moldy cereal grains. However, these problems continue to occur since it is not possible to control the weather and other environmental conditions. We may be in store for weather similar to that of the late 1980s, which resulted in outbreaks of porcine pulmonary edema due to mycotoxin contamination. Appropriate disposition of mycotoxin laden cereal grains will be a necessity. Utilization of contaminated cereal grains as animal foodstuffs is one alternative; therefore, identification and accurate determinations of mycotoxin lev-

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TABLE 1. Mean concentrations of aflatoxin in corn samples collected from Georgia fields (year — ppb) *(19)*

1978 — 57	1979 — 68	1980 — 204
1981 — 91	1982 — 92	1983 — 128
1984 — 37	1985 — 48	1986 — 190
1987 — 82	1988 — 137	1989 — 26
1990 — 218	1991 — 39	1992 — 36
1993 — 70	1994 — 6	1995 — 106
1996 — 49	1997 — 8	1998 — 236

els are essential to channel products to appropriate end users.

The extent of raw corn contamination with mycotoxins varies with geographic location, normal annual climatic fluctuations, agronomic and storage practices, and the vulnerability of the plants to fungal invasion during all phases of growth, storage and processing. Levels of mycotoxins are influenced by environmental factors such as temperature, humidity and rainfall during preharvest and harvest periods. Often high levels of mycotoxins are associated with hot, dry weather followed by periods of high humidity. Insect damage also may be a factor.

At field and storage sites, mycotoxin presence may be associated with visual and/or aromatic evidence of mold growth; however, mold infection, with mycotoxin contamination, can be so subtle as to escape casual inspection. Regardless of technologic advances, aflatoxin levels vary from year to year *(19)* (Table 1). The US Food and Drug Administration (FDA) has set a level of 20 ppb aflatoxin in all foods for animals and human beings. Of the mycotoxins found in corn, i.e., aflatoxins, deoxnivalenol (DON, vomitoxin), fumonisins, ochratoxins and zearalonone, the most research has been reported for aflatoxins because of their carcinogenic potential; however, fumonisins and deoxnivalenol are more ubiquitous. Also, aflatoxins often are found in cotton, peanuts and rice.

Conversely, cereal grains that are obviously moldy and with serious kernel destruction may not contain mycotoxins. The presence of fungus is not a confirmatory test for mycotoxins *(16)*. Mycotoxin occurrences depend upon favorable conditions being met for their production by fungi. Specific mycotoxins appear to be limited to certain environmental loci and to specific crops *(3)*; however, one fungal species can produce multiple mycotoxins.

Because requirements for mold growth and mycotoxin development are specific, mycotoxin occurrences in grain masses are inconsistent because of differing microenvironments, with mycotoxins generally occurring in hot spots. When assaying for mycotoxin presence and concentrations, there are three sources for variance: sample collection, subsampling and analysis. Sample collection is of greatest concern and shown to be the greatest source of error. Characteristically, individual kernels contain high levels of mycotoxins. As kernels are milled and particulate size decreases, variance decreases. Also, movement involves blending which contributes to sample homogenization. Therefore, inadequate sampling may result in erroneous data.

Accuracy and precision are two concerns when sampling. As test procedures for mycotoxins include sampling, preparation and analyses, a study was designed to assess variability in shelled corn contaminated with low levels of aflatoxins. When 10 ng/g aflatoxin was added to shelled corn, the coefficient of variation was ± 122% when the corn was analyzed using HPLC methods *(18)*.

Physical mixing of moist corn with dry grain, for the purpose of producing a product with an acceptable mean moisture content, can result in microenvironments that allow for production of mycotoxins *(2)*. Conditions of importance during cereal grain growing seasons include: high temperature, drought stress, excess rain just prior to combining, insect damage, root rot and unsuitability of variety for planting region. During transport and storage prior to processing, items of interest include: temperature, humidity, presence of fungi, air flow and insects. Corn rootworm larvae need adequate moisture to pupate in the spring; insects hatch after lightning bugs appear in the spring.

While controlling the occurrence of mycotoxins in foods may be possible, economic feasibility is questionable. If foodborne mycotoxin regulations were based solely on direct health effects, questions of economic feasibility for meeting strict standards could be ignored, but with potentially disastrous consequences for less developed food-exporting countries *(20, 21)*. An important consideration for control of mycotoxins will be improvement of the fundamental knowledge behind the ecology and epidemiology of fungi which produce mycotoxins.

Livestock manure is an excellent source of fertilizer, especially for organic producers, since it provides micronutrients and macronutrients required by growing plants. However, manure may contain pathogenic microorganisms which can contaminate crops grown in fields fertilized with manure, subsequently causing foodborne illnesses *(7)*.

As a result of the ubiquitous occurrence of *Fusarium verticillioides* world wide in corn and minimal scientific data concerning *F. verticillioides* mycotoxins (fumonisins, moniliformin, fusaric acid) in grains and other animal foodstuffs, identification of dietary levels of biologic relevance is elusive. Moreover, the deleterious effects can be species specific, e.g., fumonisin ingestion produces pulmonary edema in swine *(5, 6)*, leukoence-

TABLE 2. United States corn grading standards

Grade Number	BCFM, %	Minimum test wt, lb/bu
1	2	56
2	3	54
3	4	52

BCFM = broken kernels and foreign material

phalomalacia in horses, renal injury in sheep and renal cancer in rats. Sublethal levels of dietary fumonisin decrease cardiovascular function in swine *(14)* and horses *(15)*. Fumonisin B1 and alflatoxin B1 were found to be immunotoxic to swine, with fumonisin B1 predisposing to the infectious diseases of *E. coli* in swine and *Salmonella* in poultry *(10)*.

Common misconceptions throughout the cereal grain industry must be clarified, (1) Wherever fungus is observed, there is not necessarily a mycotoxin problem, (2) When mycotoxins are found in a specific locale in a given crop one year, they will not always be present at that site, (3) When a mycotoxin is detected in a crop at a specific site, the mycotoxin will not be present wherever the crop is grown, (4) Mycotoxins are not always produced in susceptible crops, (5) Not all mycotoxins are carcinogens, and (6) Mycotoxins can be produced in the field as well as during harvest and storage.

Some mycotoxins can be removed prior to processing. *Fusarium verticillioides*, one of the fungi which can produce fumonisin, is found in the tip cap of the corn kernel; therefore, screening prior to fractionation of the kernel will eliminate most of the fumonisin in a load of grain. *Aspergillus flavus*, the fungus which can produce alflatoxin, is found throughout the corn kernel; therefore, screening often is ineffective.

In stored corn, minimum moisture levels for growth of *Fusarium verticillioides* and *Aspergillus flavus* are 18 and 17%, respectively. Hawkins et al. *(7)* reported on reduced *Aspergillus flavus* maize kernel infection as a function of postharvest drying temperatures.

An important factor to consider in grain handling is distance of free fall of corn kernels into grain carts, trucks, bins, grain elevators, barges and ships. If the free fall is 30, 21 or 12 m (100, 70 or 40 ft), there will be 10, 6 or 3% breakage *(12)*. At present, Grain Inspection, Packers and Stockyards Administration (GIPSA) of the US Department of Agriculture corn grading standards are as seen in Table 2.

There has been a commonly held belief that mycotoxins stress yeast during fermentation *(9)*, resulting in lower ethanol yields. However, under controlled conditions *(11)*, it was determined that aflatoxin B1 added at levels of 100, 200, 350 or 775 ppb did not affect fermentation rate nor final ethanol concentrations. Fungal metabolism results in conversion of oxygen and starch to monosaccharides and ultimately to water, carbon dioxide and heat:

$$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ H_2O + 6\ CO_2 + 677 \text{ calories}$$

Consequently, cereal grains laden with fungal growth may have less carbohydrate available for conversion to useful end products.

When using cereal grains, e.g., barley, corn, or wheat, as sources of starch for fermentation to ethanol, relative market value of coproducts resulting from the dry grind process must be considered. For producers to realize more income, they must measure and manage those items of interest to the end users. Technologies for improved fractionation of the grain kernel will result in distillers dried grains with solubles (DDGS), which have the oil and fiber removed, thereby resulting in animal foodstuffs that can be fed to nonruminants as well as ruminants *(13)*. Animal nutritionists must be provided with precise and accurate data with respect to compositional characteristics of the DDGS.

With cereal grain marketing based only on deductions rather than on premiums, producers do not have incentive to provide management which increases costs of production. Grain buyers procure characteristics, not attributes. If producers were paid on the basis of grain quality, management will be enhanced. At present, producers are paid by the ton (not bu) delivered. Thus, if a producer delivers grain at 10% moisture, there is a decrease in gross income/acre; therefore, grain will be delivered at > 15% moisture. To address this problem, grain must be sold on a dry matter basis.

Microbial *Bacillus thuringiensis* (*Bt*) based products have been used commercially for 40 years. The safety and advantages of *Bt* protected plants to control insects have been reviewed with the intent to enable a more science based discussion of the risks, safety and usefulness to producers, the environment and society *(1)*. Mean fumonisin levels were reported to be less in *Bt* corn than in control hybrids; the lower fumonisin levels in United States *Bt* corn hybrids were consistent with findings from France, Spain, Italy, Turkey and Argentina *(4)*.

Modified grain plants may provide fewer broken stalks, less stalk required for standability, minimal volunteer corn the next growing season and decreased insect damage, thereby reducing fungal and bacterial penetration that result in lower mycotoxin levels. Reducing the amount of stalk and husk required will decrease amount of fertilizer/bushel, result in fewer problems at picker head and gathering chains, and decrease material traversing the combine, thereby reducing energy needs and diminishing the flow of four-letter and hyphenated words.

The concept of using carbon-carbon linkages in optimal ways is fundamental to providing food and fuel for life on this planet. It is essential to develop and support research directed to address the issues discussed above that impede optimal agricultural production and adversely affect human and animal health. Multidisciplinary and interinstitutional cooperation is essential to succeed in these research endeavours *(16)*. Preharvest and postharvest methodologies and technologies must be developed to optimize food safety and economic return.

REFERENCES

1. Betz, F. S., B. G. Hammond, and R. L. Fuchs. 2000. Safety and advantages of *Bacillus thuringiensis* protected plants to control insect pests. Toxicol. Pharmacol. 32:156–173.
2. Clevenger, T. E., R. D. Curry, R. L. Belyea, W. E. Artz, and M. E. Tumbleson. 2000. Electron beam sterilization, pp. 79–83. *In* M. E. Tumbleson and J. W. Snyder (eds.), Proc. Corn Util. Technol. Conf., NCGA, St. Louis, MO.
3. Council for Agricultural Sciences and Technology. 2003. Mycotoxins:

Risks in Plant, Animal and Human Systems, pp. 1–199. Report No. 139. Council for Agricultural Sciences and Technology, Ames, IA.
4. Hammond, B. G., K. W. Campbell, C. D. Pilcher, T. A. Degooyer, A. E. Robinson, B. L. McMillen, S. M. Spangler, S. G. Riordan, L. G. Rice, and J. L. Richard. 2004. Lower fumonisin mycotoxin levels in the grain of Bt corn grown in the United States in 2000–2002. J. Agric. Food Chem. 52:1390–1397.
5. Haschek, W. M., L. A. Gumprecht, G. W. Smith, H. M. Parker, V. R. Beasley, and M. E. Tumbleson. 1996. Effects of fumonisins in swine: implications for biomedical research, pp. 99–112. *In* M. E. Tumbleson and L. B. Schook (eds.), Advances in Swine in Biomedical Research, vol. 1. Plenum Press, New York, NY.
6. Haschek, W. M., L. A. Gumprecht, G. W. Smith, M. E. Tumbleson, and P. D. Constable. 2001. Fumonisin toxicosis in swine: an overview of porcine pulmonary edema and current perspectives. Environ. Health Perspect. 109(suppl. 2):251–257.
7. Hawkins, L. K., G. L. Windham, and W. P. Williams. 2005. Effect of different postharvest drying temperatures on *Aspergillus flavus* survival and aflatoxin content in five maize hybrids. J. Food Prot. 68:1521–1524.
8. Ingham, S. C., M. A. Fanslau, R. A. Engel, J. R. Breuer, J. E. Breuer, T. H. Wright, J. K. Reith-Rozelle, and J. Zhu. 2005. Evaluation of fertilization to planting and fertilization to harvest intervals for safe use of noncomposted bovine manure in Wisconsin vegetable production. J. Food Prot. 68:1134–1142.
9. Kelsall, D. R., and T. P. Lyons. 2003. Practical management of yeast: conversion of sugars to ethanol, pp. 128–129. *In* K. A. Jacques, T. P. Lyons and D. R. Kelsall (eds.), The Alcohol Textbook, Nottingham University Press, Nottingham, UK.
10. Liu, B. H., F. Y. Yu, M. H. Chan, and Y. L. Yang. 2002. The effects of mycotoxins, fumonisin B1 and alflatoxin B1, on primary swine alveolar macrophages. Toxicol. Appl. Pharmacol. 180:197–204.
11. Murthy, G. S., D. E. Townsend, G. L. Meerdink, G. L. Bargren, M. E. Tumbleson, and V. Singh. 2005. Effect of aflatoxin B1 on dry grind ethanol process. Cereal Chem. 82:302–304.
12. Paulsen, M. R. 2005. Personal communication.
13. Rausch, K. D., and R. L. Belyea. 2006. Corn processing and coproducts from animal diets. Appl. Biochem. Biotech. 128:47–86.
14. Smith, G. W., P. D. Constable, R. M. Eppley, M. E. Tumbleson, L. A. Gumprecht, and W. M. Haschek. 2000. Purified fumonisin B1 decreases cardiovascular function but does not alter pulmonary capillary permeability in swine. Toxicol. Sci. 56:240–249.
15. Smith, G. W., P. D. Constable, J. H. Foreman, R. M. Eppley, A. L. Waggoner, M. E. Tumbleson, and W. M. Haschek. 2002. Cardiovascular changes associated with intravenous administration of fumonisin B1 in horses. Am. J. Vet. Res. 63:538–545.
16. Smith, J. E., and M. O. Moss. 1985. Mycotoxins. Formation, Analysis and Significance. p. 84. Wiley, New York, NY.
17. Tumbleson, M. E. 2004. Technology of bioenergy, Part B. Issue Paper No. 27. *In* Bioenergy: Pointing to the Future. Council for Agricultural Sciences and Technology, Ames, IA.
18. Whitaker, T. B., and A. S. Johansson. 2005. Sampling uncertainties for the detection of chemical agents in complex food matrices. J. Food Prot. 68:1306–1313.
19. Widstrom, N. W. 1999. Personal communication.
20. Wu, F. 2005. Bt corn's reduction of mycotoxins: regulatory decisions and public opinion, pp. 1–22. *In* R. Just, J. Alston and W. Huffman (eds.), Economics of Regulation of Agricultural Biotechnologies, Academic Press, New York, NY.
21. Wu, F., J. D. Miller, and E. A. Dasman. 2004. Bt corn and mycotoxin reduction: economic impacts in the United States and the developing world. J. Toxicol., Toxin Rev. 23:397–424.

In Memory of...

Dr. Sue Hefle
Lincoln, Nebraska

IAFP would like to extend our deepest sympathy to the family and friends of Dr. Sue Hefle who passed away in August 2006.

IAFP will always have sincere gratitude for her contributions to the Association and the profession.

Call for Nominations 2007 Secretary

A representative from the education sector will be elected in March of 2007 to serve as IAFP Secretary for the year 2007–2008.

Send letters of nomination along with a biographical sketch to the Nominations Chairperson:

Larry R. Beuchat
University of Georgia
Center for Food Safety
1109 Experiment St.
Griffin, GA 30223-1797
Phone: 770.412.4740
Fax: 770.229.3216
E-mail: lbeuchat@uga.edu

The Secretary-Elect is determined by a majority of votes cast through a vote taken in March of 2007. Official Secretary duties begin at the conclusion of IAFP 2007. The elected Secretary serves as a Member of the Executive Board for a total of five years, succeeding to President, then serving as Past President.

For information regarding requirements of the position, contact David Tharp, Executive Director, at 800.369.6337 or 515.276.3344; Fax: 515.276.8655; E-mail: dtharp@foodprotection.org.

Nominations Close November 1, 2006

Call for Abstracts

IAFP 2007

The Association's 94th Annual Meeting

July 8-11, 2007

Lake Buena Vista, Florida

General Information

1. Complete the Abstract Submission Form Online.
2. All presenters must register for the Annual Meeting and assume responsibility for their own transportation, lodging, and registration fees.
3. There is no limit on the number of abstracts individuals may submit. However, one of the authors must deliver the presentation.
4. Accepted abstracts will be published in the Program and Abstract Book. Editorial changes may be made to accepted abstracts at the discretion of the Program Committee.
5. Membership in the Association is not required for presenting a paper at IAFP 2007.

Presentation Format

1. Technical — Oral presentations will be scheduled with a maximum of 15 minutes, including a two to four-minute discussion. LCD projectors will be available and computers will be supplied by the convenors.
2. Poster — Freestanding boards will be provided for presenting posters. Poster presentation surface area is 48" high by 96" wide (121.9 cm × 243.8 cm). Handouts may be used, but audiovisual equipment will not be available. The presenter will be responsible for bringing pins and velcro.

   Note: The Program Committee reserves the right to make the final determination on which format will be used for each presentation.

Instructions for Preparing Abstracts

1. All abstracts must be written in English.
2. All abstracts must be approved and signed off by all authors before submission.
3. Title — The title should be short but descriptive. The first letter in each word in the title and should be capitalized.
4. Authors — List all authors using the following style: first name or initials followed by the surname.
5. Presenter Name and Title — List the full name and title of the person who will present the paper.
6. Presenter Address — List the name of the department, institution and full postal address (including zip/postal code and country).
7. Phone Number — List the phone number, including area, country, and city codes of the presenter.
8. Fax Number — List the fax number, including area, country, and city codes of the presenter.
9. E-mail — List the E-mail address for the presenter.
10. Format preferred — Check the box to indicate oral or poster format. The Program Committee reserves the right to make the final determination of presentation format.
11. Category — The categories are used by the Program Committee to organize the posters and technical sessions. Please check the box which best describes the category for which the abstract is suitable.
12. Developing Scientist Awards Competition — Check the box to indicate if the presenter is a student wishing to be considered in this competition. The student will make the initial submission, and IAFP will E-mail the abstract to the major professor, who will complete the submission process. For more information, see "Call for Entrants in the Developing Scientist Awards Competitions."
13. Abstract — Key the abstract into the web-based system. In addition, a double-spaced copy of the abstract, typed in 12-point font in MS Word, should be E-mailed to IAFP at the time of submission. Use no more than 300 words. Abstracts are most often rejected because of a failure to follow the instructions below.

In addition to following these instructions, authors should carefully review the sections on selection criteria and rejection reasons as well as the sample abstracts (available online) before submitting the abstract. Original research abstracts MUST be in the following format:

Introduction: State the reason for pursuing this work (2–3 sentences)

Purpose: State the purpose or objectives of the study (1–2 sentences)

Methods: State the methodology used in the study (2–3 sentences). The methods should be specific enough that researchers in the same or similar field would understand the basic experimental design or approach.

Results: Describe the results obtained in the study (2–3 sentences). NOTE: Specific results, with statistical analysis (if appropriate), MUST be provided. A statement of "results pending" or "to be discussed" is not acceptable and will be grounds to abstract rejection. Results should be summarized, do NOT use tables or figures.
Significance: State the significance of the findings to food safety and/or public health (1–2 sentences) NOTE: Do not include reference citations in the Abstract. Please see sample abstracts for further guidance on abstract structure.

Education abstracts MUST present an improvement or innovation on a proven method in order to educate others (about a food protection related topic). There should be a way to measure the outcomes and substantiate the improvements and/or outcomes. If measured, the sample size should be sufficiently large to represent the intended population.

Abstract Submission

Abstracts submitted for IAFP 2007 will be evaluated for acceptance by the Program Committee. Please be sure to follow the instructions above carefully; failure to do so may result in rejection. Information in the abstract data must not have been previously published in a copyrighted journal.

Abstracts must be received no later than January 16, 2007. Completed abstract and information must be submitted online. Use the online submission form at www.foodprotection.org. In addition, a double-spaced copy of the abstract, typed in 12-point font in MS Word, should be E-mailed to IAFP at the time of submission. You will receive an E-mail confirming receipt of your submission.

Selection Criteria

1. Abstracts must be structured as described above.
2. Abstracts must report the results of original research pertinent to the subject matter. Papers should report the results of new, applied studies dealing with: (i) causes (e.g., microorganisms, chemicals, natural toxicants) and control of all forms of foodborne illness; (ii) causes (e.g., microorganisms, chemicals, insects, rodents) and control of food contamination and/or spoilage; (iii) food safety from farm-to-fork (including all sectors of the chain including production, processing, distribution, retail, and consumer phases); (iv) novel approaches for the tracking of foodborne pathogens or the study of pathogenesis and/or microbial ecology; (v) public health significance of foodborne disease, including outbreak investigation; (vi) non-microbiology food safety issues (food toxicology, allergens, chemical contaminants); (vii) advances in sanitation, quality control/assurance, and food safety systems; (viii) advances in laboratory methods; and (ix) food safety risk assessment. Papers may also report subject matter of an educational nature.
3. Research must be based on accepted scientific practices.
4. Research should not have been previously presented nor intended for presentation at another scientific meeting. Papers should not appear in print prior to the Annual Meeting.

Rejection Reasons

1. Abstract was not prepared according to the "Instructions for Preparing Abstracts." This includes abstracts that are too lengthy.
2. Abstract reports inappropriate or unacceptable subject matter.
3. Abstract is not based on accepted scientific or educational practices and/or the quality of the research or scientific/educational approach is inadequate.
4. Potential for the approach to be practically used to enhance food safety is not justified.
5. Work reported appears to be incomplete and/or data and statistical validity are not presented. Percentages alone are not acceptable unless sample sizes (both numbers of samples and sample weight or volume) are reported. Detection limits should be specified when stating that populations are below these limits. Indicating that data will only appear in the presentation without including them in the abstract is NOT acceptable.
6. Abstract was poorly written or prepared. This includes spelling and grammatical errors or improper English language usage.
7. Results have been presented/published previously.
8. Abstract was received after the deadline for submission.
9. Abstract contains information that is in violation of the International Association for Food Protection Policy on Commercialism.
10. Abstract subject is similar to other(s) submitted by same author. (The committee reserves the right to combine such abstracts.)
11. Abstracts that report research that is confirmatory of previous studies and/or lacks originality will be given low priority for acceptance.

Deadlines and Notification Dates

- Abstract Submission Deadline: January 16, 2007.
- Submission Confirmations: Within 48 hours of submission.
- Acceptance/Rejection Notification: February 28, 2007.

Contact Information

Questions regarding abstract submission can be directed to Tamara P. Ford, 515.276.3344 or 800.369.6337; E-mail: tford@foodprotection.org

Program Chairperson

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Call for Entrants in the Developing Scientist Awards Competitions

Supported by the International Association for Food Protection Foundation

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

Purpose

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

Presentation Format

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

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

General Information

1. Competition entrants cannot have graduated more than a year prior to the deadline for submitting abstracts.
2. Accredited universities or colleges must deal with environmental, food or dairy sanitation, protection or safety research.
3. The work must represent original research completed and presented by the entrant.
4. Entrants may enter only one paper in either the oral or poster competition.
5. All entrants must register for the Annual Meeting and assume responsibility for their own transportation, lodging, and registration fees.
6. Acceptance of your abstract for presentation is independent of acceptance as a competition finalist. Competition entrants who are chosen as finalists will be notified of their status by the chairperson by April 30, 2007.
7. Entrants who are full time students, with accepted abstracts will receive a complimentary, one-year Student Membership with *JFP* Online.
8. In addition to adhering to the instruction in the "Call for Abstracts," competition entrants must check the box to indicate if the paper is to be presented by a student in this competition. A copy of the abstract will be E-mailed to the major professor for final approval.
9. You must also specify full-time student or part-time student.

Judging Criteria

A panel of judges will evaluate abstracts and presentations. Selection of up to ten finalists for each competition will be based on evaluations of the abstracts and the scientific quality of the work. All entrants will be advised of the results by April 30, 2007. Only competition finalists will be judged at the Annual Meeting and will be eligible for the awards.

Judging criteria will be based on the following:

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

Finalists

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

Awards

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

Award winners will receive a complimentary, one-year Membership including *Food Protection Trends*, *Journal of Food Protection*, and *JFP* Online.

Policy on Commercialism

for Annual Meeting Presentations

1. INTRODUCTION

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

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

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

2. TECHNICAL CONTENT OF SUBMISSIONS AND PRESENTATIONS

2.1 Original Work

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

2.2 Substantiating Data

Submissions and presentations should present technical conclusions derived from technical data. If products or services are described, all reported capabilities, features or benefits, and performance parameters must be substantiated by data or by an acceptable explanation as to why the data are unavailable (e.g., incomplete, not collected, etc.) and, if it will become available, when. The explanation for unavailable data will be considered by the Program Committee chairperson and/or technical reviewers selected by the Program Committee chairperson to ascertain if the presentation is acceptable without the data. Serious consideration should be given to withholding submissions and presentations until the data are available, as only those conclusions that might be reasonably drawn from the data may be presented. Claims of benefit and/or technical conclusions not supported by the presented data are prohibited.

2.3 Trade Names

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

2.4 "Industry Practice" Statements

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

2.5 Ranking

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

2.6 Proprietary Information (See also 2.2.)

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

2.7 Capabilities

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

3. GRAPHICS

3.1 Purpose

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

3.2 Source

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

3.3 Company Identification

Names or logos of agencies or companies supplying goods or services must not be the focal point of the slide. Names or logos may be shown on each slide so long as they are not distracting from the overall presentation.

3.4 Copies

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

4. INTERPRETATION AND ENFORCEMENT

4.1 Distribution

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

4.2 Assessment Process

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

4.3 Author Awareness

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

4.4 Monitoring

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

4.5 Enforcement

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

4.6 Penalties

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

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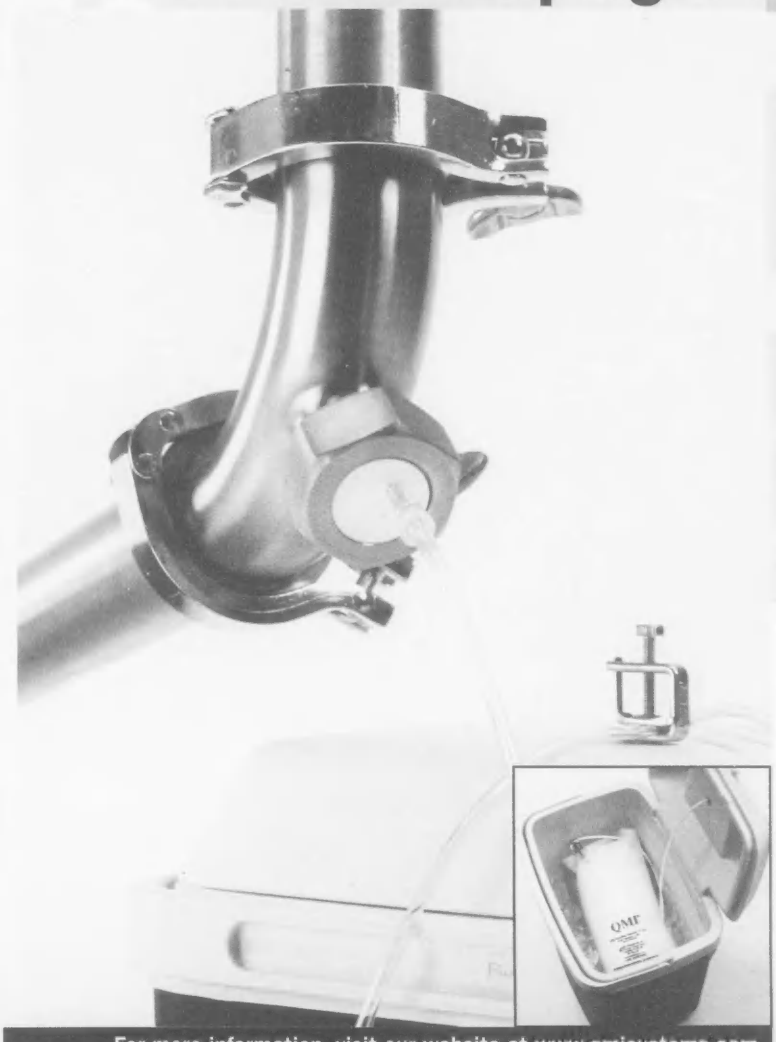

You work hard to run a clean and healthy dairy operation. Get maximum profits for all that effort by using the QMI Line and Tank Sampling System. The benefits are:

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Award Nominations

The International Association for Food Protection welcomes your nominations for our Association Awards. Nominate your colleagues for one of the Awards listed below. You do not have to be an IAFP Member to nominate a deserving professional. To request nomination criteria, contact:

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

Nominations deadline is March 12, 2007.

You may make multiple nominations. All nominations must be received at the IAFP office by **March 12, 2007.**

- Persons nominated for individual awards must be current IAFP Members. Black Pearl Award nominees must be companies employing current IAFP Members. GMA-FPA Food Safety Award nominees do not have to be IAFP Members.
- Previous award winners are not eligible for the same award.
- Executive Board Members and Awards Committee Members are not eligible for nomination.
- Presentation of awards will be during the Awards Banquet at IAFP 2007 – the Association's 94th Annual Meeting in Lake Buena Vista, Florida on July 11, 2007.

Nominations will be accepted for the following Awards:

Black Pearl Award

Award Showcasing the Black Pearl, *Sponsored by Wilbur Feagan and F&H Food Equipment Company*

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

Fellow Award

Distinguished Plaque

Presented to Member(s) who have contributed to IAFP and its Affiliates with distinction over an extended period of time.

Honorary Life Membership Award

Plaque and Lifetime Membership in IAFP

Presented to Member(s) for their dedication to the high ideals and objectives of IAFP and for their service to the Association.

Harry Haverland Citation Award

Plaque and $1,500 Honorarium, *Sponsored by Zep Manufacturing Co.*

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

Harold Barnum Industry Award

Plaque and $1,500 Honorarium, *Sponsored by Nasco International, Inc.*

Presented to an individual for dedication and exceptional service to IAFP, the public, and the food industry.

Elmer Marth Educator Award

Plaque and $1,500 Honorarium, *Sponsored by Nelson-Jameson, Inc.*

Presented to an individual for dedicated and exceptional contributions to the profession of the Educator.

Sanitarian Award

Plaque and $1,500 Honorarium, *Sponsored by Ecolab Inc.*

Presented to an individual for dedicated and exceptional service to the profession of Sanitarian, serving the public and the food industry.

Maurice Weber Laboratorian Award

Plaque and $1,500 Honorarium, *Sponsored by Weber Scientific*

Presented to an individual for outstanding contributions in the laboratory, recognizing a commitment to the development of innovative and practical analytical approches in support of food safety.

International Leadership Award

Plaque, $1,500 Honorarium and Reimbursement to attend IAFP 2007, *Sponsored by Cargill, Inc.*

Presented to an individual for dedication to the high ideals and objectives of IAFP and for promotion of the mission of the Association in countries outside of the United States and Canada.

Food Safety Innovation Award

Plaque and $2,500 Honorarium, *Sponsored by 3M Microbiology*

Presented to a Member or organization for creating a new idea, practice or product that has had a positive impact on food safety, thus, improving public health and the quality of life.

GMA-FPA Food Safety Award

Plaque and $3,000 Honorarium, *Sponsored by GMA-FPA*

This Award alternates between individuals and groups or organizations. In 2007, the award will be presented to a individual in recognition of a long history of outstanding contributions to food safety research and education.

NEW MEMBERS

AUSTRIA

Gerald Gutshcer
Romer Labs Diagnostic GmbH
Tulln

AUSTRALIA

Elizabeth Dean
Food Standards Australia
New Zealand
Canberra BC, ACT

Edward J. Jansson
NSW Food Authority
Silverwater, New South Wales

Ian Stephens
Fig Tree Pocket
Queensland

CANADA

Theresa Almonte
SGS Canada Inc.
Vancouver, British Columbia

Mauricio Arcila
Cargill
Etobicoke, Ontario

Lerrin French
3M Canada Company
London, Ontario

Nancy Metcalfe
3M Canada Company
London, Ontario

Andrew L. Moore
Effem Inc.
Bolton, Ontario

Susan Muigai
Wal-Mart Canada Corp.
Mississauga, Ontario

Craig Nowakowski
Vancouver Island Health Authority
Victoria, British Columbia

Caroline Pellerin
3M Canada Company
London, Ontario

Anna Piesik
FoodAssure Laboratory Ltd.
Vancouver, British Columbia

Stacey R. Ross
3M Canada
London, Ontario

Fred Ruf
Ministry of Health & Long Term Care
Toronto, Ontario

Liz Samis
Canadian Pork Council
Ottawa, Ontario

Dwayne Stroh
Vancouver Island Health Authority
Courtenay, British Columbia

Evelyn Lois Van Es
Nestle Purina
Innisfail, Alberta

Christian Vogl
Shafer-Haggart, Inc.
Vancouver, British Columbia

Wendy L. Wilkins
University of Saskatchewan
Dundurn, Saskatchewan

Steve Wittig
The Steritech Group
Milton, Ontario

Iain Wright
Guelph Food Technology Centre
Guelph, Ontario

FINLAND

Saija Jokela
University of Helsinki
Helsinki

FRANCE

Claude Mabilat
bioMérieux
Grenoble

GREECE

Kiriaki Panagiotidou
Hellenic Catering
Thessaloniki

JAPAN

Kunihiro Kubota
National Institute of Health Sciences
Tokyo

NEW ZEALAND

Karen De Lacy
AgriQuality Limited
Auckland

PAKISTAN

Rashida Ali
University of Karachi
Karachi, Sindh

PORTUGAL

Maria Teresa S. Felicio
Escola Superior Biotecnologia
Lisboa

SAUDI ARABIA

Ibrahim S. Al-Mohizea
Saudi Food and Drug Authority
Riyadh

SOUTH KOREA

Jeong Do-Yeong
Chonbuk National University
Jeonju, Jeonbuk

Jeong Eun-Jeong
Chonbuk National University
Jeonju, Jeonbuk

NEW MEMBERS

SoYun Jun
Kyungpook National University
Daegu, Kyungpook

Yunhwa Kim
Kyungpook National University
Deagu, Kyungbug

Ju-Woon Lee
Advanced Radiation Research Institute
Jeongeup, Jeon-Buk

Soo Jung Lee
Ewha Womans University
Seoul

Sangsuk Oh
Ewha Womans University
Seoul

Jeong Pyeong-Hwa
Chonbuk National University
Jeonju, Jeonbuk

UNITED KINGDOM

Steve D. Garrett
Campden & Chorleywood Food Research Association
Chipping Campden, Gloucestershire

UNITED STATES

ARKANSAS

Amanpreet Brar
Nestle Prepared Foods
Jonesboro

CALIFORNIA

Paul E. Gargan
Gen-Probe Incorporated
San Diego

Lauretta Johnson
Gen-Probe International
San Diego

Thilde Peterson
Senz-It, Inc.
Newport Beach

Akiko Tagawa
Quality FACTS, LLC
Beverly Hills

Lily Wong
Applied Biosystems
Foster City

GEORGIA

Troy R. Jones
TFIS
Statesboro

Claud E. Williams, Jr.
Masterfoods USA
Albany

IDAHO

Steven W. Mesia
New Albertsons, Inc.
Boise

ILLINOIS

Don Cameron
Kim Laboratories, Inc.
Champaign

Robert J. Gerdes
Illinois Institute of Technology
Summit

Myung L. Kim
Kim Laboratories, Inc.
Champaign

Bob Loerop
Regal Packaging Services
Glen Ellyn

Kathleen M. Morlok
Kim Laboratories, Inc.
Champaign

KANSAS

Scott Goltry
Cargill
Wichita

KENTUCKY

Mary G. Roseman
University of Kentucky
Lexington

MARYLAND

Alan Taylor
State of Maryland
Baltimore

MICHIGAN

Craig K. Harris
Michigan State University
East Lansing

MINNESOTA

Mike Hughes
3M Microbiology
St. Paul

Erin L. Mertz
Ecolab, Inc.
Eagan

Lori Pommer
3M Microbiology
St. Paul

Rick Underberg
Abeln, Magy, Underberg & Associates
Wayzata

MISSOURI

Barry Wiseman
Triumph Foods
St. Joseph

NEW YORK

Alan Bronstein
Certified Laboratories, Inc.
Plainview

Patricia Wood
Cornell University
Ithaca

NEW MEMBERS

NORTH CAROLINA

Kofi Adu-Nyako
North Carolina A & T State University
Greensboro

Dina Austin-Scott
The Steritech Group, Inc.
Charlotte

NORTH DAKOTA

Ellen M.L. Johnson
North Dakota State University
Fargo

OHIO

Lynn R. Bingham
Aelly, Inc.
Medina

Stephanie Campbell
Nestle USA
Dublin

OREGON

Jeffrey L. Cawley
NW Analytical, Inc.
Portland

Cheryl I. Ensign
Bear Creek Operations
Medford

Bill Snutny
PML Microbiologicals
Wilsonville

PENNSYLVANIA

Keith E. Hay
PA Milk Marketing Board
Fairhope

Kyle Olds
Verdelli Farms
Etters

SOUTH CAROLINA

Jonathan Wheeler
Microbac Laboratories, Inc.
New Ellenton

TENNESSEE

Sumalee Liamthong
University of Tennessee
Knoxville

James Nokes
Microbac Laboratories, Inc.
Maryville

NEW GOLD SUSTAINING MEMBERS

Russell Flowers
Silliker
Homewood, IL, USA

(This membership was previously a Silver Sustaining Member)

Michael C. Robach
Cargill
Minneapolis, MN, USA

UPDATES

Steritech Makes Organizational Management Changes

The Steritech Group, Inc., a provider of specialized brand protection services, has announced several appointments within its executive management team.

Rich Ennis has been named president and chief operating officer of both the company's food safety and pest prevention divisions. Mr. Ennis has held the post of president and COO of the food safety division for the past year, increasing revenues by more than 20 percent while at the same time expanding service capabilities and improving quality.

Eric Eicher, one of the company's founders and formerly president and COO of the pest prevention division, has been charged with exploring alternative growth strategies for the company, which has until recently focused primarily on organic growth. In his new role, he will seek out acquisitions and market partnerships to leverage Steritech's position as a leader in both the food safety and pest prevention industries.

Lorri MacHarg, a six-year Steritech veteran with experience in management, auditing and quality assurance, has been promoted to vice president of operations for the food safety division. In this newly created position, she will oversee and have responsibility for the day-to-day operations for the division.

Silliker Promotes Heather Hawke

Heather Hawke was promoted to technical sales manager at Silliker, Inc. and will be based at the organization's Cypress, CA, operation. She most recently served as a senior client service representative at the company's Columbus, OH facility.

Farr APC Appoints Dauber to North American Sales Manager, Frungillo and Baker to Specialized Posts

Farr Air Pollution Control (APC), a manufacturer of dust collection equipment for indoor air quality (IAQ) control and product recovery, has announced the promotion of John Dauber to North American sales manager.

Mr. Dauber brings 15 years of related experience to this newly created post. He joined Farr APC in 1998 as a regional sales manager. Prior to that, he held a range of sales engineering and sales management posts in the dust collection industry. In his new position, Mr. Dauber will be responsible for Farr APC dust collection equipment sales throughout North America and will oversee the company's US regional sales managers, Canadian sales engineers and representative and distributor networks.

The company has also appointed two other key sales managers to specialized management positions. Tomm Frungillo will serve as the new pharmaceutical market manager, and Al Baker as aftermarket HemiPleat product manager. Tomm Frungillo, Al Baker and John Dauber will all report to Farr APC president Lee Morgan.

Key Technology Promotes Ormand Hilderbrand to the New Position of Major Account Manager for ConAgra

Key Technology announces the promotion of Ormand Hilderbrand to the new position of major account manager for ConAgra. Mr. Hilderbrand is responsible for the global success of Key's relationship with ConAgra. He will work closely with ConAgra to develop and execute joint Key/ConAgra strategic plans.

"At Key, we recognize the value of building strategic relationships with our customers. Our strategic accounts program formalizes our approach to developing much more than basic vendor relationships. We're interested in fostering partnerships and we're investing significant resources to tailor products and services on behalf of those partnerships. Ormand has the skills and experience to deliver tremendous value to ConAgra. We're thrilled he's joined the Strategic Account team," noted John Boutsikaris, senior vice president sales and marketing with Key.

Mr. Hilderbrand joined Key Technology in 2000 as market development director and most recently served as sales manager for China/Korea and was responsible for establishing Key's new office in Shanghai. With more than 25 years experience in the food industry around the world, including consulting to ConAgra, Hilderbrand has a deep understanding of the industry and a broad global vision. He holds a bachelors of science degree from Oregon State University and a masters in international business from the American Graduate School of International Management.

As major account manager with ConAgra, Hilderbrand is accountable for the global success of Key's relationship with ConAgra. He will work directly with senior management at ConAgra to gain knowledge to help establish shared strategic directions. He will build and lead a multi-discipline, results-driven ConAgra major account team at Key to drive projects through Key's processes to ensure successful execution and implementation. He will also work directly with the Key field sales force to assure consistent implementation of the account strategy.

Developing a School Food Safety Program Participant's Workbook

Developing a food safety program for your district may sound challenging, but it doesn't have to be difficult. The term 'HACCP' can be intimidating to some. However, the modified Process Approach used in this training resource incorporates all of the principles of HACCP. You don't need to be concerned with the term or with the application of the individual HACCP principles, or the measures to control or prevent food safety hazards, because they are woven into the Process Approach.

The modified Process Approach is a streamlined, practical system that you can apply to your food service operation. Basing your program on this approach will provide a food safety program that is consistent with the USDA Guidance for School Food Authorities: Developing a School Food Safety Program Based on the Process Approach to HACCP Principles.

To help you develop your food safety program, Developing a Food Safety Program provides various training tools, worksheets, and templates for implementing a food safety program. The National Food Service Management Institute (NFSMI) developed these materials in cooperation with the USDA Food and Nutrition Service's Child Nutrition Division and the Food Safety Unit. For information specific to the implementation of the guidance in your state, contact your state agency.

The complete document is available at: http://www.nfsmi.org/Informationdeveloping_food_safety_program/developing_fs_wkbk.pdf.

Purdue University Creates New Low-cost System to Detect Bacteria

Researchers at Purdue University have developed a new low-cost system that analyzes scattered laser light to quickly identify bacteria for applications in medicine, food processing and homeland security at one-tenth the cost of conventional technologies.

The technique – Bacteria Rapid Detection Using Optical Scattering Technology – works by shining a laser through a petri dish containing bacterial colonies growing in a nutrient medium.

"Unlike conventional methods, we don't have to do any biochemical staining, DNA analysis or other types of manipulation," said Bartek Rajwa, a staff scientist at the Bindley Bioscience Center in Purdue's Discovery Park, the university's hub for interdisciplinary research.

Particles of light, called photons, bounce off of the colony, and the pattern of scattered light is projected onto a screen behind the petri dish. This "light-scatter pattern" is recorded with a digital camera and analyzed with sophisticated software to identify the types of bacteria growing in colonies.

"There are potentially thousands of applications for this new technology, from identifying stem cells to drug-resistant staph infections to pathogens on the battlefield," said J. Paul Robinson, a researcher at the Bindley Center and a professor in the Weldon School of Biomedical Engineering and the School of Veterinary Medicine.

The work was initiated by Arun Bhunia, a professor of food microbiology in the Department of Food Science; and E. Daniel Hirleman, a professor and William E. and Florence E. Perry, head of Purdue's School of Mechanical Engineering. Findings are detailed in a research paper appearing this month in the *Journal of Biomedical Optics*.

Hirleman has specialized in research to develop new types of sensors that work by analyzing light scattering off objects for applications such as detecting impurities on silicon wafers in computer chip manufacturing and measuring the size and speed of fuel droplets in jet engines.

"We adapted some ideas from that research to build a scatterometer for food safety, and now we're using the second generation of that instrument," Hirleman said. "A major motivation for the research is to reduce the time it takes for industry to identify harmful organisms in food processing. Scientists in food-processing plants routinely grow cultures to test for dangerous pathogens."

"The dairy industry, for example, grows bacteria on petri dishes to make sure products are safe, but industry is trying to develop technologies that will very quickly identify organisms," Robinson said. "The same sort of thing holds true for clinical microbiology and other laboratories. With our light-scattering method, it takes less than five minutes to identify harmful organisms after they have

grown in a petri dish. The analysis is faster than any other methods in existence, and it's simple."

The technique might be used to identify staph infections that are resistant to antibiotics.

"This is an extremely dangerous infection, and you want to catch it as early as possible," Robinson said.

A mass-produced system based on the technology would consist of inexpensive, off-the-shelf hardware, such as red lasers and low-resolution digital cameras available at consumer electronics stores, and likely would cost less than $1,000, Hirleman said.

A critical part of the technique was made possible by adapting a mathematical method created in 1934 by Dutch physicist Fritz Zernike, who created a set of mathematical "descriptors" subsequently called radial Zernike polynomials. These descriptors can be used to analyze how light-wave patterns are distorted after passing through lenses having complex flaws or aberrations. Individual bacterial colonies growing in a petri dish also distort light passing through them, just as a lens changes light-wave patterns. "Therefore, we can treat the colonies as lenses and use Zernike polynomials," Rajwa said.

Factors such as the shape of bacteria, their refractive indexes – or how much they bend light – the types of substances secreted by a particular bacterium and the distance between individual bacteria in a colony, all contribute to how a colony distorts light. The procedure identifies a bacterial colony by comparing an image of its scatter pattern against a template that contains 120 features described by Zernike polynomials.

"A good analogy is the method used by law enforcement to identify a person's face using specialized recognition software," Rajwa said. "You could describe the face as being made up of a combination of geometric shapes, like ovals, squares and triangles, but each face has a unique blend of these shapes. We did something similar. We reduced complicated scatter patterns to 120 numbers based on Zernike polynomials."

This reduced collection of numbers describes how well the colony fits the template, and then pattern recognition software is used to classify the bacteria.

"One of the most important developments is being able to convert images to numbers, which makes it possible to classify the patterns," Rajwa said. "We are able to take images and convert them to numbers that uniquely describe every picture."

The researchers used the new system to classify six species of *Listeria*, only one of which is a dangerous foodborne pathogen for humans.

"If you have a mixture of different *Listeria*, you would like to know which is the one that can kill you," Rajwa said. "We took pictures of the scatter patterns from different *Listeria*, and we were able to classify all of them accurately."

The system also was able to accurately identify other types of bacterial colonies, including *Salmonella*, *Vibrio*, *E. coli* and *Bacillus*.

"We were able to classify bacterial colonies with greater than a 90 percent probability of being correct, which is as good as you could do with equipment costing more than $100,000," Rajwa said. "And, unlike conventional systems, our method is 100 percent non-invasive, which means we can carry out the procedure without staining, manipulating or killing the biological samples."

"The power of this technology is that it does not require complicated lab equipment, and it could be designed so that it wouldn't require someone with a doctoral degree to operate. The whole beauty of the system is you don't invade the biological environment that you want to measure," Rajwa said. "If you are working with stem cells, you don't want to stain them to see if they are stem cells. You want to be able to look at colonies on a petri dish without touching the colonies, without staining or destroying the colonies."

The research has recently received funding from the US Department of Agriculture through Purdue's Center for Food Safety Engineering. Further work will include research to develop a graphical user interface.

"Now it requires a qualified, trained person to do all the recognition," Rajwa said. "We want a system where you can actually put a petri dish or some other container into the system, you press enter and the computer says, 'This is *Salmonella* of this type and this strain' and it does this quickly in real time. There is absolutely no fundamental reason why we wouldn't be able to do this, and we are pretty close to having an actual prototype of a product that could be commercialized."

A provisional patent has been filed for the data-processing technique, and a full patent application has been filed on the underlying light-scattering technology.

The paper published in the *Journal of Biomedical Optics* was written by Bulent Bayraktar, a postdoctoral researcher working with Robinson; Padmapriya P. Banada, a postdoctoral researcher in the Department of Food Science; Hirleman, Bhunia, Robinson and Rajwa.

Reducing *Salmonella*: Commission Sets EU Targets for Laying Hens and Adopts New Control Rules

The European Commission has adopted two Regulations aimed at reducing and controlling the prevalence of *Salmonella* in poultry and eggs across the EU. The first Regulation lays down targets for the reduction of *Salmonella* in laying hens, which in turn should lead to less *Salmonella* contamination in eggs. Every Member State will have to work towards reducing the number of laying hens infected with *Salmonella* by a specific minimum percentage each year, with steeper targets for Member States with higher levels of *Salmonella*. The first target deadline is set for 2008, although Member States will have to submit national control programs on *Salmonella* reduction in laying hens to the Commission by early 2007. The second Regulation adopted by the Commission sets out rules on the methods used to control *Salmonella* in poultry, including mandatory vaccination from 2008 onwards for laying hens in Member States with a *Salmonella* prevalence of 10% or more. In addition to the 2 Regulations adopted, the Commission is also currently looking into the possibility of introducing a trade ban on eggs from *Salmonella*-infected flocks as soon as possible. This is in light of the recent findings in the preliminary EFSA report on *Salmonella* levels in laying hens. A Commission proposal for certain trade restrictions has already been presented to Member States and the options will be discussed further with national food safety experts in the autumn.

Markos Kyprianou, commissioner for Health and Consumer Protection said, "*Salmonella* is one of the most prevalent foodborne diseases in the EU, affecting thousands of people every year, sometimes with very serious consequences. However, simple measures can greatly cut down the risk this disease poses to public health. Reducing the incidence of *Salmonella* at farm level will lower its incidence through the rest of the food chain, and help meet the ultimate objective of protecting EU consumers. For this reason, I urge all Member States to do their utmost to meet the targets we have set."

Today's Regulation setting targets for *Salmonella* reduction in laying hens is part of the overall EU strategy to reduce foodborne diseases and is in line with a timetable for drawing up *Salmonella* reduction targets for different animal species, which was set out in the Zoonoses Regulation 2160/2003 (see IP/03/1306). The targets were drawn up on the basis of the recent European Food Safety Authority (EFSA) report, which found *Salmonella* levels in laying hens to range between 0% and 79% across the EU. Member State experts have already endorsed the reduction targets in the Standing Committee on the Food Chain and Animal Health.

Meeting the targets laid down in today's Regulation will help operators to avoid having their products banned from the market in the future. Under the Zoonoses Regulation, it is foreseen that from 2010 onwards, eggs from *Salmonella*-infected flocks will be banned completely from being sold as table eggs in the EU, and will have to undergo a sterilization procedure if they are to be used for processing into egg products. The Commission, together with Member States, is now considering the feasibility of accelerating the ban on marketing eggs from *Salmonella*-infected flocks. Initial discussions on this issue have revealed generally strong Member State support for some sort of trade ban in the near future, and the Commission will look at the options with national food safety experts in September, with a view to reaching agreement as quickly as possible.

It is therefore in the interest of Member States to reduce the levels of *Salmonella* in their live flocks to the greatest possible extent, in order to avoid the heavy impact these measures could have on the poultry and egg industry. Today's Regulation setting out targets for the reduction of *Salmonella* in laying hens provides the basis for Member States to achieve this.

Under the Regulation, the following annual percentage reduction targets are set for *Salmonella* in laying hens:

- 10% reduction if the prevalence of *Salmonella* in the preceding year was below 10%
- 20% if the prevalence of *Salmonella* in the preceding year was 10–19%
- 30% if the prevalence of *Salmonella* in the preceding year was 20–39%
- 40% if the prevalence of *Salmonella* in the preceding year was over 40%

The ultimate target is to achieve a reduction in *Salmonella* levels to 2% or less. By setting incremental percentage reductions, the aim is to ensure particularly rapid progress in those Member States with a higher incidence of *Salmonella* in laying hens. The Regulation also sets out requirements for sampling and testing for *Salmonella* in laying hens, as well as the procedures for reporting results, in order to ensure that

progress on reaching the set targets can be properly monitored. The Regulation adopted will apply from August 1, 2006, and national authorities will have 6 months from that date to submit national control programs to the Commission for approval and for EU funding.

Similar targets have already been set at EU level for breeding hens and the European Commission will bring forward separate targets to reduce *Salmonella* in broiler hens, turkeys and certain types of pigs in the coming years.

The Commission also adopted a Regulation setting out the rules for certain control measures used to reduce *Salmonella* in poultry, notably vaccines and antimicrobials. From January 1, 2008, all Member States with *Salmonella* prevalence above 10% will have to vaccinate their laying hens against *Salmonella*, in order to reduce the spread of the disease and the contamination of eggs. The vaccinations used must be authorized at EU level, and must be distinguishable from the field bacteria during sampling and testing. National authorities may exempt a holding from this vaccination requirement provided satisfactory preventive measures are being applied or there has been no incidence of *Salmonella* on the holding over the previous 12 months.

With regard to antimicrobials, an EFSA opinion recommended that their use for *Salmonella* control in livestock should be discouraged, due to the public health risks associated with development, selection and spread of antimicrobial resistance. In addition, if poultry is treated with antibiotics, the detection of *Salmonella* is difficult, which could lead to a hidden infection in the flock. Therefore, today's Regulation states that antimicrobials should not be used as part of national control programs for the control of *Salmonella*, except under very limited circumstances.

For more information, see: http://ec.europa.eu/food/food/biosafety/salmonella/index_en.htm.

Food Expiration Dates Affect Perception of Freshness

As food manufacturers move away from expiration dates and use "best if used by" dates on foods instead, research shows that consumers turn their noses up as the "best if used by" date approaches — and not because of the food's perceived safety. Researchers asked 36 panelists to evaluate different types of yogurt with various "best if used by" dates, but no mention was made of the dates.

"We found that as the expiration dates approached or went by, the panelists' acceptance of the food diminished, as did their perceptions of the food's healthfulness and freshness," said Brian Wansink, a Cornell professor of marketing and of nutritional sciences, who conducted the study with Alan Wright, director of the US Army Natick Soldier Center's sensory laboratory. "It appears that it's the food's perceived freshness rather than its safety that is the driving factor."

Foods labeled as fresh were not rated any more acceptable than those without a freshness label.

Wansink said that the results imply there may be more for a manufacturer to lose than to gain by having decided to use "freshness dating" in the first place.

The study was published in the May issue of the *Journal of Food Science* (Vol. 71:4).

Researcher: Food Safety Could be Enhanced through 'Smart' Packaging

Research into one way to reduce foodborne illnesses has earned a doctorate degree in food science and technology for a Texas A&M University researcher.

Dr. Jaejoon Han studied how packing vegetables in plastic bags coated with a natural antimicrobial agent and then processing them under electronic beam irradiation can reduce amounts of foodborne pathogens.

About 76 million cases of foodborne illnesses occur in the United States every year, according to the Centers for Disease Control and Prevention. Although some cases are serious enough to require hospitalization or even cause death, most cases are mild.

Even mild cases of foodborne illness can cause a couple of days' worth of misery. That's why Han has spent the last few years studying how to prevent it.

"My research started from ready-to-eat vegetables... from minimally processed vegetables," Han said.

"These vegetables, including pre-packaged greens for salads, have a short shelf life and are most often eaten straight from the package without the need for cooking," he said.

"That means they are a prime place for foodborne pathogens – such as *Listeria* and *E. coli* – to grow," said Dr. Elena Castell-Perez, committee chair of Han's research. A Texas Agricultural Experiment Station researcher, Castell is a professor of food engineering at Texas A&M.

Han wanted to determine ways to prevent foodborne illnesses by killing the pathogens before they could contaminate foods. For this study he used romaine lettuce, a common target of pathogens.

"Our research group worked with the electronic beam irradiation," he said. "It's (a form of) non-thermal food processing so it would not alter the quality attributes of the lettuce. We also combined irradiation treatment with packaging material I devised."

This special kind of packaging material was ordinary plastic wrap/plastic bags that had been coated with a natural antimicrobial agent.

"I put the romaine lettuce inside (the plastic bag) and applied irradiation energy," Han said. "I found the microbial growth was greatly suppressed. The color and texture (of the lettuce) were not damaged by the irradiation."

"Both the plastic packaging and the antimicrobial agent Han used have been approved by the US Food and Drug Administration," Castell added.

"It's what they call 'smart packaging,'" she said, "when the packaging does something to improve or maintain the safety of the food."

"Han measured the quality, such as texture and color, and chemical aspects of the lettuce to make it remain safe," Castell said.

What he found was that the treated packaging allowed the pathogens to be killed with a smaller dose of irradiation.

"Although more research is needed," Castell said, "Han's research laid the groundwork for other researchers."

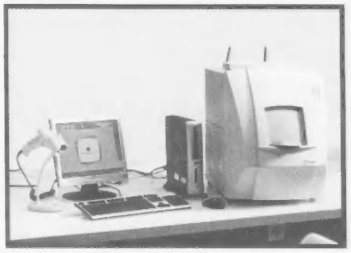
"Hopefully by getting his research out, it will help educate other people about the (scientifically based) benefits of electron beam irradiation technology," she said.

And eventually, his research could help eliminate many cases of foodborne illnesses.

He may be able to further that goal in his new position as a researcher in the department of packaging science at Clemson University in South Carolina. He starts his new duties later in the fall.

www.foodprotection.org

INDUSTRY PRODUCTS



bioMérieux, Inc.

bioMérieux Unveils TEMPO®, the First Automated Quality Indicator Testing System for the Food Industry

bioMérieux, Inc., an industrial microbiology and diagnostics company, announces the launch of TEMPO®, an industry-first for the food market. TEMPO is the food industry's first automated quality indicator testing system for the enumeration of quality indicator organisms in food and environmental samples. The system was designed to help food companies and laboratories conduct their work more accurately and efficiently with the benefits of automation.

TEMPO automates testing for total viable counts, coliform counts, generic *E. coli*, and *Enterobacteriaceae*. Testing for these organisms is important to a food quality laboratory for determining overall product hygiene and also as an indication of product spoilage. If there is an unacceptable level of these organisms in a facility's food products, it can lead to a negative financial impact. Automation helps to standardize numerous preparation steps, interpretation, and test results. This process can dramatically improve workflow and enables the lab technician more time to focus on other activities, leading to labor savings.

"Quality indicator testing is sometimes referred to as 'routine indicator testing.' We designed TEMPO to help a food facility change the 'tempo' of their work and change their routine by using a new useful tool for the testing of their quality indicator organisms," explained Herb Steward, bioMérieux's senior vice president of North American Commercial Operations. "The TEMPO takes a routine, labor-intensive test and automates it, which provides a great deal of value to the laboratory. The improved workflow allows the lab to better synchronize their production schedule and product release from inventory."

Lab automation is growing at a rapid pace due to the added benefits for the facility in terms of productivity and performance. By automating previously time-consuming tasks, lab technicians have more time to be proactive with quality assurance programs, HACCP (Hazard Analysis Critical Control Point) plans, training, and analysis. The rapid results achieved with automated systems allow the customer's product to be released earlier, thereby increasing cash flow for the organization.

bioMérieux, Inc.
800.638.4835
Hazelwood, MO
www.biomerieux.com

Wright Pump Announces Its TRA® 500 Series

Wright Pump announces the introduction of its innovative TRA®500 Series of Sanitary Centrifugal Pumps that feature stainless steel flange adapters. Providing operational reliability, low noise, and superior performance, these robust pumps also offer polished exterior surfaces and no weld inlet and outlet clamp connections on most models. Wright Pump's exclusive, patent pending Softsterile™ seal flushing system (for use on high purity water) eliminates all external flush piping loops and their multiple connections, significantly reducing the possibility of contamination. For ease of maintenance, the TRA®500 series of pumps offers integral inlet/outlet in the housing for easy back pull-out servicing. In addition, the pumps offer one mechanical seal size that fits all models through 30 HP. The TRA®500 series centrifugal is designed to be a better solution and drop-in replacement for the Fristam FPX and FPR pumps.

"The TRA®500 pump series provides customers with 14 sizes and many options to ensure the right pumping solution to precisely match your application needs and offer the highest levels of performance across a broad range of applications," said Tom Holdorf, Wright's vice president of engineering. "With Wright's pumps, you achieve a lower total cost of ownership due to product enhancements, such as stainless steel flange adapters (standard), polished exterior surfaces

(no "as cast" surfaces), back pull-out design reduces and simplifies maintenance. The commonality of parts also helps reduce inventory requirements."

The TRA®500 Series has capacity up to 900 GPM (210 M/Hr), pressure to 190 PSI (13 Bar), viscosity to 2,700 SSU (600 cPs), and can be used in temperatures up to 380°F (195°C). The pumps are well-suited to multiple applications, including beverages, dairy, candy, oils, personal care, cosmetics, pharmaceuticals, and biotech. Heavy-wall, cast 316L stainless steel construction extends service life and minimizes vibration.

Wright Pump
262.679.8000
Muskego, WI
www.wrightpump.com

SDI's RapidChek® SELECT™ *Salmonella* Product Approved by AOAC

Strategic Diagnostics Inc., a provider of biotechnology-based detection solutions for a broad range of food, water, agricultural, industrial, environmental and scientific applications announced that its new RapidChek® SELECT™ *Salmonella* product has earned performance tested certification from the AOAC Research Institute (# 080601) for use in raw meat, raw poultry, deli meats, liquid eggs and chicken carcass rinsates applications.

Salmonella is an important human pathogen which has been implicated as a major cause of illness worldwide. Each year, this organism is responsible for approximately 1.4 million cases of illness in the United States, 95% of which are contracted through foodborne transmission. With the FSIS division of the USDA announcing several changes to the agency's *Salmonella* verification testing program in February 2006, a strong focus has been placed on the increase in testing frequency in establishments with process control problems. This means that processing plants will need a dependable, accurate testing method that provides high sensitivity and specificity to ensure that effective monitoring and control of *Salmonella* is established. RapidChek® SELECT™ *Salmonella*, with patent pending phage enhanced media, offers advanced, reliable testing technology that is user friendly and will simplify a testing program without compromising sensitivity of the test.

"We believe the RapidChek® SELECT™ *Salmonella* test offers a clearly differentiated solution to our customers, with several advantages over competitive methods, including simplified media preparation, fewer transfer steps and less false positives that, for the customer, translate into reduced overall total cost in use," said Matthew H. Knight, president and CEO of SDI.

Strategic Diagnostics Inc.
800.544.8881
Newark, DE
www.sdix.com

An Excellent Choice for Sanitation Programs from Charm Sciences

Charm Sciences, Inc., is pleased to announce the release of FireFly-2, a palm sized luminometer built for speed, reliability and convenience.

The FireFly-2's ergonomic design is modeled on the same platform as the Charm novaLUM®. Both are light weight and run the same ATP hygiene tests, the PocketSwab® Plus and the WaterGiene® to validate sanitation effectiveness and water quality. The FireFly-2 and novaLUM provide an excellent choice in monitoring surface hygiene with greatly enhanced sensitivity over conventional ATP surface hygiene swabs.

The novaLUM has additional versatility. For example, it has an ATP-based test to assist with allergen control programs (AllerGiene®), and tests to verify thermal processing in dairy (Paslite™) and meat products (CHEF™ test).

All FireFly-2 tests are conveniently stored, tracked and trended by the dedicated FireLink™ software. The FireFly-2 stores 6,000 test results, and is configured to manage multiple sampling plans and surface types with a 1,000 test sites per single plan.

Like the novaLUM, the FireFly-2 delivers rapid and cost-effective monitoring of sanitation effectiveness. It utilizes a high speed data processor, a complete keyboard with a rocker, toggle switch, and a direct swab chamber entry design, ensuring the fastest pre-operational results which accelerates the production process. FireFly-2 is manufactured rugged to operate in the toughest environments.

Charm Sciences, Inc.
978.687.9200
Lawrence, MA
www.charm.com

Nilfisk-Advance America Highlights Heavy-duty Machines at Metalworking Show

Nilfisk-Advance America showcased a range of its powerful industrial vacuums at the 26th International Manufacturing Technology Show (IMTS 2006).

In response to diverse workplace safety and sanitation needs, Nilfisk showcased the Oil Vac 220 and IW 2050, designed specifically for the extended metalworking industries, and the newly launched SL Vacs, appropriate for multiple industrial applications.

The "workhorse" CFM Oil Vac 220 retrieves metal shavings, lubricants, and coolants, filters out debris, then pumps the purified fluids directly into the reservoir tank – all without leaving the sump. In addition, this vacuum performs all of these tasks simultaneously – cutting the time and effort it takes to reclaim fluids by 50%. The CFM Oil Vac line also includes the 440 model, which features a greater collection capacity, and the Oil 675, which is the largest model, and is ideal for cleanup of lathes, milling machines, and cutting and grinding machines.

The IW 2050 vacuum features a multi-stage filtration system designed to trap MWF aerosols, making it ideal for the metal removal process, changeout, deep machine sump cleaning, and general plant maintenance. With powerful dual motors and a 13-gallon tank capacity, its accessories are resistant to oil and water-based fluids. Standard accessories include a ten-foot hose, crevice nozzle, steel wand, floor tool, and utility tool.

Designed to meet the twin concerns of cost and performance, the SL Vacs feature solid construction and strong performance at an affordable price, making them a cost-effective solution for many companies in a range of industries. Lightweight and highly maneuverable, the SL Vacs feature rear swiveling wheels with locking brakes and a unique release lever, which lowers the wheeled collection container for fast and easy disposal of collected debris.

Nilfisk-Advance America
610.647.6420
Malvern, PA
www.nilfisk-advance.com

DuPont Qualicon Launches Real-Time PCR Assay for Detecting Three Species of *Campylobacter* in Poultry

DuPont Qualicon has released a new test for detecting *Campylobacter* in poultry that shortens PCR processing time and introduces quantified results by species. This new assay was designed specifically for the BAX® System Q7 instrument and takes advantage of powerful real-time PCR capabilities.

Using enhanced software and multiple probe technology, the BAX® System Q7 differentiates the presence of three species of harmful *Campylobacter* — *C. jejuni*, *C. coli* and *C. lari* — in a single test. Beyond detection, the system also determines concentration levels and reports the number of colony forming units per milliliter (CFU/mL) for each species in the sample.

Developed in alliance with Applied Biosystems, this BAX® System real-time PCR assay for *Campylobacter jejuni/coli/lari* enables the Q7 instrument to detect target concentrations as low as 10^4 CFU/mL, with or without a 24-hour enrichment period. Validated on ready-to-eat poultry and carcass rinses, the system can process up to 96 samples per batch in less than 90 minutes.

"Poultry processors now have a way to quickly find out if pathogenic *Campylobacter* are present in their products and at what levels. Compared with waiting up to five days for culture results, this new BAX® system assay can significantly speed up product release decisions in the poultry industry," said Kevin Huttman, president of DuPont Qualicon.

Campylobacter infection is the leading bacterial cause of diarrheal illness in the United States, affecting about 2.4 million people each year. Ingesting even low doses (less than 500 cells) can cause campylobacteriosis, with possible complications that include arthritis and Guillain-Barr syndrome. Infection is often a result of handling raw poultry or eating raw or undercooked poultry meat. Most cases of campylobacteriosis are caused by one species, *C. jejuni*, but *C. coli* and *C. lari* are also associated with human illness.

DuPont Qualicon
302.695.5300
Wilmington, DE
www.qualicon.com

AirOcare and Tyler Refrigeration Team to Distribute Patented Air Purification Technology

AirOcare has announced it has teamed with Tyler Refrigeration, a division of Carrier Commercial Refrigeration, to establish a new standard of care for food handling and food safety. Tyler will sell, install and service AirOcare's patented air purification equipment to food retailers and related wholesale food distribution businesses across North America, Central America, and the Caribbean Islands. Carrier Commercial Refrigeration is a unit of United Technologies Corp.

AirOcare equipment increases product shelf life, quality, and safety when applied to perishable food display cases, in-store coolers, food processing rooms, and wholesale distribution facilities. In independent laboratory and USDA tests, AirOcare's equipment has been proven to virtually eliminate molds, mildew, viruses, and bacteria, including *Salmonella* and *Listeria*. The AirOcare process generates oxygen radicals to purify air in a safe, effective, and efficient manner.

"AirOcare and Tyler are perfectly aligned to address the increasing demands of the food industry for improved food safety. The proven effectiveness of AirOcare's technology will enable Tyler to expand our product portfolio to improve the quality and safety of perishable foods sold by our customers," said Doug Bishop, director of marketing for Tyler.

In addition to its applications in the retail grocery and wholesale distribution industries for the safe and effective storage of produce, meats, seafood, and dairy products, the AirOcare equipment is used to reduce odors and contaminants in many other applications including food transportation on trucks, shipping containers, and rail cars; restaurants; commercial office buildings; food processing plants; and storage and transportation of flowers.

"Tyler's knowledge of refrigeration and cold storage equipment together with its extensive distribution network perfectly complements AirOcare's innovations in continuous air and surface sanitization. Together our companies will ensure the highest product quality, value, and safety for our customers all along the cold chain," said Jack Prouty, chief operating officer of AirOcare.

AirOcare Technology
888.368.2232
Rockville, MD
www.airocare.com

Neogen's New 24-hour *Listeria* Protocol Receives AOAC Approval

Neogen Corporation has received approval from the AOAC Research Institute for its new 24-hour environmental sample enrichment protocol for *Listeria*. Neogen's approved new enrichment protocol is for use with either its Reveal® for *Listeria* ELISA lateral flow assay or GeneQuence® *Listeria* microwell DNA probe assay. Both of Neogen's test systems for *Listeria* had been earlier AOAC-approved (Reveal #9607901, GeneQuence #010403); in both cases this new approval reflects the modification of the enrichment of environmental samples with Neogen's new LESS 24-hour single-step *Listeria* medium.

"It's gratifying any time a well-respected third party confirms the exceptional performance of our testing products," said Ed Bradley, Neogen's vice president of Food Safety. "This AOAC approval is particularly important because it verifies the validity of a significantly improved method of *Listeria* testing. The new LESS medium was shown to produce accurate results in only 24 hours, as opposed to other test systems that can take twice as long. In addition, because it is a single-step medium, LESS eliminates the time and effort associated with *Listeria* test systems that require multiple enrichment media."

Neogen's Reveal for *Listeria* provides a very easy method of screening environmental samples for the presence of the pathogen. Just add an enriched sample to the testing device, and a clear result is available in about 15 minutes.

GeneQuence *Listeria* and GeneQuence *Listeria monocytogenes* are assays that combine DNA hybridization technology with full automation capability to provide rapid, highly accurate results. GeneQuence's ability to test relatively few samples manually, or large numbers automatically, provides easy method standardization for companies with many testing facilities with varying test volumes.

In validation studies, LESS medium demonstrated superior recovery performance when used with swabs and sponges that sampled various environmental surfaces. LESS medium dramatically increased the recovery of stressed *Listeria* cells spiked onto the surfaces, and all positives detected with LESS were confirmed using the standard BAM culture method.

COMING EVENTS

NOVEMBER

- **1, Ohio Association of Food and Environmental Sanitarians,** Ohio Dept. of Agriculture, Reynoldsburg, OH. For more information, contact Gloria Swick-Brown at 614.466.7760; E-mail:gloria.swick-brown@odh.ohio.gov.
- **1–2, Sanitary Design for Equipment, Materials and Establishments,** Guelph Food Technology Centre, Guelph, Ontario, Canada. For more information, call 519.821.1246 or go to www.gftc.ca.
- **4–8, American Public Health Association's 134th Annual Meeting and Expo,** Boston, MA. For more information, call 202.777.APHA or go to www.apha.org.
- **6–8, Advanced Sanitation Workshop,** Randolph Associates, Inc., Raleigh, NC. For more information, call 205.595.6455 or E-mail HERConsult@aol.com.
- **6–8, The 4th World Mycotoxin Forum,** Hilton Cincinnati Netherland Plaza, Cincinnati, OH. For more information, call 31.30. 229 42 47; or go to www.bastiaanse-communication.com.
- **7–8, Cheese Grading and Evaluation Short Course,** University of Wisconsin-Madison, Madison, WI. For more information, contact Dr. Scott Rankin at 608.263.2008 or go to www.cdr.wisc.edu.
- **8, British Columbia Food Protection Association Meeting,** Hilton Hotel, Burnaby, British Columbia. For more information, contact Terry Peters at 604.666.1080; E-mail: terry_peters@telus.net.
- **8–10, The Dairy Practices Council's 37th Annual Conference,** Galt House Hotel and Suites, Louisville, KY. For more information, call 732.203.1947; E-mail: dairypc@dairypc.org.
- **9, Ontario Food Protection Association Meeting,** Mississauga Convention Center, Mississauga, Ontario, Canada. For more information, contact Gail Seed at 519.465.5674; E-mail:seed@golden.net.
- **9–11, Mexico Association for Food Protection Meeting,** Mexico Universidad de Guadalajara, Guadalajara, Mexico. For more information, contact Alejandro Castillo at 979.845.3565; E-mail: a-castillo@tamu.edu.
- **30–Dec. 1, IAFP's Second European Symposium on Food Safety, "Innovations in Food Safety Management,"** Fira Palace Hotel, Barcelona, Spain. For more information, contact IAFP at 800.369.6337; E-mail: info@foodprotection.org.

DECEMBER

- **4–8, Diploma in Food Hygiene and Safety,** Guelph Food Technology Centre, Guelph, Ontario, Canada. For more information, call 519.821.1246 or go to www.gftc.ca.

JANUARY

- **24–26, International Poultry Expo and International Feed Expo,** Georgia World Congress Center, Atlanta, GA. For more information, call 770.493.9401 or go to www.ipe07.org.

MARCH

- **20–23, ISOPOL XVI,** Marriott Riverfront Hotel, Savannah, GA. For more information, contact Terry Reamer at 240.485.2776; E-mail: terry.reamer@aphl.org.

IAFP UPCOMING MEETINGS

JULY 8-11, 2007
Lake Buena Vista, Florida

AUGUST 3-6, 2008
Columbus, Ohio

JULY 12-15, 2009
Grapevine, Texas

CAREER SERVICES SECTION

CAREER SERVICES SECTION

List your open positions in *Food Protection Trends*. Special rates for this section provide a cost-effective means for you to reach the leading professionals in the industry. Call today for rate information. Send your job ads to Donna Bahun at dbahun@foodprotection.org or to the Association office: 6200 Aurora Ave., Suite 200W, Des Moines, IA 50322-2864; Phone: 800.369.6337; 515.276.3344; Fax: 515.276.8655.

International Association for Food Protection®

The **Faculty of Health Sciences** of the **American University of Beirut** currently seeks for its **Department of Environmental Health** a faculty position in the area of Environmental Health Sciences with focus on: Environmental Microbiology and Food Quality Control.

Applicants should have a doctoral degree, teaching and research experience. Rank will depend on the teaching and research experience of the candidate. Visiting positions at all levels may be considered.

Successful candidates are expected to actively participate in undergraduate and graduate teaching, as well as to be involved in multi-disciplinary research in the Department, the Faculty, and as part of the Interfaculty Graduate Environmental Sciences Program (IGESP). For further information about AUB: URL: http://www.aub.edu.lb and FHS: http://fhs.aub.edu.lb

Interested candidates should submit a complete resume, statement of teaching and research interests and three letters of reference to:

Huda Zurayk, Dean, Faculty of Health Sciences, American University of Beirut, 3 Dag Hammarskjold Plaza, 8th Floor, New York, NY 10017-2303. Fax in Beirut +961-1-744470. E-mail: hzurayk@aub.edu.lb.

Deadline for receipt of applications is **January 15, 2007** for a starting date of **September 15, 2007.**

The American University of Beirut is an affirmative Action/Equal Opportunity Employer.

IAFP Members

Did you know that you are eligible to place an advertisement if you are unemployed and looking for a new position? As a Member benefit, you may assist your search by running an advertisement touting your qualifications.

CAREER SERVICES SECTION

Research Food Technologist
(GS 11/12/13)
USDA, Agricultural Research Service,
Eastern Regional Research Center
Food Safety Intervention Technologies
Research Unit
Wyndmoor, PA

The USDA, Agricultural Research Service, Food Safety Intervention Technologies Research Unit, is recruiting for a permanent full-time Research Food Technologist. This individual will serve as an independent scientist at the Eastern Regional Research Center, which is located on an attractive 27-acre campus just outside Philadelphia, in Wyndmoor, Montgomery County, Pennsylvania. Employees enjoy a flexible work schedule and have access to public transportation, and modern research instrumentation (microscopic imaging, magnetic resonance spectroscopy, and nucleic acid facility). The scientist will be responsible for development of nonthermal and advanced thermal intervention technologies to improve the safety and security of liquid egg products, while maintaining or improving product quality attributes. Research will involve studies encompassing food science and engineering, microbiology, chemistry, processing and packaging technology. Additionally, knowledge of statistical methodology and the ability to plan, conduct, and report research on food safety is required. Expertise in processing of liquid eggs or closely related areas is highly desirable. Salary is commensurate with experience, which ranges from $54,521 to $101,016 per year, plus benefits. U.S. Citizenship is required. For information on the position, visit http://www.afm.ars.usda.gov/divisions/hrd/vacancy/resjobs/...., or call Dr. Howard Zhang at 215-233-6582, e-mail address, hzhang@errc.ars.usda.gov. To obtain an application package, call Mary Ann Byrne at 215-233-6571. Incomplete applications will not be accepted. Applications must be marked ARS-X6E-0254 and postmarked by October 31, 2006.

USDA/ARS is an equal opportunity employer.

Research Food Technologist
(GS 11/12/13)
USDA, Agricultural Research Service,
Eastern Regional Research Center
Food Safety Intervention Technologies
Research Unit
Wyndmoor, PA

The USDA, Agricultural Research Service, Food Safety Intervention Technologies Research Unit, is recruiting for a permanent full-time Research Food Technologist. This individual will serve as an independent scientist at the Eastern Regional Research Center, which is located on an attractive 27-acre campus just outside Philadelphia, in Wyndmoor, Montgomery County, Pennsylvania. Employees enjoy a flexible work schedule and have access to public transportation, and modern research instrumentation (microscopic imaging, magnetic resonance spectroscopy, and nucleic acid facility). The scientist will be responsible for developing physical, chemical and/or biological-control intervention technologies to improve the safety and security of fresh and fresh-cut fruits and vegetables. Research will involve studies encompassing food microbiology, biochemistry, processing and packaging technology. Additionally, knowledge of statistical methodology and the ability to plan, conduct, and report research on food safety is required. Expertise in competitive exclusion, biological control or closely related areas is desirable. Salary is commensurate with experience, which ranges from $54,521 to $101,016 per year, plus benefits. U.S. Citizenship is required. For information on the position, visit http://www.afm.ars.usda.gov/divisions/hrd/vacancy/resjobs/ ...., or call Dr. Howard Zhang at 215-233-6582, e-mail address, hzhang@errc.ars.usda.gov. To obtain an application package, call Mary Ann Byrne at 215-233-6571. Incomplete applications will not be accepted. Applications must be marked ARS-X6E-0253 and postmarked by October 31, 2006.

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Journal of Food Protection®

ISSN: 0362-028X
Official Publication

International Association for Food Protection

Reg. U.S. Pat. Off.

Vol. 69 | September 2006 | No. 9

IT'S A FACT

IAFP 2006 had more than 1,700 attendees

ADVERTISING INDEX

WANTED

The editors are seeking articles of general interest and applied research with an emphasis on food safety for publication in *Food Protection Trends*.

Submit your articles to:

Donna Bahun, Production Editor
Food Protection Trends
International Association for Food Protection
6200 Aurora Ave., Suite 200W
Des Moines, IA 50322-2864, USA
E-mail: dbahun@foodprotection.org

IAFP Offers "Guidelines for the Dairy Industry" from The Dairy Practices Council®

This newly expanded Five-volume set consists of 80 guidelines.

1 Planning Dairy Freestall Barns
2 Effective Installation, Cleaning, and Sanitizing of Milking Systems
3 Selected Personnel in Milk Sanitation
4 Installation, Cleaning, & Sanitizing of Large Parlor Milking Systems
5 Directory of Dairy Farm Building & Milking System Resource People
6 Natural Ventilation for Dairy Tie Stall Barns
7 Sampling Fluid Milk
8 Good Manufacturing Practices for Dairy Processing Plants
9 Fundamentals of Cleaning & Sanitizing Farm Milk Handling Equipment
10 Maintaining & Testing Fluid Milk Shelf-Life
11 Sediment Testing & Producing Clean Milk
12 Tunnel Ventilation for Dairy Tie Stall Barns
13 Environmental Air Control and Quality for Dairy Food Plants
14 Clean Room Technology
15 Milking Center Wastewater
16 Handling Dairy Products from Processing to Consumption
17 Prevention of & Testing for Added Water in Milk
18 Fieldperson's Guide to High Somatic Cell Counts
21 Raw Milk Quality Tests
22 Control of Antibacterial Drugs & Growth Inhibitors in Milk and Milk Products
23 Preventing Rancid Flavors in Milk
24 Troubleshooting High Bacteria Counts of Raw Milk
25 Cleaning & Sanitation Responsibilities for Bulk Pickup & Transport Tankers
27 Dairy Manure Management From Barn to Storage
28 Troubleshooting Residual Films on Dairy Farm Milk Handling Equipment
29 Cleaning & Sanitizing in Fluid Milk Processing Plants
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31 Composition & Nutritive Value of Dairy Products
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33 Brucellosis & Some Other Milkborne Diseases
34 Butterfat Determinations of Various Dairy Products
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37 Planning Dairy Stall Barns
38 Preventing Off-Flavors in Milk
39 Grade A Fluid Milk Plant Inspection
40 Controlling Fluid Milk Volume and Fat Losses
41 Milkrooms and Bulk Tank Installations
42 Stray Voltage on Dairy Farms
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46 Dairy Odor Management
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49 Pre- & Postmilking Teat Disinfectants
50 Farm Bulk Milk Collection Procedures
51 Controlling the Accuracy of Electronic Testing Instruments for Milk Components
53 Vitamin Fortification of Fluid Milk Products
54 Selection of Elevated Milking Parlors
54S Construction Materials for Milking Parlors
56 Dairy Product Safety (Pathogenic Bacteria) for Fluid Milk and Frozen Dessert Plants
57 Dairy Plant Sanitation
58 Sizing Dairy Farm Water Heater Systems
59 Production and Regulation of Quality Dairy Goat Milk
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92 HACCP - Principle Number One: Hazard Analysis
93 HACCP - Principles 2 & 3 Critical Control Points & Critical Limits
97 Direct Loading of Milk from Parlor into Bulk Tankers
100 Food Safety in Farmstead Cheesemaking
101 Farmers Guide To Somatic Cell Counts In Cattle
102 Effective Installation, Cleaning & Sanitizing of Tie Barn Milking Systems
103 Approving Milk and Milk Product Plants for Extended Runs
105 Sealing Bulk Milk Truck Tanks

IAFP has agreed with The Dairy Practices Council to distribute their guidelines. DPC is a non-profit organization of education, industry and regulatory personnel concerned with milk quality and sanitation throughout the United States. In addition, its membership roster lists individuals and organizations throughout the world.

For the past 37 years, DPC's primary mission has been the development and distribution of educational guidelines directed to proper and improved sanitation practices in the production, processing, and distribution of high quality milk and milk products.

The DPC Guidelines are written by professionals who comprise six permanent task forces. Prior to distribution, every guideline is submitted for approval to the state regulatory agencies in each member state. Should any official have an exception to a section of a proposed guideline, that exception is noted in the final document.

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

If purchased individually, the entire set would cost $367.00. We are offering the set, packaged in five looseleaf binders for $265.00.

Information on how to receive new and updated guidelines will be included with your order.

To purchase this important source of information, complete the order form below and mail or fax (515-276-8655) to IAFP.

Please enclose $265 plus $17 shipping and handling for each set of guidelines within the U.S. Outside U.S., shipping will depend on existing rates. Payment in U.S. $ drawn on a U.S. bank or by credit card.

Name Phone No.

Company

Street Address

City, State/Province, Code

VISA/MC/AE No. Exp. Date

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Web Site: www.foodprotection.org

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First Name _____ M.I. ____ Last Name _____

Company _____ Job Title _____

Mailing Address _____

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DAIRY

- ❒ D1010 The Bulk Milk Hauler: Protocol & Procedures
- ❒ D1030 Cold Hard Facts
- ❒ D1040 Ether Extraction Method for Determination of Raw Milk
- ❒ D1031 Dairy Plant
- ❒ D1050 Food Safety: Dairy Details
- ❒ D1060 Frozen Dairy Products
- ❒ D1070 The Gerber Butterfat Test
- ❒ D1080 High-Temperature, Short-Time Pasteurizer
- ❒ D1090 Managing Milking Quality
- ❒ D1100 Mastitis Prevention and Control
- ❒ D1105 Milk Hauling Training
- ❒ D1110 Milk Plant Sanitation: Chemical Solution
- ❒ D1120 Milk Processing Plant Inspection Procedures
- ❒ D1125 Ohio Bulk Milk Hauling Video
- ❒ D1130 Pasteurizer: Design and Regulation
- ❒ D1140 Pasteurizer: Operation
- ❒ D1150 Processing Fluid Milk
- ❒ D1170 5-A Symbol Council
- ❒ D1180 10 Points to Dairy Quality

ENVIRONMENTAL

- ❒ E2012 Better TEDs for Better Fisheries
- ❒ E3010 The ABC's of Clean – A Handwashing and Cleanliness Program for Early Childhood Programs
- ❒ E3020 Acceptable Risks?
- ❒ E3030 Air Pollution: Indoor
- ❒ E3031 Allergy Beware
- ❒ E3040 Asbestos Awareness
- ❒ E3050 Down in the Dumps
- ❒ E3055 Effective Handwashing – Preventing Cross-Contamination in the Food Service Industry
- ❒ E3060 EPA Test Methods for Freshwater Effluent Toxicity Tests (Using Ceriodaphnia)
- ❒ E3070 EPA Test Methods for Freshwater Toxicity Tests (Using Fathead Minnow Larva)
- ❒ E3075 EPA: This is Super Fund
- ❒ E3080 Fit to Drink
- ❒ E3090 Food-Service Disposables: Should I Feel Guilty
- ❒ E3110 Garbage: The Movie
- ❒ E3120 Global Warming: Hot Times Ahead
- ❒ E3125 Good Pest Exclusion Practices
- ❒ E3128 Integrated Pest Management (IPM)
- ❒ E3130 Kentucky Public Swimming Pool and Bathing Facilities
- ❒ E3131 Key Pests of the Food Industry
- ❒ E3133 Physical Pest Management Practices
- ❒ E3135 Plastics Recycling Today: A Growing Resource
- ❒ E3140 Putting Aside Pesticides
- ❒ E3150 Radon
- ❒ E3160 RCRA-Hazardous Waste
- ❒ E3161 The Kitchen Uncovered: Orkin Sanitized EMP The New Superfund: What It Is and How It Works
- ❒ E3170 Tape 1 – Changes in the Remedial Process: Clean-up Standards and State Involvement Requirements
- ❒ E3180 Tape 2 – Changes in the Removal Process: Removal and Additional Program Requirements
- ❒ E3190 Tape 3 – Enforcement & Federal Facilities
- ❒ E3210 Tape 4 – Emergency Preparedness & Community Right-to-Know
- ❒ E3220 Tape 5 – Underground Storage Tank Trust Fund & Response Program
- ❒ E3230 Tape 6 – Research & Development/Closing Remarks
- ❒ E3235 Regulatory and Good Manufacturing Practices
- ❒ E3236 Rodent Control Strategies
- ❒ E3240 Sink a Germ
- ❒ E3245 Wash Your Hands
- ❒ E3250 Waste Not: Reducing Hazardous Waste
- ❒ E3251 Would Your Restaurant Kitchen Pass Inspection?
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- ❒ F2154 Tape 5 – Production and Process Controls
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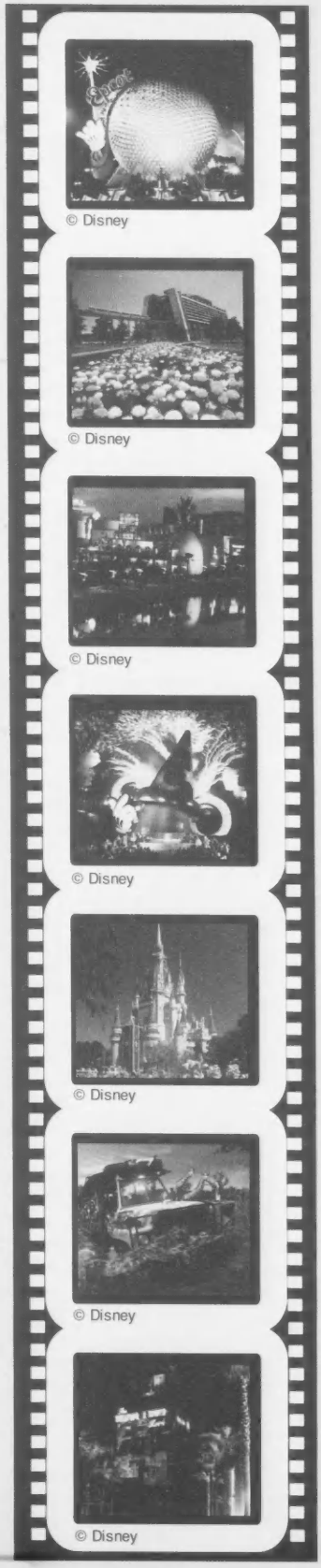

IAFP 2007

July 8–11, 2007

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References

1. Rose, Bonnie E. 2001. Isolation and identification of *Salmonella* from meat, poultry and egg products. *In* Microbiology laboratory guidebook, 3rd ed., Food Safety and Inspection Service, U.S. Department of Agriculture, Washington, D.C.
2. U.S. Food and Drug Administration. 2003. Bacteriological analytical manual (online), AOAC International, Gaithersburg, MD.
3. International Organization for Standards (ISO). Microbiology of food and animal feeding stuffs – Horizontal method for the detection of *Salmonella* spp., 4th Edition, ISO 6579:2002.
4. Data on file, Diagnostic Systems, Sparks, MD 21152, USA.

BBL™ CHROMagar™ Family AOAC™-RI Approved	Cat. No.	Unit
BBL™ CHROMagar™ Listeria	215085	20 plates
BBL™ CHROMagar™ O157	214984	20 plates
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