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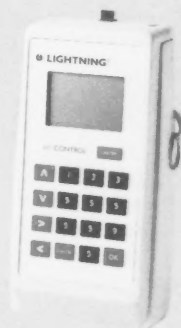
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My Perspective



By JENNY SCOTT
President

“My how time flies!”

Remember when you were a child and it seemed to take forever for school to be over for the year? And how fast the summer holidays went by and it was time for school again? Well, this past year as IAFP President has seemed to fly by like the summer holidays – it is hard to believe that the time has come for the Annual Meeting and the passing of the gavel to Jim Dickson, President of your Association for the next year. But when I think back over some of the year's accomplishments, then I can believe it has been a full year.

Of course the year started out with our highly successful meeting in Atlanta – over 1,300 attendees, with representatives from 31 countries. Not too many months later we held our first workshop in a country other than the United States and Canada. “Produce Safety in Latin America: Experiences, challenges and impact on international trade” was held November 12, 2000, in Guadalajara, Mexico, in cooperation with our Affiliate, the Mexico Association for Food Protection. We learned a lot about the challenges of hosting a workshop in another country, which has better prepared us for the next one. And there will be a next one. Right now we are looking into an “opportunity” for a similar workshop in Costa Rica and a symposium in Guatemala.

This year we instituted a new award, not to make the Awards Banquet even longer, but because we became aware that there was a gap in recognizing bench scientists, who are a strong component

of our Membership. Weber Scientific stepped up to sponsor the Maurice Weber Laboratorian Award to be presented to an individual for outstanding contributions in the laboratory and recognizing a commitment to the development of innovative and practical analytical approaches in support of food safety. We are delighted that Beth Johnson received the award at IAFP 2001. We have also been in the process of developing criteria for a new International Service Award to recognize a deserving candidate for promotion of the mission of the Association in countries outside of the United States and Canada. Thanks to Anna Lammerding and Paul Hall, we will solicit nominees for this award this fall for presentation at IAFP 2002.

This year also saw the inauguration of a tiered Sustaining Membership program, with silver and gold levels of support in addition to the base level. A substantial portion of the silver and gold membership fee goes to the IAFP Foundation Fund to establish a speaker support mechanism, expanding our capability to provide travel assistance to Annual Meeting speakers. Kraft Foods became our first Gold Sustaining Member. F&H Food Equipment Company, Dupont Qualicon, Silliker Laboratories Group and Weber Scientific have led the way as Silver Sustaining Members. We are very excited about this program, as it will provide the opportunity to bring to our Meeting cutting-edge and high-profile speakers who

might not otherwise be able to attend.

In the May 2001 issue of *Dairy, Food and Environmental Sanitation*, IAFP published its first paper in a language other than English. This paper, originally published in English in *DFES* in August 1999 (Tompkin, R. B. et al., 1999. Guidelines to prevent post-processing contamination from *Listeria monocytogenes*, Dairy, Food Env. Sanit. 19:551-562), was re-published in Spanish. The Board felt that publishing an article on practical, applied topics occasionally in another language might help demonstrate our commitment to being an international organization. The Executive Board provided a response form to determine our Members' thoughts on this. More than two-thirds of respondents felt that we should occasionally publish an article in both English and a non-English language; over 90% saw the benefit of putting the non-English version on the Association's Web site at the time the English version was published in *DFES*. Full details of the survey are published on page 718 and have been reviewed by the *DFES* Management Committee.

This year IAFP also had a professional survey of our publications conducted. We commissioned Research USA, Inc. to survey our Members to find out more about them, their work, and their readership of our publications. The response rate was fantastic – over two-thirds of those sent the survey returned

them. The responses were quite favorable; it appears that our Members make good use of the journals, finding information of use to themselves and passing the publications or articles from them on to others. The survey information has been provided to the *Dairy, Food and Environmental Sanitation* and *Journal of Food Protection* Management Committees for their consideration. The survey summary will also be published in *DFES* later this year.

And while we are on the topic of the journals, I am pleased to report that submissions to *JFP* have grown so much that we have had to take on a third editor. The search committee, under the direction of *JFP* Management Committee Chairperson Don Conner, also had to find a replacement editor for Larry Beuchat, who is retiring as co-editor at the end of December. After carefully considering the submissions, which included a number of highly qualified candidates, the search committee selected Joe Frank and Michael Davidson to join John Sofos as editors of the *Journal of Food Protection* this fall. Please join me in welcoming them to their new positions.

Another highlight of this year was the election of Kathy Glass to the IAFP Board. Her term as Secretary starts August 9 and progresses through various Executive Board positions to President (where she will have to write this column!) and then Past President – a five-year commitment. Please congratulate Kathy when you have the opportunity.

Some of you may remember that in my first column last September I wrote about the IAFP Foundation Fund and the goal of "\$100,000 in 2000." The plan was to raise the balance of the Foundation Fund from around \$70,000 in 1997 to \$100,000 by the year 2000. Unfortunately, we didn't quite make it by the end of December 2000. However, we weren't off by too much: in April 2001, just four months later than targeted, the IAFP Foundation Fund reached \$100,000. We couldn't have done it without the generosity of the many contributors listed on page 724 of this issue. Well over 100 individual contributors and four of our Affiliate Associations made contributions between June 1, 2000 and the end of May 2001. In addition, a portion of the Sustaining Members' dues goes to the Foundation. I am also delighted to report that **Kraft Foods is making a \$25,000 contribution to the Foundation Fund**. Stay tuned for information on the Corporate Challenge that accompanies this contribution.

We completed the year with our Annual Meeting in Minneapolis, which at the time of writing this column, appears to be headed toward exceeding this year's attendance. Let me be the first to thank all of the presenters and convenors who make our program successful. I hope you were able to join us in Minneapolis to take advantage of the great technical program.

COMMENTARY

From the Executive Director



By DAVID W. THARP, CAE
Executive Director

“Plan now for IAFP 2002”

It is hard to believe that another year has passed us by, but by the time you read this column, IAFP 2001 – the 88th Annual Meeting will be completed! We have a few ways to measure a year at the International Association for Food Protection. One is by the calendar, January to December; one is by our Annual Meeting, normally the first weekend in August each year; and one is by the financial year, September 1 to August 31. Many accomplishments take place throughout the year and can overlap each of our year measurements.

Today, I want to discuss the Annual Meeting year – from August to August. I have said this before, but we many times refer to the “88th Annual Meeting” without ever thinking how important that “88” is or what it may mean. In our case, 88 refers to how many Annual Meetings this Association has held. Eighty-eight Annual Meetings or conferences to discuss how to better serve the public with a safer food supply! Eighty-eight – just think for a minute, 88 years of coming together to form life-long bonds between food safety professionals. What has that meant to the United States of America, to North America, to the World? Look at how this Association and our 88 Annual Meetings have affected the world we live in today!

We ask the question many times, “What does the IAFP Annual Meeting mean to attendees?” It means meeting face-to-face with colleagues, it means discussing pressing issues, it means arriving at decisions, and it means learning methods that can change processes that lead to a more healthful, more wholesome product for the consumer. The Annual Meeting provides connectivity to the information you need to carry out your job duties and responsibilities. If you missed the 88th Annual Meeting in Minneapolis, begin your plans now, because you certainly will not want to miss IAFP 2002 in San Diego. Note that our meeting date is moved forward and begins on June 30, concluding on July 3

in 2002. This date shift was necessary to make the hotel room rate economical (we saved more than \$50 per night over August’s rates!).

So, the next Annual Meeting year will be a short year, only 11 months. This will affect our internal planning, but will not affect much for you as an attendee. You will only have to mark your calendar with the appropriate date, make your hotel reservation early, and plan to be in San Diego on June 30, 2002!

We have some milestones quickly approaching. The 90th Annual Meeting will be held in 2003 in New Orleans (see page 705) and the 100th Anniversary of the beginning of the Association will take place in the year 2010. We look forward to celebrating these high points in the Association’s history and hope that you do too.

From the beginning mission of the Association to today, we have always been intently interested in protecting the food supply to provide products that consumers have confidence in when serving meals to their family or purchasing restaurant meals. We have come a long way since 1911 and continue to evolve as an Association to meet the needs of our Members. The Annual Meeting serves Members by providing current research presentations and connectivity to resources you can use throughout your career. Plan NOW for IAFP 2002; you owe it to yourself and your profession!



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Scanning Electron Microscope Analysis of Changes in High Density Polyethylene Conveyor Surfaces During Normal Processing in Meat Plant Operations

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SUMMARY

Conveyor systems in food processing facilities have advanced from stainless steel contact surfaces to complex integrated plastic modular systems. Polyethylene and polypropylene of various molecular weights and densities are the most common plastics in the food industry for conveyors, cutting boards, and tubs. Extensive research has been conducted on stainless steel surfaces used in the food industry, but little research has been reported on the effects of soiling, cleaning, or normal wear on the deterioration of plastic food contact surfaces. New surface features of plastic polymers are important for product selection only if the surface remains stable for long periods of time under conditions found in food processing environments. Conveyor systems in a meat plant environment are affected by many factors, including product impacts, abrasions from knives, and friction against other components of the conveyor complex. Each of these factors actively degrades the surface texture. Processes used during cleaning, such as scrubbing and pressure washing coupled with the chemical influences of high acid and alkaline detergents, may all induce varying degrees of surface damage. This study used scanning electron microscopy to examine (i) unused surfaces of a high density polyethylene plastic conveyor link, (ii) changes that occurred on links exposed to normal processing conditions, and (iii) polyethylene surfaces from a conveyor receiving extensive knife work.

A peer-reviewed article.

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TABLE 1. High Density Polyethylene (HDPE) food contact surfaces examined

Sample	Description
A	New, unused link directly from manufacturer
B, C, D	Link collected from a 2-year-old conveyor system used to handle raw meat products "scrubbed conveyor"
E	Link collected from a 2-year-old conveyor system used to handle raw meat products "unscrubbed conveyor"
F	Link collected from a 2-year-old conveyor system in a poultry processing plant; frozen products dropped onto conveyor; "impact"
G, H	Link extracted from a one-year-old boning conveyor; extensive use of knives, detergents and sanitizers

INTRODUCTION

Conveyor systems in food processing facilities have advanced from stainless steel contact surfaces to complex integrated plastic modular link systems. In these new systems, independent link assemblies are easily connected with a rod, which runs through attached hinge sections, allowing easy setup and repairs to the conveyor (1, 2). Polyethylene is inexpensive (3, 7, 13) and easily molded into complex shapes (15). Equipment constructed of polyethylene is light in weight, which results in substantial savings in energy consumption within the facility (5, 21). In the last ten years various types of plastic have been used extensively in the food industry to handle a variety of food products such as meat, poultry, and fish (5).

Conveyor surfaces in a meat plant environment are affected by many different factors, including product impacts, abrasions from knives, and friction against other components of the conveyor system. Each of these factors may actively degrade the surface texture. The selected high density polyethy-

lene (HDPE) plastic polymer composition used in meat plants should be able to provide maximum strength to withstand product loads or strains produced by product weight and movement of the conveyor. The polyethylene polymer must also be resistant to the environmental influences found in food processing facilities, such as variations in temperature and humidity, and interaction with hot water and chemical cleaning agents. Processes used during sanitation operations, such as scrubbing and pressure washing coupled with the chemical effects of various acid and alkaline based detergents, may all induce varying degrees of surface damage (11). Extensive research has been conducted on stainless steel surfaces used in the food industry (4, 12, 17, 19, 20, 22, 23), but little research has been conducted on the effects of soiling, cleaning, and normal wear on the deterioration of plastic surfaces. The use of plastic contact surfaces in the industry without proper evaluation may be influential in biofilm development and bacterial transfer. This study used scanning electron microscopy to examine

(i) unused surfaces of a high density polyethylene plastic conveyor link, (ii) changes that occurred on links exposed to normal processing conditions, and (iii) polyethylene surfaces from a conveyor receiving extensive knife work.

MATERIALS AND METHODS

Samples

The plastic polymer samples observed in this study are described in Table 1. All samples evaluated were from the same manufacturer.

PROCEDURES

Samples from each conveyor complex were extracted from the units after completion of the representative cleaning programs by the plant employees and taken back to the Agricultural Research Facility for sample preparation. New and used samples were cut using a small hacksaw and trimmed with a scalpel, using precautions to avoid handling the contact surface. Following all trimming procedures, forced air was blown on the samples to remove any loose fibers. Samples were air dried in a hood and mounted to SEM stubs with double-sided tape (3M Inc., St. Paul, MN). The samples were then sputter coated (Hummer VII, Anatech, Ltd., Alexandria, VA) with gold-palladium to a thickness of 15nm and viewed under a JEOL JSM-T330 scanning electron microscope (Anatech, Ltd., Alexandria, VA).

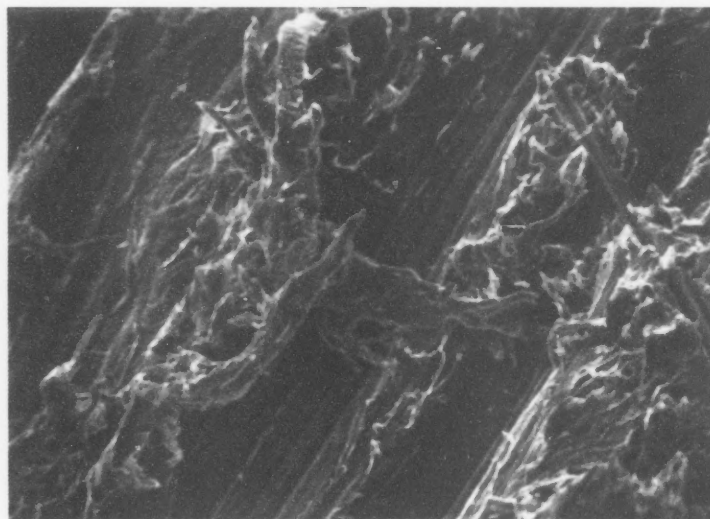
RESULTS

Sample A, a new HDPE link, viewed with the SEM appeared smooth with numerous cavities randomly distributed in clumps over the surface (Fig. 1). Cavities appeared as a sinkhole or indentation in the upper surface or with a peripheral lip on one side or surrounding the entire cavity hole. The inside surface of some of the cavities appeared convoluted, with numerous ridges and crevices. The largest cavities were approximately

Figure 1. Sample A. Scanning electron microscopy of a new, unused HDPE conveyor link.



Figure 2. Sample B. Scanning electron microscopy of a HDPE link extracted from a conveyor that had been in use for 2 years in a meat processing facility.



50 μ m in diameter and had an estimated depth of 5 μ m. Other features included shallow ridges (<1 μ m), scratches roughly 1 μ m in width, and very small amounts of particulate materials, ranging in size from 0.5 μ m to 1 μ m in diameter, which were clearly not associated with the cavity formations.

SEM analysis of a high density polyethylene (HDPE) link (Sample B) extracted from a conveyor which had been in use for 2 years in a meat processing facility showed a series of knife marks with frayed plastic filaments extending out from the incision boundary (Fig. 2). In general, the surface showed an uneven

distribution of matted, frayed plastic fibers that are known in the meat industry as "angel hair" (21). The surface features typical of a new link were totally destroyed or hidden below a mat of extensive formations of frayed fibers 300 to 500 μ m in length. Distribution of the angel hair was not uniform, appearing thicker in some areas. The fibrous mats occurred in multilayered accumulations around large cracks and as single filaments in smoother zones. The frayed plastic fibers observed in this scan were all associated with knife cuts or surface abrasions. Areas on the same sample with unmarked smooth zones were devoid of frayed filaments.

A conveyor link sample (Sample C) extracted from a 2-year-old HDPE conveyor (scrubbed) illustrates microscopic ripples found in zones on the link. The abundant shallow ripples appeared to be associated with retained lipid globules attached to the immediate surface, possibly by a dissolution process (9). Small stress cracks were found running perpendicular to the direction of the ripples. The lipid accumulations were clumped in the cracked zones and were associated with the stress cracks (Fig. 3).

Sample D shows a large crack in the surface of the HDPE link but no other surface damage such as knife marks or angel hair for hundreds of microns (Fig. 4). Minor stress cracks less than 0.5 μ m in width and ranging from 1 to 3 μ m in length were closely associated with this larger, possibly stress-related crack.

The sample removed from the second conveyor system (Sample E), which received no scrubbing in the cleaning program, displayed thicker, slimy-looking angel hair heavily coated with some soil residues or possible bacterial exopolysaccharides (Fig. 5). The samples viewed from this link showed higher numbers of bacterial cells among the leaf-like fibers, especially in the lower areas of the grooves from the knife cuts.

Figure 3. Sample C. Scanning electron microscopy of a HDPE link extracted from a conveyor that had been in use for 2 years in a meat processing facility, demonstrating lipid accumulation in the cracked zones of the surface.

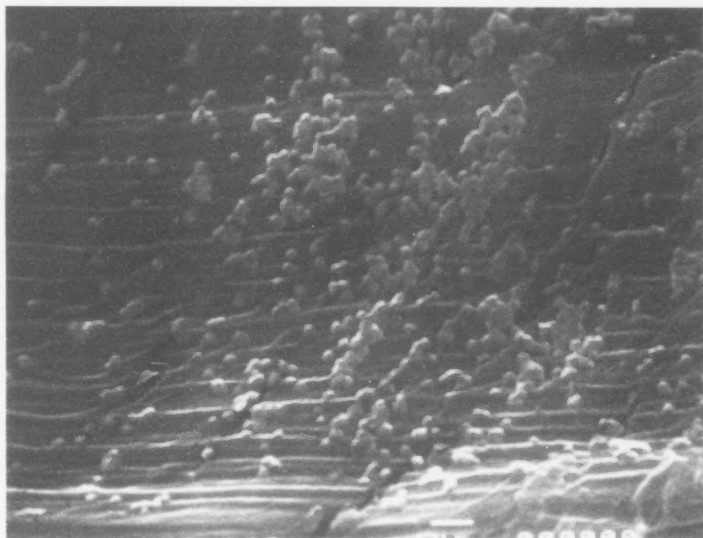
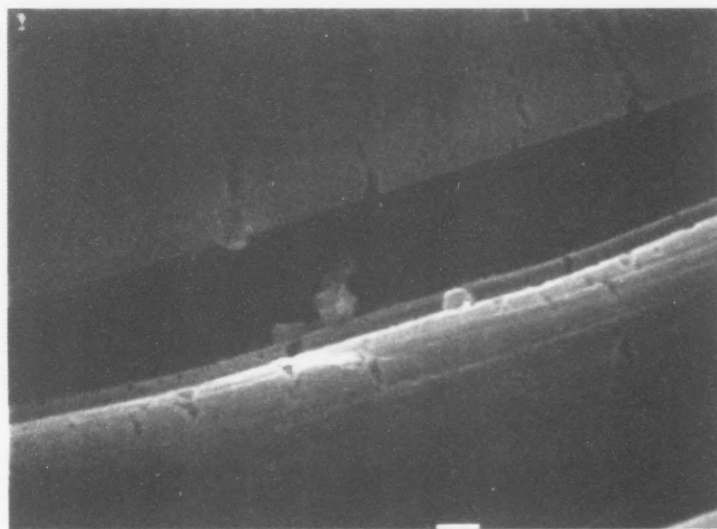


Figure 4. Sample D. Scanning electron microscopy of a HDPE link extracted from a conveyor that had been in use for 2 years in a meat processing facility, demonstrating stress-related crack.



A sample extracted from a poultry processing facility (Sample F) showed similar angel hair formations (Fig. 6), but the distribution on the surface was very uniform. The filaments appeared shorter and consistent in length in contrast to

various lengths of angel hair on the other samples.

Sample G, extracted from a boning table (Fig. 7), showed extensive surface damage compared to samples B, C, and D. The characteristic angel hair observed in other

samples was not present. The surface appeared very cut up and large pieces appeared to be missing, leaving many large grooves and surface inclusions. In Fig. 8, Sample H, also from the boning table, showed heavy accumulations of bacterial cells and soil debris inside knife cuts.

DISCUSSION

The new surfaces, although displaying cavities and attached particulate materials, could be acceptably cleaned to provide the necessary sanitary level for food contact surfaces. Surface areas of any one piece of equipment may exhibit many different surface topographical features: new, pitted, frayed, cracked, etc., depending on the amount and type of wear. Observations of used samples even after insertion for two months showed extensive deterioration, with masses of frayed plastic fibers providing abundant surface area for the accumulation of soils and bacterial cells (data not shown). The roughness or degree of surface topography and porosity may directly affect the sanitation program (6, 10, 14, 16, 17). The cleanability of any surface is associated with its surface finish, and rougher surfaces will be more difficult to clean and sanitize.

The extensive deterioration noted on the observed test surfaces will directly affect the cleaning process as well as the ability of microorganisms to adhere and gain protection from the effects of cleaning. The mat of entangled plastic fibers may directly influence bacterial retention by physical entrapment of interacting cells, allowing time for bacterial adherence to occur. The frayed formations are directly associated with primary incisions in the upper layers of the link assemblies, since they are prominent only in areas of primary incision and are lacking in zones with no initial cuts. The cleaning processes, both chemical and physical, act synergistically to increase the damage occurring on the surface (11).

Figure 5. Sample E. Scanning electron microscopy of a HDPE link extracted from a conveyor system in a meat processing facility in which no scrubbing was used.

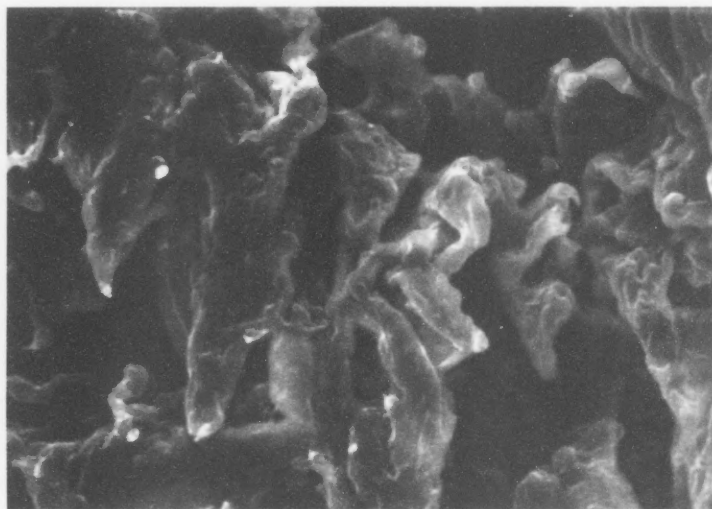


Figure 6. Sample F. Scanning electron microscopy of a HDPE link extracted from a conveyor system in a poultry processing facility where frozen nuggets had drapped onto the belt.



Ripples in the microscopic surface are due to hesitation of the polymer entering the mold forming flow lines (8). The presence of small stress cracks in this zone appear to be a result of the ripples

increasing the accumulations of lipids which, via a dissolution process, are incorporated into the polymer surface (9). This process may be a factor initiating the stress cracks, or the deposition and attachment of

the lipid residues could be the result of the initial formation of the cracks by some other mechanism. Their association, either as the initiator of stress cracks or their accumulation in this area due to the presence of preformed stress cracks, cannot be evaluated without further study. Their close association in various areas of the samples indicates they are somehow interrelated.

Small stress cracks in Fig. 3 appear completely different from the cracks noted in Fig. 4 and may be the result of stress applied to the surface during the formation of the larger crack. The larger crack may be initiated by intrinsic factors of link design or from stresses applied during use (19). Its presence has placed undue stress on surrounding surface layers forming the small, closely related stress points.

Observations of knife grooves in the surface verify the presence of bacterial cells attached to lower areas of the incisions, with fewer being found on scrubbed conveyor than on unscrubbed sample and the worst contamination problem in Sample G, which received extensive cutting and surface damage. The actual attachment mechanism cannot be determined from the data in this study because of the lack of fixation and specific staining during sample preparation.

It has been verified that although scrubbing procedures induce physical deterioration of the polyethylene surface, they result in surfaces that are cleaner than those that are not scrubbed. Scrubbed samples, although deteriorated to the same extent as conveyors cleaned only with pressure wash applications, appeared to be much cleaner when visualized under SEM.

It clearly appears that surface physical abuse is a direct factor in surface deterioration. Samples extracted from a conveyor after 3 months show similar, but less extensive, deterioration than samples extracted after 2 years of use (data not shown). Samples from the non-scrubbed conveyor show similar

Figure 7. Sample G. Scanning electron microscopy of a HDPE link extracted from a conveyor system used for boning in a meat processing facility.

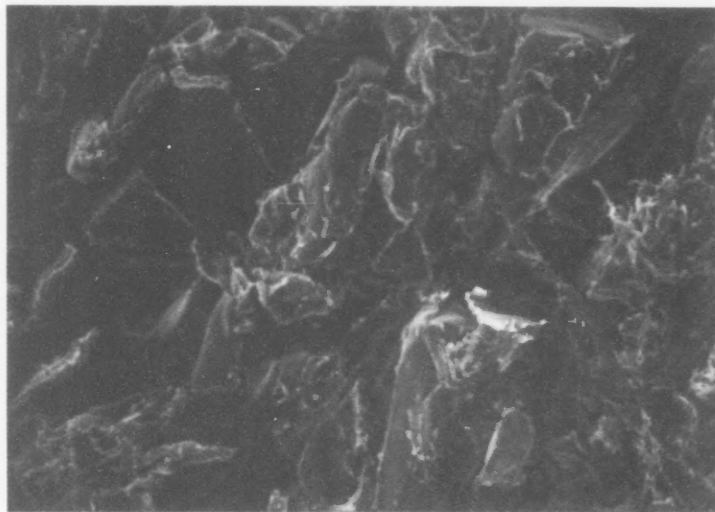
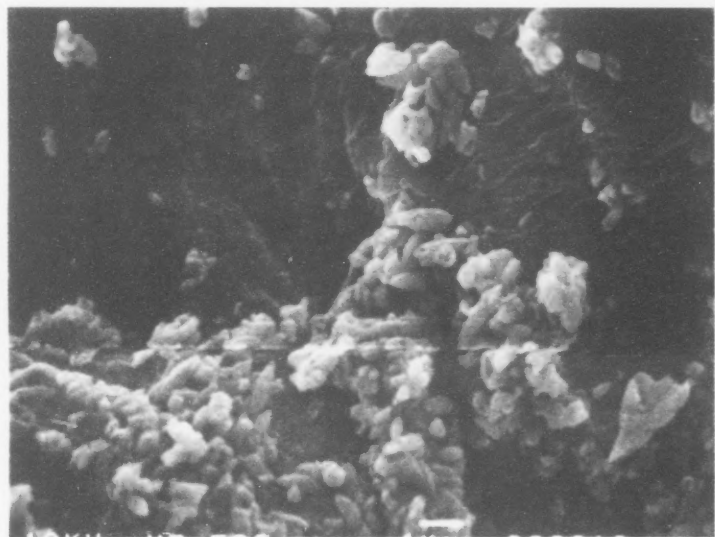


Figure 8. Sample H. Scanning electron microscopy of the inside of the knife grooves in a HDPE link extracted from a conveyor system used for boning in a meat processing facility.



surface features and extent of deterioration as those from the scrubbed conveyor, but with heavier accumulations of soils. In the knife-abraded conveyors the delamination and production of angel hair appeared to be linked closely to initial knife incisions in

the surface (11). Frayed zones were linked directly to the cut surface boundary.

Sample G extracted from a heavily knife abraded surface clearly showed the extent of deterioration that is possible with undue physical abuse on the surface.

The plastic materials from these upper layers appear to be worn away or to have been released, potentially onto products during the boning processes, and transferred away with the associated bacteria on the plastic fibers.

Abrasion from impact appears to be an initiating factor for shear forces from cleaning operations to produce the same angel hair formations as noted repeatedly in knife incised surfaces (11). A more uniform distribution would result from multiple impacts over the entire surface, each forming a pinpoint initial spot of surface damage.

Surface topography and microscopic roughness have been shown to be direct influences on bacterial adherence and retention (6, 10, 14, 16, 17). Bacterial retention and soil buildup are directly related to deterioration, either by means of bacterial adherence, which has been clearly shown, by physical entrapment in cavities, or by entanglement in frayed plastic fibers.

CONCLUSIONS

Physical deterioration of an evaluated high-density polyethylene surface is clearly linked to initial damage, either from knife incision or impact (11). Deterioration appears to be strongly linked to delamination of upper surface layers. Physical abuse coupled with chemical abuse (improper chemical product selection and abusive/excessive chemical concentration) leads to extensive deterioration of the contact surface into interfaces extremely difficult to clean and sanitize.

Increased surface roughness has been shown to be intimately linked to increased bacterial retention in knife incisions. Increased damage means an increased risk of bacterial transfer as shown in the heavily abused surface, where upper layers are worn away and released into the products during processing. Carpentier and Cerf (6) recommend reducing surface roughness to reduce biofilm prob-

lems. Construction materials must be smooth initially and be resistant to wear, minimizing cracked and pitted surfaces that serve as foci for biofilm formation.

More intensive methods of cleaning (scrubbing) will result in a cleaner, less soil-coated surface. Cleaning with excessive concentrations of chemical agents is detrimental to the properties of the polymer and may be linked to increased rates and extents of deteriorative change.

High density polyethylene conveyor links may not all exhibit the same patterns or extents of damage, since different properties of the same polymer type can be modified by altering molecular weights, crystal formation and density, incorporating additives to prevent oxidative or degradation changes, or altering crystal formation in the polymer lattice (7, 8, 18). To clearly understand the extent and severity of this problem and its relation to product safety and consumer risk, other studies must be conducted.

Polyethylene and other plastics are becoming common food contact materials, yet we do not fully understand the effects on food safety of the massive deterioration encountered in this study. Cleaning program design and/or potential changes in process technology or modifications to composition may lower the deterioration rates. Other studies provide an insight into the effects of physical removal of deteriorated upper layers, with an increase in abrasion resistance found in the inner zones of link assemblies (11). To assure a surface capable of efficient sanitation and high food safety, it is essential that the dete-

riorative patterns and causes be further investigated.

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Bovine Spongiform Encephalopathy: A Brief Overview

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SUMMARY

Bovine Spongiform Encephalopathy (BSE) is a newly emerging disease that affects cattle. This disease emerged in the United Kingdom less than twenty years ago, and in a matter of years it has crippled the beef industry in European countries. BSE belongs to a category of diseases called Transmissible Spongiform Encephalopathies (TSEs). It has been proposed that these diseases are caused by a newly discovered infectious protein called a prion. In 1994, a new, human form of BSE was found. It is theorized that perhaps, the infectious agent can cross the species barrier and infect humans who eat contaminated meat. This gives rise to a whole new group of problems that need to be addressed. Extensive regulations have been put in place in the affected European countries, as well as in the United States, in an attempt to halt the spread of the disease and eventually get it under control. This article provides an overview of BSE, discusses the history and etiology of the disease, as well as other types of TSE diseases, and addresses regulations that have helped to slow the spread of BSE.

INTRODUCTION

Bovine Spongiform Encephalopathy (BSE) is a newly emerging disease that affects cattle, the first documented case of which occurred less than two decades ago. Many questions remain unanswered about the agent that causes it and its transmission pathway. Although the disease affects cattle, there is speculation about what type of infectious agent causes it, where it came from, how it evolves, and most importantly whether it can be transmitted to humans.

Although no cases have been reported in the United States, there is always the chance that our food supply could become tainted with BSE-infected meat. National surveillance and current importation regulations make the chance of a diagnosis of BSE very slim.

BSE is in a category of illnesses that all appear to be caused by the same infectious agent. A brief overview of this disease will be presented, along with a discussion of governmental and regulatory issues surrounding this topic.

A peer-reviewed article.

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HISTORY AND GEOGRAPHY OF BSE

BSE was first documented in November of 1986 at Central Veterinary Laboratory, Wehbridge Surry in the United Kingdom (6). As of December 2000, an estimated 180,376 cases have been reported in the United Kingdom alone (5). These numbers peaked in January 1993, when an average of 1,000 cows were diagnosed per week (2). Other areas in Europe have also been affected, with approximately 1,512 confirmed cases since 1986 (5).

Although no known cases of BSE have occurred in the United States, other diseases related to BSE have been present for many years. Cases of BSE have been confirmed in cattle that are native to Ireland, France, Portugal, Switzerland, The Netherlands, Belgium, Denmark, Luxembourg, and Liechtenstein (2). BSE has been on the rise in all these countries except the United Kingdom, where BSE was first discovered. There, a decline in cases has occurred because of strict regulations initiated by the British government (2). On February 16, 2001, the European Union's Scientific Steering Committee added five more nations to the list of at-risk countries (11): Botswana, Lithuania, Namibia, Nicaragua, and Swaziland (11).

SIGNS AND SYMPTOMS

There are many different symptoms of BSE, and because not all cattle display every symptom, it is hard to diagnose. The incubation period, or period between exposure to the infectious agent and the onset of symptoms, can be between 3 and 6 years (6). Most cases have occurred in dairy cows between the ages of 3 and 6 years (2).

In the early stages of the disease, cattle are mentally alert but unusually anxious and apprehensive (6). Symptoms that appear later can include a wide-base stance while standing still; a drawing up of the abdomen; an abnormal and elongated gait; splaying at the hind limbs when turning sharp corners

(6). In addition there can be skin wounds and firmer feces; weight loss; reduction in milk production; exhibition of fine muscle fasciculations; vigorous and repetitive jerking of small muscles all over the body; a change in the tone of the 'moo'; and aimless head-butting and other frenzied movements (6). All of these physical symptoms are accompanied by an abnormal pattern of brain activity, which can be measured by electroencephalography (6).

Cattle suffering from other illnesses can have symptoms similar to BSE. For example, magnesium deficiency in cattle presents with the same basic symptoms as BSE; however, once the animal is treated, the symptoms disappear (6). Other illnesses are not likely to be fatal.

Currently there is no treatment or cure; therefore, ultimately, infected cattle would die of the disease, if not destroyed first (2). Because the infective agent is not considered "foreign" by the cow's body, there is no immune response, i.e., no antibodies are made. This makes it difficult to develop a diagnostic test or vaccine for the illness. The only way to diagnose BSE with one hundred percent certainty is by performing a brain biopsy after the cow has been destroyed. Death usually occurs between 2 weeks and 6 months after the onset of symptoms (6). This makes the agent extremely hard to detect and makes the disease impossible to treat.

TRANSMISSIBLE SPONGIFORM ENCEPHALOPATHIES

BSE belongs to a category of diseases called Transmissible Spongiform Encephalopathies (TSEs). There are many different types of TSEs. All are fatal, neurodegenerative diseases that affect both humans and animals (9).

There are three cellular changes that take place in all TSEs. The first is the degeneration of neurons (6). Neurons are the nervous system cells that are responsible for generating and transmitting nerve impulses (10). If neurons were broken down, the infected animal or human would have a decrease in

motor skills. The brain would have difficulty transmitting the signal to the rest of the body.

Another cellular change is the hypertrophy, or enlargement, of supporting astrocytes (6), the most abundant support cell in the nervous system. They have radiating "star-like" projections that cling to surrounding neurons and capillaries, anchoring neurons to the nutrient supply (10). They are responsible for making exchanges between capillaries and neurons, presenting antigens during an immune response, and controlling the chemical environment around the neurons (10).

The third cellular change is status spongiosus, the sponge-like appearance of the brain (6). As the astrocytes become enlarged, holes develop in the brain, making its appearance look rough and cavernous, similar to the appearance of a sponge. This is how the disease is diagnosed in a brain biopsy.

The most widely known TSE is scrapie. Scrapie was the first prion disease discovered 250 years ago (9). It is a naturally progressive brain disease in sheep, characterized by intense itching that causes the sheep to scrape off their wool for relief (14). Other TSEs that infect animals include transmissible mink encephalopathy (TME), infecting mink; feline Spongiform encephalopathy (FSE), infecting cats; and chronic wasting disease (CWD), infecting deer and elk (9).

Of the several forms that infect humans, the most common is Creutzfeldt-Jakob disease (CJD). Two types of CJD are genetic, or familial: Gerstman-Straussler-Schneinker (GSS) syndrome, which progresses much more slowly and produces multi-centric amyloid plaques and Fatal Familial Insomnia (FFI), which presents itself as persistent morbid insomnia (14). These TSEs are caused by a germ line mutation in the gene that encodes for a protease resistant protein (PrP), a host-encoded cellular protein (14). PrP is the normal form made by the body and is present in all cells (14). If the PrP is defective, or has a different form, then its functions change slightly and the

abnormal PrP (PrP^{Sc}) can aid in the destruction of the nervous system (9). In this case, the onset of the disease is probably triggered by prion inoculation from infection, transplantation, or consumption of meat products (9).

Prions are "small proteinaceous infectious particles" that are resistant to inactivation by most procedures that modify nucleic acids (14). The term, "prion" "underscores the requirement of a protein for infection" and is used instead of the term "unusual slow virus-like agent" (14).

The most common TSE to affect humans is sporadic classical CJD (3). This type of CJD occurs worldwide, in countries where no BSE has ever been reported. According to the Animal Plant Health Inspection Service (APHIS), it affects about 1 person per million people per year (2). This type typically infects older individuals, and is independent of eating meat (2). Persons infected with classical sporadic CJD will live for an average of 4.5 months after diagnosis (17).

A new variant form of CJD (vCJD) was discovered when ten new cases surfaced between February 1994 and October 1995 (3). Ten persons became infected with a CJD-like disease that seemed to be geographically dependant and presented with slightly different symptoms (3).

While there is no link between classical CJD and BSE, there is strong evidence that BSE can be linked to vCJD (2). Variant CJD affects much younger persons, with the average age being 28 (3). The course of this disease last about twice as long as the classical form. Patients with vCJD also show very different electroencephalographic brain activity, and differing brain pathology, with large aggregates of prion protein plaques (3). All 10 victims were known to have eaten beef products within the last five years. In all cases the prion phenotype was the same as the BSE phenotype, suggesting that BSE may have crossed the species barrier, ultimately infecting humans, (9).

There is further evidence that supports the possibility that BSE

may be able to transfer across the species barrier through food. It was found that some exotic ungulates and domestic felines that were fed meat and bone meal also developed a similar infection (5). In addition, wild felines that were fed raw meats that included nervous tissue from cattle also acquired a similar disease (5).

As of November 2000 there have been 87 suspected cases of vCJD reported in the United Kingdom, 3 in France, and 1 in Ireland (5). There has been an increase in the emergence of vCJD cases since 1996, when the first 10 cases were discovered.

Another TSE that affects people is kuru, a disease found only in the Eastern Highlands of Papua New Guinea (14). Ritualistic cannibalism and the eating of brains and brain products are thought to transmit kuru (14). Trends in the illness among the Fore people of this area show that infected persons are commonly women and children. Women and children ritualistically eat the brains of their dead loved ones (14).

INFECTIOUS AGENT

The causes of TSE are still unknown. There are many theories. One theory is that the causative agent is an unconventional virus (2). An unconventional virus would be a newly discovered virus with characteristics that are different from those of other known viruses (14). All known viruses would trigger the host body to have an immune response in an attempt to kill the foreign agent. No immune response is mounted in TSE infections.

Another theory is that a virino, or "incomplete" virus composed of naked nucleic acid protected by host protein causes TSEs (2). A virino is a hypothetical viral agent that consists of a short piece of DNA that takes over host processes to make its own protein coat and to reproduce (14). This virino would have to be protected by host proteins, which would explain why an immune response is not elicited (14). The final theory, the most

widely accepted one, is that TSEs are caused by a prion, which as described earlier, is an infectious protein (2).

There are two different isoforms of the protein involved in TSEs, the host encoded cellular prion protein that the brain makes naturally (PrP^C) and the abnormal isoform thought to be related to BSE infection (PrP^{Sc}) (9). PrP^C is not completely understood; it is thought to be involved in normal synaptic function of neurons, responsible for long-term survival of Purkinje neurons, which are "modified cardiac muscle fibers of the conduction system of the heart" (10); for regulation of circadian activity; and for the binding of copper *in vivo* (9).

The PrP^C and the PrP^{Sc} are practically identical. The differences are found in the degrees of glycosylation of the protein and in the fact that PrP^{Sc} isoform is partially digested by proteases (15), insoluble in non-ionic detergents, and also partially proteinase-K-resistant (12).

This deviant protein (PrP^{Sc}) is thought to either trigger the PrP^C to flip on its own, or enter from outside the body, inducing the PrP^C to change (8). Once present, this protein acts as a crystal, inducing other normal proteins to change their configuration. This forms a precipitate that clogs up, or "clouds," the cells in the brain (8). It is theorized that this protein keeps being duplicated and, as these protein molecules destroy brain cells, large holes are formed, making the brain look like a sponge under the microscope (8). Because this protein is in the body, and not foreign, it does not trigger an immune response; thus there is no evidence that there is a problem (8). This makes the disease hard to diagnose.

There are two theories about how the PrP^{Sc} actually causes the PrP^C to change. This first theory, called the conformational model, hypothesizes a slow change from PrP^C to PrP^{Sc} (9). Once the PrP^{Sc} is formed, it will react to form a heterodimer with PrP^C present (9). This causes the other end of the heterodimer to transform, creating

two PrP^{sc} proteins (9). Chaperone molecules, or mutations, overcome the activation energy necessary for the proteins to change (9). This would explain the extremely long incubation period of the onset of illness.

The other explanation, called the nucleation-dependant polymerization model, suggests that the PrP^{sc} is in thermodynamic equilibrium with a monomeric precursor of a very similar conformation to that of the PrP^{sc} (9). The PrP^{sc} formed must be a certain size so that it can act as a nucleus to incorporate more PrP^{sc} precursors (9). Under normal physiologic conditions, the precursor is rare, but if there is a shift in the equilibrium, then many PrP^{sc} proteins are formed (9). This model does not involve direct contact between the different isomers.

Whatever the agent, it is smaller than most virus particles, making it impossible to detect with an electron microscope. Additionally, it is highly resistant to heat, ultraviolet light, ionizing radiation, and most disinfectants, making it very hardy and almost indestructible.

Pathway of Infection

When the first cases of BSE were discovered in 1986, the cattle were analyzed demographically. It was found that there was not isolated infection of single cows, but infection of entire herds (14). In addition, the herds were all in close proximity to one another geographically (14).

The Central Veterinary Laboratory in Surrey investigated the cases and found that the brains of the affected cattle were damaged and showed signs related to other Spongiform diseases (14). Brain analysis showed scrapie-associated fibrils (SAFs) (14), which are "crystals visible under an electron microscope as twisted fibers in homogenates of brain tissue infected with TSE" (14). This proved that the disease was a new form of TSE.

Because of the similarity among cases, it was thought that there must be a common source. Many ideas were considered and

ruled out. For example, it would not be from scrapie because most cattle herders didn't keep sheep, not all herds had been exposed to wild animals, and herds had been inoculated with any new vaccines (14). Finally, food contamination was considered; this was a possibility in that meat-and-bone meal was commonly fed to all cattle because it is a very nutrient-rich protein supplement. It was fed to dairy cattle to increase their milk production, to beef cattle prior to slaughter, and to calves to maximize their growth (14).

The entire animal carcass that enters a meat processing plant is used; 'left-overs' are sent to a rendering plant to be processed further. The 'left-overs' include fat trimmings, bones, offal (guts, head, tails, blood) and carcasses (14). Cooking, grinding, chopping and dissolving these products produces a substance called tallow (rendered beef fat) (14). This is used as meat for dogs, hogs, and fish bait, and then desiccated (5) into meat-and-bone meal that is fed to livestock and other captive animals (5, 14).

There are many different processing systems. The American system typically used a lower temperature that was more efficient, and British plants had begun to change their process to the more efficient one the Americans used (14). This change, along with the elimination of solvent extraction in 1981, after an explosion in a chemical plant, is thought to be responsible for transmission of BSE from sheep to cattle (14).

The increased amount of fat in the meat-and-bone meal helps to protect microorganisms from heat. This, in conjunction with lower processing temperatures could have been responsible for transfer of BSE to humans (14).

Brains of dairy cattle and beef cattle are commonly made into ground beef (14). This would also provide a link between vCJD and BSE, because BSE present in the nervous tissue used to make the ground beef may still be infective (14). If the meat is not cooked long enough or if increased amounts of fat are present, the infectious agent

could still be present and able to infect the consumer.

REGULATION OF BSE IN THE UK

Attempts to eradicate BSE have been made in the United Kingdom. First, the UK made BSE a notifiable disease in 1988 (5). This brought out to the public the fact that BSE was a potential hazard to farmers, to make people more aware of its presence. The UK also began prohibiting the inclusion of mammalian meat-and-bone meal in feed for all food-producing animals in 1988 (5). If BSE was, in fact, a product of scrapie and BSE-infected meal, then this should eventually eradicate the problem.

A CJD surveillance unit was implemented in the United Kingdom in 1990 and later expanded to other European countries (5). This unit was to monitor any new cases of CJD to make sure that the BSE was not impacting the food chain. It was due to this surveillance that the first 3 cases of uncharacteristic CJD were discovered (5). If this surveillance had not been implemented, the vCJD might not have been detected until much later.

Another measure, taken in December of 2000, was the prohibition of inclusion of animals more than 30 months old into the animal-human food chain without their first being examined for proteinase-resistant proteins first (5). Because the infectivity of the cattle is hard to diagnose, the older the cow, the more likely that it is infected but asymptomatic. Examining older cattle before they entered the food chain would reduce the amount of infected beef reaching the consumer. In addition, the UK required farmers to destroy any animal that showed any signs of the disease or was at any risk to develop the disease (2). The farmers would be compensated at 50% of the market value of the cow and would be given fees to cover disposal of the meat and milk (6). This action provided farmers with an incentive to report and destroy any cattle with BSE-like symptoms.

Some other measures that have been implemented recently by all the European Union Nations include the ban on specified bovine materials, sheep and goat heads and spleens, and spinal cords from any animal over one year of age (5). In addition, a ban has implemented on slaughter techniques that are thought to contaminate bovine carcasses with brain matter (5). The ban on these techniques, such as pithing or pneumatic stun guns, became effective in January of 2001 (5). Finally, animal protein of any kind was banned from use in feed for any farm animal, not just ruminants, effective January 1, 2001 (5). This is in hope of preventing the passage of any other types of illnesses through the food chain.

By following these steps, the United Kingdom has been successful in reducing the number of cases of BSE. As stated before, currently only about 60 new cases are diagnosed per week, a drastic reduction from the 1,000 per week in 1993 (2).

WORLD REGULATION AND REGULATION IN THE UNITED STATES

Since the discovery of BSE, the World Health Organization (WHO) has held meetings discussing the hazard that Spongiform encephalopathies present to humans. These were held between 1991 and 1995 (17). The WHO has also held meetings in collaboration with the Office of International Epizootics to update knowledge of TSEs, including BSE, and to evaluate methods of transmission (17). International meetings have been helpful for accessing current findings and altering response plans accordingly. Yearly meetings of this nature help to publicize what is being accomplished and what areas still need to be considered.

No known cases of BSE have ever been diagnosed in the United States (2). The government has taken strict action to ensure that there will not be any cases in the United States. The mission of the United States Department of Agriculture (USDA) is to:

“Enhance the quality of life for the American people by supporting production agriculture; ensuring a safe, affordable, nutritious, and accessible food supply; caring for agricultural, forest, and range lands; supporting around development of rural communities; providing economic opportunities for farm and rural residents; expanding the global markets for agricultural, and forest products and services, and working to reduce hunger in America and throughout the world (16).

The USDS has two agencies to address BSE: the Animal and Plant Health Inspection Service (APHIS), responsible for insuring the health and care of plants and animals; and the Food Safety Inspection Service (FSIS), responsible for protection of the meat and poultry supply nationwide. Both have put in place strict measures to prevent, educate, survey, and respond if BSE was ever found (2).

In 1989, APHIS began prohibiting the importation of live ruminants from other countries in which it is known that BSE exists in native cattle (2). This keeps any animal that could potentially be infected from ever coming to the United States. Products derived from ruminants (fetal bovine serum, bone meal, meat-and-bone meal, blood meal, offal, fats, and glands) are also prohibited (2). Importation is currently prohibited from Albania, Austria, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Federal Republic of Yugoslavia, Finland, Germany, Greece, Hungary, Italy, the former Yugoslavian Republic of Macedonia, Norway, Poland, Romania, Slovak Republic, Slovenia, Spain, and Sweden (2).

APHIS provides educational training to keep veterinary practitioners, veterinary laboratory diagnosticians, industry, and producers informed about the clinical signs and symptoms of BSE (2). Along with offering these educational programs, they also lead an interagency surveillance program for signs of BSE in the United States (2). Activities include identifying ani-

mals with central nervous system conditions so that such animals would be reviewed by the APHIS rather than being slaughtered (2). In addition, the postmortem examination of all brains was incorporated to ensure that BSE was not present (2).

Before the ban on importation of cattle was implemented, cattle were imported from Great Britain (2). APHIS monitors these cattle for signs of BSE. Of the 496 head of cattle imported between 1981 and 1989, only 10 of which are still alive (2), none ever displayed signs of BSE and the remaining 10 are still under quarantine (2).

As of December 2000, the importation of any rendered protein or waste from any European country has been banned (5), in hope of preventing any contaminated products from reaching our food supply. In addition, the FDA held a public discussion in July of 2000, to discuss the risks associated with vaccines that may be produced using bovine-derived materials (5). In the future, these products may also be banned from importation.

An emergency response plan has been drafted by APHIS to provide instructions in case BSE was ever found in the United States (2). There is also a TSE Working Group under APHIS to monitor other TSEs that have been found in the United States (2).

Numerous briefings have been held to increase education regarding this disease among cattle producers and veterinarians (2). In addition to animal-related professions, the APHIS also has compiled videos, information packets, and press releases to be given to all APHIS field offices for public information (2).

BOVINE SPONGIFORM ENCEPHALOPATHY RESPONSE PLAN SUMMARY

The Bovine Spongiform Encephalopathy Response Plan was formed by APHIS in conjunction with the FSIS. This is the outline of a plan to be initiated in case BSE is

ever diagnosed in the United States (16). Topics included are identification of suspect animals, laboratory procedures for diagnosis, epidemiological investigation plans, and animal herd characteristics (16). This plan is distributed to agency headquarters and field offices to ensure quick action in the event that a case is discovered (16).

As a precautionary measure, all animals with conditions similar to BSE are not slaughtered for human consumption, but are destroyed so that their brains can be analyzed (16). The National Veterinary Services Laboratories (NVSL) is responsible for examining all brains (16). Samples are also tested by immunohistochemistry, which tests for PrP in the brain (16).

NVSL is also responsible for the notification in the event that the agent is ever present in brain tissue (16). It is in charge of activating the response plan. In the event that a positive BSE test is received, the sample is sent to the United Kingdom for confirmation of the diagnosis (16).

ADDITIONAL AREAS OF CONCERN

There are many other areas of concern related to BSE and its transmission. The newest topics involve whether the infectious agent contaminates cow milk, tallow, gelatin, pharmaceutical products, cheese products (13) or baby food (7), all of which have previously been considered safe, because they are all processed in a way thought to inactivate the agent (17).

Because vCJD disproportionately infects younger people, there are theories that the BSE agent could have been present in baby food in the past. A large amount of baby food produced in the 1980s included meat that could have contained remnants of spinal cord (7).

Other research extends to the urgent need to discover a screening process capable of diagnosing the disease in humans before symptoms appear. It is feared that many more people may actually have the

disease; it just hasn't been symptomatic yet (4).

Additional research shows a possible relation between the prion associated with BSE and the causative agent in Alzheimer's disease. Similar patterns of amino acids have been found when the prion and the amyloid protein precursor responsible for Alzheimer's are compared (1). The continuation of such research can perhaps increase the understanding of the mechanism behind both diseases.

CONCLUSION

BSE has become of great international concern. Because of the infectious agent's long incubation period, the degree of danger and number of persons that may have been infected have yet to be determined. In addition to a fatality rate of 100 percent and the possible ability to jump the species barrier, this newly emerged disease could have detrimental effects on the world's food supply.

Implementation of response programs to deal with outbreaks is crucial in keeping the disease out of the United States. Exceptional effort has been made by US agencies to inform the public and educate farmers of the signs and symptoms of such illnesses. And by examining the brains of all destroyed cattle, examiners are ensuring that a case would never go undiagnosed.

The effect of BSE on humans is of utmost importance. Keeping the spread of BSE controlled can be successfully accomplished only through complete understanding of the infectious agent and its transmission. Until such understanding is available, BSE and vCJD cases will continue to occur.

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PulseNet: The Molecular Subtyping Network for Foodborne Bacterial Disease Surveillance, United States

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SUMMARY

PulseNet, the national molecular subtyping network for foodborne disease surveillance, was established by the Centers for Disease Control and Prevention and several state health department laboratories to facilitate subtyping bacterial foodborne pathogens for epidemiologic purposes. PulseNet, which began in 1996 with 10 laboratories typing a single pathogen (*Escherichia coli* O157:H7), now includes 46 state and 2 local public health laboratories and the food safety laboratories of the U.S. Food and Drug Administration and the U.S. Department of Agriculture. Four foodborne pathogens (*E. coli* O157:H7; nontyphoidal *Salmonella* serotypes, *Listeria monocytogenes* and *Shigella*) are being subtyped, and other bacterial, viral, and parasitic organisms will be added soon.

Molecular subtyping of bacterial isolates by characterization of proteins or nucleic acids has been successfully applied to aid epidemiologic investigations of foodborne disease outbreaks since the initial use of plasmid fingerprinting nearly 20 years ago (1, 2). Since that time, several methods for identifying restriction fragment length polymorphisms on chromosomal DNA have been developed, and molecular subtyping has become an essential component of epidemiologic investigations of infectious diseases (3-10).

This widespread use of molecular typing has resulted in a plethora of techniques and protocols for subtyping even the same species of bacteria (11). Because each laboratory uses its own protocols for molecular typing and designations of patterns, the results cannot be compared with those of another laboratory, even if both laboratories have used essentially the same methods. This lack of comparabil-

Figure 1. Locations of PulseNet laboratories in the United States. PulseNet participant states are currently participating. States labeled PulseNet participants 2001 are expected to complete the requirements for entry by December 2001. The area laboratories provide surge capacity and technical support to neighboring states. FDA-CFSAN: U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition Laboratory; FDA-CVM: U.S. Food and Drug Administration, Center for Veterinary Medicine Laboratory; USDA-FSIS: U.S. Department of Agriculture, Food Safety and Inspection Service Laboratory.



ity has greatly diminished the power of molecular subtyping methods.

In 1993, during the investigation of an *Escherichia coli* O157:H7 outbreak caused by contaminated hamburgers served in a fast-food restaurant chain in the western United States, Barrett et al. in our laboratory applied pulsed-field gel electrophoresis (PFGE) to characterize clinical and food isolates of *E. coli* O157:H7 and demonstrated its utility in outbreak investigations (12). Subsequently, our laboratory received numerous requests from state health departments for subtyping *E. coli* O157:H7. The demand soon overwhelmed our testing capacity, and delays in subtyping isolates meant that results were mostly useful only for laboratory confirmation of conclusions from epidemiologic investigations. We reasoned that decentralization of subtyping activities and transfer of standardized molecular subtyping methodology to public health laboratories should enable more timely subtyping of clinical and food isolates. One result would be information useful to epidemiologists while they were investigating outbreaks. In addition, routine

subtyping of isolates of foodborne pathogenic bacteria received by public health laboratories should lead to identification of outbreaks not readily recognizable by other means. Use of standardized subtyping methods would allow isolates to be compared from different parts of the country, enabling recognition of nationwide outbreaks attributable to a common source of infection, particularly those in which cases are geographically separated.

In 1995, the Centers for Disease Control and Prevention (CDC), with the assistance of the Association of Public Health Laboratories (APHL), selected the state public health laboratories in Massachusetts, Minnesota, Washington, and Texas as area laboratories for a national molecular subtyping network for foodborne bacterial disease surveillance. This network later became known as PulseNet (13). Standardized PFGE typing and pattern analysis technology would be transferred to the area laboratories, which would assume responsibility for subtyping foodborne pathogenic bacteria from their states and providing subtyping service to neighboring states that requested assistance. At about the

same time, CDC and five state health departments, as part of a response to emerging infectious disease threats (14), implemented an active foodborne disease surveillance program called FoodNet (15). The objectives of FoodNet were to accurately estimate the burden of foodborne disease in the United States, investigate the sources of infection in outbreaks and sporadic cases, and build public health infrastructure for dealing with emerging foodborne disease issues. In 1996, FoodNet included Minnesota, Oregon, Connecticut, and Georgia and selected counties in California. Participants in FoodNet recognized the advantages offered by PulseNet, and the public health laboratories in Oregon and Georgia began participating in PulseNet. The first 5-day workshop on standardized methods for PFGE for foodborne pathogenic bacteria was held in January 1996. By early 2000, PulseNet included 46 state public health laboratories, the public health laboratories in New York City and Los Angeles County, California, the U.S. Department of Agriculture's Food Safety and Inspection Service Laboratory (USDA-FSIS), and the U.S. Food and Drug Administration laboratories in the Center for Food Safety and Applied Nutrition (FDA-CFSAN) and Center for Veterinary Medicine (Fig. 1). In addition, six provincial Canadian laboratories joined PulseNet in 1999-2000; their participation is coordinated through the National Laboratory for Enteric Pathogens, Canadian Science Centre for Human and Animal Health Winnipeg, Manitoba.

As PulseNet's capacity expands, the need for epidemiologic assessment of new information expands in parallel because timely evaluation of clusters identified by the network is critical and warranted. PulseNet's laboratory evaluation of isolates from clusters or outbreaks identified through routine epidemiologic surveillance has already demonstrated its value in early recognition of outbreaks and rapid identification of their sources. A welcome consequence is engendering close collaboration between

TABLE 1. Interlaboratory reproducibility of pulsed-field gel electrophoresis patterns of 64 *Escherichia coli* isolates by eight laboratories following the PulseNet standardized protocol

Result	1	2	3	4	5	6	7	8
Matched expected pattern	64/64 ^a	63/63	59/63	62/64	62/64	62/64	61/64	61/64
	(100)	(100)	(93.7)	(96.9)	(96.9)	(96.9)	(95.3)	(95.3)
≤ 1-band difference from expected pattern	64/64 ^a	63/63	62/63	64/64	63/64	64/64	64/64	64/64
	(100)	(100)	(98.4)	(100)	(98.4)	(100)	(100)	(100)

^aValues represent no. of patterns fitting in the specified category/no. of isolates tested.

epidemiologists and microbiologists throughout the public health system.

STANDARD PROTOCOLS

During 1996 and early 1997, we evaluated the standard protocol for *E. coli* O157:H7 at participating PulseNet laboratories. The original protocol, similar to the one used by Barrett et al. (12), required 3 to 4 days of testing; it involved an overnight incubation for cell lysis and another for restriction of chromosomal DNA. A set of 64 *E. coli* O157:H7 strains was compiled to evaluate the reproducibility of DNA fingerprint patterns in different laboratories. This set was sent to participating laboratories, which were asked to type strains by using the standardized protocol and return the raw electronic images of PFGE patterns to a common CDC database for study. Data analysis showed that when the standardized protocol is strictly followed by participating laboratories, results are highly reproducible and DNA patterns generated at different laboratories can be compared (Table 1). Also included in this set were duplicates of nine isolates to assess intralaboratory reproducibility of PFGE patterns; the testing laboratories were unaware of the duplicate strains until results were analyzed and reported. For six of nine sets, all laboratories generated patterns that were exact matches within each set. For each of the

three remaining sets of duplicates, one of seven laboratories did not generate an exact match but matched the duplicates at 95%-97% similarity.

STANDARDIZED EQUIPMENT FOR PARTICIPATING LABORATORIES

PulseNet laboratories use CHEF-DRII, CHEF-DRIII, or CHEF-Mapper (Bio-Rad Laboratories, Hercules, CA) for PFGE of restricted bacterial DNA. Although all three instruments can run PulseNet protocols, CHEF-Mapper allows greater flexibility in development of electrophoretic separation conditions and nonlinear ramping. After electrophoresis, the gels are stained with ethidium bromide, and PFGE patterns are digitized in a TIFF format (uncompressed .tif file) by using a Gel-Doc 1000 (replaced by Gel-Doc 2000; Bio-Rad Laboratories) or other image acquisition equipment capable of 768 × 640 pixels or higher resolution. Molecular Analyst Fingerprinting Plus with Data Sharing Tools (MAFP-DST; Bio-Rad Laboratories; sold as Gel Compar in Europe) is the software program used by PulseNet laboratories for analysis of PFGE patterns. MAFP-DST is being replaced with BioNumerics software (Applied Maths, Kortrijk, Belgium); the change-over will be completed in 2001. Each PulseNet laboratory has all the above equipment and has the capability to normalize the pat-

terns, compare them with other patterns, and maintain local databases of PFGE patterns for each bacterial pathogen of interest.

NATIONAL DATABASE OF PFGE PATTERNS AND ASSOCIATED EPIDEMIOLOGIC INFORMATION

A national database of PFGE patterns is being assembled for foodborne bacterial pathogens. These databases reside on a PulseNet server at CDC. For each bacterial pathogen, the normalized PFGE pattern is associated with a pattern database and a database of epidemiologic and clinical information for isolates. One isolate may be associated with more than one PFGE pattern in the database because PulseNet protocols may call for the use of more than one restriction enzyme to achieve appropriate discrimination between epidemiologically unrelated isolates. The *E. coli* O157:H7 database is functional; databases for nontyphoidal *Salmonella* serotypes and *Listeria monocytogenes* are under construction.

Seven PulseNet laboratories (four state public health laboratories, FDA-CFSAN, USDA-FSIS, and CDC) have direct access to the PulseNet database server through the Internet, enabling them to submit normalized PFGE patterns and associated epidemiologic information. (The DST version of the Molecular Analyst software creates a

TABLE 2. Priority order for inclusion of foodborne bacterial pathogens in PulseNet

Pathogen	Expected year of inclusion
<i>Escherichia coli</i> O157:H7	1997
Nontyphoidal <i>Salmonella</i> serotypes	1998
<i>Listeria monocytogenes</i>	1999
<i>Shigella sonnei</i>	1999
<i>Clostridium perfringens</i>	2001
<i>Campylobacter jejuni</i>	2001
<i>Vibrio parahaemolyticus</i>	2001
<i>V. cholerae</i>	2001
<i>Clostridium botulinum</i>	2002
Other pathogenic <i>E. coli</i>	2002
<i>Yersinia enterocolitica</i>	2003

special "bundle" file for comparison with the national database.) Laboratories query the national database for identical matches or closely related patterns (>95% related under specified conditions). If identical or close matches to the submitted patterns are found, the submitting laboratory can access epidemiologic information associated with those patterns from the text database. When a PulseNet participating laboratory logs on to the PulseNet server, it will display a "recent match" message if two or more laboratories submit identical or closely related patterns within a specified time. This alert provides an early warning to PulseNet laboratories about possible multisite foodborne disease outbreaks.

PulseNet laboratories that do not yet have direct online access to the PulseNet server may still electronically submit raw TIFF images and normalized PFGE patterns (bundle files) to the PulseNet database administration team by e-mail or through file transfer protocols (ftp). The team compares the submitted patterns with those in the national database and e-mails the results to the submitting laboratory

as quickly as possible. We expect that direct access to the PulseNet server will be available to all participating laboratories that have satisfactorily completed certification requirements by June 30, 2001.

DEVELOPING STANDARDIZED PROTOCOLS

Standardized protocols for foodborne bacterial pathogens were developed in priority order based on the ability of PFGE to discriminate among strains of the organism and the epidemiologic utility of the resulting data. Standardized PFGE protocols have been developed for *E. coli* O157:H7, *Salmonella enterica* serotype Typhimurium, *L. monocytogenes*, and *Shigella* species. The *S. Typhimurium* protocol is applicable to most other nontyphoidal *Salmonella* serotypes, including *S. Enteritidis*. However, neither PFGE nor other molecular sub-typing methods provide acceptable discrimination among strains of this highly clonal serotype. Standard PFGE protocols for *Campylobacter jejuni*, *C. coli*, and *Clostridium perfringens* (7) are being developed and validated. Al-

though *C. jejuni* and *C. coli* infections are common, developing a standardized PFGE protocol for these organisms was not a high priority because they infrequently cause outbreaks. On the other hand, although outbreaks of *C. perfringens* infections are seldom widespread, state and local public health laboratories requested a standardized subtyping protocol to assist with local outbreak investigations. All PulseNet protocols are 1-day procedures based on the PFGE protocol developed by the Washington State Public Health Laboratory in response to the need for more rapid techniques (16). All new protocols and modifications of existing protocols are evaluated initially at the developing laboratory, followed by a second evaluation at CDC, alpha-testing at one or two PulseNet laboratories, and beta-testing at several PulseNet laboratories before they are adopted as official PulseNet protocols. Evaluation criteria include reproducibility of patterns, appropriateness of the strain used as the reference standard, and robustness of the procedure. Once a protocol is officially adopted, no changes can be made except by a petition to CDC's PulseNet Task Force, discussion of the proposed changes, and adoption of the proposal by PulseNet laboratories. The PulseNet Task Force at CDC is composed of personnel who carry out PulseNet-related activities. The Task Force members develop and evaluate protocols, provide technical support for participating laboratories, organize and conduct training workshops, administer the certification program and proficiency testing program, and maintain the national databases of PFGE patterns for the bacteria under surveillance in PulseNet.

QUALITY CONTROL AND ASSURANCE PROGRAM

A quality assurance program has been instituted for PulseNet to ensure the integrity of results obtained with the standardized PFGE techniques. This program requires

strict adherence to the standardized PFGE protocols (17). In addition, the quality assurance program consists of standards for training, analytical procedures, documentation, and equipment; standard operating procedures; an initial certification set of isolates for each organism; and an ongoing proficiency testing program. The standards detail the minimum requirements a laboratory must meet for training personnel, analytical procedures, documentation, equipment calibration and maintenance, proficiency testing, and review of results. The laboratory standard operating procedures describe procedures for record keeping, equipment maintenance, gel image acquisition, data analysis, and administrative policies. The certification sets consist of isolates with known patterns, which are sent to each laboratory.

Laboratories type the isolates by the standardized protocol and send the gel images to the PulseNet National Database Administration Team for review. This team, part of the PulseNet Task Force, is responsible for maintaining and updating the PFGE pattern databases for foodborne disease-causing bacteria. Team members review new patterns submitted to the databases and verify matches. In addition, this team evaluates the certification data submitted by PulseNet laboratories. Laboratories with DST version of the MAFP software also analyze their gel images and send the results (bundle files) to the PulseNet National Database Administration Team for review. This team checks gel images and bundle files against the master certification set to ensure that the laboratory has obtained the correct patterns. Successful completion of the certification set allows PulseNet-affiliated laboratories to compare results with the National Database. As part of the proficiency testing program, laboratories will be sent a combination of isolates and TIFF files on a semiannual basis both to test the laboratory's ability to perform the standardized protocol cor-

rectly and to ensure that data analysis is consistent from laboratory to laboratory.

A quality assurance and control manual, being developed, will describe standardized training, laboratory and administrative procedures, and policies. A proficiency testing manual, also in preparation, is designed to maintain the reproducibility of patterns and consistency in analysis of patterns that make PulseNet a valuable tool for epidemiologists.

Laboratories joining PulseNet are sent the standardized PFGE protocols and certification sets appropriate to the organism(s) being tested. Appropriate training is scheduled and follow-up is provided by means of the certification sets and the regularly scheduled proficiency testing program. An annual meeting enables microbiologists from participating PulseNet laboratories to discuss new protocols and software upgrades and exchange information on problems and solutions.

STANDARDIZED NOMENCLATURE FOR PFGE PATTERNS

A major problem in comparing and interpreting molecular subtyping information from different laboratories has been the lack of a universal naming system for PFGE patterns. In response, we have developed a standardized nomenclature system for designating PFGE patterns in PulseNet. Each unique pattern in the database is represented by a 10-character code as follows:

XXXYYY.0000

The first three characters in the code represent the bacterial pathogen, the next three characters denote the enzyme used for DNA restriction, and the last four characters represent the pattern designation. For example, in the pattern designation EXHA26.0026, EXH represents *E. coli* O157:H7, A26 represents restriction endonuclease *AvrII*, and 0026 is the pattern number. Because the pattern numbers

are assigned sequentially to unique patterns, no evolutionary, phylogenetic, or clonal relationships should be implied from the order of pattern numbers.

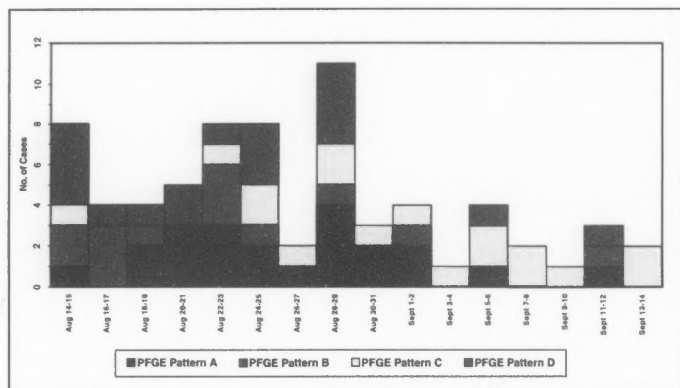
A priority order has been developed for inclusion of foodborne bacterial pathogens in PulseNet (Table 2). The prioritization takes into account the availability of an acceptable molecular subtyping method for a pathogen, severity of disease caused by that pathogen, propensity for the pathogen to cause outbreaks, and the potential for recognizing outbreaks and taking preventive action by routine subtyping.

ROLE OF PULSENET IN OUTBREAK INVESTIGATIONS

PulseNet plays several roles in detecting, investigating, and controlling outbreaks. Identification by PulseNet of an increase in a specific subtype of a pathogen may be an early indication of an outbreak. PFGE patterns submitted to the participating laboratories may link apparently unrelated cases that are geographically dispersed. Once a cluster is detected through PulseNet, an epidemiologic investigation is initiated to determine if there is a common source. This epidemiologic investigation may be guided by the PFGE subtypes identified through PulseNet. PulseNet can identify outlier cases in other areas and define the geographic scope of the outbreak. If a common food source is identified and the pathogen is isolated from that food, subtyping helps confirm it as the outbreak strain. Finally, once control measures are instituted, PulseNet can help confirm that the outbreak is over by showing a substantial decrease in circulation of the outbreak strain in the affected communities. The following examples illustrate these PulseNet functions.

In 1996, epidemiologists at the Washington State and Seattle-King County health departments traced an outbreak of *E. coli* O157:H7 in-

Figure 2. Distribution by date and pulsed-field gel electrophoresis subtype of *Salmonella* ser. Typhimurium isolates received by the Minnesota Department of Health, August 14-September 14, 1995. Data provided by Jeffrey Bender and John Besser, Minnesota Department of Health.



fections in four states and one Canadian province to commercial unpasteurized apple juice. Of 70 persons identified as part of this outbreak, 25 required hospitalization, 14 had hemolytic uremic syndrome, and one died. DNA fingerprinting by PFGE at the Washington State Public Health Laboratory, a PulseNet area laboratory, showed that isolates from patients and the apple juice were the same strain. Prompt recognition of the apple juice as the source of this outbreak resulted in rapid recall of the widely distributed product (18).

EMERGING INFECTIOUS DISEASES

In 1997, the Colorado State Public Health Laboratory, which had just initiated PFGE typing of *E. coli* O157:H7, identified a cluster of 14 ill persons whose *E. coli* O157:H7 isolates had matching PFGE patterns. About the same time, the USDA laboratory isolated an *E. coli* O157:H7 strain from a ground beef patty from the same package as a patty eaten by an ill person. DNA fingerprinting by PFGE on the human isolate from Colorado and the food isolate from USDA-FSIS were generated by the PulseNet standardized protocol. The PFGE patterns were transmitted electronically to CDC via the

Internet, where they were found to be indistinguishable. This outbreak pattern was then transmitted to PulseNet sites and compared with patterns from >300 other recent *E. coli* O157:H7 isolates. No matching patterns were found other than one case in Kentucky, providing strong evidence that the outbreak was not nationwide.

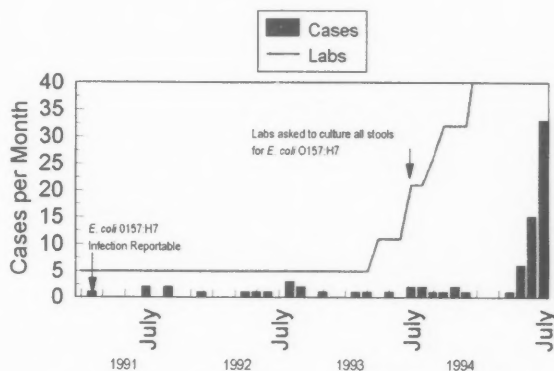
In May 1998, PulseNet facilitated the investigation of two clusters of *E. coli* O157:H7 infections in the northeastern United States. Timely fingerprinting of *E. coli* O157:H7 isolates by the Massachusetts Area Laboratory for PulseNet and other PulseNet laboratories in that region revealed two simultaneous clusters of *E. coli* O157:H7 infections (32 isolates in four of five states with one PFGE pattern and 25 isolates in all of five states with a second PFGE pattern), one of which could be traced to two supermarkets that received ground beef from the same distributor. Without assistance from PulseNet, epidemiologists would have found it difficult to identify cases associated with each cluster.

Also in May 1998, the state public health departments in both Illinois and Pennsylvania informed CDC about increases in *Salmonella* Agona infections. Serotype-specific surveillance data from other states quickly confirmed that 10 states had increases in *S. Agona*

infections. A national outbreak of *S. Agona* was occurring, with no obvious source. Subsequently, the outbreak was traced to contaminated ready-to-eat toasted oats cereal product from a food-processing facility in Minnesota (19). PulseNet laboratories helped in this investigation by distinguishing cases that were associated with the outbreak from those that were not. In addition, timely PFGE typing of *S. Agona* by PulseNet laboratories helped identify outbreak-associated cases in states where the contaminated product was not initially thought to have been distributed. PFGE subtyping of *S. Agona* isolates was important in confirming the successful control of the outbreak. Not only did the number of reported isolates return to baseline, but also the outbreak strain disappeared. By the time this investigation was completed, PulseNet laboratories had typed >1,000 isolates of *S. Agona*. Four hundred nine cases (one fatal) in 23 states were linked to this outbreak (CDC, unpub. data).

From October 20 to November 9, 1998, health officials in Connecticut, New York, Ohio, and Tennessee reported increases in *Listeria* infections in their states (20). PFGE typing by PulseNet laboratories showed that several case isolates from different states had indistinguishable DNA fingerprints. On further investigation, 101 *Listeria* infections (including 15 perinatal infections) with bacteria having the same or highly similar DNA fingerprints were identified in 22 states. Fifteen deaths and six miscarriages or stillbirths were reported among patients who were infected with the outbreak strain. This outbreak was traced to contaminated hot dogs and sandwich meat produced at a single large meat-processing plant in Michigan (21). After the company voluntarily recalled the implicated lots of product and suspended production, the outbreak rapidly ended.

Figure 3. Reported cases of culture-confirmed *Escherichia coli* O157:H7 infection and percentage of surveyed laboratories routinely testing all stool specimens for *E. coli* O157:H7, New Jersey, January 1991 through July 1994 (10).



SURVEILLANCE FOR FOOD-BORNE OUTBREAKS

Twenty years ago, most foodborne outbreaks were local problems that typically resulted from improper food-handling practices. Outbreaks were often associated with individual restaurants or social events and often came to the attention of local public health officials through calls from affected persons. These persons, who may have known others who had become ill after eating a shared meal or visiting the same restaurant, provided health officials with much of the information needed to begin an investigation.

Today, foodborne disease outbreaks commonly involve widely distributed food products that are contaminated before distribution, resulting in cases that are spread over several states or countries. It is less common for ill persons to know others who were ill or to be able to identify a likely source of their infection. For these reasons, it is becoming increasingly important to be able to identify potential common exposures through DNA fingerprinting of patient isolates. For foodborne outbreak surveillance to be effective, isolates must be subtyped routinely and the data analyzed promptly at the local level.

Clusters can often be detected locally that could not have been identified by traditional epidemiologic methods alone. This is especially true of infections with common pathogens such as *S. Typhimurium*, which occur so frequently that clusters may be hidden among sporadic cases. For *S. Typhimurium* isolates received by the microbiology laboratory at the Minnesota Department of Health from August 14 to September 14, 1995, temporal distribution did not suggest any obvious clustering, but the distribution of PFGE subtypes suggested multiple common sources with continuing exposures (Fig. 2). Epidemiologic investigation ultimately linked three of the subtypes to local restaurants, where exposure to *S. Typhimurium* occurred throughout the month (Jeffrey B. Bender, pers. comm.). Without subtyping data, it would have been very difficult to associate cases with exposures occurring over such a prolonged period.

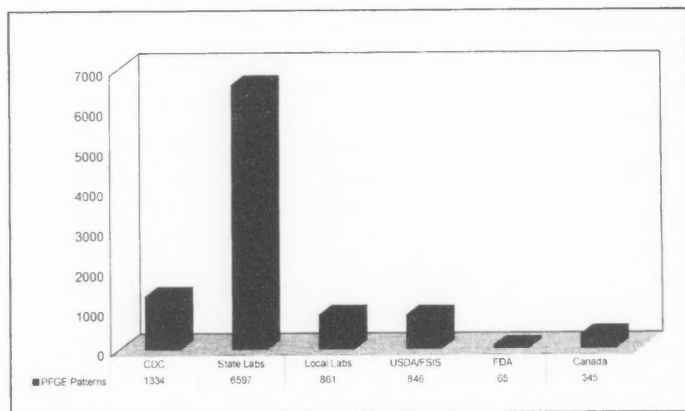
In September 1998, the Minnesota state public health laboratory informed other PulseNet laboratories that it was investigating two clusters of *Shigella sonnei* infections associated with restaurants in Minnesota and asked if other states had observed increases in *S. sonnei* infections or *S. sonnei* isolates with

the outbreak PFGE pattern. The Los Angeles County public health department immediately responded that it was also investigating restaurant-associated outbreaks of *S. sonnei* and that the PFGE pattern of their outbreak strain was very similar to the Minnesota pattern. Epidemiologic and laboratory investigations ultimately determined that outbreaks in Massachusetts, Florida, and two Canadian provinces were linked to the Minnesota and Los Angeles outbreaks. With the assistance of the FDA's outbreak traceback and coordination group, parsley imported from Mexico was identified as the common vehicle (22). Mexican and U.S. authorities inspected the parsley farm and recommended changes in growing and harvesting practices to prevent recurrence of the problem. Rapid sharing of PFGE subtyping data through PulseNet played a critical role in linking these apparently unrelated outbreaks and identifying a common vehicle.

The use of molecular subtyping as part of routine surveillance has benefits beyond outbreak detection. Temporal clustering of unrelated cases is not uncommon, and without molecular subtyping, valuable public health resources can be wasted investigating pseudo-outbreaks. In June and July 1994, an outbreak of *E. coli* O157:H7 infections was suspected when the New Jersey Department of Health and Senior Services received reports of 48 culture-confirmed cases; only four were reported during the same period in 1993 (23). PFGE subtyping found most isolates to have unique patterns, indicating that a large outbreak was unlikely. The probable reason for the sudden increase in case reports was the concomitant increase in the number of laboratories culturing stools for *E. coli* O157:H7 (Fig. 3).

Although PulseNet has proven invaluable in detecting foodborne disease outbreaks and facilitating their investigation, molecular subtyping is an adjunct to epidemiologic investigation and not a

Figure 4. Sources of pulsed-field gel electrophoresis patterns submitted to PulseNet in 1999.



replacement for it. The observation that isolates from two or more persons have indistinguishable PFGE patterns should not be considered proof that the persons had a common exposure, merely that the isolates in question share a common ancestry. Moreover, outbreaks can be caused by more than one subtype, so that differences in PFGE pattern alone cannot prove that isolates did not have a common source (24, 25).

REQUIREMENTS FOR EFFECTIVE FUNCTIONING

Although the area laboratories are set up to assist neighboring state public health laboratories that are not PulseNet participants, every state must have PFGE subtyping capacity for optimum performance of the network. A dramatic indication of this was provided during the 1997 ground beef-associated *E. coli* O157:H7 outbreak in Colorado. When the outbreak pattern was posted on PulseNet ListServ, most laboratories that were network participants responded within 48 hours that they had no matching PFGE patterns from a recent *E. coli* O157:H7 isolates. In contrast, it took more than 2 months to identify a case in Kentucky (not a PulseNet participant state in 1997)

that was related to the Colorado outbreak. The Association of Public Health Laboratories has determined that PulseNet participation is a core capacity for all state and territorial public health departments in the United States.

For the network to work efficiently in detecting foodborne disease outbreaks through routine surveillance, PulseNet laboratories must perform, at a minimum, routine PFGE subtyping of *E. coli* O157:H7 and *L. monocytogenes* as soon as isolates are received. In addition, they must perform PFGE subtyping of other foodborne pathogenic bacteria (*Campylobacter jejuni* and *C. coli*, *Salmonella* serotypes, *Shigella* spp., *Bacillus cereus*, *Vibrio cholerae*, *V. parahaemolyticus*, *V. vulnificus*, *Clostridium botulinum*, *C. perfringens*, *Yersinia enterocolitica*) rapidly when the number of isolates received by the laboratory exceeds the expected number for that period. Unfortunately, microbiologists at state and local public health laboratories often have responsibilities for all pathogenic bacteria and may not be able to type incoming isolates of foodborne pathogenic bacteria in a timely manner. In addition, like public health surveillance in general, PulseNet depends on physicians requesting culture of patient

specimens if a bacterial infection is suspected and the clinical diagnostic laboratory promptly forwarding isolates to the public health laboratory for typing.

PulseNet relies on the cooperation of all participants in typing foodborne pathogenic bacteria by strict adherence to the standard protocol. Without such a total commitment, PFGE patterns from different PulseNet laboratories could not be compared to ascertain which cases are associated with a specific outbreak. The importance of this was underscored by a recent experience. One PulseNet laboratory had decided to change the PulseNet protocol for *S. Typhimurium* and was using a variation of the standard protocol. A cluster of *S. Typhimurium* cases was detected in that state, and PFGE analysis confirmed that many of the isolates were indistinguishable. However, when attempts were made to determine if an increase in *S. Typhimurium* infections in neighboring states were related to the cluster, the PFGE patterns could not be compared. This caused a delay of several days in the investigation because isolates from the first state had to be re-typed by the standardized protocol.

COST-BENEFIT ANALYSIS

Elbasha et al. recently compared the costs and benefits of PulseNet's molecular subtyping-based surveillance system, using as an example the Colorado state public health laboratory's investigation of the 1997 *E. coli* O157:H7 outbreak in which contaminated frozen hamburger patties were implicated (26). If 15 cases were averted by the recall of potentially contaminated ground beef, the PulseNet system in Colorado would have recovered all costs of start-up and 5 years of operation. These authors point out that the system becomes even more cost-effective if one takes into account resources that would have been wasted to investigate apparent increases in sporadic cases of *E. coli* O157:H7 infections.

THE GROWTH AND FUTURE OF PULSENET

Within a very short time, PulseNet has grown beyond expectations and has convincingly demonstrated its effectiveness as a tool for foodborne disease surveillance. It began with one pathogen (*E. coli* O157:H7) and 10 participating laboratories in 1996 that submitted 191 PFGE patterns to the PulseNet database during that year. In 1999, four pathogens (*E. coli* O157:H7, *Salmonella*, *Shigella*, and *Listeria monocytogenes*) were tracked through PulseNet and >9,500 patterns were submitted to the PulseNet database. State and local public health laboratories contributed >78% of the patterns to the PulseNet database (Fig. 4). As the FDA are increasing the number of laboratories that perform PFGE subtyping using PulseNet protocols, and the USDA are setting up their own PulseNet-compatible local networks, their contributions to the PulseNet database will no doubt substantially increase. In addition, the representation of PFGE patterns in the PulseNet databases will increase for pathogenic bacteria isolated from foods.

As more public health laboratories at the local and state levels join PulseNet, the role of the area laboratories is changing. The area laboratories provide training and consultation to neighboring PulseNet laboratories, coordinate multi-state outbreak investigations when requested, and provide surge capacity for neighboring PulseNet laboratories. Three additional area laboratories, in Michigan, Utah, and Virginia, were designated in 2000, bringing the total number to seven.

Canada is already an active participant, and international expansion of the network with partners in Mexico, South America, and Europe is anticipated. The long-term vision for PulseNet is a global network of public health laboratories working with food regulatory agencies and industry to improve food safety worldwide.

Finally, we recognize that the methods currently used for subtyping and data analysis will not always be state-of-the-art. We are working to develop, evaluate, and validate DNA sequencing-based subtyping methods for foodborne pathogens. These methods will be gradually implemented in the network, and compatibility will be maintained with existing PFGE data. We are also working with software developers to implement new versions of pattern analysis software and DNA sequence comparison software to improve pattern matching, automate pattern normalization and sequence alignment, and reduce subjectivity in subtype comparisons.

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Dr. Swaminathan is chief of the Foodborne and Diarrheal Diseases Laboratory Section, CDC, and the principal architect of PulseNet.

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Marth, E. H. 1974. Fermentations, p. 771-882. *In* B. H. Webb, A. H. Johnson and J. A. Alford (eds.). *Fundamentals of dairy chemistry*. 2nd ed. AVI Publishing Co., Westport, CT.

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Minor, T. E., and E. H. Marth. 1976. *Staphylococci and their significance in foods*. Elsevier Scientific Publishing Co., Amsterdam.

Book by editor(s)

Vanderzant, C., and D. F. Splittstoesser (eds.). 1992. *Compendium of methods for the microbiological examination of foods*. 3rd ed. American Public Health Association, Washington, D.C.

Patent

Hussong, R. V., E. H. Marth, and D. G. Vakaleris. 1964. Manufacture of cottage cheese. U.S. Pat. 3,117,870. Jan. 14.

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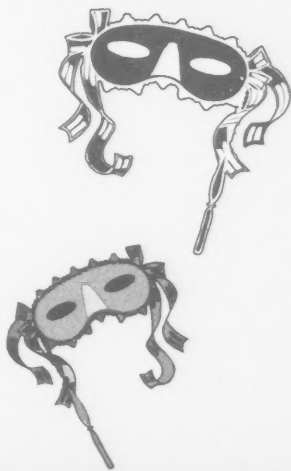


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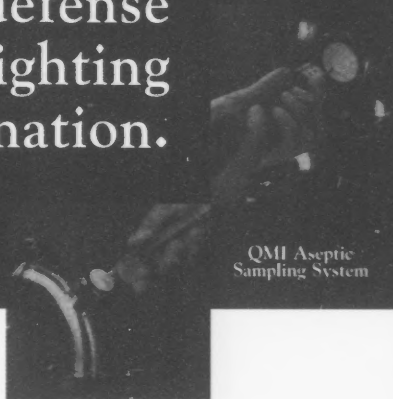
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Updates

NC State Food Scientist Elected to National Academy of Sciences

Dr. Todd R. Klaenhammer, William Neal Reynolds Professor of food science and microbiology at North Carolina State University, has been elected to the National Academy of Sciences (NAS).

Klaenhammer is director of the Southeast Dairy Foods Research Center at NC State and is one of the world's leading experts on the role of lactic acid bacteria in food fermentation. He is widely cited for his seminal research on the development of a genetic trap that stops the spread of bacteriophages – viruses that kill or destroy cells – in starter cultures used in industrial bioprocessing and dairy food fermentation. This defense mechanism genetically programs dairy foods starter bacteria to die after infection by a bacteriophage, entombing the infecting phage so that it cannot propagate and spread to other cells in the food.

Klaenhammer joined the NC State faculty in 1978 as an assistant professor of food science. He was appointed an associate professor in 1983 and a full professor in 1988. In 1992, he was named William Neal Reynolds Professor of food science and microbiology. In 1993, he was named NC State Alumni Distinguished Graduate Professor and appointed director of the Southeast Dairy Foods Research Center at NC State.

He is a member of the American Society for Microbiology, Sigma Xi Science Honor Society, the Institute of Food Technologists, and the American

Dairy Science Association, among other professional associations.

Klaenhammer received a bachelor's degree in microbiology, a master's degree in food science, and a doctoral degree, also in food science, from the University of Minnesota in 1973, 1975 and 1978, respectively.

Quality Chekd Dairies, Inc. Hires Paul A. Van House as Technical Trainer

Quality Chekd Dairies, Inc. has hired Paul A. Van House as a technical trainer. The appointment is effective immediately.

As a technical trainer, Van House will plan, manage, and facilitate training workshops and develop new training methods to ensure that Quality Chekd member dairies in the United States, Canada, Mexico, and Colombia continue to meet consumer needs and the high quality standards that are the cornerstone of Quality Chekd's mission.

Van House has more than 20 years of experience in the food industry in the areas of quality assurance and training. Van House comes to Quality Chekd from Cutrale Juices in Auburndale, FL, where he served as the quality assurance manager. Prior to working at Cutrale Juices, Van House served as the quality systems coordinator at Tropicana in Bradenton, FL, and as the superintendent at Kerr Glass in Santa Ana, CA.

A native of Austin, MN, Van House received a degree in food technology from Riverland College in Albert Lea, MN.

HFM Announces Election Results

The National Society for Healthcare Foodservice Management announced results of its 2001 election of officers and Board of Directors. Barry Schlossberg, director of food and nutrition service at Continuum Health Partners, New York, NY, was elected as the HFM president-elect for 2001-2002. He will assume the office of president in September of 2002.

Re-elected to the Board of Directors for two-year terms were Diane Betkoski, director of food and nutrition at St. Francis Medical Center, Hartford, CT, and David Savage, director of nutrition and Hospitality Services at St. Joseph's Hospital, Hamilton, Ontario, Canada.

Newly elected members of the Board of Directors include Mary Angela Miller, director of nutrition and dietetics, Ohio State University Medical Center, Columbus, OH; Peter Savenko, director of food and nutrition services, Baystate Health System, Springfield, MA; Betty Perez, director of food and nutrition services, University of Medicine and Dentistry, Newark, NJ; Joyce Scott-Smith, director of nutrition and foodservices, UPMC Shady-side, Pittsburgh, PA; Sherri Driscoll, director of food and nutrition services, Dakota Heartland Health, Fargo, ND; and Linda Lafferty, director of food & nutrition services, Rush Presbyterian St. Luke's Medical Center, Chicago, IL.

These new Board Members will commence their terms in August 2001. Elected as the

member-at-large of the 2002 nominating committee was Shawn Noseworthy, nutrition services director, Orlando, FL.

Duane Ehlke Promoted at Fristam Pumps

Fristam Pumps, Inc. is pleased to announce the promotion of Duane Ehlke to the position of design engineering manager.

A member of Fristam's engineering department for seven years, Duane holds a bachelor of science degree in mechanical

engineering from the University of Wisconsin-Platteville.

He is responsible for the design, development and improvement of Fristam's product lines, as well as providing technical support for the company and its customers.

ADPI Announces Committee to Select New CEO

Mark Davis, Davisco Foods International, Inc., LeSueur, MN, president of the American Dairy Products Institute, has

announced that the following Institute Officers will serve as the committee to select the Institute's new CEO, succeeding Warren S. Clark, Jr., who plans to retire in February, 2002: Lee E. Blakely, Land O'Lakes, Inc., St. Paul, MN, committee chairman; Mark Davis, Davisco Foods International, Inc.; Walt W. Wosje, Michigan Milk Producers Assn., Novi, MI; Phillip Dale Smith, Leprino Foods, Denver, CO; and Richard W. Stammer, Agri-Mark, Inc., Lawrence, MA.



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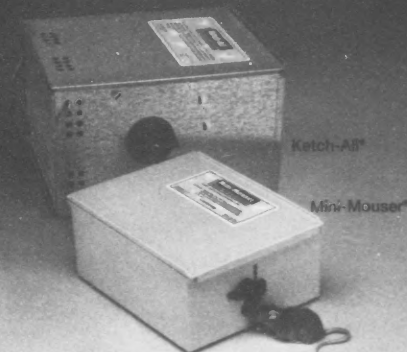
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World Health Organization (WHO) Surveillance Programme for Control of Foodborne Infections and Intoxications in Europe

The Programme for Surveillance of Foodborne Diseases in Europe was launched by the WHO Regional Office for Europe in 1980, with the participation of 8 countries. Currently the responsibility of the WHO European Centre for Environment and Health, the Programme is managed by the Institute for Health Protection of Consumers and Veterinary Medicine (BGVV), a FAO/WHO Collaborating Centre for Training and Research in Food Hygiene and Zoonoses located in Berlin, Germany. The number of participating countries has steadily increased and reached 51 as of December 1998.

The Programme is non-mandatory and based on surveillance activities at the national level. Each country has designated a National Contact Point, providing country data to the Programme through standardized reporting forms.

The following information and data are reported:

- (1) number of ill persons;
- (2) causative agent;
- (3) type of food;
- (4) place where food was consumed;
- (5) place where food was acquired;
- (6) place where food was contaminated; and
- (7) factors contributing to outbreak.

The national sources of this information are: (a) statutory notifications (cases reporting); (b) reporting of investigated outbreaks; (c) laboratory reports; and (d) special surveys.

Statutory reporting merely counts the number of patients, while reports on foodborne disease outbreaks normally provide epidemiological background information. This information is necessary for the



implementation of appropriate control measures.

The Berlin Centre compiles all national data, producing reports available to all interested institutions within and outside Europe. The 7th Report of the Surveillance Programme, covering the years from 1993 to 1998, is now available at: www.bgvv.de/publikationen/who/7threport/7threp_fr.htm.

Report Evaluates Microbial Threats to Water Quality, Makes Recommendations

New molecular techniques and recent advances in the science of microbiology can make the detection of harmful microorganisms and contaminated water faster and more accurate than ever, a new report from the American Academy of Microbiology says. Development of direct molecular tests for use in the environment is the key to strong early warning systems, more reliable diagnosis, and better treatment and cleanup of microbial pathogens in water and shellfish that threaten public health and economies worldwide.

The current standard method for water testing has been used for more than 100 years to detect and count "indicator" bacteria. Water samples are exposed to nutrients and then incubated to encourage the growth of bacteria that usually thrive in the human

colon, so growth of the "coliform" bacteria indicates fecal contamination. Such testing cannot pinpoint the source of contamination or detect disease-causing viruses like Hepatitis A or E, indigenous pathogenic bacteria like Helicobacter, or parasites like Cryptosporidium. Current testing practices cannot help to identify or prevent the enteric waterborne diseases that kill up to 2 million of the world's children each year.

"Re-evaluation of Microbial Water Quality: Powerful New Tools for Detection and Risk Assessment" outlines gene probes, genotyping, antibody, and PCR (polymerase chain reaction) techniques that stand to replace outdated methods. The promising technologies can aid in identifying microbes suspected of causing disease and confronting emerging problems like antibiotic resistant bacteria and the geographic spread of harmful microbes that can come from increased globalization.

The report presents the conclusions of a panel of experts who spent several days deliberating the issues in March of 2000. It discusses the fundamental importance of ensuring water quality and assesses progress since the Academy first addressed the subject 5 years ago. "Reevaluation of Microbial Water Quality: Powerful New Tools for Detection and Risk Assessment" makes specific recommendations for risk assessment, technology use, data collection, research collaboration, and evaluation and development of best practices.

The American Academy of Microbiology is the honorific leadership group within the American Society for Microbiology (ASM) whose mission is to foster and recognize excellence in the microbiological sciences. Academy programs include convening critical issues colloquia and developing consensus-building position papers that provide expert scientific opinion and advice on current and emerging issues in microbiology.

Salmonella Newport Infection in England Associated with the Consumption of Ready-to-Eat Salad

Nine human cases of infection with *Salmonella newport* with a possible link to a salad item have been identified in England. The cases were identified following the isolation of *S. newport* from a salad item as part of the PHLS/LACOTS survey of retail prepared pre-packed ready-to-eat salad vegetables in the United Kingdom.

Cases range in age from 4 to 74 years (median 33 years) and are distributed throughout England. Onset dates of illness range from June 2nd through the 8th. Salad consumption has been confirmed in six cases and food histories are awaited from the other two. The two cases from one area (who are not related to each other) are known to have consumed the implicated salad item three and six days prior to the onset of illness. One of the six cases from whom a food history has been obtained is known to be a vegetarian. None of the cases travelled abroad during the incubation period.

Isolates from the salad item and the nine cases exhibit an unusual reaction with the PHLS Laboratory of Enteric Pathogens phage typing scheme for *S. newport*. Additional molecular work has shown that isolates from the salad and five of the human cases have a unique plasmid profile. The salad isolate and three of the human isolates are also indistinguishable by use of pulsed field gel electrophoresis. Examination of the remaining human isolates with molecular methods is under way.

On June 22nd an urgent request for information was sent to all participants in the Enternet (www.Enternet.org.uk) surveillance network. Of the seven countries that had replied by June 28th, none reported an increase

in human cases of *S. newport* in recent weeks. Several countries reported on foodstuffs contaminated with this serotype, predominantly strains from poultry samples and a few that had been isolated from reptiles.

Salmonellosis associated with the consumption of salad items is relatively uncommon, although two notable outbreaks occurred last year. In a widespread outbreak of multiresistant *S. Typhimurium* DT104 infection in England, where 361 people were affected and one person was known to have died, illness was epidemiologically linked to the consumption of lettuce away from home in the three days prior to the onset of illness. Investigations in Iceland into a Europe-wide outbreak of multiresistant *S. Typhimurium* DT204b (which included 125 cases in England and Wales) revealed an association between illness and the consumption of imported iceberg lettuce.

ARS Patents Filed and Waiting for Commercial Partners

A new system for detecting contaminants during food processing – a potentially important weapon in avoiding foodborne illness – is one example of new technology developed by Agricultural Research Service scientists and available for commercial development.

The system uses near-infrared light and imaging to detect disease-causing microbes on meat. By detecting material that may not be visible to the human eye, this system can target areas that require washing, thus saving money, energy and water, according to ARS scientist William R. Windham. The US Department of Agriculture has filed a patent application on the technology. Research and patents are only the first steps in bringing technology to the marketplace. Commercial partners are needed to move this and other ARS research to practical implementation. To help

accomplish this, the ARS Office of Technology Transfer (OTT) is offering a full listing of current and pending ARS patents on its Web site. The OTT's redesigned Web site (www.ott.ars.usda.gov), searchable and updated daily, also contains information about how to license ARS technologies.

Among other technology featured on the site: A technique that uses two natural substances designed to alleviate some incidences of foodborne pathogens. The compounds, produced worldwide and currently used by the food industry, can be applied as a spray, in a dip tank, or during washing of poultry to inhibit pathogens. The two substances may also be used to reduce bacterial contamination of seafood products.

Parasitic wasps can detect the smallest traces of many chemicals. They also may be used to monitor the health of plants and soil, both of which emit high or low levels of certain chemicals when diseased or distressed.

Food Safety Authority Warns Businesses to Enhance Standards

The Food Safety Authority of Ireland (FSAI) has announced details of a new campaign warning the catering sector (hotels, pubs, restaurants) that unhygienic food practices will not be tolerated and Closure Orders will be served on premises found to pose a grave and immediate danger to public health. The FSAI is making this warning to specifically raise awareness during the summer months. The warmer weather combined with poor food safety practices increases the risk of food poisoning. Historically the summer months show a peak in food poisoning outbreaks. The FSAI is communicating directly with the catering industry through a new national advertising and direct mail campaign which focuses on the concept that the closure of a food business is extremely serious

and detrimental to its image and future operations.

According to Dr. Patrick Wall, chief executive, FSAI, in 2000, a total of 22 Closure Orders were served on food businesses; however, in the first six months alone of 2001, a total of 18 have already been served. Between 1998 and 2000 there were 100 reported outbreaks to the FSAI, which resulted in 2,700 people becoming ill, 246 being hospitalized, and six fatalities. The principal contributory factors were poor hygiene practices, improper storage, inadequate cooking/re-heating, cross contamination and inadequate training. "There have been a number of high profile closures in the last number of months that could have been avoided if the proprietors took action following inspections by environmental health officers. If you have a food business you must comply with the law and make food safety and hygiene an integral part of your business. Failing to do so may result in closure. For those businesses operating with excellent food standards our campaign will be no threat, it will simply reaffirm the need to be continuously conscious of good food safety practices," says Dr. Wall. "We are issuing this warning to industry to raise standards or face the consequences. Environmental health officers (EHOs) working under service contract to the FSAI carry out spot checks on premises and those who do not heed the advice of the EHOs could face closure."

The FSAI's advertising campaign incorporates two 30-second national and local radio advertisements focusing on closures. One suggests that businesses can cut electricity costs by 100% by simply being closed down for poor hygiene practices. The second is set in a busy restaurant, where a waitress gives the chef food orders – one of which is an EHO ordering a 'closure'.

Campylobacter Mystery Moves toward Resolution

A variation on the age-old question of which came first – the chicken or the egg – is one Agricultural Research Service scientist are pondering as they search for the source of a foodborne bacterium that causes human illness. The scientific riddle the researchers want to solve is how each new generation of chicks is infected with *Campylobacter*. To find the answer, ARS researchers traveled to Iceland, where poultry is produced in a closed system. Breeder eggs are obtained from Sweden, hatched in Iceland and quarantined at rearing farms. It is an integrated approach with a high degree of control.

ARS scientist Norman Stern and his colleagues at the Poultry Microbiological Safety Research Unit, Athens, GA, believe they have found one major source of *Campylobacter*, the fertile chicken egg. Historically, possible sources of the bacteria were thought to be the feed, wild birds, well water, bird fluff and pads in the cages.

Through inoculation studies, scientists showed that *Campylobacter* couldn't survive long in dry conditions, eliminating bird feathers and hatchery transport paper pads from the list of possible sources. Other studies showed that feces on the surface of eggs were an unlikely source of contamination. Thus, attention focused on transmission of the bacteria in the egg itself.

Through sequencing genetic material, a specific gene in *Campylobacter* was isolated and used as a marker to identify identical organisms. Evidence shows that the same *Campylobacter* isolate was detected in poultry production plants about 20 miles apart. The only way the organism was able to travel from one location to the other was in the moist confines of the egg.

The research may lead to understanding of the major sources involved in transmitting the bacteria – and may help reduce or prevent *Campylobacter* from entering the marketplace.

FAO Announces New Initiatives to Improve Food Safety and Quality

A series of initiatives aimed at improving food safety and quality, following recent food safety incidents that have caused serious turmoil in the world food markets and raised concern among consumers, was announced by the assistant director-general of the UN Food and Agriculture Organization, Hartwig de Haen.

At the Committee on World Food Security meeting in Rome (May 28 to June 1, 2001), Mr. de Haen said, "Food safety and quality have become subjects of increased concern for consumers, producers, and policy makers all over the world."

In collaboration with the World Health Organization (WHO), the FAO intends to convene a Global Forum on Food Safety Regulators in October 2001. The venue is yet to be determined. "The main purpose of the Global Forum is to promote the exchange of information and experience on how to deal with food safety issues of potential importance to public health and international food trade," Mr. de Haen underlined.

Experiences in the reduction of foodborne diseases, in establishing food-safety regulations and risk management procedures, in dealing with emerging foodborne illnesses, in new inspection models, in the implementation of the Codex Alimentarius standards and guidelines, and transboundary consequences in food safety emergencies will be the main subjects on the agenda of the Global Forum on Food Safety Regulators, according to FAO.

The Global Forum will not be a decision-making body, nor will it duplicate the work of the Codex Alimentarius Commission. It will bring together officials involved in the regulation of food safety and risk management from all over the world. In addition to international organizations, non-governmental organizations representing consumers, producers, the food industry and trade interests will also be involved in the discussions, FAO indicated.

In the meantime, a joint technical consultation on BSE (mad cow disease) took place in Paris (June 11-14, 2001) to review the scientific information available and address outstanding questions related to this animal disease and its transmission to humans in the form of a variant of Creutzfeldt-Jacob disease. The joint technical consultation, organized by WHO, FAO and Office International des Epizooties (OIE), will focus on preventing a global spread of the disease and on protecting both human and livestock populations.

Another initiative launched by FAO and WHO is a Pan-European Conference on Food Safety and Quality to be held in Budapest February 18-21, 2002. Its main objective is to promote the creation of a platform for mutual understanding of food safety and quality problems through institutional cooperation and exchange of information among European countries, according to FAO.

The Pan-European Conference will discuss the feasibility of establishing an information and communication system on food safety and animal and plant health, including a rapid alert system. A conference on food safety and quality for the entire European region was proposed by The Netherlands and endorsed at the last session of the FAO Regional Conference for Europe (Porto, July 2000).

Similar conferences are being considered by FAO for other regions of the world. In addition, FAO and WHO are participating actively in a number of related

initiatives sponsored by others, such as the UK/OECD Conference on New Biotechnology Food and Crops: Science, Safety and Society which will take place in Bangkok in July 2001.

The quality and safety of the food supply are of increasing importance for developing countries as well. In response to this, the FAO recently proposed setting up a food safety and quality facility for the world's least developed countries (LDCs) to establish the necessary institutional framework and infrastructure to improve the safety and quality of their food products and to participate more actively in the international standard setting bodies such as the Codex Alimentarius Commission.

The proposal was made at the third UN Conference on the LDCs (Brussels, May 14-20, 2001). The facility will include a US \$98 million trust fund. In addition to upgrading national food safety and quality systems, it would also assist poor countries to comply with the Codex Alimentarius standards and guidelines. "Improving the safety, quality and sanitary standards of food products in the developing countries would significantly improve their export performance and, at the same time, protect consumers in both exporting and importing countries," according to FAO.

For further information, please consult FAO Web site at www.fao.org.

What is Water and Sanitation?

Societies put increasing demands on water resources while polluting these resources with their wastes. This diminishes their ability to support beneficial uses – whether for drinking, recreation, cooking, irrigation and food production, industry, navigation, or as a vital part of the natural environment at the centre of biodiversity.

The competition amongst agriculture, modern forestry

practices, irrigation, industry and urban areas for limited water supplies has intensified and placed additional stresses on water resources. Widespread mismanagement of water resources in the past amongst all sectors has contributed to the creeping freshwater crisis threatening the European region, abuse of large bodies of water, the irreversible deterioration in surface water quality by urban and industrial waste, saline intrusion of coastal aquifers and contamination of groundwaters by nitrates, are examples of stresses faced by available water resources. The potential for water-related diseases increases with the poor recognition of the relationship between quality and quantity of water.

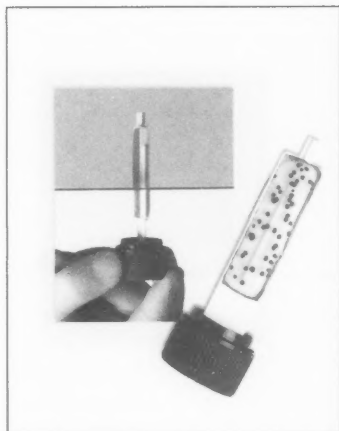
Tourist and resident populations worldwide use coastal and freshwaters, swimming pools, spas and similar facilities extensively for recreation. A number of health hazards associated with recreational waters have long been recognized, including those related to water quality and communicable and non-communicable diseases. In addition to these hazards, new challenges continue to be recognized, including pathogens such as *Cryptosporidium* and byproducts of water treatment.

Healthy development has occurred throughout the European region where effective water resource management has taken place.

The past has seen considerable investment in water sanitation such that the tools needed to maintain water of good quality and quantity are available. To meet the continued demands for high quality water and its handling, a sustainable well-focused investment of small additional funds is required.

The WHO Water and Sanitation Program pages are available at www.who.it/HT/water_and_sanitation.htm.

Industry Products



BD Diagnostic Systems

BD Hycheck™ — The Flexible Tool for Bioburden Sampling on Surfaces and in Liquids or Semi-Solids

BD Diagnostic Systems announces the immediate availability of BD Hycheck™ Hygiene Contact Slides — a uniquely flexible tool for collecting bioburden samples on surfaces and in liquids or semi-solids. BD Hycheck™ Hygiene Contact Slides are designed with a hinged media paddle that easily bends to make contact with hard-to-reach surfaces. The surface of the paddle is double-sided, allowing separate samples to be taken on each side. The simple sampling procedure begins by pressing the Hycheck slide to a surface or dipping it in a liquid. The

Hycheck slide is then incubated in an upright position so that the colonies can be counted on each agar surface. Media choices are available for a range of applications including, sampling for molds, yeasts, bacteria and coliform bacteria.

The design of the Hycheck slide offers further benefits to the user. A plastic vial screws into the handle of the slide, enclosing it for easy transport to the laboratory. Economic benefits are apparent with two sides of the Hycheck slide equipped to take two separate samples — reducing labor costs and saving extra testing steps. In addition, Hycheck slides are usable for up to 9 months from the date of manufacture, a feature that also reduces waste.

Seven choices of media are available in the BD Hycheck™ Hygiene Contact Slides: DIE Neutralizing Agar for neutralizing sanitizing agents, Tryptic Soy Agar combined with either DIE Neutralizing Agar or Violet Red Bile Glucose Agar, Plate Count Agar with TTC and without TTC, Tryptic Soy Agar combined with Rose Bengal Chloramphenicol Agar, and Tryptic Soy Agar, TTC combined with Rose Bengal Chloramphenicol Agar.

BD Diagnostic Systems,
Sparks, MD

Reader Service No. 289

ABB Launches Combined Process Indicator, Recorder

ABB has introduced a new cost-effective, entry-level indicator recorder, the Commander CR100. Designed for use by both processors and OEMs, the unit combines process indicator functions and chart recording for basic applications.

The Commander CR100 features a large, five-digit LED display showing process value and alarm status, while the combined 100mm strip-chart recorder provides continuous-line recording with the pen permanently on the chart. It is available in one- or two-pen versions with the display toggling between both inputs on the two-pen unit.

The new indicator recorder is designed for basic applications, such as cold storage and humidity and temperature monitoring in the food and beverage industry, heat treating operations in the metals industry, and batch monitoring of tests or test chambers in laboratories.

With universal inputs that can be applied to local monitoring and alarms for measuring level, flow and pH, it can also be used for monitoring effluent discharge in water and wastewater applications. A rugged case with IP65 (NEMA 3) front-face protection ensures reliable operation in harsh environments.

ABB Instrumentation,
Warminster, PA

Reader Service No. 290

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

Pentalift Equipment Corporation Announces New Series of Air-Actuated Lift and Rotate Table

A new air-actuated lift and rotate table designed to raise or lower product into the most ergonomically-correct work position is announced by Pentalift Equipment Corporation, Buffalo, NY.

The Pro Air Lift and Rotate Table provides a simple and economical lifting/lowering operation with a rotating top which features a heavy-duty central thrust bearing and a minimum of four steel rollers to ensure a quiet, easy rotation.

According to the company, the new lift table runs completely off shop air with no electricity, hydraulics or related maintenance necessary, making it ideal in operations where cleanliness is required. Pentalift states that the simplicity of the new Pro Air Table's design makes it easy to move from one work station to another.

Capable of handling lifting capacities to 4,000 lbs., the Pro Air Lift and Rotate Tables feature platform sizes up to 48" x 60" and are equipped with either a pedestal-installed control station or a foot pedal control.

Pentalift claims that its engineering of the new table allows for customization of vertical travel, capacities and deck sizes to meet special job requirements. Available options for the Pro Air tables include manually operated platform rotation locks and safety accordion skirting.

Pentalift Equipment Corporation, Buffalo NY

Reader Service No. 291



Palmer Wahl Instrumentation Group

Lufft Opus 10 Thermo/Hygrometer Available from the Palmer Wahl Instrumentation Group

The Palmer Wahl Instrumentation Group introduces the new Lufft® Opus 10 recording Thermo/Hygrometer. This compact and completely self-contained instrument provides both current and long-term measurement and data logging of interior air temperature and relative humidity. The instrument's temperature range is 0/50°C (32/122°F), and the relative humidity range is 0 to 95%. The unit's power is supplied for two years (under normal operating conditions) from one 3.6V replaceable battery.

The Opus 10's versatility comes into play in its role as a datalogger. Parameters can be set to capture and store readings at programmable intervals. Internal capacity is available for up to 120,000 stored records. These stored records may be downloaded to a PC via use of an RS232 interface port and Windows™ compatible "SmartGraph" software. Both the interface cable and software are provided as standard equipment with each Opus 10.

Two versions of the Opus 10 are available: one with sensors housed within the console and one with external sensors. The external sensor model can be equipped with an optional extension cable to locate the sensors as much as 2 meters remote from the console. Both the temperature sensor (NTC thermistor) and relative humidity sensor (capacitive) are contained in a common module. Replaceable sensors are available from the factory.

Opus 10 Thermo/Hygrometers are designed to serve in laboratories, HVAC/R installations, hospitals, extended care facilities, computer rooms, printing press operations, art galleries, museums, food/drug storage areas, greenhouses, material curing processes, and many other applications requiring precise and accessible temperature and humidity measurement.

Palmer Wahl Instrumentation Group, Asheville, NC

Reader Service No. 292

Glanbia Ingredients Introduces TruCal™ FP... a Multi-dimensional Approach to Controlling Hypertension

To assist in the battle against hypertension, Glanbia Ingredients has recently introduced TruCal™ FP, milk derived peptide mineral complex.

Recent studies, including Griffith et al. (1999) and Appel et al. (1997) (known as the Dietary Approaches to Stop Hypertension study), have demonstrated that dairy products that include calcium as well as milk/whey minerals can be an effective dietary method for reducing hypertension. The Griffith study,

in particular, showed that dairy products enhance hypertension control in a two-dimensional manner. Because dairy products contain potassium, phosphorus, magnesium, and vitamin D, calcium depletion through urinary loss is minimized. In addition, dairy peptides have been shown to reduce hypertension by inhibiting ACE (Angiotensin Converting Enzyme), which causes high blood pressure due to vasoconstriction of blood vessels.

Based on these findings, Glanbia Ingredients has developed TruCal™ FP, a high-calcium (24% Ca) ingredient that battles the problem of hypertension because milk minerals, including calcium, reduce blood pressure, and because it contains dairy peptides that inhibit ACE which reduces vasoconstriction of blood vessels, and thereby reduces blood pressure.

TruCal™ FP can be used in food and nutraceutical products such as beverages, bakery products, dairy products, chews, tablets and bars.

Glanbia Ingredients, Inc.,
Monroe, WI

Reader Service No. 293

Sigma-Aldrich Speeds Extraction and Analysis of Plant Genomic PCR with Extract-N-Amp™ Plant PCR Kit

Sigma-Aldrich has introduced the first plant PCR kit containing reagents to rapidly extract genomic DNA from plant leaves and amplify targets of interest by PCR. Extract-N-Amp plant PCR kit (Product number XNA-P) offers a single-step extraction of plant genomic DNA in less than 15 minutes.

A novel Extraction Solution eliminates the need for conventional freezing of plant tissues

with liquid nitrogen, mechanical disruption, organic extraction, column purification, or precipitation of DNA. The kit also includes REExtract-N-Amp PCR mix, specially formulated for amplification directly from the plant extract. This formulation uses TaqStart antibody for specific hot start amplification, and contains the same inert red dye found in REDTaq. This red dye acts as a tracking dye and allows for convenient direct loading of PCR reactions onto agarose gels for analysis.

Sigma-Aldrich, St. Louis, MO

Reader Service No. 294

Scintimammography QC Phantom from Nuclear Associates

A comprehensive quality control program is essential to every mammography department. That's why Nuclear Associates — your quality assurance source — is proud to introduce its new Scintimammography QC Phantom (model 76-514). The phantom is innovatively designed to simulate the actual scintimammography imaging configuration that is used in nuclear medicine departments everywhere. It can be used as a stand-alone phantom, purchased as a complete patient positioning QC system or used with your existing prone breast cushion.

Simplicity is key with the Scintimammography QC Phantom. It's easy-to-use and consists of two main components: a simulated breast and a simulated lesion that can be positioned anywhere within the simulated breast. Just fill the tank with water and 100 μ Ci Tc-99m for background, fill the lesion sphere with 30 μ Ci Tc-99m, then insert the lesion into the tank. By repositioning the lesion within the tank, you can

effectively simulate a variety of different imaging situations.

Nuclear Associates' complete Scintimammography Patient Positioning QC System (model 37-014-6514) is also available to you. Included is the Scintimammography QC Phantom and the deluxe Scintimammography Prone Breast Cushion — very effective for simulating the entire patient procedure. When you purchase the complete system, Nuclear Associates will give you, absolutely free, the "Guide to Scintimammography."

Nuclear Associates, Carle Place, NY

Reader Service No. 295

Parker Hannifin Corporation's Membrane Air Dryer Offers an Economical, Efficient, Reliable Alternative to Refrigerant Dryer Technology!

The new Balston® SMD Membrane Air Dryer now available from Parker Hannifin Corporation will provide pure, dry compressed air and offer an economical, efficient alternative to refrigerant dryer technology.

The Balston SMD Membrane Air Dryer will dry compressed air to dewpoints as low as 35°F at flow rates of up to 1200 SCFM. As the Balston® SMD Membrane Air Dryer has no moving parts, it operates reliably and efficiently without operator attention.

Dry air is achieved by returning a small portion of the dry product air to sweep out moisture, which preferentially passes through the membranes. The degree of drying is controlled by varying the compressed air throughput the system. The moisture laden sweep gas is vented to the atmosphere, eliminating potential liquid-handling and freezing problems.

Since the Balston SMD Membrane Air Dryer is compact and lightweight, it can be easily mounted in an existing pipeline. Coalescing prefiltration is employed immediately upstream of the membranes to protect them from pipe scale, other particulate, and liquids. The Balston SMD Membrane Air Dryer requires no electrical connections, which makes it ideal for remote and point-of-use installations or for flammable and explosive applications.

Applications for the Balston SMD Membrane Air Dryer include: Low dewpoint instrument air, pneumatic equipment, pressurizing electronic cabinets,

analytical instrumentation, dry air for hazardous areas, pneumatic autosamplers, and general laboratory air supply.

Parker Hannifin Corporation,
Tewksbury, MA

Reader Service No. 296

Wireless Sensor Telemetry System from Sensotec

New brochure from Wireless Data Corporation offers application information and specifications on digital FSK telemetry systems for obtaining strain gage sensor data from rotary shafts up to 42" in diameter. Reliable wireless telemetry system collects multiple channels

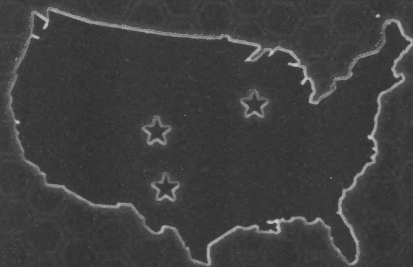
from dc to 1000 Hz without using slip rings, bearing or brushes. Applications include measuring torque, horsepower and pressure on engine and transmission test stands, temperature on rotating kilns, and thrust on marine propulsion shafts.

The transmitter components from WDC are designed for high G forces on shafts up to 12,000 RPM in high temperature and vibration environments. The exclusive CAT (Calibrate Anytime) technology and easy installation completes the package for a reliable rotary data system.

Wireless Data Corporation,
Columbus, OH

Reader Service No. 297

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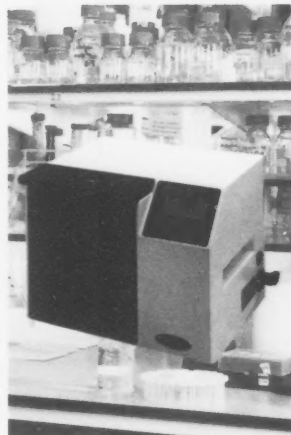
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Reader Service No. 156

Survey Results

A Spanish version of "The Control of Post-Processing Contamination by *Listeria monocytogenes*," originally published in English in *DFES* in August of 1999, was printed in the May 2001 issue of *DFES*. The following questions appeared with the May 2001 article. Responses have been summarized for your review.

1. Do you feel only articles written in English should be published in *DFES*?

Yes: 43% **No:** 57% Base: 23

Comments Summary:

- (No) Need to know audience to target which language to publish articles (in).
- (Yes) Perhaps abstracts occasionally in other languages.

2. Should we occasionally publish an article in both English and a non-English language?

Yes: 73% **No:** 27% Base: 22

Comments Summary:

- (Yes) Put article with both languages in same issue.
- (No Answer) If so, then run together in the same journal issue.

3. Do you believe publishing articles in a non-English language benefits all International Association for Food Protection Members?

Yes: 43% **No:** 57% Base: 21

Comments Summary:

- (No Answer) What is the membership need for language?
- (No Answer) Obviously those who cannot read English, but then why would they receive this publication?

4. Do you see benefit in publishing an article in English in *DFES* and simultaneously providing the article in a non-English language on the Association Web site?

Yes: 95% **No:** 5% Base: 22

Comments Summary:

- No real cost associated with Web site, short of translation.

5. Would you prefer this approach to publishing an article in both English and a non-English language?

Yes: 74% **No:** 26% Base: 19

Comments Summary:

- (No Answer) Can Members access Web easier than a journal?
- (Yes) Most of the time, more articles get printed if not print both languages in hard copy.
- (No) Because not all who work in this industry have access to the Internet.
- (No Answer) Not sure.

6. Can you suggest alternative approaches that might be better?

- I think it would be great to have all articles available in Spanish, but Spanish version should be available on Web site. I have forwarded my copy of the Spanish article to a customer in Mexico. It would have been easier to refer them to a Web site for the article.
- I think the Association is ready to make available a subset of articles in Spanish for every month that would be available to Members as a supplement to the English version for an additional cost. This separate Spanish booklet would be sent in addition to the English version to Members willing to pay for it.
- I'd like to see what it costs me for the Web vs. print methods before making a final decision.
- Do we need alternative approach? Hard to financially justify for a very small group.
- Just keep it in English. If you publish in a non-English language, which language to be published is an issue. It becomes discriminatory to many other non-English languages. Also, the cost of publication goes up, which is passed on to the Membership.
- Other non-English journals don't publish in English why should we?
- Training material in Spanish.

7. Other Comments:

- There are too many extras and too few articles.
- I have lived and worked in Europe for 5 months, and although I agree with having documents in other languages, I think all documents should be in English first.
- Cross-referencing the English document to the non-English document is a must!
- Hispanic or Spanish-speaking employees are found in many food processing establishments. I hope you occasionally translate other articles in Spanish.
- I was very pleased to see this important work published in Spanish and immediately shared it with some of our Spanish-speaking employees. Although they speak good English, they appreciate having the information in their native language. I see them retaining the report, studying it, and most importantly, passing it on to others who will benefit from it.
- I like the idea of having Spanish articles. It will make it easier to communicate with some of our employees.
- Most workers in food plants speak Spanish. Most supervisors speak English. The food safety risk is lack of communication and/or lack of training.

Number of respondents: 23

Coming Events

SEPTEMBER

• **5, Managing Dairy Food Safety Workshop**, Madison, WI. For additional information, contact W. L. Wendorff at 608.263.2015; E-mail: wfwendor@facstaff.wisc.edu.

• **11, International Inflight Food Service Association (IFSA) Second Annual Food Safety Summit**, Renaissance Concourse Hotel, Atlanta, GA. For additional information, contact IFSA at 502.583.3788

• **12-13, Marschall Cheese Seminar 2001**, Visalia, CA. For further information, call 219.264.2557; E-mail: sterenberg@galaxyinternet.net.

• **12-14, 3rd International Whey Conference**, Munich, Germany, sponsored by the American Dairy Products Institute (ADPI), and the European Whey Products Assn. (EWPA). For additional information, contact Warren S. Clark, Jr., at 312.782.4888; fax: 312.782.5299; E-mail: adpi@flash.net.

• **13-15, 2nd International Mastitis & Milk Quality Symposium**, Vancouver, British Columbia, Canada. For additional information, contact National Mastitis Council, 608.224.0622; fax: 608.224.0644; E-mail: nmc@nmconline.org.

• **17-21, Thermal Process Development and Thermal Processing Deviations Workshops**, Dublin, CA. For more information, contact Lilly Mitchell at 800.355.0983, or E-mail: lmitchell@nfpa-food.org.

• **18-19, Upper Midwest Dairy Industry Association Annual Meeting**, Holiday Inn, St. Cloud, MN. For additional information, contact Paul Nierman at 763.785.0484.

• **18-20, Fresh-Cut Products: Maintaining Quality and Safety Workshop**, University of Califor-

nia-Davis, Davis, CA. For further information, call 800.752.0881; E-mail: aginfo@unexmail.ucdavis.edu.

• **18-20, New York State Association of Milk and Food Sanitarians Annual Meeting**, Holiday Inn, Syracuse/Liverpool. For additional information, contact Janene Lucia at 607.255.2892.

• **19-21, Microbiology and Engineering of Sterilization Processes Course**, University of Minnesota, St. Paul, MN. For more information, contact Ms. Ann Rath at 612.626.1278; fax: 612.625.5272.

• **21-25, 129th APHA Annual Meeting**, Atlanta, GA. For more information, call 202.777.2470; fax: 202.777.2531.

• **24-26, Indiana Environmental Health Association, Inc., Fall Conference**, Holidome, Columbus, IN. For further information, contact Helene Uhlman at 219.853.6358.

• **25-26, Wisconsin Milk and Food Sanitarians Association 2001 Joint Conference**, Chula Vista Resort and Conference Center, Wisconsin Dells, WI. For further information, contact Kathy Glass at 608.263.6935.

• **26-28, Washington Association for Food Protection Annual Conference**, Campbell's Lake Chelan Resort and Conference Center, Chelan, WA. For further information, contact Bill Brewer at 206.363.5411.

OCTOBER

• **10-11, Iowa Association for Food Protection Annual Meeting**, Starlite Village, Ames, IA. For further information, contact Monica Streicher at 712.324.0163.

• **13-17, Anuga 2001, The Entire World of Food**, Cologne, Germany. For additional information,

call 212.974.8835; fax: 212.974.8838; E-mail: info@citf.com.

• **15-16, International Fresh-cut Produce Association (IFPA) 9th Annual Fall Seminar**, Charleston, SC. For further information, contact Seneta Burns at 703.299.6282.

• **15-17, European Hygienic Equipment Design Group (EHEDG) with AINIA 11th Annual Conference and Workshop, Food in Europe: Building in Safety**, Valencia, Spain. For further information, visit www.ainia.es/safetycongress.

• **15-18, North Dakota Environmental Health Association Fall Meeting**, Best Western Doublewood Inn, Bismarck, ND. For further information, contact Deb Larson at 701.328.1292.

• **16-18, 1st International Symposium on the Spray Drying of Milk Products**, Rennes, France. For additional information, E-mail: sympo2001@rennes.inra.fr.

• **18-21, Worldwide Food Expo**, McCormick Place, Chicago, IL. For additional information, call 202.371.9243.

• **21-25, 129th American Public Health Association Annual Meeting**, Atlanta, GA. For further information, contact Ashell Alston at 202.777.2470; Fax: 202.777.2531.

• **24-25, Associated Illinois Milk, Food and Environmental Sanitarians Annual Meeting**, Stoney Creek Inn, East Peoria, IL. For further information, contact Pat Callahan at 217.854.2547.

NOVEMBER

• **7-8, Alabama Association for Food Protection Annual Meeting**, Homewood Holiday Inn, Birmingham, AL. For further infor-

mation, contact Karen Crawford at 205.554.4546.

• **9-10, 3rd International Food Safety Conference**, Sponsored by University of Guadalajara, Mexico and Mexico Association for Food Protection. For additional information, contact Dr. M. Refugio Torres-Vitela, phone: 523.619.8158 ext. 16; E-mail: torres@ccip.udg.mx.

• **14-16, Florida Association for Food Protection Annual Education Conference**, FFA Leadership Training Center, Haines

City, FL. For further information, contact Frank Yiannas at 407.397.6060.

• **14-17, Agritrade 2001**, Hyatt Regency Convention Center, Guatemala City, Mexico. For additional information, call 502.362.2002 ext. 163; Fax: 502.362.1950; E-mail: agritrade@agexpront.org.gt.

• **15, Ontario Food Protection Association Annual Meeting**, Delta Meadowvale Hotel, Mississauga, Ontario. For further information, contact Glenna Haller at 519.823.8015.

• **21-24, 3rd International Dairy and Food Technology Expo 2001**, Mumbai, India. For further information, call 49.0.221.8210; Fax: 49.0.221.821.2092; E-mail: idftexpo@kmi.koelnmesse.de.

• **21-24, Food Technology Expo 2001**, Xiamen International Conference & Exhibition Center, Fujian, China. For further information, contact Mr. Louis Leung at 852.2865.2633; Fax: 852.2866.1770; E-mail: enquiry@bitf.com.hk.



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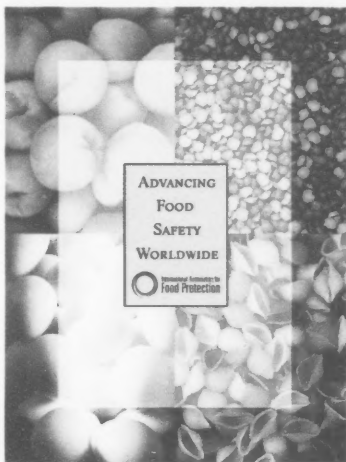
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| <input type="checkbox"/> E3080 | Fit to Drink | <input type="checkbox"/> F2102 | Tap 2-Food Safety for Food Service: HACCP | <input type="checkbox"/> F2460 | Safe Processing of Sprouts |
| <input type="checkbox"/> E3110 | Garbage: The Movie | <input type="checkbox"/> F2103 | Tap 3-Food Safety for Food Service: Personal Hygiene | <input type="checkbox"/> F2340 | Sanitation for Seafood Processing Personnel |
| <input type="checkbox"/> E3120 | Global Warming: Hot Times Ahead | <input type="checkbox"/> F2120 | Tap 4-Food Safety for Food Service: Time and Temperature Controls | <input type="checkbox"/> F2340 | Sanitizing for Safety |
| <input type="checkbox"/> E3130 | Kentucky Public Swimming Pool & Bathing Facilities | <input type="checkbox"/> F2126 | Tap 5-Food Safety for Food Service: Food Safety Zone: Basic Microbiology | <input type="checkbox"/> F2350 | SERVSAFE® Steps to Food Safety (6 Videos) |
| <input type="checkbox"/> E3145 | Plastic Recycling Today: A Growing Resource | <input type="checkbox"/> F2127 | Tap 6-Food Safety for Food Service: Food Safety Zone: Personal Hygiene | <input type="checkbox"/> F2430 | Smart Sanitation: Principles & Practices for Effectively Cleaning Your Food Plant |
| <input type="checkbox"/> E3140 | Putting Aside Pesticides | | | <input type="checkbox"/> F2370 | Supermarket Sanitation Program - "Cleaning & Sanitizing" |
| <input type="checkbox"/> E3150 | Radon | | | <input type="checkbox"/> F2380 | Supermarket Sanitation Program - "Food Safety" |
| <input type="checkbox"/> E3160 | RCRA - Hazardous Waste | | | <input type="checkbox"/> F2390 | Take Aim at Sanitation |
| <input type="checkbox"/> E3170 | The New Superfund: What It Is & How It Works-(1) Changes in the Remedial Process: Clean-up Standards & State Involvement Requirements | | | <input type="checkbox"/> F2410 | Wide World of Food-Service Brushes Your Health in Our Hands - Our Health in Yours |
| <input type="checkbox"/> E3180 | The New Superfund: What It Is & How It Works-(2) Changes in the Remedial Process: Removal & Additional Program Requirements | | | | |
| <input type="checkbox"/> E3190 | The New Superfund: What It Is & How It Works - (3) Enforcement and Federal Facilities | | | | |
| | | | | <input type="checkbox"/> M4010 | OTHER
Diet, Nutrition & Cancer |
| | | | | <input type="checkbox"/> M4020 | Eating Defensively: Food Safety Advice for Persons with AIDS |
| | | | | <input type="checkbox"/> M4030 | Ice: The Forgotten Food |
| | | | | <input type="checkbox"/> M4040 | Legal Aspects of the Tampering Case |
| | | | | <input type="checkbox"/> M4050 | Personal Hygiene & Sanitation for Food Processing Employees |
| | | | | <input type="checkbox"/> M4060 | Psychiatric Aspects of Product Tampering |
| | | | | <input type="checkbox"/> M4070 | Tampering: The Issue Examined |

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

Invite A Colleague to Join

The International Association for Food Protection, founded in 1911, is a non-profit educational association of food safety professionals with a mission "to provide food safety professionals worldwide with a forum to exchange information on protecting the food supply."

* Who Should Join?

The Association is comprised of a diverse membership of 3,000 people from 50 nations. The International Association for Food Protection Members belong to all facets of the food protection arena, including Industry, Government and Academia.

* Why Should They Become Association Members?

Dairy, Food and Environmental Sanitation — A reviewed monthly publication that provides practical and applied research articles and association news, updates, and other related information for food safety professionals. All Members receive this publication as part of their Membership.

Journal of Food Protection — An international, refereed scientific journal of research and review papers on topics in food science and food aspects of animal and plant sciences. This journal is available to all individuals who request it with their Membership.

The Audiovisual Library — Provides quality training videos dealing with various food safety issues. Members are allowed free use of these videos.

The Annual Meeting — Is a unique educational event; three days of technical sessions, symposia and exhibits provide attendees with over 250 presentations on current topics in food protection. The International Association for Food Protection Members receive a substantially reduced registration fee.

* Help Others Find Out About the Association...

To learn more about the Association and the many other benefits and opportunities available to a Member, visit our Web site: www.foodprotection.org or please call 515.276.3344 or 800.369.6337; Fax: 515.276.8655; E-mail: info@foodprotection.org. We will be happy to send new Member information if you provide us the necessary mailing information.



International Association for
Food Protection®

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MEMBERSHIP APPLICATION



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Web site: www.foodprotection.org

MEMBERSHIP DATA:

Prefix Prof. Dr. Mr. Ms.)

First Name _____ M.I. _____ Last Name _____

Company _____ Job Title _____

Mailing Address _____

(Please specify: Home Work)

City _____ State or Province _____

Postal Code/Zip + 4 _____ Country _____

Telephone # _____ Fax # _____

E-mail _____

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

MEMBERSHIP CATEGORIES:

	US	Canada/ Mexico	International
<input type="checkbox"/> Membership with JFP & DFES	\$150.00	\$175.00	\$220.00
12 issues of the <i>Journal of Food Protection</i> and <i>Dairy, Food and Environmental Sanitation</i>			
<input type="checkbox"/> Membership with DFES	\$90.00	\$100.00	\$115.00
12 issues of <i>Dairy, Food and Environmental Sanitation</i>			
Student Membership*			
<input type="checkbox"/> <i>JFP and DFES</i>	\$75.00	\$100.00	\$145.00
<input type="checkbox"/> <i>Journal of Food Protection</i>	\$45.00	\$60.00	\$90.00
<input type="checkbox"/> <i>Dairy, Food and Environmental Sanitation</i>	\$45.00	\$55.00	\$70.00
*Student verification must accompany this form			
<input type="checkbox"/> Sustaining Membership	Gold	Silver	Sustaining
Includes recognition for your organization and many other benefits. Contact IAFP for details.			
	\$5,000.00	\$2,500.00	\$750.00

◀ **BEST VALUE**

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MARK OF COMPLIANCE



The 3-A Symbol Story

The 3-A Sanitary Standards Symbol Administrative Council, known throughout the industry as the "3-A Symbol Council," was organized in 1956. Its purpose is to grant authorization to use the 3-A Symbol on equipment that meets 3-A Sanitary Standards for design and fabrication.

Processors (DIC)



Sanitarians
(IAFP)

Equipment Mfrs.
(IAFIS)

A Modern Concept

The modern concept of the 3-A program was established in 1944 when the Dairy Industry Committee (DIC) was formed. DIC is one of the three industry segments involved in the preparation of 3-A Sanitary Standards. These industry segments are:

- **Processors**, represented by DIC
- **Equipment Manufacturers**, represented by IAFIS
- **Sanitarians**, represented by IAFP

Use of the Symbol

Voluntary use of the 3-A Symbol on dairy equipment:

- assures processors that equipment meets sanitary standards
- provides accepted criteria to equipment manufacturers for sanitary design & fabrication
- establishes guidelines for uniform evaluation and compliance by sanitarians.

3-A Sanitary Standards Symbol Administrative Council

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