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DAIRY, FOOD AND ENVIRONMENTAL

Sanitation

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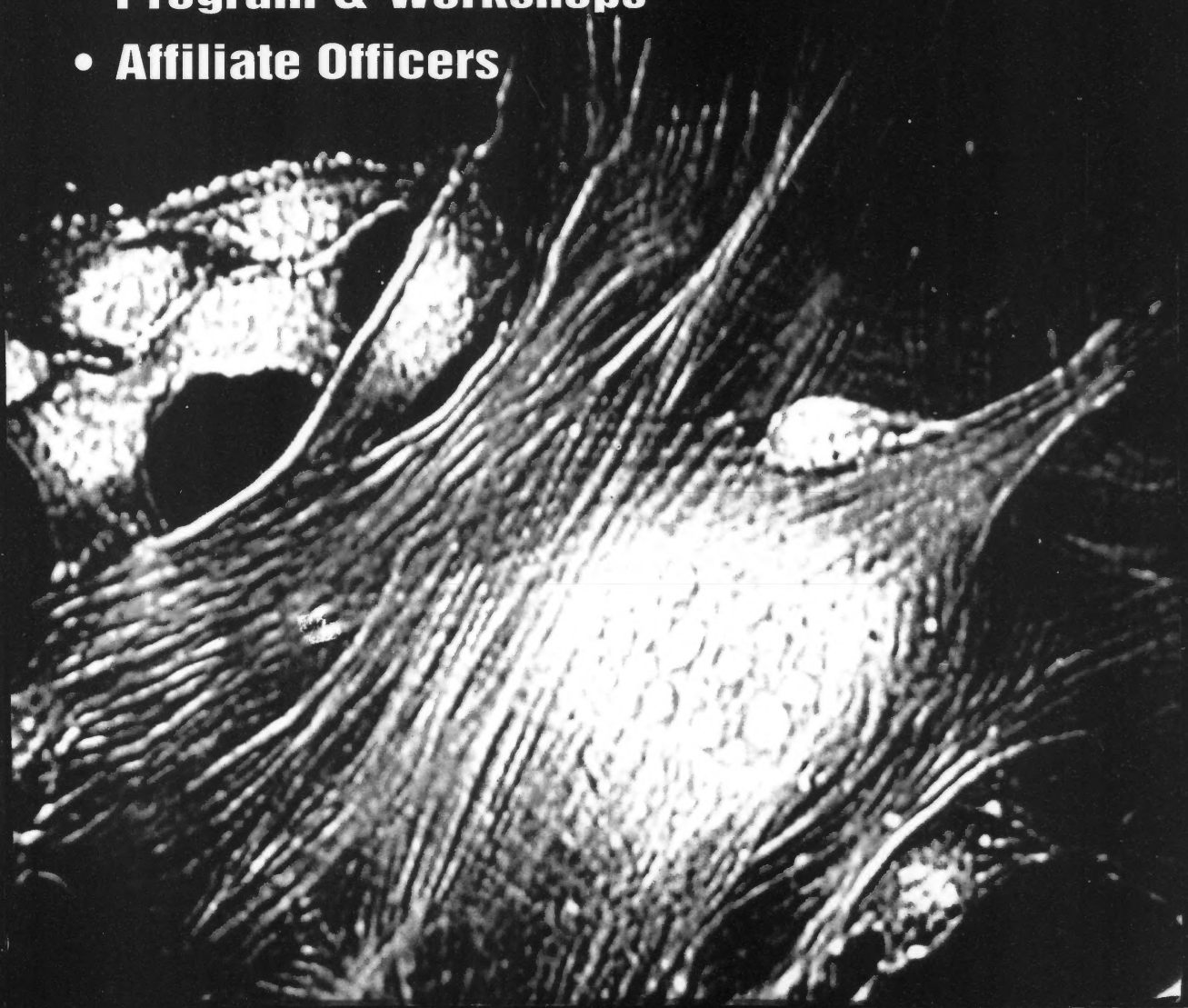

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ARTICLES

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Editor's Note:

On page 403 of this issue is a corrected copy of Table 7 from the article *Waterless (Towelette) Emergency Sanitation System for Food-Serving Utensils and Equipment* which appeared in the April issue of *Dairy, Food and Environmental Sanitation* on page 215.

We apologize for the error.

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"The mission of IAMFES is to provide food safety professionals worldwide with a forum to exchange information on protecting the food supply."

THOUGHTS

FROM THE PRESIDENT

By C. DEE CLINGMAN,
IAMFES President

S-I-L-E-N-T L-I-S-T-E-N

Have you ever noticed that the word SILENT has the exact same letters as the word LISTEN? I wonder if there is a meaning there? "Even a fool, when he holdeth his peace, is counted wise" (Proverbs 17:28).

Our ability to learn is based on our ability to listen. Those who never listen will never learn. Publilius Syrus, a Roman writer, stated in about 100 BC,"I have often regretted my speech, never my silence." Since that time there have been countless numbers of politicians, athletes, sanitarians, etc., who have fallen in their speech when listening would have been more appropriate and less threatening.

Even Thomas Edison found that silence, even by accident, led to wealth. When Western Union offered to buy the ticker invented by Thomas Edison, the great inventor was unable to name a price. Edison asked for a couple of days to consider it. He talked the matter over with his wife, and she suggested he ask $20,000, but this seemed exorbitant to Edison. At the appointed time, Edison returned to the Western Union office. He was asked to name his price. "How much?" asked the Western Union official. Edison tried to say $20,000, but lacked the courage, and just stood there speechless. The official waited a moment, then broke the silence and said, "Well, how about $100,000?"

Listening is essential in everyday survival, even if the information you are receiving is from diverse viewpoints. By capturing diversity as well as concurrence, one can better form an opinion that can lead to beneficial actions.

Many ancient prophecies from people like Nostradamus in the 16th century and today's prophets like George Michael Scallion state that the earth will undergo major changes between now and May of the year 2000. Perhaps Armageddon will result. Scientists state that in May of 2000 seven of the planets in our solar system will align with earth in a perfectly straight line causing the earth to rotate permanently on its axis by 14 degrees. This dramatic pull on earth's gravitational force may cause massive volcanic eruptions, major earthquakes, and violent storms, so say these "experts". The world's climates will change with the Equator moving to about only 10 degrees south of Florida. Who is to say all these people are wrong? That is why listening is so important – how about if they are right?

Society will always need two things for survival no matter what occurs in the future – safe food and water. Each of us must play our part in food safety each day. We must always be conscious that we are building the future with the actions we do each day. Ongoing support of food safety programs need to be the top of everyone's agenda. Some of us take an active role in the food safety arena on a daily basis. For others, yet not less of an important role, lead and guide programs, research, and regulatory activities that promote and support food safety. These too are critical for survival.

If we are to survive beyond the year 2000 our daily work must build the foundation for future food safety programs. Things will change. The only thing permanent in life is change. We must plan for change. We must LISTEN to what "mother earth" is telling us. To do that we must be SILENT at times.

On My MIND...

By STEVEN K. HALSTEAD, CAE
IAMFES Executive Manager

"So, why this interest in accents?"

Is language...

I don't know why, but I have always been fascinated with accents. The greater the accent, the more I liked to hear a person speak. Maybe it was because it was new. Maybe it was because it was different. Maybe it was because it was a challenge.

As a boy, I attended a Boy Scout jamboree in Canada. When I got back, the first thing my parents asked of the scoutmaster was if I had behaved. His immediate answer was "Yes" (like you thought I was going to say anything different?) but he went on to describe in some detail how my accent changed as we spent time in various parts of the country. After two days in Canada, he said I sounded just like a Canadian. In Boston, I sounded like a Bostonian. And, after one day in New York City, I had a "Bronx" accent. He found the whole thing rather amazing. And amusing.

You might guess that I have a natural ear for language and can learn languages easily. Wrong! I took a year of Spanish in high school which has stuck with me fairly well. Its greatest value, however, seems to have been when my children took Spanish, I could help them. It certainly did not seem to do me much good last summer in San Antonio! Russian took me for a semester in college. The latter clearly demonstrated that I had no natural talent for languages.

So, why this interest in accents? It might be that I come from the Midwest. Although there is talk of a "Midwestern twang" most people seem to feel that Midwesterners have no accent. This is often used to explain why so many telemarketing and claims servicing firms have located in the Midwest.

The Pittsburgh Convention and Visitor's Bureau likes to talk about Pittsburgh as being a Midwestern city located out East. I have to agree that it has a Midwestern feel to it, BUT its language is definitely not Midwestern!

In fact, Sam McCool has written a book called "Pittsburghese – How to speak like a Pittsburgher." Given my love of accents, it was natural that I would pick up a copy (that and the fact that it was cheap)! Suddenly, words like "ARN" (iron); "STILLERS" (Steelers); and "YUNZ" (you guys) became crystal clear.

Imagine my surprise, however, to actually hear someone talking like that. When I heard our waitress in the restaurant at the Hilton speaking that way, I immediately thought it was a put on. Her reaction to being quizzed about it quickly convinced me that it was genuine. It was the Pittsburgh accent.

In Pittsburgh, people drink "POP" instead of sodas, or they have an "ARN" (Iron City beer). They like to eat "KLONDIKES" (ice cream bars), "CHIPPCHOPPED HAM" (processed ham sliced paper thin), and "JUMBOS" (bologna) which they buy at the "JYNT IGL" (Giant/Eagle Grocery).

For those of you with an ear for such things, you'll have a ball in Pittsburgh. For the rest of you, hopefully the above will be enough to get you through until you can get a copy of McCool's book.

Dairy, Food and Environmental Sanitation, Vol. 15, No. 6, Pages 357-367

Prevention of Food-borne Illness

Reprinted from: *Food-borne Pathogens: Risks and Consequences;*
Council for Agricultural Sciences and Technology, September 1994

The good safety record of the U.S. food supply has been accomplished by voluntary and regulated control activities primarily undertaken by or directed toward the food industry, surveillance activities, and educational activities. New opportunities exist or are being developed that will complement or replace historical efforts to enhance control from the source to the consumer by preventing the occurrence of pathogens in foods or by reducing their numbers or destroying them.

INTRODUCTION

Current and historical measures used to prevent and to control food-borne infections and intoxications can be classified as voluntary processing and handling controls practiced by the food industry plus *surveillance*, *educational*, or *regulatory* activities *(2)*. Voluntary controls practiced by the food industry largely are responsible for the good safety record of the U.S. food supply. There is *surveillance* of (1) diseases; (2) food establishments workers; (3) foods; (4) facilities in which foods are processed, transported, stored, and prepared and equipment on which foods are processed and prepared; and (5) operations (practices, procedures, or processes) to which foods are exposed. *Educational* activities include both (1) training professional public health, regulatory, and food-industry quality-control personnel in matters related to prevention and control of food-borne diseases and (2) educating food industry managers, supervisors, and workers, as well as the public, about hazards and risks associated with food-borne diseases and their prevention. Food-borne disease *regulatory* activities include product inspection, process inspection, product recall, and legal action (including fines and criminal prosecution). Opportunities exist to apply current knowledge and modern approaches and technologies to enhance food safety today and in the future. The following provides details of historical and current methods, some successful and some unsuccessful, as well as modern options for enhancing food safety.

Voluntary Food Industry Controls

Voluntary controls practiced by the food industry to enhance food safety are varied and include adherence to good manufacturing practices (GMPs), voluntary implementation of the hazard analysis critical control point (HACCP) programs (described below), use of sanitation practices exceeding those required, use of microbiological specifications in decisions regarding purchases and processing, and use of educational and training programs for personnel, for example. The food industry supports food safety research to enhance the understanding of pathogenic microorganisms and the control of the organism and its toxic end products and supports the exchange of food safety information within the industry. In many instances, processing (time/temperature of pasteurization, sterilization, or final pH in a fermentation) requirements are more rigid than required to ensure pathogens will not be a concern in the processed, packaged food. In many cases, the approaches voluntarily used by individual companies later become industry standards and, in some instances, regulatory requirements because of their successes. For example, HACCP was an industry initiative voluntarily adopted by much of the industry and now is likely to be adopted soon as a regulatory approach.

Surveillance of Diseases

The primary purpose of surveillance is to provide a basis on which to take rational action to control continuing outbreaks and to prevent additional occurrences. Surveillance of diseases is an indispensable part of every successful disease control program, yet food-borne disease surveillance is either nonexistent or ineffective in many jurisdictions. Nearly one quarter of states have no surveillance staff assigned to monitor food associated pathogens *(1)*. Useful surveillance programs seek notification of illness, identify and investigate outbreaks, interpret investigative data, and disseminate findings *(6)*.

Investigations of outbreaks and sporadic cases of food-borne disease should consist of (1) taking steps or verify diagnoses (including collection of case histories and specimens); (2) making time, place, and person associations; and (3) reviewing operations of the establishment at which foods likely were mishandled. This last step includes interviewing managers and workers, collecting samples, tracing routes of contamination to their source–if possible, examining workers, and identifying operations contributing to the outbreak. This crucial phase of investigation must account for contamination of the implicated food; survival of pathogens or toxins during heat processes, if applicable; and multiplication of food-borne pathogenic bacteria to such an extent as either to create numbers or to produce toxins in quantities sufficient to cause illness.

Presently, once a food is implicated, its sale is stopped, products already sold are recalled, and safeguards are established and monitored. Application of the risk assessment approach would provide input of cost-benefit information into the decision of how to handle implicated foods in the marketplace. Salient features of the outbreak should be communicated to the agency responsible for disease surveillance at the national level, i.e., the CDC, and to other scientists. These information channels improve our knowledge and ability to reduce the occurrence of food-borne disease. Information about the factors contributing to an outbreak should be used either to select or to devise and implement both control and prevention measures in the implicated establishment and other locations *(3, 4)*. Factors contributing to outbreaks associated with homes, food service establishments, and food processing plants are presented in Table 1.

In time, surveillance data become bases for determining predominant food-borne diseases in a community, for indicating principal vehicles, and for identifying primary factors contributing to the occurrence of outbreaks of food-borne disease.

With advances in epidemiology and rapid testing for microbial pathogens, and given sufficient funding, a risk assessment database, which could be a superior tracking and monitoring system, could be established for use by food safety and public health professionals and by regulators. The CDC now collects and disseminates some of these data in its food-borne disease outbreak reports. Expanding the scope of the CDC's efforts, linking it to data collected in other health surveys, and linking it more closely to food vehicles would improve the ability of the FDA and the FSIS to quantify food-borne disease risks and fashion regulatory programs to reduce human illnesses from food-borne sources (Table 2). Particular attention should be given to strengthening identification of microbial food-borne deaths, both because of the importance of achieving a consensus on the number of food-borne deaths and because of the high social costs associated with deaths *(20)*.

Human health databases could be searched for information about food-borne pathogens identified by ICD-9 codes. Sources include public and private hospital databases, death databases, and doctor visit databases *(9, 10, 11, 16)*. Special studies may be necessary to identify the pathogens for cases entered in the miscellaneous categories (Table 5.3). Analysis of these databases could clarify how many people become ill enough to seek medical attention. Emerging pathogens could be detected to provide to industries, consumers, and regulators feedback on the success of various forms of intervention, e.g., additional laboratory food testing, food handling and meat cooking instructions, HACCP programs, and industry education.

The CDC has proposed expanding its food-borne disease sentinel surveillance *(7)* and including a geographically representative sample of urban and rural populations and public and private health care providers. Such data could be used to generate U.S. food-borne-disease incidence rates for persons ill enough to seek medical attention. Cost of such a system is estimated to range from $8 million to $24 million annually. An alternative may be to survey insurance records.

Improving food-borne disease surveillance will enable all participants in food production and consumption (industries, consumers, and governments) to reach a consensus on the magnitude of food-borne illneses and deaths caused by various pathogens and to set goals for improved food safety. Such surveillance also will facilitate (1) identification of foods implicated as vehicles for pathogens, (2) determination of possible control points for specific pathogens, (3) the analysis of costs and benefits of controls at specific locations, and (4) implementation of intervention methods for specific pathogens (Figure 1).

Surveillance of Food Establishment Workers

A number of approaches to detecting infected workers and preventing them from contaminating foods have been taken by health and regulatory agencies throughout the years. These approaches include medical histories, physical examinations, blood tests, x-rays, and feces examinations for parasites of bacterial pathogens, e.g., *Salmonella* and *Shigella*. Recently, some citizens have shown interest in returning to these practices primarily because of the concern about the transmission of AIDS. Each practice, however, is significantly limited *(26)*, and none seems cost effective.

Medical histories may indicate previous illnesses in which a carrier state may still exist yet a disease condition may be diagnosed. Blood tests usually are done to detect venereal diseases of HIV carriers; skin tests and x-ray examinations, to detect tubercular infections. These infections are not transmitted via food. Other than in regions in which certain bacterial pathogens are quite prevalent, routine examinations of stools for pathogens generally would yield negative results. Furthermore, the information may engender a false sense of safety. Many microorganisms trans-

mitted by foods–*Bacillus cereus*, *Campylobacter jejuni*, *Clostridium botulinum*, *C. perfringens*, pathogenic *Escherichia coli*, *Listeria monocytogenes*, *Staphylococcus aureus*, *Vibrio cholerae*, non-O1 vibrios, *V. parahaemolyticus*, *Yersinia enterocolitica*, and intestinal viruses–seldom are sought during routine examination of specimens from food workers. Epidemiological data indicate that the source of *Salmonella* causing outbreaks of food-borne salmonellosis usually is raw foods of animal origin rather than persons excreting *Salmonella*. The role of asymptomatic carriers is of secondary importance in transmission of *Salmonella*, and screening for them has a high cost-to-benefit ratio. Food-handler examination programs that seldom reveal a carrier or a positive stool culture often lead administrators to believe mistakenly that they are protecting the public or safeguarding the food supply.

Surveillance of Feeds, Ingredients, and Foods

Foods sometimes are sampled and tested to evaluate their safety in regard to a variety of items including presence or number of pathogens, number of microorganisms or amount of metabolites indicating the possible presence of pathogens (indirect, indicator-approach), condition of containers, temperature, pH, and/or water activity. Foods may be sampled at ports-of-entry, at harvest, during storage, at critical stages of processing, at completion of processing in plants, in retail stores at markets, or in food service establishments. The laboratory is an essential resource for a food safety program.

Although surveillance of foods is expensive and time consuming, it has provided a great deal of useful information including improving our understanding of the microbial ecology of foods, verifying control procedures, and identifying hazardous lots of food. It is limited statistically by the number of samples analyzed; interpretation of data therefore must be done with care. Contaminants at times are non-uniformly distributed. This is especially true when a small population of contaminants is present. When no positive samples are found, contaminants are not detected in the samples collected and tested; yet the lot may contain contaminants. Carefully designed statistical sampling plans are critical *(13)*. Such plans become relatively stringent when (1) large numbers of samples are taken, (2) large amounts of each sample are tested, (3) multiple culture media are used, (4) multiple criteria are used in the limits, e.g., the three-class plan, (5) limits are low, (6) tolerances are low or absent, and (7) samples are taken where most contamination occurs. Testing identifies defects and may indicate but not identify where the contaminations occurred or where the process failed. Moreover, testing usually requires a few days, and by the time results are available, foods often have been eaten or shipped.

End-product microbiological testing is used in conjunction with monitoring the process (surveillance of operations) to evaluate the safety of foods. The value of microbiological testing of raw foods is constrained because the results rarely correlate strongly with the risk of illness. This is so because food likely will be cooked and multiple food processing or handling errors can occur before illness results. Microbiological criteria for ready-to-eat foods have been useful in protecting public health *(18)*.

TABLE 1. Home, food service establishment, and food processing plant factors contributing to the occurrence of 1,080 outbreaks of food-borne disease that resulted because of mishandling and/or mistreatment of foods in the United States from 1973 to 1982 *(4)*

Contributing factor	Home (345 outbreaks)		Food service establishments (660 outbreaks)		Food processing plants (75 outbreaks)	
	Number[a]	Percent[b]	Number[a]	Percent[b]	Number[a]	Percent[b]
Contamination						
Contaminated raw food/ingredient	145	42	58	9	14	19
Food/ingredient obtained from unsafe source	99	29	42	6	5	7
Colonized person handling implicated food	34	10	160	24	8	11
Toxic plants mistaken for foods[c]	24	7	1	<1	–	–
Toxic containers or pipelines[c]	12	4	23	4	1	1
Cross contamination	11	3	31	5	1	1
Intentional additives (e.g., monosodium glutamate)[c]	8	2	13	2	5	7
Incidental additives[c]	3	1	9	1	6	8
Contaminated water	2	<1	2	<1	1	1
Improper cleaning of equipment/utensils	1	<1	38	6	8	11
Poor dry-storage practices	1	<1	–	–	–	–
Faulty sealing	1	<1	–	–	–	–

(continued)

TABLE 1. *Continued.*

Contributing factor	Home (345 outbreaks) Number[a]	Home (345 outbreaks) Percent[b]	Food service establishments (660 outbreaks) Number[a]	Food service establishments (660 outbreaks) Percent[b]	Food processing plants (75 outbreaks) Number[a]	Food processing plants (75 outbreaks) Percent[b]
Fly contaminated food	1	<1	–	–	–	–
Improper dishwashing/contamination after dishwashing	–	–	1	<1	–	–
Microbial growth during germination of seeds	–	–	–	–	1	1
Post processing contamination	–	–	–	–	3	4
Soil/fertilizer contamination[c]	–	–	–	–	1	1
Survival						
Inadequate cooking/canning/heat processing	108	31	29	4	20	27
Improper fermentation[d]	16	5	–	–	–	–
Inadequate reheating	12	4	130	20	–	–
Inadequate acidification[d]	2	<1	–	–	–	–
Growth						
Improper cooling	77	22	366	56	11	15
Lapse of 12 or more hours between preparing and serving	44	13	203	31	1	1
Improper hot holding	11	3	107	16	2	3
Use of leftovers (also lapse of 12 or more hours between preparation and serving)	9	3	31	5	1	1
Inadequate drying	1	<1	–	–	1	1
Inadequate preservation[d]	1	<1	–	–	–	–
Improper/inadequate thawing	–	–	6	1	–	–

[a]Number of outbreaks to which this factor contributed. Many outbreaks involved more than one contributing factor.

[b]Percentage of outbreaks to which this factor contributed. Percentages exceed 100 because multiple factors contribute to single outbreaks.

[c]These factors are not due to food-borne pathogens and therefore are not the focus of this report.

[d]These factors may lead to survival and also permit growth. They were categorized in this table, where they are considered to have the more common or fundamental contribution.

For *Listeria monocytogenes*, the U.S. regulatory policy of zero tolerance in all ready-to-eat foods has been questioned *(8)*. This microorganism is widespread in the environment and probably is ingested frequently through environmental exposure. Only a limited population is at risk of contracting listeriosis. As in other countries, e.g., Germany and Canada, microbiological criteria that allow tolerance could be considered for this pathogen. Thus, small populations of the microorganism in foods would be tolerated.

Indicator microorganisms in surveillance programs have been useful (1) to detect potential human or fecal contamination, (2) to detect possible presence of pathogens, (3) to detect post-heat process contamination, and (4) to assess microorganism number, microbiological activity, or sanitary quality. If a relatively limited spectrum of economical and rapid laboratory tests is used, properly selected and applied indicator microorganisms may provide a broad spectrum of knowledge about food quality and safety. However, reliable indicator microorganisms or classes of microorganisms do not exist for certain pathogens, a notable example being viral contaminants in harvesting waters for seafood. Lack of useful indicator microorganisms may be due to the unique presence of the pathogen in food or to our lack of knowledge about the ecology of microorganisms in the environment, including the food chain.

Surveillance of Physical Facilities and Equipment

History teaches that certain facilities—potable running water, plumbing systems free of cross-connections and of back-siphoning potential, toilet facilities, lavatory facilities, and safe sewage disposal systems—are essential for preventing contamination and for promoting personal hygiene of workers in food establishments. Today in the United States, few outbreaks implicate deficient facilities. Recurrence of these problems must be guarded against because transmission of diseases by such routes can be reestablished. In addition to the traditional surveillance activities, equipment should be designed and arranged to reduce the possibilities of cross-contamination from raw foods to foods receiving no further heat processing.

Inspection can be done neither frequently nor thoroughly enough to provide the degree of food safety desired by processors and preparers of foods and by the public. Furthermore, inspections may be done at times when either high-risk foods are not being prepared or critical processes are not being done; hence,

factors critical to food safety may be overlooked. Some inspectors fail to distinguish between factors critical to food safety and those that are purely aesthetic or trivial. Laws and regulations seldom indicate the relative importance of specific items; hence, many interpretations are left to the discretion of an inspector.

Surveillance of Operations from Farm to Food Preparation

The factors in homes, food service establishments, and food processing plants, which contributed to 1,080 documented outbreaks of food-borne illness in the United States from 1973 to 1982, are detailed in Table 1. Review of these data indicates that cooling of foods (leaving foods at room or warm outside temperatures and attempting to cool large masses of foods in large containers) is the most important factor contributing to food-borne disease. Other frequently occurring factors include use of a contaminated raw food ingredient, preparing foods 12 hours or more before serving, inadequately reheating cooked foods, inadequately cooking or otherwise heat processing foods, colonized persons' touching foods not subsequently heated, and improper hot holding of cooked foods. Many items which are usually part of sanitary inspections of food handling facilities never have been cited; hence, they are of negligible significance. The food safety emphasis should be on processes to which foods are exposed as well as on physical facilities.

At present, the best way to ensure food safety is by continual surveillance of food production, food processing, and food service operations. Emphasis should be on (1) hazards associated with sources of contamination to which foods are exposed, modes of contamination, and effects of the process to increase or to decrease the level of that contamination; (2) probability that microorganisms or toxic substances survive processing or process failure, and (3) chances that bacteria or fungi multiply during processing or storage. Risk assessment should be applied to enhance our understanding of the cost-to-benefit ratio of this strategy. The HACCP system *(14, 17)* provides a rational and contemporary approach to decrease the risk of food-borne illness. The seven steps or principles in HACCP are as follows:

1. Identifying hazards (contamination, survival of pathogens and toxins, and multiplication of microbes) and assessing severity of hazards and risks.

TABLE 2. Data needed for estimating microbial health risks *(20)*

Data need	Possible solution	Likely cost
Better recording of existing data	Expand CDC's passive laboratory based reporting from 9 food-borne microbial pathogens to about 30	About $500,000/yr (Expanding the use of tests by state laboratories would increase costs more.)
	Expand CDC's laboratory-based reporting to make surveillance active in selected counties (sentinel counties)	Additional $1 million/year
Better demographic data on who becomes ill	Study various methods of making reporting active and estimate likely costs and benefits of increased identification of cases	About $75,000
Increased knowledge of risk factors	Study individual susceptibilities as well as food handling and consumption practices for people becoming ill and control groups	About $500,000/pathogen
Increased knowledge of disease severities	Increase the number of pathogens investigated in depth with surveys of people becoming ill from specific food-borne pathgens	Each survey may cost about $100,000-$200,000
Increased knowledge of deaths from food-borne sources	Expand the sentinel county survey to include all U.S. counties for a few selected pathogens to develop a solid baseline on food-borne deaths	About $1 million/pathogen for passive surveillance, and much more for active surveillance
	Study improving the identification of food-borne deaths in the National Death Index by improving entry of laboratory test data, by revising the death certificate to ask specifically for laboratory data	About $300,000
Increased knowledge of hospitalizations caused by food-borne pathogens	Study impraving identification of food-borne pathogens in the National Hospital Discharge Survey (NHDS) by (1) examining a sample of the 150,000 hospitalizations under ICD-9 "008-unspecified intestinal infections" to see if medical records cantain laboratory data, (2) exomining septicemia/bacteremia records for 1 yr. to determine if food-borne pathogens are involved,	Unknown, but likely to be less than $200,000/study

(continued)

TABLE 2. *Continued.*

Data need	Possible solution	Likely cost
	(3) estimating the cost of revising the face sheet for entry of NHDS data to include laboratory data and where sample was taken (blood, stool, cerebrospinal fluid), and (4) comparing state systems	
Quantification of chronic conditions caused by food-borne pathogens	Review the literature and estimate the likelihood that food-borne pathogens are important in certain chronic disease syndromes such as reactive arthritis, neurological disorders, cardiac dysfunction, food allergies, gastritis, kidney and liver dysfunction, etc.	Literature review about $100,000, original research more costly

2. Determining critical control points required to prevent or to control the hazard(s) identified. A *critical control point* is an operation (practice, procedure, process, or location) at or by which preventive or control measures can be exercised that will eliminate, prevent, or minimize (a) hazard(s).
3. Implementing effective preventive and control measures and specifying criteria (or critical limits) indicating whether an operation is under control.
4. Monitoring each critical control point to evaluate whether it is under control. Systematic observation, measurement, and/or recording of significant factors for prevention or control of hazards are involved.
5. Taking appropriate and immediate corrective action whenever the monitoring results indicate that criteria established for safety at a critical control point are not met, i.e., that the operation is out of control.
6. Establishing effective record-keeping procedures documenting the HACCP system.
7. Verifying by either supplemental test or record review (a) whether the HACCP system is in place, (b) that appropriate critical control points have been designated, (c) that they are being monitored effectively and properly, and (d) that appropriate action is taken whenever criteria are not within specified limits. Hence, verification evaluates whether the HACCP system is functioning as planned.

The HACCP approach can be applied to foods during production and harvest, during distribution and holding, during processing, during display at retail establishments, and during preparation and awaiting use in food service establishments. It, however, is not ideal for addressing problems occurring in home food handling and preparation. When properly applied, the HACCP approach offers a high level of assurance of food safety to persons concerned with food control, to those processing and preparing foods, and to the public. Hence, it is a desirable alternative to the more traditional control options, which sometimes are ineffective or inefficient.

Three goals of the HACCP concept include (1) preventing or delaying growth of pathogens occurring in food, (2) eliminating or reducing pathogen numbers, and (3) reducing food-borne pathogen initial load and minimizing subsequent contamination (Figure 2). The third goal may be combined with either of the first two. Preventing or delaying growth may be achieved by appropriate storage (time and temperature), acidification, lowering water activity, and/or use of preservatives or preservation processes, for example. Reducing numbers could be achieved by use of appropriate thermal processing, cooking, acidification, fermentation, and other processing or handling procedures. Reducing initial numbers or subsequent contamination could be achieved by reducing contamination at the farm or growing site, harvesting or securing foods from reputable sources/locations, and avoiding cross-contamination, for example.

Figure 1. Food-borne disease surveillance and intervention points.

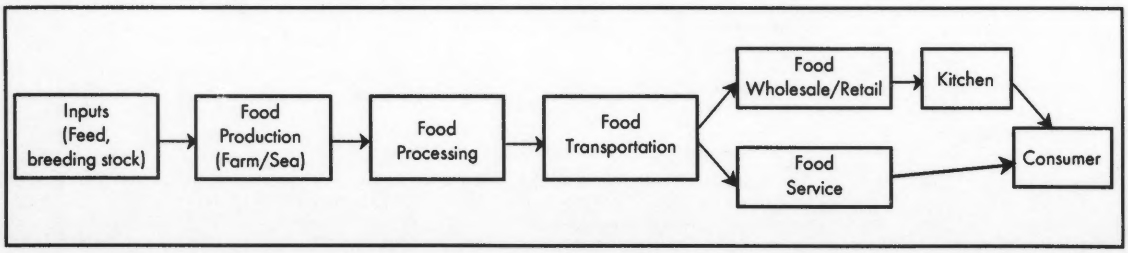
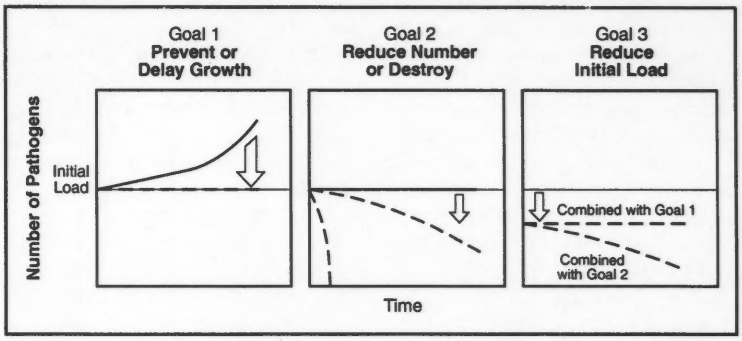


Figure 2. Possible Hazard Analysis Critical Control Point (HACCP) goals.



Application of the HACCP concept is somewhat complex. Conducting hazard analysis and determining critical control points require the input of trained specialists supported by adequate laboratory services. Because (1) the concept is simple yet the application is relatively complex and (2) the program requires daily attention, there is a potential for improper implementation and false security. Monitoring of critical control points and verification may require laboratory services or specialized equipment. Currently, microbiological testing is not a primary component of most HACCP plans because response time is too long for decision making. If, however, rapid microbiological methods become available that could be applied on-line, they would be useful components of future HACCP programs.

The HACCP concept is rational because it is based on historical data about causes of illness and spoilage. It is comprehensive because it relates to inputs, e.g., water and feeds, ingredients, processes, and subsequent product uses and can be applied at any or at all links of the food chain. It is continual because problems are detected when they occur and action is taken for correction. It is systematic because it is a thorough plan covering step-by-step operations and procedures. At present, the HACCP system is the best means of ensuring appropriate food handling in food processing and food service operations and, therefore, of providing assurance that food-borne illness will not result. It is the "state of the art and science" of food safety and will reduce risks greatly wherever properly implemented and maintained.

In some instances, a HACCP plan to *prevent* contamination will be most cost effective; in others, one to *reduce* pathogens through pasteurization or irradiation will be, for example (Figure 2). What is needed is careful evaluation of each HACCP plan to determine whether public health protection benefits are worth the costs. Given the high cost of laboratory tests, a HACCP plan based exclusively on laboratory testing easily could be devised that would be so expensive as to offset likely public health protection benefits. In addition, because of the often dispersed distribution of pathogens in many foods, laboratory testing can be an unreliable and misleading indicator of food safety.

Training

Specialists in food safety must understand the epidemiology of food-borne diseases and the microbial ecology of foods so that measures to prevent these diseases can be devised or selected and given appropriate skills to investigate outbreaks of food-borne diseases, to use the data gathered in preventive programs, and to set program priorities. Technically trained professionals must be prepared to develop and to verify a HACCP system.

Food establishment managers have the primary responsibility for preventing conditions that can lead to outbreaks of food-borne disease within their establishments (Table 1). They must be aware of the kinds of operations that can lead to outbreaks and of their relative risks and insist that appropriate preventive measures be practiced and monitored routinely during or before operations. To achieve the goal of food safety, persons working with foods should be convinced that foods that have been mishandled or mistreated can lead to outbreaks of food-borne disease. These concepts must be stressed in the training program. Because food service establishments are implicated in the majority of cases, training of the personnel in these establishments is particularly critical. This task is difficult because personnel turnover tends to be high and the educational level, skill, and compensation typically are low.

Food establishment workers need to know how to do their jobs so that they will not contribute to the contamination of foods and so that either the microbial contaminants entering the foods are killed or their multiplication is inhibited. Hence, through training, employees must develop an understanding of the hazards and skill in monitoring critical control points and an appreciation of their significance. The continued implication of food service workers in transmission of hepatitis illustrates both the importance and difficulty of successful training.

Education

A large number of food-borne illnesses can be attributed to food handling errors that occur in the home (Table 1). Because of the diffuse nature of these outbreaks, public education is one key to their prevention. A scientifically literate public would be well equipped to understand the principles of safe food handling and risk-benefit decision making. Food science, food safety, and public health provide an excellent context for improving overall scientific literacy of the public since most people find these topics interesting

because of their practical importance to everyday life. The public should be educated to understand that our goal must be risk minimization and that zero risk is not attainable relative to food safety. An educated public could become involved in a dialogue addressing what responsibilities fall to individuals, to the food industry, and to the government relative to their preferences regarding enhancing food safety.

Public education regarding foodborne disease risks and control must begin with teachers and progress to pupils in primary and secondary schools and beyond. The adult public must continue to be educated in the important hazards and risks associated with food purchase, preparation, and storage. Appropriate educational materials must be developed and used. These efforts may include traditional approaches (posters, news reports) as well as more modern approaches (computer based problem solving educational packages, dissemination of information into schools and homes via computer networks). In each case, it is critical that the information be credible and accurate, and reflect realistic risk analysis.

A new safe-handling label for meat has been implemented in the United States. This instructional label contains information about storing and thawing meat, avoiding cross-contamination, cooking, and properly refrigerating leftovers. This should improve the handling of meat in the home and address many of the primary factors contributing to foodborne illness (Table 1). It thus should reduce the incidence of meatborne disease.

Regulatory Approaches

The USDA and the FDA share responsibility for food inspection at the federal level and have primary responsibility for inspecting imported food and domestic food production (Federal Meat Inspection Act of 1906, Amended 1967; Federal Poultry Products Inspection Act of 1957, Amended 1968; Federal Food, Drug and Cosmetic Act, 1938). The USDA/FSIS has primary responsibility for meat and poultry; the USDA and the FDA share responsibility for egg, milk and grain inspection; and the FDA has primary responsibility for all other foods in interstate commerce including processed foods, fresh seafood and game meats, and foods served on interstate public conveyances, such as airlines and trains. States and cities have primary responsibility for food safety at dairy farms, supermarkets, restaurants, and nursing homes and may certify food safety training for people working there. In 1992, the FDA devoted about 255 staff years to inspecting 53,000 food establishments, while the FSIS devoted 9,000 staff years to inspecting 6,100 food processing plants *(12)*.

The FDA and the FSIS have different approaches to regulation. The FDA has emphasized voluntary adoption of GMPs, the Pasteurized Milk Ordinance, etc. by states and firms. The FDA uses random inspection on occasion, relies on firms for voluntarily recalling contaminated products, and lacks FSIS' mandatory record-keeping requirements except in the case of low-acid canned foods. The FSIS and the FDA can seize (domestic) or detain (imported) suspect or known contaminated products. The FSIS has in-house inspectors in all slaughterhouses who inspect every carcass. As reflected in the design, inspection is intended primarily to ensure that diseased carcasses do not enter the food supply. The problem is that pathogens are not detectable by sight, touch, or smell, although product safety is enhanced by inspection because inspectors ensure that animals' intestines are not severed, thus minimizing contamination of the carcass with intestinal microorganisms. The FSIS, however, seldom recalls products and seldom tests carcasses or meat products for pathogens.

Both the FDA and the FSIS are moving towards more risk-based inspection, such as the HACCP, and integration of some rapid tests for pathogens into their food safety monitoring. At this writing, there are proposals in Congress and in the Executive Branch for reorganizing food safety regulatory responsibilities. Under Vice President Gore's recommended streamlining, inspection would become consolidated into the FDA.[1] Several Congressional bills further elevate food safety regulation by creating a food safety regulatory agency.

Development of rapid, low-cost methods may allow future on-line monitoring of pathogens, but application of methods and knowledge will be complex because the interpretation of microbiological data from raw products generally is controversial. Since microbiological specifications regarding the presence of low numbers of pathogens in foods such as raw meat and poultry do not exist, knowledge of pathogen presence would be meaningless from a regulatory standpoint at the present time. Development and implementation of rapid microbiological tests on the line should not be considered a panacea for improved food safety inasmuch as opportunities for contamination will continue to occur after harvesting/slaughtering and processing during distribution, preparation, and storage.

The HACCP system, if properly implemented and continuously practiced, offers a valuable means of institutionalizing safe food practices. Both the USDA and the FDA have incorporated HACCP principles in proposed future regulations. Congress must provide regulatory agencies with adequate resources and staff directed to ensure food safety, and regulatory laws must be based on good science. Food safety legislation without this basis inevitably will needlessly increase the cost of food in the United States and may prove detrimental to the cause of public health.

Future Trends and Food Control Opportunities

Three trends will lead to provision of a safer food supply: greater demand for food safety, continuing scientific advances in our knowledge of the pathogens and how they are transmitted in the food chain, and increased efficiency in providing safer food.

Demand for food safety regulations may grow due to changes in food demand and demographics. An older population will be more willing to pay for health attributes of food *(15)*. The growing popularity of convenience foods further reduces consumers' control over food preparation and may alter the nature of foodborne illness risks. A growing population of high-risk consumers means that for a given number of pathogens in food, more people are likely to get sick.

New scientific advances increase our options in producing safer food. Our ability to identify food-borne pathogens causing acute and chronic illnesses in humans is improving, as is our understanding of the relationship between pathogens and production, processing, transportation, and retailing practices. Continued development of faster, cheaper, more specific, and more sensitive tests for pathogens improves detection of contaminants in foods and permits more statistical testing.

Increased efficiency in providing safer food is resulting from (1) better risk assessment databases' being developed *(1, 23)* and (2) increased use of a systems approach, such as HACCP, to identify where pathogens or their toxins come into the food chain (Figure 1) and to reduce the likelihood of food-borne illness. Increased evaluation of the benefits and costs of control at various control points will lead to an improved understanding of the most efficient intervention points. Vice President Gore's *Report of the National Performance Review* advocates using incentives to reward firms with strong safety records and enforcement to punish firms with poor performance. Economic incentives are an efficient mechanism for sending signals to the market and encouraging production of products with desirable characteristics, such as safety. In the short run, firms can increase testing for contaminants and buy from suppliers with low levels. In the long run, research on new production practices should be encouraged as well as research to allow development of new, safer products. Existing food safety regulations were not designed to provide market incentives for "safer" food, but rather one safety standard for all. Protecting the more vulnerable groups in each case, such as children or the elderly, may result in higher costs for the average consumer.

We are poised to make changes that will have a real, positive impact on food safety. Opportunities exist for *prevention*, *reduction*, and *destruction* of pathogens in foods. Historically, primary efforts at control have been focused on food processing and food service. Oftentimes warning consumers is sufficient; in some instances, voluntary actions by industry suffice; in others mandating actions to reduce pathogens in a specific food may be required. New opportunities involve these areas yet include others, extending control efforts to the source (farm or sea) and to the home:

1. An educational label addressing safe meat handling has been adopted recently. This will serve as a constant reminder and as a resource to persons preparing foods in the home and will help ensure their participation in safe food handling and preparation.

2. Future labeling or package inserts may include information relative to "safer" foods for individuals in the population who are (permanently or temporarily) at increased risk for food-borne illness. Presumably, these products would be priced accordingly and consumers would be free to choose whether to alter purchasing practices based on food safety considerations. To be effective, this will require a public educated in risk-benefit decision making and who understand that the goal is risk minimization, not zero risk.

3. The rapid improvements in telecommunications and increased access to the "information highway" will provide new opportunities to bring food safety information of an educational (e.g., safe handling procedures, knowledge of high-risk populations) or decision making (risk-benefit problem solving) nature into grocery stores, restaurants, schools, or homes.

4. The HACCP approach likely will be incorporated as a regulatory approach quite soon, as well. For example, on January 1, 1994, the FDA proposed regulations to ensure the safe processing and importing of seafood that include monitoring of selected processes in accordance with HACCP principles. The USDA has drafted a new statutory proposal directly addressing the need for pathogen control in the prevention of food-borne illness and uses the process control, or HACCP, strategy to accomplish pathogen reduction.

5. Irradiation of pork and poultry is approved in the United States, and approval of the irradiation of beef and other products may follow shortly. Consumer acceptance of this practice will improve food safety by significantly reducing pathogen numbers in raw meats *(19)*. The government should share its extensive knowledge of this subject with the public so as to further acceptance.

6. Farm-level control may be improved as we learn more about the ecologies of pathogens, including how they interact with host animals. One opportunity is to use the concept of competitive exclusion to prevent the intestines of young animals from being colonized by human pathogens *(22, 24)*. Research indicates that this may be accomplished by introducing the newborn animal to, for example, harmless microorganisms quite early (by adding the desire microorganisms to water or feed) so that they will establish themselves in the animal intestine. Thus, the undesirable microorganisms would be unable to compete and would be excluded.

The animal no longer would be a carrier or a source of the pathogen when used in human food, given successful competitive exclusion.

7. Animal identification and traceback methods may be applied to identify the source(s) (processing facility, slaughterhouse, feedlot, or farm) of food-borne illnesses.

8. Microbiological methods are being developed at a rapid rate, and the costs of technologies generally are falling. Thus, improved, useful, rapid methods, perhaps even some that can be applied on-line (during food processing, distribution, handling), should become available continually. Many useful methods are currently available. Appropriate and expanded applications of such methods will improve our understanding of the ecology of food associated pathogens, thereby improving our control procedures indirectly if not through direct (on-line) applications.

9. The analytical tools available to epidemiologists continue to improve so that our ability to trace the microorganisms involved in a food-borne illness outbreak from person to person and from person to food handler and back to the processing location and farm will improve. Thus, our understanding of the microorganisms and their occurrence as well as our ability to select and to apply appropriate control procedures will increase.

10. Development of integrated databases regarding animal pathogens, retail food tests, and human illnesses will clarify how pathogens move through the food chain and what their human health consequences are. Such databases would facilitate consensus regarding the magnitude of the food-borne disease problem, identify the most dangerous pathogens, and aid in the development of control options by identifying food chain entry points. The CDC recently developed a surveillance strategy that includes the use of sentinel networks linking groups of healthcare providers or laboratories to a central data receiving and processing center *(7, 25)*.

11. Improved databases and risk assessment techniques also will aid identification of high-risk human subpopulations and high-risk foods. Specific control procedures can be developed to reduce risks by informing high-risk individuals to take precautionary actions or by devising new control procedures for high-risk foods. To augment existing databases and to increase food-borne disease reporting, innovative ideas should be explored, such as adding an e-mail address and an 800 number to telephone directories and to restaurant and fast food menus to facilitate reporting to potential food-borne diseases to local, state, and federal authorities.

12. Increasingly, economic incentives are being proposed and used to improve food safety and quality. United States dairy farmers are paid premiums for milk with low bacterial counts (total plate counts) and somatic cell counts (indicating infection) and are discounted for milk with counts above minimum levels. Dutch hog producers are field testing plans to reduce parasite levels and are receiving prices for compliance. Food service firms increasingly are specifying microbial levels in food purchasing contracts in the aftermath of problems with *Salmonella enteritidis* in eggs and *Escherichia coli* O157:H7 in ground beef *(21)*.

13. Improvement of K-12 and adult education in areas of science, technology, and health education as well as in critical thinking skills will improve public understanding and individual ability to protect health through making informed decisions on issues that impact food safety.

It is important to capitalize on the synergism gained from appropriate research, education, and implementation relative to food safety knowledge and advancements. It is critical to continue research to generate new knowledge relative to food safety, and to continue educational effort to disseminate the knowledge so that it can be properly and wisely implemented by policymakers, regulators, producers, processors, food handlers, public health officials, and consumers. Informed implementation will be enhanced by honest public discussion regarding needs, expectations, and costs.

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Maintaining Udder Health and Milk Quality During Periods of Hot Weather

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Hot humid weather in combination with wet and muddy environmental conditions are tremendously stressful for high producing dairy cows and account for profound reductions in lactational and reproductive performance. Less well defined, but just as apparent, is a heightened disease challenge in the face of compromised disease resistance. The result is increased risk that manifests itself during the summer as an increase in the incidence of clinical mastitis and higher somatic cell counts. To successfully endure periods of extreme heat and environmental stress requires not only sound mastitis control practices, but also proper feeding, management, and facilities to ensure cow comfort.

Heat Tolerance: Breed Considerations

The combination of high ambient air temperatures with high humidity, intense solar radiation, and mud create just about the worst type of environmental conditions one could possibly create for dairy cows. This is particularly true when one considers the origins of our domestic cattle population.

Historians believe that cattle were first domesticated in Europe and Asia and that today's cattle are descendants of either or both of two ancient ancestors: Bos taurus or Bos indicus. Bos taurus, ancestral species to our modern dairy breeds, originated from temperate regions of Europe. They are by nature more cold, than heat tolerant.

Bos indicus or Zebu, on the other hand, originated in tropical areas of the world. Zebu are characterized by their hump, pendulous dewlap, large drooping ears, and grunting voice. As one might assume, they are more heat tolerant. Furthermore, they tend to be more resistant to certain diseases and parasites. These are attractive advantages indeed, and through the years many have attempted to capitalize on these traits through cross-breeding programs. Unfortunately, when cows are bred to obtain heat tolerance it is done at the expense of milk production potential. In other words, heat tolerance is a function of milk production – high producing cows are less heat tolerant.

Thermoregulation and the Thermal Comfort Zone

Mammals and birds are homeotherms. Despite wide fluctuations in environmental temperature they are capable of maintaining a relatively constant body temperature. This ability to maintain a relatively constant body temperature is essential to a multitude of biochemical reactions and physiological processes associated with normal metabolism.

Temperature-sensitive neurons (nerves) are located throughout the animal's body. These specialized neurons are designed to channel information to the hypothalamus which receives and integrates it, and by some unknown mechanism induces the appropriate physiological, anatomical, or behavioral response required to maintain acceptable body temperature.[1] Some of the more common of these responses by cows during periods of heat stress are:

- reduced feed intake which results in reduced milk yield
- decreased activity
- shade or wind seeking
- wallowing
- increased respiratory rate
- increased peripheral blood flow and sweating

The most comfortable environmental temperature range for milk production of dairy cattle is between 41°F and 77° F.[2] This is referred to as the thermal comfort zone. Tolerance of cows to temperatures below 41°F varies with age and level of milk production. For example, a mature cow in peak lactation is quite tolerant to cold temperatures (at or below 0°F) by virtue of heat gained from ruminal fermentation and nutrient metabolism.[3-5] On the other hand, cow comfort and performance decline rapidly as temperatures rise above 78°F regardless of age or lactation status.[6]

Sources of Body Heat

As eluded to total body heat load is a combination of the heat derived from normal metabolism (35-70%) and that obtained from the environment (solar radiation and high ambient air temperature). Other important sources

of heat load in dairy cattle are those associated with physical activity and performance. For example, the spatial layout of facilities affects the distance cows must travel to and from feed, water tanks, and milking parlors. Ill-designed walkways and mislocated cow lots which become mud bogs during rainy wet weather increase physical exertion and thus heat load as cows trudge through the mud. And finally, inadequate fly control can be tremendously bothersome for cows. While these additional sources of heat are often overlooked in the context of total heat load, they are significant and represent a measure of that heat which may be preventable.

Body heat derived from performance activities in dairy cattle is that associated with milk production. Overall metabolic rate, and thus heat production is increased dramatically as a result of higher levels of feed intake during lactation. For this reason, cows experiencing heat-stress will voluntarily reduce dry matter intake by as much as 25% in order to lower body heat production.[2,7]

Effects of Heat Stress on Milk Production

Based on the previous discussion, it is not surprising that the lactating cow is particularly sensitive to hot weather. The rapid decline in feed intake and milk production are readily apparent. Consequently, dairy operations that take steps to manage heat stress emphasize their activities on lactating cows. This leaves dry cows, sick cows and young stock as the most likely groups of animals to be denied shade or supplemental cooling.

At least 3 studies demonstrate that heat stress on dry cows will lower calf birth weights and reduce milk production in the subsequent lactation.[8-10] Prolonged exposure to elevated temperatures during late gestation reduces blood flow to the uterus and interferes with normal placental growth and endocrine function. The result is lower calf birth weight and hormonal alterations that affect mammary development, lactogenesis, and milk yield. In the study by Collier, 305-day predicted milk yield was increased by 12% in the group with access to shade prepartum, compared with a no shade group.[8]

For lactating cows, voluntary reduction in dry matter intake is a major strategy for reducing body heat buildup. The obvious consequence is depressed milk production. The attenuation of heat stress improves feed intake and will improve milk production a minimum of 10-20%.[11-13]

Heat and Environmental Stress — Effects on Udder Health

Somatic cell counts and the incidence of clinical mastitis in the southeastern region of the United States increase during the summer months.[14-16] These observations suggest that heat stress may amplify the cow's susceptibility to infection by either decreasing host resistance or by increasing host exposure to pathogens, created by conditions that favor their growth and propagation in the cow's environment.

Evidence for a direct effect of elevated ambient temperature on the immune system is limited and based primarily on in vitro studies. Indirect effects on immunity may occur as a result of decreased feed intake, and consequently, deficient uptake of essential nutrients important to optimal immune function. Vitamin E and the selenium-containing enzyme, glutathione peroxidase, are antioxidants that protect body cells and tissues from oxidative attack by free radicals, which are released during the respiratory burst associated with bacterial killing in neutrophils and macrophages. Neutrophils obtained from cows deficient in Vitamin E and selenium had reduced intracellular bacterial killing.[17]

Elevated temperature and high relative humidity positively influence the survival and proliferation of pathogens in the environment. Opportunities for exposure are increased during periods of extreme heat when cows are denied supplemental cooling and must rely on their own devices. Under such circumstances cows will lie in the alleyways of freestall barns or wallow in ponds, streams, and mud holes in pastures. Surprising to some, mud wallowing is actually an effective means of heat loss by conduction and by evaporative cooling. Concerns for udder health are obvious. However, when faced with a choice between the certainty of suffering through acute heat stress or cooling in a wallow and possibly acquiring mastitis, no doubt most would choose to wallow.

Managing Heat Stress

As indicated earlier in this discussion, the primary sources of heat gain from the environment are solar radiation and elevated ambient air temperature. In many areas of the country this is significantly complicated by high relative humidity and the lack of air movement. Practical measures to diminish the negative effects of heat stress on performance and health include modification of the environment and nutritional management schemes.

The primary methods for altering the environment include the provision of shade, evaporative cooling with water in the form of fog, mist, or sprinkling in combination with forced air ventilation and possibly cooling ponds. The incorporation of these methods into an integrated management system which protects cows from the primary sources of heat gain from the environment, while taking advantage of opportunities to enhance evaporative heat loss, has the best potential for successful abatement of heat stress.[18]

Nutritional management strategies may include: 1) increasing the number of feedings per day and providing supplemental cooling in close proximity to feed bunks, 2) anticipating that feed intake will decrease during periods of heat stress, one may increase nutrient density of rations, 3) feeding supplemental fat, 4) providing abundant clean drinking water, and 5) increasing dietary concentrations of minerals, particularly potassium and sodium.[19]

Mud in cow lots is, among other things, a mixture of manure, urine and dirt. It is not only a source of

pathogens, but as described earlier, a major contributor to stress during hot weather. Proper design of facilities is the best way to avert many of the problems encountered with mud. However, since few have the luxury of redesigning facilities to better avoid mud problems, most must find alternatives for managing high intensity cow flow areas.

As the saying goes – "where the concrete stops the mud begins." These areas are nearly unavoidable on dairy farms and difficult to remedy. Many attempt to improve these trouble spots by removal of the mud and replacement with fresh soil, sand, gravel, limerock or other material. Success is variable and rarely results in a permanent fix.

Another approach to mud management used in the southeast, particularly Florida, is "cow carpet".[20] Cow carpet is a porous synthetic material originally designed to stabilize the soil undergirding pavement in highway construction. It is applied in a 4-step process in cow lots (and cow lanes):

1) lots or lanes are smoothed and sloped for adequate drainage
2) carpet is rolled out onto the smoothed surface
3) sand is applied on top of the carpet
4) sand is graded on top of the carpet to a 4 inch depth

Lots properly fitted with carpet provide a firmer base for cows to walk or lie in. Cows are prevented from sinking beyond the 3-4 inches of sand above the carpet. This helps to keep cows cleaner and greatly reduces the stress associated with trudging through areas of deep mud.

Summary

Heat and environmental stress adversely effect milk production, reproductive performance, udder health, and milk quality. Dairies should strive to alleviate these effects through proper design of facilities, environmental modification to provide supplemental cooling during hot weather, instituting effective nutritional management strategies, and by implementing sound mastitis control practices.

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Air Quality in the Food-Processing Environment: A Cleanable HEPA Filtration System

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Abstract

The quality of the air in a food-processing environment is essential to ensuring the longevity of the finished goods, extending the storage or shelf life. Air quality is often equated with the ability of a filtration unit to remove small particulates, particularly microorganisms and their spores. Filtration can be expensive; however, new technologies allow for a cleanable high-efficiency particulate air (HEPA) filtration system which has the capability to be automated, or self-cleaning. The system cleans air to 99.6% at the 0.3 micron level. A system evaluated at California Polytechnic State University reduced the overall microbial load in the test environment by about 90%.

Introduction

In the construction of a food-processing facility, one factor which is often overlooked or not given sufficient consideration is the quality of the air in the processing environment. Air quality can mean a variety of things to different people; to some it is the mystery of "sick-building syndrome," which can be due to excessive mold-spore levels in the environment *(4)*, or air quality may mean the hydrocarbon levels in our urban environment. To the food processor, air quality is most often synonymous with microbial purity, or the absence of microbes and their spores in the air which may come in contact with the food at critical times during the processing of agricultural commodities and finished goods.

Most food-safety experts will agree that the number-one safety concern for our food supply is the concern of microbial food safety. We simply prefer not to have microorganisms, especially the pathogens, in or on our food! There are exceptions such as yogurt, where we enjoy the consumption of millions of microbes, but still, it is critical to have only the desirable microorganisms in the process or product. Quality control and quality assurance are critical to the success of a modern food-processing operation. Since workers and the food-processing lines are all surrounded by air, and a variety of microorganisms are floating in the air around us, it makes sense to want to have that air as clean as possible to avoid contamination of food products.

According to Leo Gabriel, who since 1953 has been involved at all levels in the meat-processing industry, the most dramatic improvement to the shelf life of a ready-to-eat meat product will result from filtering the air in the final packaging environment *(5)*. Gabriel also states that "this final filtration cannot be a substitute for good sanitary practices. Pasteurization without recontamination can double and triple shelf life." This is somewhat in line with the conclusion of Al-Dagal et al. *(1)* who say that reducing the exposure time of the product is a logical solution to the problem of insanitary air. We go one step further and state that the air must be properly filtered, since the air is the source of the contamination.

To address this concern, Airborne Contamination Control (ACC) Systems has developed and patented a filtration technology which will cleanse the air of all particulates down to the 0.3 µm level using a patented high-efficiency particulate air (HEPA) filter *(8)*. Initial filter efficiency will meet or exceed 97% on 0.3 µm particles by laser spectrometer analysis. This filtration efficiency quickly increases to 99.6% (99.9% at 1 µm), because of the Van der Waal principle. What makes the unit complete is the ability of the filtration system to be manually cleaned in place while at rest or in operation. A larger, self-cleaning unit has been in operation at a fruit (lemon) packing house since 1992. As much as 10 lb. of mold spores and other particulates have been removed from the processing environment in a single day, while the automated system cleans itself and produces clean air for the workers. Mold spores are removed from the packing environment at an efficiency greater than 99.9% (1.0, µm particle size as determined by a Met-one laser particle counter).

Table 1	Recovery of airborne microbial contaminants from locations within the fruits and vegetables pilot plant.				
Location	N	Sum	Mean	SD	SE
1	37	140	3.78	3.89	0.64
2	37	138	3.73	2.99	0.49
3	37	70	1.89	2.17	0.36
4	37	322	8.7	12.2	2.01
5	37	509	13.8	22.6	3.72
6	37	424	11.5	15.4	2.53
7	37	631	17.1	20.5	3.37
8	37	617	16.7	21.0	3.45
9	37	295	7.97	8.3	1.36
10	37	320	8.65	10.9	1.79

The data from Table 1 is summarized in Figure 3, giving an indication of the amount of reduction realized through filtration of the air in a portion of the pilot plant. The quality of the air at sample site 3 is in the cleanest environment and had significantly fewer microbial counts as opposed to the other sample sites (4 to 10) in the pilot plant. With limited human traffic in the laboratories, it is easier to maintain microbial-free air quality. Sample sites 1 and 2 have much more traffic by people using the facility on a daily basis, and it is known that personnel act as a major source of biological aerosol (9, 10). Within a processing facility, microbial counts will relate to the level and type of activity, as well as to the amount of air flow and the purity of that air. These findings are nothing new (6, 7), however, there appears to have been little progress made in the food industry with regard to having clean, HEPA-filtered air in the processing environment.

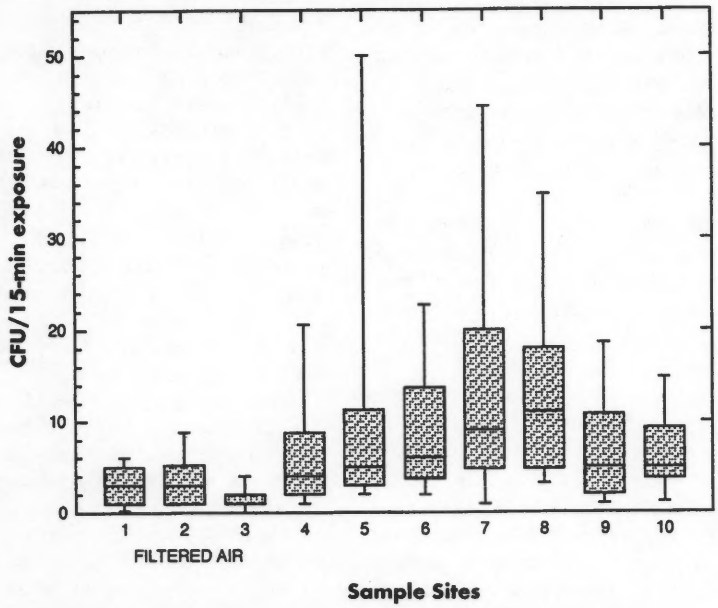


Figure 3. CFU per 15-min exposure at 10 sample sites (μ=37). Boxes indicate the range between the 25th and 75th percentiles of the data; a line marks the value of the 50th percentile. Capped bars indicate the 10th and 90th percentile points.

Since people spend up to 90% of their time indoors, and much of this is often at work, it stands to reason that this technology should be used to eliminate bacteria and mold spores from the working environment. Approximately 10% of the U.S. population suffers from allergies caused by environmental inhalants leading to the aforementioned sick-building syndrome *(3)*. It is important to consider the removal of microbes and particulates from more than just the processing environment; computer or controller rooms as well as laboratories and the workers in these areas will benefit.

The economical practicality of this technology is derived from the following characteristics: little to no down time, permanent filters, minimal cleaning time in the dust-free processing environment, and eliminating disposal of filters; and these filters are low-resistance filters which require less energy consumption for their operation. For the self-cleaning filtration unit, a special vacuum with a disposable containment bag made from the same material as the HEPA filter is used. The unique vacuum unit contains its contents even during cleaning and disposal.

Materials and Methods

For several months, the air in a portion of the Food Science and Nutrition Department's Fruits and Vegetables Pilot Plant (see Figure 1), California Polytechnic State University at San Luis Obispo, has been continuously filtered through a HEPA filtration system. The area of the laboratories is approximately 432 ft^2 (4320 ft^3) and the volume of filtered air is equal to about 1500 ft^3 per minute (CFM), or ca. 21 changes per hour.

Pilot Plant

The filtration unit (see schematic, Figure 2) is a scaled-down version of a commercial unit. Periodically, the pre-filter is replaced with a clean filter and the HEPA filtration system will need to be manually cleaned using a vacuum cleaner. Again, a special vacuum unit with a unique contain-

ment bag made from the same material as the HEPA filter is used to prevent contamination from the cleaning process and to prevent the cleaning person from inhaling the trapped mold spores and other particulates. Air pressure across the HEPA filter is monitored via a magnahelic gauge which indicates resistance to air flow, which would indicate a clogged or dirty filter. So far, after 7 months of operation, we have not had to clean the HEPA filtration system; however, the pre-filter has been changed twice.

Filter Apparatus

Tests performed on similar filter units indicate that particles in the size range of bacteria and mold spores, 0.3 to 30 μm, are excluded by the filter and as a filter builds up, or becomes dirty, the efficiency at removing smaller particulates increases. In order to determine the ability of the filter unit to reduce airborne microbial contaminants in the pilot plant laboratories, air monitoring was performed using the gravitational sedimentation sampling method as described by the American Public Health Association *(11)*. Though this procedure has been criticized for being more qualitative and not being a true quantitative method *(2)*, it is a commonly used procedure and is widely used in the food industry as an index of air sanitary quality.

The method is quite simple: standard methods agar or aerobic plate count agar plates were prepared a day or two ahead of time in 15-ml portions under aseptic conditions. These plates were subsequently used for 15-min air exposures by placing the plate(s) horizontally on a clean surface and then re-covering the plates after the 15-min had elapsed. Following incubation at 35°C for 48 h, the plates were counted for all viable microorganisms. Since a standard petri dish bottom is 1/15 of a square foot, the results are expressed as the number of microorganisms per square foot per minute, or colony forming units (cfu) per 15-min exposure.

Figure 1. Pilot Plant Schematic

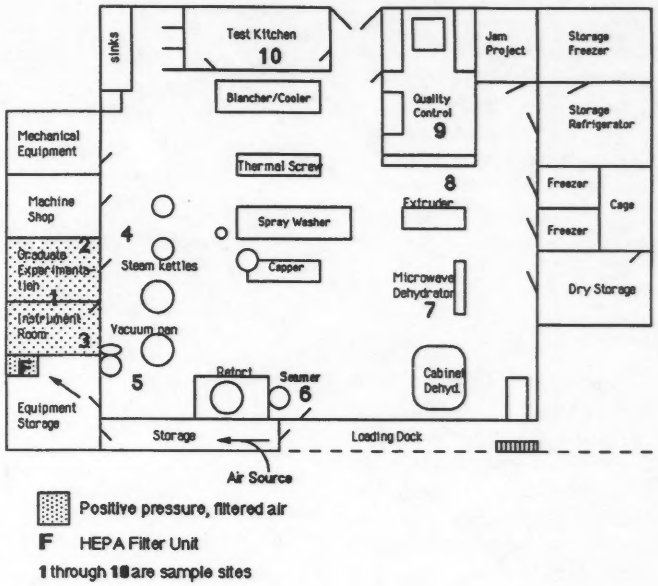
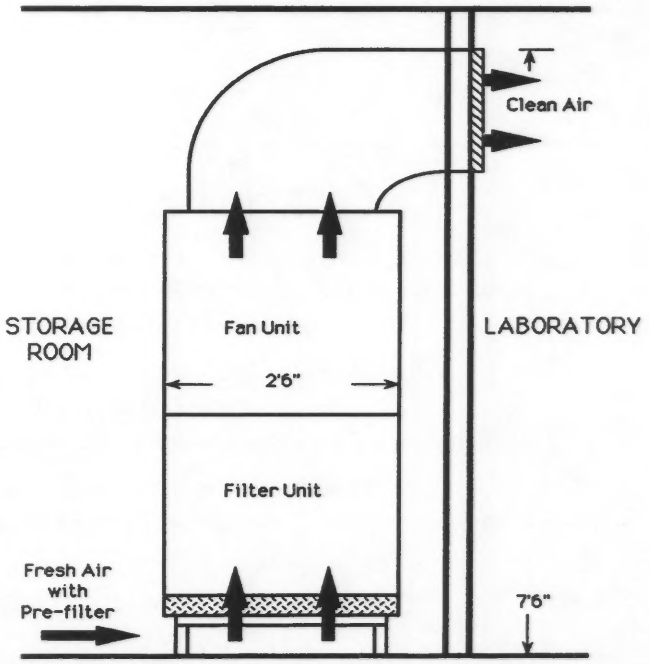


Figure 2. Filter Unit Schematic



Results and Discussion

As seen from the analysis of the data in Table 1, there are significantly fewer microorganisms found in the air of the filtered laboratories compared to the nonfiltered air portions of the pilot plant. Theoretically, by using a properly sized filtration unit, we could achieve similar air quality throughout the pilot plant and the processing environment would have positive pressure using extremely clean air.

Conclusion

The impact of air quality on food processing, in terms of adding an extra measure of safety and extending the shelf life of many foods, is not being fully realized in the food industry. Having positive air pressure through the use of HEPA filtration can dramatically improve the quality of a food product, and ultimately the profit margin for the company which takes such measures. Self-cleaning, efficient HEPA filtration systems are a reality and should be installed in many food plants where air quality is a critical factor. Due to the value and increasing affordability of this technology, further research and evaluation under production conditions is warranted.

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Dairy, Food and Environmental Sanitation, Vol. 15, No. 6, Pages 375-376

Call for Symposia
1996 IAMFES Annual Meeting
June 30 – July 3, 1996 Seattle, WA

The Program Advisory Committee invites IAMFES members to submit symposia proposals for presentation during the 1996 IAMFES Annual Meeting in Seattle, Washington, June 30 – July 3, 1996. Proposals may be submitted by mail to IAMFES headquarters by July 15, 1995 or by contacting the Program Advisory Committee prior to its open meeting at the 1995 IAMFES Annual Meeting on Sunday, July 30, 1995 in Pittsburgh, PA.

Generally, each symposium will be a half-day session (8:30 to Noon or 1:30 to 5:00) with a scheduled break. Symposia emphasize a central theme and usually consist of six 30-minute presentations by each speaker. Proposals will be evaluated by the Program Advisory Committee for relevance to current science and to IAMFES members.

Guidelines for submitting symposia proposals: Use the printed Symposium Proposal form that appears on the other side of this page or reasonable facsimile. The following information must be included: (1) Title of Symposium, (2) Names, telephone numbers, fax numbers, and complete mailing addresses of the person(s) organizing the symposium and conveners of the session, (3) Topics for presentations, suggested speakers and affiliations, (4) Description of audience to which this topic would be of greatest interest, (5) Signature of submitter. Proposals must be received by IAMFES headquarters by July 15, 1995 or be presented to the Program Advisory Committee's open meeting on July 30, 1995.

Proposals may be submitted by individuals or by committees.

Organizers for accepted proposals will be contacted after the 1995 Annual Meeting in Pittsburgh, PA to secure speaker commitment.

Questions? Contact the Program Advisory Committee for the 1996 IAMFES Annual Meeting:

John Cerveny, Oscar Mayer Foods Corporation, P.O. Box 7188, Madison, WI 53707, Phone: 608-241-3311 ext. 4056, Fax: 608-242-6010

Symposium Proposal
1996 IAMFES Annual Meeting
June 30 – July 3, 1996
Seattle, WA

Title of symposium _____

Organizer's name _____

Address _____

Phone_____ Fax _____

Topics for Symposium – Suggested Speakers – Affiliation

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

Conveners of Session – Address – Phone – Fax

_____

_____

Description of Audience _____

Signature of Submitter: _____

Submit by July 15, 1995 to:

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6200 Aurora Avenue
Suite 200W
Des Moines, IA 50322-2838

or Contact:

John Cerveny, Program Advisory Committee
(Phone) 608-241-3311 or (FAX) 608-242-6010

Federal Register

Indirect Food Additives: Adjuvants, Production Aids, and Sanitizers

FDA is amending the food additive regulations to provide for the safe use of 2, 4-di-tert-pentyl-6-[1 -(3, 5 - di - tert - pentyl -2 - hydroxyphenyl) ethyl] phenyl acrylate as an antioxidant in the manufacture of polystyrene and rubber-modified polystyrene articles that contact food. This action is in response to a petition filed by Sumitomo Chemical America, Inc.

Indirect Food Additives: Paper and Paperboard Components; Adjuvants, Production Aids, and Sanitizers; Technical Amendment

FDA is amending its regulations to correct an error in nomenclature for a food additive. The amendment adds alkyl mono- and disulfonic acids, sodium salts (produced from n - alkanes in the range of C10 - C18 with not less than 50 percent C14 - C16) as a component of paper and paperboard in contact with food, as an antistatic agent, and as an emulsifier and/or surface active agent. Additionally, because certain sections contain multiple entries for the additive, FDA is amending its food additive regulations so that all uses of the additive will be combined under single entries in those sections of the regulations.

Johnson Matthey Chemicals; Filing of Food Additive Petition

FDA is announcing that Johnson Matthey Chemicals has filed a petition proposing that the food additive regulations be amended to provide for the safe use of silver chloride coated titanium dioxide in resinous and polymeric coatings.

BASF Corp.; Filing of Food Additive Petition

FDA is announcing that BASF Corp. has filed a petition proposing that the food additive regulations be amended to provide for the safe use of a polyamide – ethyleneimine – epichlorohydrin resin as a component of paper and paperboard in contact with aqueous and fatty food.

Indirect Food Additives: Adjuvants, Production Aids, and Sanitizers

FDA is amending the food additive regulations to provide for the safe use of an aqueous solution of citric acid, disodium ethylenediaminetetraacetate (dissodium EDTA), sodium lauryl sulfate (SLS), and monosodium phosphate as a sanitizing solution to be used on food-processing equipment and utensils, including dairy-processing equipment. This action responds to a petition filed by Gycor International Ltd.

Listing of Color Additives Exempt from Certification; Astaxanthin

FDA is amending the color additive regulations to provide for the safe use of astaxanthin as a color additive in the feed of salmonid fish to enhance the color of their flesh. This action is in response to a petition filed by Hoffmann – La Roche, Inc.

USDA Issues Final Rule for Export Bonus Programs

The U.S. Department of Agriculture has issued a final rule to amend the Export Enhancement Program (EEP) and Dairy Export Incentive Program (DEIP).

According to Christopher E. Goldthwalt, general sales manager for the USDA's Foreign Agricultural Service and vice president of the Commodity Credit Corporation, the regulations are amended to: (1) Delete the export experience requirement for qualification to participate in the EEP and DEIP; and (2) establish the time at which new program participants would be eligible to receive bonus payments.

Removing the export experience requirement will provide an opportunity for more companies to qualify to participate in the EEP and DEIP programs. In the past, companies were required to document experience of selling for export within the preceding three calendar years.

The final rule was published May 1 in the Federal Register (60 FR 21037) and becomes effective May 31, 1995.

EEP and DEIP help U.S. agricultural producers, processors and exporters gain access to foreign markets. The program makes possible sales of U.S. agricultural products that otherwise would not have been made due to subsidized prices offered by competitor countries.

Questions regarding this regulatory change may be directed to Linda Wheeler or William S. Hawkins, (202) 690-0637 or (202) 720-3241. Copies of the Federal Register can be obtained from the Government Printing Office or viewed at any local Federal Depository Library.

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UpDates

Pro-Tek Packaging Group, Inc. Promotes Alice Zebrowski to General Manager

Pro-Tek Packaging Group, Inc., a leading manufacturer and supplier of stock and custom decorated heat shrink film for tamper-evident protection and primary package labeling, has promoted Alice Zebrowski to General Manager.

Zebrowski, who formerly served as Assistant Operations Manager, has been with Pro-Tek for five years. She is a graduate of Skidmore College and resides in Central Islip, NY.

Dean Foods Announces New Corporate Vice President

Dean Foods Company announced that Jenny Carpenter has been appointed a Corporate Vice President for the Specialty Foods Division, a newly-created position, effective April 5, 1995. Ms. Carpenter has been Director of Marketing and Sales for the Specialty Foods Division of Dean Foods Company since 1988.

Ms. Carpenter joined the Green Bay Food Company in Green Bay, Wisconsin, a subsidiary of Dean Foods Company in 1967 and held various administrative positions including Vice President of Purchasing, Packaging, and Administrative Services. In 1988 she was promoted to Director of Marketing and Sales for the Specialty Foods Division of Dean Foods Company in Franklin Park.

In addition to her current responsibilities for the Specialty Foods Division, she will also assume responsibility for the development and introduction of Dean's Guilt Free Dairy Product line.

Chr. Hansen Promotes New Food Ingredients National Sales Manager

Chr. Hansen of Milwaukee, Wisconsin, announces the promotion of Mike Bailey to National Sales Manager, Food Ingredients Division. His new responsibilities include overall sales and account management of this fast-growing Chr. Hansen division.

Bailey was most recently a Marketing Manager and a Product Manager; both positions were held in the Food Ingredients Division at Chr. Hansen, where he successfully introduced new custom colors and flavors to meet specific customer needs at a variety of national food and beverage accounts of Chr. Hansen. Prior to his management positions, Bailey was a Technical Sales Representative in the South East territory at Chr. Hansen. His background also includes six years at Griffith Laboratories U.S.A. as a sales representative. Bailey has seven additional years of food ingredient experience from Goodmark Foods, where he worked in new product research and development. Bailey holds a B.S. in Food Science from North Carolina State University.

Elgin Dairy Names Jackson Purchasing/Credit Manager

Elgin Dairy Foods, Inc., the Chicago-based manufacturer of a variety of dairy and non-dairy mixes, toppings and proprietary food products, has promoted Vanessa A. Jackson to the post of Purchasing/Credit Manager. Her responsibilities include the purchase of raw materials, supervision of accounts receivable and review and approval of credit applications.

Jackson, who holds an Associate Degree in Liberal Arts from Harold Washington Junior College in Chicago, joined Elgin in 1988.

Elgin manufactures a variety of dairy food products sold under its own name as well as private label and co-packed dairy ingredients and proprietary formulations for the food service and food processing industries.

Lou Thomas Assumes Full Time Role as Vice President/ General Manager of Groen's Process Equipment Group

Groen, a Dover Industries Company, has announced the full time appointment of Louis P. Thomas as Vice President and General Manager of Groen's Process Equipment Group. Thomas will be responsible for all Process Equipment sales, marketing, engineering and manufacturing operations at Groen's Elk Grove Village Plant. Thomas had also served as Groen's Treasurer/ Controller, since assuming his dual role as General Manager of the Process Equipment Group in 1990.

Prior to joining Groen, Thomas was Treasurer at Davenport Machine Tool, another Dover company headquartered in Rochester, New York. He has also served as Director of Accounting with Universal Instruments and Assistant Controller-Cost Accounting, with Anitec Image Corporation.

Groen's Process Equipment Group is the world's largest producer of batch processing agitator kettles and a leader in the development of continuous heat exchange technology, serving food, confectionery, drug, chemical and cosmetic processors around the world.

Food Processing Industry Achieves Adoption of Food Safety Amendment in Clean Water Act Reauthorization — Supports Risk Assessment Principles of House Bill

In a major victory for the food processing industry, the Food Industry Environmental Council (FIEC) was victorious in persuading a House of Representatives subcommittee to adopt a food safety amendment to legislation to reauthorize the Clean Water Act (CWA). FIEC sees the victory as the first step in ensuring that CWA reauthorization will not adversely affect safe food manufacturing and processing.

FIEC, a coalition of food processing organizations whose members represent approximately 15,000 companies employing over 1.4 million people and $121 billion annually in sales, developed the amendment based on concerns that proposed legislation to reauthorize the Clean Water Act overlooked the importance of food safety. The amendment was included in legislation passed by the Water Resources and Environment Subcommittee of the Transportation and Infrastructure Committee.

In communications with members of the subcommittee, FIEC said, "the safety and integrity of the food supply is a priority for every citizen of this country."

Good manufacturing practices for the food industry, as regulated by the Food and Drug Administration, the U.S. Department of Agriculture and others, include standard sanitation and cleaning activities that may involve using products defined under the Clean Water Act as nonconventional pollutants.

According to FIEC, the food processing industry relies on numerous procedures for the cleaning and sanitizing of processing equipment, work surfaces and raw foods such as fruits and vegetables, which are essential to the growers and processors of food, as well as consumers.

The "Food Safety Assurances" amendment developed by FIEC requires the Environmental Protection Agency (EPA) to consult with other federal agencies responsible for regulating the food processing industry prior to issuing new effluent guidelines, pretreatment standards, process changes, new source performance standards, or use restrictions under the Act, in order to ensure the proposed requirement would not adversely affect food safety, food processing operations, or the integrity and wholesomeness of a food product.

The full Transportation and Infra-structure Committee is scheduled to hold its mark-up of H.R. 961.

Difco Laboratories: Leading Microbiology into the 21st Century

Difco Laboratories, one of the oldest and most respected manufacturers of microbiology products, is celebrating its centennial year in 1995.

"We're proud to have maintained our leadership role in microbiology products and services that have affected millions of people," said William B. Burnett, CEO of Difco Laboratories. "We're looking forward to even more cutting-edge development in the 21st century."

Difco Laboratories has a tradition of providing high-quality microbiology products. Established in 1895, the business originally produced high-quality enzymes, dehydrated tissue and other biomedical materials. Difco actually pre-dates the American Society for Microbiology by four years; ASM was founded in 1899.

The company went on to produce many innovative microbiological products, including Proteose Peptone for the preparation of diptheria toxin in 1919, C-Reactive Protein Antiserum in the 1950's, and the Bactrol line of quality control disks containing pure bacterial cultures in the 1970's.

In the 1990's, Difco continues to provide technology leadership with its ESP Blood Culture System, new technology for blood culture instrumentation. Difco will introduce more innovative products in 1995, including the EZ Coli™ Rapid Detection System, which detects the deadly *E. coli* bacteria in food products just ten minutes after enrichment. Difco will also unveil more industry-leading technologies this year, such as the ESP Myco System II™, for mycobacteria growth and detection.

Difco Laboratories is a technological leader in the development and manufacture of microbiology products, celebrating its centennial of excellence in 1995.

New DuPont Food Quality Business Obtains PCR License for Microbial Testing

In another step forward for its major commitment to the food processing and testing industry, DuPont has obtained licenses from Roche Molecular Systems, Inc. and the Perkin-Elmer Corporation to use the Polymerase Chain Reaction (PCR) in the microbial testing field. PCR is an innovative method that makes it possible to rapidly produce millions of copies of DNA from a single target organism.

These agreements will enable the DuPont Food Quality Management Systems business venture to commercialize PCR-based products

and services for a wide variety of microbial testing applications outside of the human medical diagnostics field.

After more than eight years of research and development, the DuPont venture is introducing a family of products that use breakthrough genetic technologies such as PCR to address the safety and quality management needs of the food industry. Initially, the business will use PCR in a test to screen foods for potentially dangerous bacteria such as *Salmonella, E. coli* O157:H7, *Listeria,* and *Listeria monocytogenes*. The venture's other new product, which is slated for introduction later this year, is the RiboPrinter™ Microbial Characterization System, a fully automated instrument that produces a DNA "fingerprint" of bacteria, called a RiboPrint™ pattern, in about eight hours.

"Our screening products will allow much faster, more reliable detection of pathogens in food samples than has been previously possible," said Dr. Krishna Doraiswamy, Business Development Manager of DuPont Food Quality Management Systems. "And, because the results are definitive, immediate preventive or corrective action can be taken without waiting for additional confirmatory testing."

"This license extends the industrial application of PCR to the critical and complicated field of food testing and also permits broader application of PCR-based microbial analyses in fields other than human diagnostics," said Dr. Ellen Daniell, Director of Licensing, Roche Molecular Systems.

Bob Jones, Director of Perkin-Elmer's PCR Business Unit said, "Perkin-Elmer is pleased to further extend PCR licensing and make more tools available within the food processing and testing industry."

The DuPont screening products will have a wide variety of applications in food production and processing, ranging from quality assurance of incoming raw materials to testing of the finished product. DuPont plans to introduce initial products based on these methods later this year, with fully automated systems for high-volume applications planned for 1996.

PCR is a definitive method of amplifying and identifying specific DNA or RNA sequences. Using PCR, technicians can quickly produce millions of copies of a single segment of DNA from a microorganism, thereby creating quantities large enough to be detected. Because the PCR process is rapid and extremely sensitive, this technique represents a major advance over traditional methods for microbial analysis which required repetitive culturing and growth of bacteria to get numbers sufficient for detection.

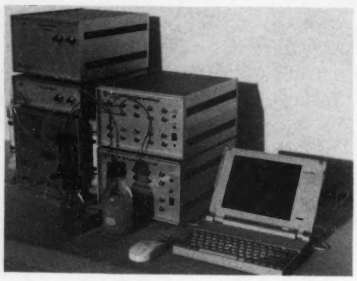
Hoffmann-La Roche, with worldwide headquarters in Basel, Switzerland, and U.S. headquarters in Nutley, N.J., is a world leader in original research and development in the health care field. Through the Company's Diagnostics Division, which includes Roche Biomedical Laboratories, Roche Diagnostic Systems, Roche Molecular Systems and Roche Image Analysis Systems, innovative and cost-effective testing products and services are made available to physicians, patients, hospitals and laboratories worldwide.

The Perkin-Elmer Corporation is the world leader in the manufacture, development and distribution of analytical and bioresearch systems used in markets such as environmental, biotechnology, chemical, food and agriculture. Headquartered in Connecticut, Perkin-Elmer had $1 billion in revenues in the fiscal year 1994 and employs 5,900 people worldwide.

DuPont is a $32 billion research and technology-based global chemical and energy company offering high-performance products in chemicals, polymers, fibers and petroleum. The company serves worldwide markets in aerospace, agriculture, apparel, automotive, construction, packaging, refining and transportation industries. DuPont's New Business Development has a major initiative addressing the food industry's need for new methods to assure the safety and quality of food products.

Index of Advertisers

Industry**Products**



Columbus Instruments

Toxicity Analyzer

Columbus Toxicity Analyzer measures the impact of toxic substances on organic life using bacteria cultures. It measures the rate of production of CO_2 and O_2 consumption which are directly related to the rate of growth of aerobic bacteria. When equipped with methane and CO_2 sensors, it can also utilize anaerobic bacteria. Bacteria cultures can be either in natural form of active sludge or waste water, or as a precisely controlled and cultivated culture.

Up to 80 different culture samples can be tested at the same time on a continuous basis with periodic printouts and graphic presentation of gas exchanges versus time in the head space of each chamber. As the gas sensors are remote to the substances being tested, there is no danger that toxic chemicals can affect the sensors as is the case with the method where dissolved oxygen sensors are used. Sensitivity of the system is on the order of 0.2 µg O_2/h and measurement values are presented in µg O_2 consumed and CO_2 produced per units of time (minutes, hours etc.). *Toxicity Analyzer* provides not only minute rates of gas exchanges, but also provides accumulated amounts in grams or mL of each gas consumed and produced from the beginning of the experiment. *Columbus Toxicity Analyzer* is also offered in a shock-resistant transportable version with a laptop computer which can easily be transported to remote test sites. *Toxicity Analyzer* can operate either in high sensitivity mode which involves sequential sampling of head space gas from each chamber and returning it back to the same chamber after passing through gas sensors, or in the high metabolic "open air flow mode" in which a precisely measured amount of air is continuously passed through the sample chambers and gradient of O_2 and CO_2 are measured across the chambers.

Applications for this instrument range from environmental sciences (bioremediation and waste) to medicine (antibiotics), tissue cultures and biotechnology.

Columbus Instruments – Columbus, OH

Reader Service No. 389

New Reactors for Toxicity Testing and Wastewater Operations Control

An expanded line of reactors for the BI-1000 Electrolytic Respirometer has been introduced by Bioscience, Inc. The new reactors make possible automated toxicity testing, evaluation of biodegradability and operations control for municipal and industrial wastewater treatment.

These reactors may be used for testing of soils, sludges or liquids. Models have also been developed for samples with very high or low BOD.

Tests made with the reactors conform to Standard Methods for determining treatability by means of oxygen consumption rate. They meet U.S. and international standards for biodegradability testing and industry standards for sludge inhibition studies.

Bioscience, Inc. – Bethlehem, PA

Reader Service No. 390

Isomatic New Mini Airlock

Isomatic Inc., a leading company in the design and manufacture of high quality processing equipment and components, has developed a new Mini-Airlock.

This Mini Airlock is ideal for applications that require feeding small quantities of dry powder in pharmaceutical, food processing, chemical and pilot plant operations.

The Model-19 has been designed specifically for small capacity applications. The airlock is available in two sizes: .003 CFR and .006 CFR. Both units incorporate the small heavy-duty housing, drop-through style, 3" square inlet, outlet, cast iron 8-vane flat tip rotor and outboard bearings. Stainless steel construction and electroless nickel chrome plating are available. Other options include: easy-clean features and air purge capabilities.

Both versions of the Model 19 easily handle smaller quantities of most dry materials. A.006 CFR operating at 20 RPM will take 8 minutes to convey one cubic foot of product.

Isomatic Corp. – Hopkins, MN

Reader Service No. 391

J&W Scientific's DB™-1701P Megabore® Provides Guaranteed Resolution and Inertness for Pesticide Analysis

J&W Scientific's new DB™-1701P Megabore® column is tested specifically to measure resolution and response of the critical pesticides in U.S. Environmental Protection Agency CLP organochlorine pesticide analysis.

J&W guarantees inertness by specifically testing every DB™-1701P column using an electron capture detector, at part-per-billion levels, ensuring that they exceed CLP performance criteria.

In addition, J&W determines the best linear velocity and guarantees the resolution of selected critical pains on a DB™-1701P to be at least 10% more than required by CLP standards. The 30-meter columns are available in a variety of inner diameters and film thickness with upper temperature limits of 280 - 300°C.

J&W Scientific – Folsom, CA

Reader Service No. 392

Maximum Value in a Miniature Size ... The New Ashcroft® MiniGauge™

Dresser Industries Instrument Division is pleased to present the newest member of the Commercial Instrument family, the Ashcroft® MiniGauge™. The MiniGauge is designed to fit in those installations where limited space is a primary design consideration.

At 23 mm, the compact Ashcroft MiniGauge is smaller than one-inch diameter and is available in ranges from 60 psi through 300 psi. Taking into consideration the small size, the dial face was designed to afford the user maximum readability.

The Ashcroft MiniGauge surpasses the demands of durability in two key ways: first, by using direct drive reading, the spiral tube transmits motion directly to the pointer with no gears or bearings to wear out; and second, the case material of ABS blend is both enduring and attractive. This gauge is available in 1/8" NPT, center back connection with wrench flats for easy installation.

The combination of all of the above features provides a versatile product that is suitable for a host of applications.

Dresser Industries – Stratford, CT

Reader Service No. 393

Sigma-Aldrich Techware

Kodak IBI Base Runner™ Nucleic Acid Sequencers Now Available from Sigma-Aldrich Techware

A highly advanced generation of DNA sequencing systems is now available from Sigma-Aldrich Techware. Designed to provide faster set-up, more reproducible results, and greater flexibility than conventional sequencers, the Kodak IBI Base Runner Nucleic Acid Sequencers are available in two different models: The Base Runner 200, which features a dual gel design for maximum sample capacity and the Base Runner 100, which is an economical, single gel sequencer.

Both models incorporate a variety of features to reduce labor and enhance overall performance. The adjustable height gel assembly accommodates gels from 30 to 60 cm in length and is capable of resolving 400 or more bases per run. Specially designed Thermocore plates eliminate gel artifacts and minimize pre-run time. And removable buffer tanks with drain valves permit safe and convenient disposal. Each IBI Base Runner is shipped complete with 60 cm plates, combs, spacers, and the other accessories required for nucleic acid sequencing.

Sigma-Aldrich Techware – St. Louis, MO

Reader Service No. 394

Automatic Colony Counting System Separates Spreaders, Creates Audit Trail

A new high throughput colony counting system that utilizes video and menu-driven computer technology to provide accurate counts of bacteria, cells and plaque on a wide variety of media is being introduced by Optomax of Hollis, New Hampshire.

The Cardinal Automatic Colony Counting System features a compact plate viewer for colonies on transparent and opaque nutrient media with software selectable bright- or dark field illumination. Easy to operate within the Windows® environment, users simply place their sample plate into a petri

viewer and click on "measure" to obtain instant results, while creating a complete audit trail.

Capable of up to 600 plates/hour throughput, the Cardinal Automatic Colony Counting System typically performs measurements within 0.5 seconds with 0.15 mm resolution at full plate magnification and results provided as count, count/plate, count/ml, area and frame area. An option allows direct connection to a light microscope for counting silver grains, nuclei or fluorescing bacteria.

Optomax – Hollis, NH

Reader Service No. 395

Sellers Cleaning Systems

Sellers ORBI-G3 Rotating Tank Cleaner Designed for Optimum Cleaning of Limited Access Containers

Sellers Orbi-G3 Rotating Tank Cleaner is specifically designed to provide thorough, cost-effective cleaning of limited access vessels. The unit is designed to fit a 3" (76.2 mm) opening, making it ideal for optimum cleaning of IBC's, totes or other limited access containers.

The Orbi-G3 is fluid driven, with a set of bevel gears which provide a complete 360-degree indexing pattern, every 44 revolutions. The cleaner is designed with a rotating head which is driven by the cleaning solution, which produces dual streams that contact all surface areas.

The Orbi-G3 has various options available which will provide cost effective cleaning in an operating pressure range of 75-300 psi (5.2-20.7 bar), and a flow capacity ranging from 11-27 gpm (42-102 1/m). It features an effective cleaning radius of 10 feet!

This model weighs just 2 lbs., has an overall head length of 6 1/4", and provides ease of field maintenance at low costs. Constructed of stainless steel and food grade plastics, this cleaner is ideal for a wide variety of applications in the bulk transport, food and beverage, chemical processing, pharmaceutical, paint, and dairy industries.

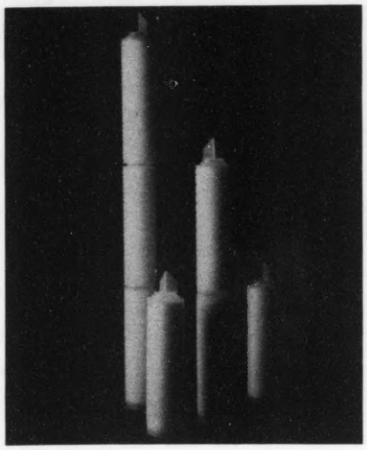
Sellers Cleaning Systems – Piqua, OH

Reader Service No. 396

Fluorodyne® II Pharmaceutical Grade Filters for the Pharmaceutical, Biologicals, and Bioprocessing Industries

A new Fluorodyne® II Pharmaceutical Grade filter introduced by Pall Ultrafiltration Company provides safe and reliable sterile filtration of a wide range of liquids. Applications include sterile filtration of ophthalmics and dilute protein solutions, hot water, chemicals and solvents.

The Pall proprietary water-wettable polyvinylidene (PVDF) double-layer membrane exhibits broad chemical compatibility, high temperature rating, long steam life, and superior bacterial removal efficiency. These absolute rated 0.2 µm filters are easily wetted for integrity testing and offer exceptionally high flow rates. The high flow rates and low pressure drop of Fluorodyne II filters permit the use of smaller filtration systems, resulting in reduced operating costs and lower product hold-up.



Pall Corporation

Fluorodyne II filter cartridges have been validated by bacterial challenge and 100% integrity tested by the Forward Flow Method to ensure their efficacy as sterilizing grade filters. Production filter cartridges are sampled and routinely tested by the bacterial challenge test. Samples from every batch are tested for oxidizable substances, endotoxins, particulates and pH shift per USP methodology, and are steam autoclave tested. Each filter carries a serial number ensuring full traceability.

Pall Corporation – Port Washington, NY

Reader Service No. 397

BusinessExchange

Services/Products

Model III ss x

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The CDT™ Test Device*
For testing all differential
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Reader Service No. 124

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Reader Service No. 153

FOOD SPECIALIST

Zep Manufacturing Company, a leader in the specialty chemical industry and division of a Fortune 500 company, has an immediate opening for a Food Specialist. Job duties include extensive traveling throughout the U.S. to survey food plant facilities, development of surveys, reports and and procedure manuals and selling Zep's program to food plants. Also responsible for teaching Sales Representatives how to maintain established accounts.

Ideal candidate would possess a 4-year college degree, 2-3 years of food sanitation experience, the ability to teach sanitation procedures, and knowledge of processing products. Desirable skills include basic knowledge of chemistry and WordPerfect. The ability to travel is a must.

Zep offers competetive slary, medical benefits and 401K/Profit Sharing. Interested individuals should send a current resume with salary requirements to:
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Atlanta, GA 30301
No Phone Calls, Please
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Reader Service No. 206

DQCI Services,Inc.
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Reader Service No. 129

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- Vendor and Sanitation Audits
- Some HACCP Enforcement & Implementation
- Laboratory Equipment Experience
- Electron Microscopy Experience
- Pathogen Isolation Identification

Prefer Northeast Area
(But Would be Willing to Relocate)

Please contact
Howard Malberg
914-794-8264

ComingEvents

JULY

·**11-12, AIB Regional Updates in Food Plant Sanitation,** Cherry Hill, NJ. The program will include new topics in addition to the basic key elements for any viable sanitation program, as well as sessions on the basic principles of HACCP and sanitary design standards. Tuition fees are $300 per person for members of the American Institute of Baking, and $325 for non-members. For more information, write to the Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66052, or call (913) 537-4750 or (800) 633-5137.

·**17-20, Granulation, Tabletting and Capsule Technology,** San Francisco Bay Area, CA. The course begins with a consideration of raw material testing and the basic aspects of powder and granulation technology, progresses through formulation of solid dosage forms to manufacturing processes and equipment, and concludes with key aspects of the evaluation of finished products, and the regulatory constraints. For more information, please contact Registrar, The Center for Professional Advancement, PO Box 1052, East Brunswick, NJ 08816, or call (908) 613-4500; fax (908) 238-9113.

·**24-27, Pharmaceutical Water Systems,** East Brunswick, NJ. The factors that influence water system design are discussed in terms of the different water sources and the impurities they contain. The chemical purity standards newly set for pharmaceutical waters are described. The choices for removing impurities are detailed and the considerations in making selections among the alternatives are evaluated. For more information, please contact Registrar, The Center for Professional Advancement, PO Box 1052, East Brunswick, NJ 08816; telephone (908) 613-4500; fax (908) 238-9113.

AUGUST

·**2-3, 4-State Applied Nutrition and Management Conference,** Sponsored by 4-State (IA, IL, MN and WI) Extension. For registration, contact CALS Conference Office, UW-Madison; telephone (608) 263-1672.

·**7-11, Contracting Pharmaceutical Operations,** This course deals with the contracting of pharmaceutical operations (including manufacturing, packaging and laboratory work) from the time which the customer i.e., the requestor of the services first considers having work performed by a supplier through to the production of an acceptable product by the supplier. For more information, please contact Registrar, The Center for Professional Advancement, PO Box 1052, East Brunswick, NJ 08816; telephone (908) 613-4500; fax (908) 238-9113.

·**21-23, Current Good Manufacturing Practice (cGMP) for the Pharmaceutical and Allied Industries,** Chicago, IL. Topics covered will include not only the legal requirements for cGMP in the Federal Food, Drug, and Cosmetic Act but primarily the practical "how to" of purchasing, manufacturing, packaging, labeling and QA/QC, as well as training production personnel in cGMP. For more information, please contact Registrar, The Center for Professional Advancement, PO Box 1052, East Brunswick, NJ 08816; telephone (908) 613-4500; fax (908) 238-9113.

·**29-30, Producing Safe Dairy Foods,** Sponsored by the Wisconsin Center for Dairy Research. For registration information, call (608) 263-1672. For program information, call Sarah Quinones, (608) 262-2217.

SEPTEMBER

·**6-8, Symposium on Heat Treatments and Alternative Methods,** The purpose of the Symposium is to provide a forum of exchange of information on processing technologies and their product-related effects as well as the methodology and criteria of measurement of these effects. For more information, contact IDF Secretariat, 41, Square Vergote, B-1040 Brussels, Belgium; telephone (+32 2 733 98 88); fax (+32 2 733 04 13).

·**8-9, 1995 Annual Conference of the Wisconsin Laboratory Association,** The overall theme for this year's conference is Analytical Precision. On Thursday, Sept. 9, Dr. Michael L. H. Brodsky, Ontario Minister of Health, will keynote the general session with a presentation on Quality Assurance in the Laboratory, entitled "What is this thing called QA?" For more information, write to WLA, PO Box 28045, Green Bay, WI 54324; or call George Nelson at (715) 232-2560.

·**20-21, OSMO® RO/UF Equipment Operation and Maintenance Seminar,** "Equipment Operation and Maintenance" is oriented specifically for operators of RO/UF equipment used for water treatment, pollution control and process applications. This seminar will provide operators a complete background necessary to operate and maintain RO/UF equipment at peak performance year-in and year-out. For more information, contact Ms. Bette Nelson, Travel & Seminar Coordinator, 5951 Clearwater Dr., Minnetonka, MN 55343-8990; telephone (612) 933-2277.

• **25-29, The 12th European Symposium on the Quality of Poultry Meat and the 6th European Symposium on the Quality of Eggs and Egg Products,** Zaragoza, Spain., Auditorium/Congress Palace. Working languages will be English, Spanish and French. Simultaneous translations will be organized in plenary sessions. For more information, please contact the Symposia Secretariat, Ricardo Cepero Briz, Veterinary Faculty, Miguel Servet 177, 50013 Zaragoza SPAIN.

• **27-30, Healthcare Food service Management National Training Conference,** The National Society for Healthcare Food service announced the details of its 1995 National Training Conference at La Quinta Resort in Palm Desert, CA. For the first time HFM will also sponsor four pre-conference workshops. For registration information, contact HFM at (202) 546-7236.

• **28-29, Wisconsin 16th Annual Joint Conference, A Dairy, Food and Environmental Health Symposium,** The Wisconsin Association of Milk and Food Sanitarians (WAMFS), Wisconsin Environmental Health Association (WEHA), Wisconsin Association of Dairy Plant Field Representatives (WADPFR), joint conference at the Paper Valley Inn in Appleton, WI. Each group is planning separate programs at the conference that would be of interest of all groups. For more information, please contact Neil Vassau, Dept. of Agriculture, Trade, & Consumer Protection, Bureau of Laboratory Services, PO Box 7883, Madison, WI 53707; telephone (608) 267-3504.

OCTOBER

• **4-5, Crossflow Membrane Technology Workshop,** The workshop will cover the fundamentals of reverse osmosis, nanofiltration, ultrafiltration and microfiltration, total system design considerations, pilot testing of new applications, and the "zero discharge" approach to pollution control. Hands-on operation of bench-top, pilot and full-scale equipment will be included both days of the workshop. For more information, contact Ms. Bette Nelson, Travel & Seminar Coordinator, OSMONICS, 5951 Clearwater Dr., Minnetonka, MN 55343; (612) 933-2277.

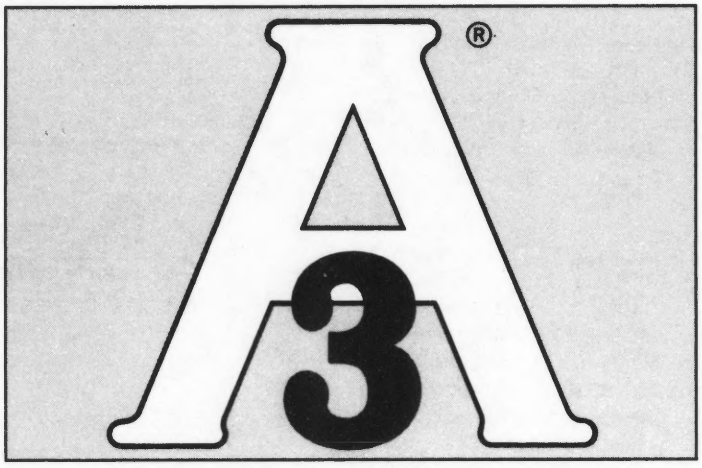
NOVEMBER

• **4-6, 6th Egyptian Conference of Dairy Science and Technology,** Cairo, Egypt. Organized by The Egyptian Soc. of Dairy Science. For more information, contact Dr. M. H. Abd El-Salam, National Research Center, Dokki, Cairo, Egypt; telephone (20-2-625 026) or fax (20-2-700 931).

• **5-9, Anuga FoodTec International Food Technology Fair,** Anuga FoodTec will be an extensive multi-industry food technology trade fair, but will also allow individual product categories to present themselves independently. Companies will have the opportunity to present their latest innovations in food technology. Anuga Foodtec guarantees a comprehensive overview of the food processing and packaging technology sectors. For further information, contact Cologne International Trade Fairs, Inc., 40 West 57th St., 31st Floor, New York, NY 10019; telephone (212) 974-8836.

• **5-9, American Association of Cereal Chemists 80th Annual Meeting,** The world's largest gathering of cereal industry professionals will convene their 80th Annual Meeting in San Antonio, Texas at the Henry B. Gonzales Convention Center. AACC Annual Meeting registration materials are available after July 1, 1995, from AACC Headquarters, 3340 Pilot Knob Road, St. Paul, MN 55121-2097 U.S.A.; telephone (612) 454-7250; fax (612) 454-0766.

Confidence: The Most Important Ingredient In America's Dairy Products



Americans can consume milk and other dairy products with the certainty that they are the safest and healthiest in the world.

That's because America's dairy industry, led by the Dairy and Food Industries Supply Association, has taken upon itself the responsibility of coordinating the development of 3–A Sanitary Standards for equipment and 3–A Accepted Practices for systems used in processing dairy foods.

For more than half a century, this voluntary and self-regulated program, conducted in concert with state and federal regulators, has been helping to provide: **equipment manufacturers** with clear standards for their products, **processors** with a means of assuring sanitary conditions, **sanitarians** with tools to make more sophisticated and consistent inspections, and **consumers** with priceless peace of mind.

The 3–A Sanitary Standards Program is just one of the ways DFISA is helping America's dairy and food industries serve the public more effectively, today and in the future.

For more information:

Dairy and Food Industries Supply Association, Inc.
6245 EXECUTIVE BOULEVARD
ROCKVILLE, MARYLAND 20852-3938
301/984-1444 • TELEX: 908706

Reader Service No. 126

IAMFES

Preliminary Program

82nd Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians, Inc.

In Cooperation with Pennsylvania Association of Milk, Food and Environmental Sanitarians

Hilton Hotel & Towers, Pittsburgh, PA
July 30 — August 2, 1995

REGISTRATION TIMES

Saturday, July 29	1:00 p.m. - 5:00 p.m.
Sunday, July 30	8:30 a.m. - 7:00 p.m.
Monday, July 31	8:00 a.m. - 4:00 p.m.
Tuesday, August 1	8:00 a.m. - 4:00 p.m.
Wednesday, August 2	8:00 a.m. - 12:00 p.m.

EXHIBITORS HOURS

Sunday, July 30 (Following the Opening Session)	8:00 p.m. - 10:00 p.m.
Monday, July 31	9:30 a.m. - 3:30 p.m.
Tuesday, August 1	9:30 a.m. - 3:30 p.m.

IAMFES BOARD MEETINGS

Friday, July 28	2:00 p.m. - 6:00 p.m.
Saturday, July 29	8:00 a.m. - 1:00 p.m.
Monday, July 31	7:00 a.m. - 9:00 a.m.
Wednesday, August 2	11:30 a.m. - 2:00 p.m.
Thursday, August 3	8:00 a.m. - 12:00 p.m.

COMMITTEE/PROFESSIONAL DEVELOPMENT GROUP MEETINGS

SUNDAY, JULY 30

7:00 - 10:00 a.m.	Affiliate Council
10:00 - 11:00 a.m.	Dairy Quality & Safety (Farm Section)
9:30 - 11:00 a.m.	Audio Visual Library
10:00 - 11:00 a.m.	Baking Industry Sanitary Standards
10:00 - 11:00 a.m.	Past Presidents Advisory
10:00 - 12:00 p.m.	Poultry Safety and Quality
10:00 - 5:00 p.m.	Communicable Diseases Affecting Man
11:00 - 12:00 p.m.	Dairy Quality and Safety (Plant Section)
11:00 - 12:00 p.m.	Foundation Fund
11:00 - 12:00 p.m.	Nominating
1:30 - 2:30 p.m.	Constitution and By-Laws
1:30 - 2:30 p.m.	Sanitary Procedures
1:30 - 3:30 p.m.	Meat Quality and Safety
1:30 - 3:00 p.m.	Dairy, Food & Environmental Sanitation Management
1:30 - 3:30 p.m.	Seafood Safety and Quality
1:30 - 3:30 p.m.	Applied Laboratory Methods
1:30 - 3:30 p.m.	Food Sanitation
3:00 - 4:00 p.m.	Environmental Issues in Food Safety
3:00 - 4:30 p.m.	Journal of Food Protection Management
3:00 - 5:00 p.m.	Food Safety Network
4:00 - 6:00 p.m.	Program Advisory

WEDNESDAY, AUGUST 2

12:00 - 4:00 p.m.	Program Advisory (members only)

Sunday Evening — July 30, 1995

Opening Session

7:00 **Welcome to the 82nd Annual Meeting** – C. D. Clingman, President of IAMFES and P. Hoge, Chairperson of the Local Arrangements Committee.

7:15 **Introduction of the Ivan Parkin Lecture** – F. A. Draughon, President-Elect of IAMFES

7:20 **Ivan Parkin Lecture** – James M. Jay, PhD, Wayne State University, Detroit, MI

The Ivan Parkin Lecture is sponsored by the IAMFES Foundation Fund and is supported by the Sustaining Members

8:00 **Cheese and Wine Reception** – Held in the Exhibit Hall. An opportunity to greet old friends, make new ones and view the excellent technical displays.

Monday Morning — July 31, 1995

Practical Approach to Quality Milk — General Session

8:30 NCIMS Update and Structure of NCIMS – D. RACKLEY, Oklahoma Dept. of Agricultural, Oklahoma City, OK

8:55 3-A Sanitary Standards – Now and in the Future – T. GILMORE, Dairy and Food Industries Supply Association, McLean,VA

9:20 Laying the Groundwork for HACCP and ISO 9000 – J. ADAMS, National Milk Producers Federation, Arlington, VA

9:45 Dairy Product Shelf Life Tests for Quality Control and Research and Development – T. GRUETZMACHER, Dean Foods Company, Rockford, IL

10:10 Break

10:30 National Milk Drug Residue Database – J. SMUCKER, FDA, Washington, DC

10:55 Practical Solutions to Pathogens from Milk and Other Animal Products – S. KNABEL, Pennsylvania State University, University Park, PA

11:20 Design, Installation, and Maintenance of Plate Heat Coolers – D. COLE, Alfa Laval Agri., Newburg, PA

Technical Session — Control of Food-borne Microorganisms

8:30 Shelf Life Extension and Safety of Fresh Pork Treated with High Hydrostatic Pressure – V. ANANTH, E. Murano, and J. Dickson, Iowa State University, Ames, IA

8:45 Microbial Monitoring of Irradiated, Commercially-Prepared, Chub-Packed Ground Beef – S. GAMAGE, J. Luchansky, and S. Ingham, University of Wisconsin-Madison, Madison, WI

9:00 Reduction of *Salmonella typhimurium* on Chicken Carcasses Using Pulsed Electricity – Y. LI, H. Xiong, P. Mastler, and M. Slavik, University of Arkansas, Fayetteville, AR

9:15 Isolation and Characterization of Gram-negative Bacteria, Isolated from Ground Beef, that Exhibited Inhibition of *Escherichia coli* O157:H7 – T. BRIDGEMAN and E. Zottola, University of Minnesota, St. Paul, MN

9:30 Inhibition of a Psychrotrophic *Clostridium* Species by Sodium Diacetate and Sodium Lactate in a Cook-in-the-Bag, Refrigerated Turkey Breast Product – J. MEYER, J. Cerveny, and J. Luchansky, University of Wisconsin-Madison, Madison, WI

9:45 Inhibitory Effects of Sucrose Fatty Acid Esters, Alone and in Combination with EDIA and Organic Acids, on *Listeria monocytogenes* and *Staphylococcus aureus* – J. MONK, L. Beuchat, and A. Hathcox, University of Georgia, Griffin, GA

10:00 Break

10:20 Evaluation of Colicins for Inhibition Against Diarrheagenic Verotoxigenic *Escherichia coli* Strains – S. MURINDA and R. Roberts, Pennsylvania State University, University Park, PA

10:35 Inhibition of *Listeria monocytogenes* and *Aeromonas hydrophila* on Cooked Beef by Plant Extracts Combined with Dried Whey Preparations of Antagonistic Bacteria – P. YORK, Y. Hao, R. Brackett, and M. Doyle, University of Georgia, Griffin, GA

10:50 Control of *Listeria monocytogenes* on Catfish Fillets (Ictalurus punctatus) Using Food Grade Antimicrobials – A. DEGNAN, M. Tamplin, R. Murphree, C. Kaspar and J. Luchansky, University of Wisconsin-Madison, Madison, WI

11:05 Microbial Decontamination of Fecally Contaminated Carcasses as Affected by Various Temperature Water Sprays and Steam – W. DORSA, C. Cutter, G. Siragusa, and M. Koohmaraie, USDA-ARS, Clay Center, NE

11:20 Disinfection of Cutting Boards by Microwave Energy – P. PARK and D. Cliver, University of Wisconsin-Madison, Madison, WI

International Approaches to Meat Safety and Quality

8:30 General Principles of ISO 9000 and ISO 45000: HACCP, TQM and ISO Links – L. PEDROSO, Fricarnes, S. A. Portugal

9:00 An Integrated System of ISO 9000 and ISO 45000 Certificates in the Control of Food Hygiene – F. ROSSEM, Food Quality Systems, Portugal

9:30 Procurement and Quality Assurance of Meats by the Department of Defense – R. RALYEA, U.S. Army, Fort Sam Houston, TX

10:00 Break

10:20 Integrated Quality Control in the Pig Sector – B. LAUTHER, National Pork Producers Council, Des Moines, IA

10:50 Quality Systems in Canadian Meat Processing Operations – Dr. L. McMULLEN, L. J. Harris, University of Alberta, Edmonton, Canada

11:20 Application of HACCP Principles and Beyond: Beef Slaughter and Fabrication – J. SOFOS, Colorado State University, Ft. Collins, CO

An Introduction to Molecular Typing Methods for the Food Microbiologist (Sponsored by ILSI)

8:30 Introduction to the Hows and Whys of Molecular Typing – J. FARBER, Health Canada, Ottawa, Ontario, Canada

9:00 The Riboprinter™ System – A Novel Automated Method for Molecular Typing of Food-borne Microorganisms – J. WEBSTER, Dupont, Wilmington, DE

9:30 Use of PFGE for the Molecular Typing of Food-borne Pathogens – J. LUCHANSKY, University of Wisconsin-Madison, Madison, WI

10:00 Break

10:20 Methods for Data Capture, Analysis, and Interpretation of DNA Fragment Patterns for Molecular Subtyping of Bacterial Pathogens – B. SWAMINATHAN, CDC&P, Atlanta, GA

10:50 Use of Molecular Typing in Food-borne Outbreak Investigations: Pitfalls and Advantages – J. ROCOURT, Institut Pasteur, Paris, France

11:20 Molecular and Conventional Typing Methods for *Listeria monocytogenes* – the U.K. Approach – J. MCLAUCHLIN, Public Health Laboratory Service, London, United Kingdom

Posters – Growth/Behavior of Food-borne Microorganisms

- Growth of *Listeria monocytogenes* and Listeriolysin O Secretion in Broth Containing Salts of Organic Acids – Y. KOUASSI and L. Shelef, Wayne State University, Detroit, MI
- Heat-resistance of *Listeria monocytogenes* Increases when Production of Osmoprotectants is Induced – Y. LOU and A. Yousef, Ohio State University, Columbus, OH
- A Comparison of Processing Facility Size and Sanitation to the *Presence of Escherichia coli* O157:H7, *Klebsiella pneumoniae*, *Campylobacter*, and *Salmonella* in Fresh Blue Crab (*Callinectes sapidus*) Meat – R. REINHARD, T. McAdams, G. Flick, A. Diallo, R. Croonenberghs, and R. Wittman, Virginia Tech, Blacksburg, VA
- A Comparision of Quantitative Levels of *Escherichia coli* O157:H7, *Klebsiella pneumoniae*, *Campylobacter*, and *Salmonella* in Fresh Blue Crab (*Callinectes sapidus*) – R. REINHARD, T. McAdams, G. Flick, A. Diallo, R. Croonenberghs, and R. Whittman, Virginia Tech, Blacksburg, VA
- Survival and Growth of *Escherichia coli* O157:H7 on Produce – K. RICHERT, J. Albrecht, S. Sumner, and L. Bullerman, University of Nebraska, Lincoln, NE
- Competitive Growth of Enterohemorrhagic *Escherichia coli* in Ground Beef at 9.5°C – O. SANTOS, T. Schwach, and E. Zottola, University of Minnesota, St. Paul, MN
- Thermal Resistance of *Aeromonas hydrophila* in Liquid Whole Egg – J. SCHUMAN and B. Sheldon, North Carolina State University, Raleigh, NC
- The Incidence of Pathogens in Aquaculture Recirculation Water Systems and a Comparision of Their Presence to Fish Size and Stocking Densities – D. STREBEL, R. Reinhard, T. McAdams, and G. Flick, Virginia Tech, Blacksburg, VA
- Growth and Survival of *Listeria monocytogenes* in Minimally Processed Green Beans as Influenced by Modified Atmosphere Packaging, NaCl Treatment and Storage Temperature – W. TAN, D. Grinstead, J. Mount and F. Draughon, University of Tennessee, Knoxville, TN
- Radiosensitivity of *Listeria monocytogenes* Following Split-Dose Application of Gamma Radiation – L. ANDREWS, R. Grodner and P. Wilson, Louisiana State University, Baton Rouge, LA
- Growth of *Yersinia enterocolitica* on Osmotically Dehydrated Broccoli Packaged in Modified Atmospheres and Stored at 10°C – P. BODNARUK, F. Draughon, and J. Mount, University of Tennessee, Knoxville, TN
- Survival/Growth of Gram Positive Bacteria in Reconditioned, Potable, and Non-chlorinated Water – J. CALL, S. Palumbo, B. Huynh, J. Fanelli, and P. Jackson, USDA-ARS, ERRC, Philadelphia, PA
- Presence of *Listeria* Species in Market Beef – C. CHUNG, D. Jeong and D. Gu, Kon-Kuk University, Seoul, Korea

- Susceptibility of Pre-evisceration Washed Carcasses to Contamination by *Escherichia coli* O157:H7 and Salmonellae – J. DICKSON, Iowa State University, Ames, IA
- The Potential of Danish Market Cheeses to Support Growth of Food-borne Pathogens – K. JENSEN and S. Knochel, RVAH Centre for Food Research, Frederiksberg, Denmark
- Influence of Temperature Abuse on Growth of *Clostridium perfringens* from Spores in Cooked Turkey – V. JUNEJA and B. Marmer, USDA-ARS, ERRC, Philadelphia, PA
- Effect of High pH on the Survival of *Salmonella typhimurium, Salmonella newport* and *Campylobacter jejuni* in Poultry Scald Water at 55°C – A. MENDONCA and J. Njoroge, North Carolina A&T State University, Greensboro, NC
- Potential for Growth, Injury, and Survival of Food-borne Pathogens in a Model Propylene Glycol Product Cooling System – A. MILLER, C. Paska, and B. Eblen, USDA-ARS, ERRC, Philadelphia, PA
- Growth of *Salmonella* & *Vibrio cholerae* in Reconditioned Water – K. RAJKOWSKI, E. Rice, and B. Huynh, USDA-ARS, ERRC, Philadelphia, PA
- Nebraska Survey of Organic and Coventionally Grown Produce for *Escherichia coli* O157:H7, *Salmonella*, and *Shigella* – S. SUMNER, K. Richert, J. Albrecht, and L. Bullerman, University of Nebraska, Lincoln, NE
- HACCP in Practice – J. ROMERO, HACCP Committee of SCTA, Sante fé de Bogota, Columbia

Monday Afternoon – July 31, 1995

Practical Approach to Quality Milk – Plant Session

1:30 Technical Challenge in Progressing from Conventional Milk Processing to Aseptic Processing – B. RITSCHARD, Parmalat, Inc., Spring City, PA

2:00 Issues of Using Reclaimed Water – R. TASSONE, Diversey Water Technologies Inc., Chagrin Falls, OH

2:30 Crisis Management and Product Recalls – G. PRINCE, Kroger Co., Cincinnati, OH

3:00 Break

3:20 Innovations in Plant Design and Processing – D. SIEBERLING, Sieberling Association, Inc., Roscoe, IL

3:50 Public Health and Regulatory Aspects of Emerging Milk Plant Technology – S. SIMS, FDA, Washington, DC

Practical Approach to Quality Milk – Producer Session

1:30 Dairy Farmstead Evaluation as a Response to Environmental Issues – University Viewpoint – L. LANYON, Pennsylvania State University, University Park, PA

2:00 Environmental Issues – Dairy Producer Viewpoint – L. JONES, Lester C. Jones & Sons, Inc., Massey, MD

2:30 Design Challenges in Modern Milking Equipment – S. SPENCER, Pennsylvania State University, University Park, PA

3:00 Break

3:20 Current Cleaning Chemical Technology & Recommendations for Maximum Cleaning Effectiveness – D. SIMYAK, Diversey Corp., Livonia, MI

3:50 Futuristic Dairy Farm Design – D. WAYBRIGHT, Mason Dixon Farms, Inc., Gettysburg, PA

Technical Session – Detection and Enumeration Methods

1:30 Rapid Multianalyte Immunoassay to Screen for Antibiotic Residues in Milk – A. KUMAR, K. Hara, S. Kharadia, D. Leung, M. Piani, R. Rocco, and C. Yu, Idetek, Inc., Sunnyvale, CA

1:45 The Rapid Charm Phosphatase Test Conforms with USDA Requirements for Cooked Meat and Gauges Microbial Log Reduction – E. ZOMER, J. Scheemaker, and S. Trivedi, Charm Sciences, Inc., Malden, MA

2:00 Specificity of Four Monoclonal Antibodies Produced Against *Salmonella typhimurium* – Z. JARADAT and J. Zawistowski, University of Manitoba, Winnipeg, Manitoba, Canada

2:15 Antigenicity of 35 and 24 kDa Outer Membrane Proteins of *Salmonella* – Z. JARADAT and J. Zawistowski, University of Manitoba, Winnipeg, Manitoba, Canada

2:30 A New Petrifilm™ Method for *Enterobacteriaceae* Testing – P. MACH and G. Sandberg, 3M Company, St. Paul, MN

Quality Assurance

2:45 Ontario's Inspection Protocol for Undrawn Dressed Poultry (UDP): A Model for Standards Development for Ethnic Markets – T. BAKER and P. Johnson, Ontario Ministry of Agriculture, Guelph, Ontario, Canada

3:00 Break

3:20 Re-engineering of Licensing Audit for Ontario Abattoirs – P. JOHNSON and T. Baker, Ontario Ministry of Agriculture, Guelph, Ontario, Canada

3:35 The Application of Risk Assessment and Standard Audit Principles for Compliance Verification in Ontario Inspected Abattoirs – T. BAKER and P. Johnson, Ontario Ministry of Agriculture, Guelph, Ontario, Canada

3:50 Advances in Laboratory Information Managements Systems (LIMS) in Dairy Quality Control Labs – D. BLOMQUIST and R. Bakka, Klenzade, Tampa, FL

4:05 A Computer Program for Managing a Food-borne Disease Surveillance Network & Compiling Surveillance Data – J. GUZEWICH and D. Sackett, New York State Department of Health, Albany, NY

4:20 International Trends in HACCP – I. HIGUERA-CIAPARA, L. Noriega, and G. Arteaga, Research Center for Foods & Development, Hermosillo, Sonora, Mexico

Posters – Control of Food-borne Microorganisms

- Modeling the Effect of Temperature on Growth Rate and Lag Time of *Bacillus Stearothermophilus* Using Vanance Stabilizing Transformations – R. DOGRA and D. Schaffner, Rutgers University, New Brunswick, NJ
- Antimicrobial Action of a Nisin-Based Treatment Against *Salmonella typhimurium* in Fresh Pork Loin – N. LLORCA and B. Sheldon, North Carolina State University, Raleigh, NC
- Effect of Trisodium Phosphate on *Listeria monocytogenes* Attached to Rainbow Trout – D. MU and Y. Huang, University of Georgia, Athens, GA
- *Nannocystis exedens* as a Potential Biocompetitive Agent Against Toxigenic *Aspergillus flavus* and *Aspergillus parasiticus* – W. TAYLOR and F. Draughon, University of Tennessee, Knoxville, TN
- Determination of Purging Rate of *Escherichia coli* O157:H7 Contamination from a Model Meat Grinding System – A. TINDLE, R. Phebus, C. Kastner, J. Marsden, D. Fung, H. Thippareddi, R. Prasai, and K. Karr, Kansas State University, Manhattan, KS
- Reduction of Food-borne Pathogens on Beef Carcass Tissue Using Sodium Bicarbonate and Hydrogen Peroxide – K. YOST and S. Sumner, University of Nebraska, Lincoln, NE
- Efficacy of Trisodium Phosphate for Killing *Salmonella* on Tomatoes – L. BEUCHAT, University of Georgia, Griffin, GA
- Expanded Models for Predicting the Non-Thermal Inactivation of *Listeria monocytogenes* – R. BUCHANAN and M. Golden, US FSIS, Washington, DC
- Effect of Chlorine Dioxide Spray Washes for Reducing Fecal Contamination on Beef – C. CUTTER and W. Dorsa, USDA-ARS, Clay Center, NE
- Antimicrobial Properties of Volatile Horseradish Distillates – P. DELAQUIS, H. Graham, and G. Mazza, Agriculture and Agri-Food Canada, Summerland, British Columbia, Canada
- Effect of Citricidal, Chloride, and Benomyl on *Vibrio Cholerae* Growth in Vitro – M. DIAZ-CINCO, R. Troncoso-Rojas, V. Mata-Haro, and E. Acedo-Felix, CIAD, A.C., Hermosillo, Sonora, Mexico
- Effect of Processing Protocols on the Quality of Aquacultured Fresh Catfish Fillets – C. FERNAUDES, G. Flick, Jr., J. Silva, T. McCaskey, and A. Hood, Virginia Polytechnic Institute and State University, Blacksburg, VA
- A Model for the Effects of Temperature, pH and Lactate on the Survival of *E. coli* O157:H7 – M. GOLDEN and R. Whiting, USDA-ARS, ERRC, Philadelphia, PA
- Intervention Through the Use of Hand-trimming, Chemical Sanitizers, and Hot Water Spray-Washing to Remove Fecal and Microbiological Contamination from Beef Adipose Tissue – B. GORMAN, J. Sofos, J. Morgan, G. Schmidt, and G. Smith, Colorado State University, Ft. Collins, CO
- Influence of Fat Content in Pork Liver Sausage on Growth of *Listeria monocytogenes* and Its Inhibition by Lactate and Sorbate – A. HU and L. Shelef, Wayne State University, Detroit, MI
- Destruction of *Listeria monocytogenes* on Catfish Fillets Using Lactic Acid and Monolaurin – D. MARSHALL, E. Verhaegh, and D. Oh, Mississippi State University, Mississippi State, MS
- Sensitization of *Escherichia coli* to Nisin and Lysozyme by High Hydrostatic Pressure, EDTA and Chitosan – C. MICHIELS, K. Versyck, K. Hauben, and E. Wuytack, Katholieke University, Heverlee, Belgium
- Effects of Lactate, Spice Oil, and pH Levels on the Growth and Survival of *E. coli* O157:H7 at 35 and 4°C – J. PRICE, J. Cherry-Merritt, A. Orta-Ramirez, E. Tindall, and L. Gilbert, Michigan State University, East Lansing, MI
- Comparison of Mathematical Models to Estimate Growth Rate of *Escherichia coli* O157:H7 at Fluctuation Temperatures – K. RAJKOWSKI, USDA-ARS, ERRC, Philadelphia, PA
- A Survey of College Students' Knowledge of Food Safety & Home Food Preparation Practices – M. SALAMANCA, R. Gravani, Cornell University, Ithaca, NY

- Feasibility of Using Food Grade Food Additives to Control the Growth of *Clostridium perfringens* – A. SIKES, U.S. Army, Natick, MA
- Effect of Time of Exposure of Beef Fat Fascia to *Escherichia coli* ATCC 11370 on Its Removal by Spray-Washing with Chemical Solutions and 35° or 74° Water – J. SOFOS, L. Cabedo, J. Morgan, G. Schmidt, and G. Smith, Colorado State University, Ft. Collins, CO
- Radiation Resistance of Pathogenic *Escherichia coli* Serotypes – D. THAYER and G. Boyd, USDA-ARS, ERRC, Philadelphia, PA
- Sensitivity of Six Strains of *Listeria monocytogenes* to Nisin in Broth at pH 5, 6, and 7 – D. UKUKU and L. Shelef, Wayne State University, Detroit, MI
- Ecology and Control of Bread Spoilage by Rope – A. von HOLY, C. Bailey, C. McNaughton, and L. Kirschner, University of the Witwatersrand, South Africa
- Effect of Polyvalent Metal Ions on Growth Inhibition of *Listeria monocytogenes* by Sodium Polyphosphate – L. ZAIKA, O. Scullen, and J. Fanelli, USDA-ARS, ERRC, Philadelphia, PA

Tuesday Morning — August 1, 1995

Hurdles to Improve Safety and Quality of Ready-To-Eat (RTE) Meats

8:30 Pretreatment of Meat in the Slaughter Process – J. DICKSON, Iowa State University, Ames, IA

9:00 Food Additives in Processed Meats – R.TOMPKIN, Armour Swift-Eckrich, Inc., Downers Grove, IL

9:30 Packaging and Storage Conditions to Enhance Meat Safety – S. INGHAM, University of Wisconsin, Madison, WI

10:00 Break

10:20 Elimination of Pathogens on Red Meats with Irradiation – D. THAYER, USDA-ARS, ERRC, Philadelphia, PA

10:50 Novel Approaches in Hurdles Technology – C. CUTTER, USDA-ARS, Clay Center, NE

11:20 Hurdles in Getting Hurdle Approval – D. BERNARD, National Food Processing Association, Washington, DC

Technical Session — Growth/Behavior of Food-borne Microorganisms

8:30 Influence of pH and Incubation Temperature on Virulence and Fatty Acids of *Yersinia enterocolitica* – P. BODNARUK and D. Golden, University of Tennessee, Knoxville, TN

8:45 Growth of *Listeria monocytogenes* and *Yersinia enterocolitica* on Cooked Poultry Stored Under Modified Atmosphere at 3.5, 6.5, and 10°C – L. HARRIS and R. Barakat, University of Guelph, Guelph, Ontario, Canada

9:00 Natural Occurrence of *Listeria monocytogenes* in Fresh Blue Crab (*callinectes sapidus*) Meat & Its Growth Characteristics at Refrigeration Temperatures – D. DIEZ de MEDINA, G. Flick, R. Whittman, R. Croonenberghs, and A. Diallo, Virginia Tech, Blacksburg, VA

9:15 The Effect of Iron Levels on Growth, Toxicity and Adherence of Enterohemorrhagic *Escherichia coli* – T. SCHWACH and E. Zottola, University of Minnesota, St. Paul, MN

9:30 Acid Adaptation in *Listeria monocytogenes* Scott A – V. SCOTT, R. Buchanan, and D. Westhoff, National Food Processors Association, Washington, DC

9:45 Stress Protein and Fatty Acid Composition Effects on Heat Resistance of *Escherichia coli* O157:H7 – H. THIPPAREDDI, D. Fung, R. Phebus, I. Jeon, and R. Thakur, Kansas State University, Manhattan, KS

10:00 Break

10:20 Survival Characteristics & Injury of *Escherichia coli* O157:H7 During Conventional & Microwave Heating at Constant Temperatures –S. CZECHOWICZ and E. Zottola, University of Minnesota, St. Paul, MN

10:35 Comparison of D_{55C} Values of Antibiotic-resistant and Antibiotic-sensitive Strains of *Salmonella* – P. DAVIDSON and T. Henson, University of Idaho, Moscow, ID

10:50 Dose-response of *Salmonella* in Cheese – E. TODD, R. Szabo, J. D'Aoust, A. Sewell, C. McDonald, A. Ellis, B. Miller, and P. Stone, Health Canada, Ottawa, Ontario, Canada

11:05 Biological Characterization of *Enterobacter sakazakii* – M. NAZAROWEC-WHITE and J. Farber, Health Canada, Ottawa, Ontario, Canada

11:20 Spoilage Ecology of Vacuum-Packaged Vienna Sausages – A. von HOLY, C. Franz, M. Papathanasopoulos, and G. Dykes, University of the Witwatersrand, South Africa

Emerging Issues in Microbiological Food Safety (Sponsored by ILSI)

8:30 Bovine Spongiform Encephalopathy: Potential Risk from Foods? – H. MOON, U.S. Dept. of Agriculture, Plum Island Animal Disease Center, Greenport, NY

9:00 Viability of *Cryptosporidium parvum* Oocysts in Beverages: Correlation of In Vitro

Excystation with Inclusion or Exclusion of Fluorogenic Vital Dyes – K. PATTEN and J. Rose, University of South Florida, Tampa, FL

9:30 Growing Concerns and Recent Outbreaks of Enterohemorrhagic *Escherichia coli* – non-O157:H7 Serotypes – R. CLARKE, J. Wilson, S. Read, K. Rahn, R. Johnson, D. Alves, M. Karmali, H. Lior, S. McEwen, J. Spika, C. Gyles, Agriculture and Agri-Food Canada, Guelph, Ontario, Canada

10:00 Break

10:20 Staphylococci – Are Atypical and Non-*S. aureus* Toxigenic Species on the Horizon? – R. BENNETT, U.S. Food and Drug Administration, Washington, D.C.

10:50 *Arcobacter* and *Helicobacter* – Risks for Foods and Beverages – I. WESLEY, National Animal Disease Center, Ames, IA

11:20 Dealing with an Expanding, Global Food Supply – Z. MERICAN, Malaysian Agriculture Research & Development Institute, Kuala Lumpur, Malaysia

Poster Session — Detection and Enumeration Methods

- Transformation of Bacterial Luciferase DNA into *Escherichia coli* O157:H7 for Use as a Marker in a Ground Beef System – R. PANCHEV and S. Sumner, University of Nebraska, Lincoln, NE
- Genomic Fingerprinting of *Bifidobacterium* spp. from an Infant – S. TSAI and J. Luchansky, University of Wisconsin, Madison, WI
- Evaluation of Universal Preenrichment Versus Lactose Broth Plus Various Plating Media for Isolating Salmonellae from Naturally Contaminated Fresh Chicken and Pork Sausage – E. VESTERGAARD and L. Restaino, Northern Illinois University, De Kalb, IL
- Evaluation of an Automated Assay for the Detection of *Listeria monocytogenes* in Food Products – T. ARMSTRONG, L. Brusatti, F. Prost-Gorse, and R. Johnson, bioMérieux Vitek, Inc., Hazelwood, MO
- Optimization of Polymerase Chain Reaction Parameters Utilizing an Experimental Design Approach – J. BASS and G. Tice, R. Jackson, DuPont, Wilmington, DE
- Antibiotics and Sulfonamides in Meat Samples Destined for Human Consumption – M. BERMUDEZ-ALMADA and L. Vazquez-Moreno,Centro de Investigacion en Alimentacion y Desarrollo, Hermosillo, Sonora, Mexico
- Biodegradation of Aflatoxins by *Flavobacterium aurantiacum* in Culture Media – L. BOHRA, R. Phebus, J. Smith, and B. Ioerger, Kansas State University, Manhattan, KS
- Lightning™: Introduction of a Machine-Side Rapid Hygiene Monitoring System – E. EHRENFELD, S. Miller, K. Barber, and C. Carpenter, IDEXX Labs, Westbrook, ME
- Evaluation of Microbial Swabs for Releasing HCMC and Their Viability on Ice Using 3M™ Petrifilm™ – C. FERNANDES, G. Flick, Jr., J. Silva, T. McCaskey, and A. Hood, Virginia Polytechnic Institute & State University, Blacksburg, VA
- A New Rapid Method for the Detection of *Escherichia coli* O157 in Raw Meat – R. FIRSTENBERG-EDEN, M. Averill, S. Allen, and N. Sullivan, Difco Laboratories, Ann Arbor, MI
- The Use of a Single Tablet for Delivery of Critical Reagents to a Polymerase Chain Reaction – G. TICE, O. Rubino, and R. Jackson, DuPont, Wilmington, DE
- A Membrane-lift Method for Rapid Detection of *Escherichia coli* O157:H7 Contaminating Chicken Carcasses – H. TSAI and M. Slavik, University of Arkansas, Fayetteville, AR
- Detection of *Escherichia coli* O157:H7 in Foods by Multiplex PCR – P. FRATAMICO and M. Deng, USDA-ARS, ERRC, Philadelphia, PA
- Determination of Trace Elements in Muscle, Liver & Kidney from Pork Produced in Sonora, Mexico – L. GARCIA-RICO, M. Jara-Marini, and L. Vazquez-Moreno, CIAD, A. C., Hermosiollo, Sonora, Mexico
- Evaluation of a Rapid Screening Kit for the Detection of *Escherichia coli* O157:H7 in Foods – J. GEBLER, and C. Chambers, Murray Goulburn Co-op Co., Yarram, Victoria, Australia
- Chemical and Mineral Analysis of Surimibased Seafood Products – Y. HUANG, A. Aal, and A. Awad, University of Georgia, Athens, GA
- Comparison of ISO-Grid™, DRBC, Petrifilm™, and PDA Pour Plate Methods for Enumerating Yeasts and Molds on Shredded Cheese – S. INGHAM and J. Ryu, University of Wisconsin-Madison, Madison, WI
- Use of Blue Lake as an Indicator of Bacterial Penetration into Eggs – J. KIM, M. Slavik, and J. Walker, University of Arkansas, Fayetteville, AR
- Rapid Estimation of Raw Milk Quality – W. LACHOWSKY, M. Griffiths, L. Harris,

J. Odumeru, and L. Szijarto, Ontario Ministry of Food & Agriculture, Guelph, Ontario, Canada

- Evaluation of a Miniaturized Microbial Inhibition Assay for Screening of Antimicrobial Residues in Animal Tissues – M. MITCHELL, J. Samoluk, and A. Yee, Ontario Ministry of Agriculture, Guelph, Ontario, Canada
- Comparison of Five Media for Enumeration of *Escherichia coli* O157:H7 – A. ORTA-RAMIREZ, J. Price, and J. Cherry-Merritt, Michigan State University, East Lansing, MI
- The Charm Alkaline Phosphatase Test: Rapid Bioluminescence Method for the Determination of Alkaline Phosphatase in Pasteurized Milk and Other Dairy Products – Collaborative Study – G. RUTH, and E. Zomer, Charm Sciences, Inc., Malden, MA
- Charm Cloxacillin Antibody Performance Validated for Bulk Tank Milk – R. SALTER, P. Donahue, J. Cunningham, and S. Charm, Charm Sciences, Inc., Malden, MA
- A New Rapid Method for Detection & Enumeration of *Listeria monocytogenes* in Food Samples – L. SHELEF and G. Eden, Wayne State University, Detroit, MI
- Validation of Predictive Mathematical Models to Demonstrate Applicability to Foods – I. WALLS, V. Scott, and D. Bernard, National Food Processors Association, Washington, DC
- Detection by PCR of *Campylobacter jejuni* in Contaminated Chicken Products – D. WINTERS, A. O'Leary, X. Wang, and M. Slavik, University of Arkansas, Fayetteville, AR
- E*Colite, The New Standard in Monitoring Coliforms & *Escherichia coli* Contamination in Water – E. ZOMER and R. Lifshitz, Charm Sciences, Inc., Malden, MA
- Detection of *Salmonella* in Foods by Transduction of Ice Nucleation Genes – P. WOLBER and R. Green, Idetek, Inc., Sunnyvale, CA

Tuesday, August 1, 1995 — Afternoon

General Session — Equivalency of Inspection — Impact of NAFTA and GATT

1:30 Equivalency of Inspection – Practical Realities in the Real World – I. KIRK, Agriculture and Agrifood Canada, Guelph, Ontario, Canada

2:00 The European Perspective on Equilibrating International Meat and Poultry Inspection Systems – L. PEDROSO, Fricarnes, S.A., Portugal

2:30 Harmonization of Regulation in a Global Economy – J. KOZAK, International Dairy Food Assoc., Washington, DC

Wednesday, August 2, 1995 — Morning

Current Issues in Food Services: A Practical Symposium — Part 1

8:30 Food Code – A Practical Approach – E. JULIAN, Rhode Island Department of Health, Providence, RI

9:00 Food Service Plan Review – Standardization for Efficiency – F. PETERSEN, City of Stamford, Stamford, CT

9:30 Integrated Pest Management (IPM) in Food Facilities – R. GARDNER, Cornell University, Ithaca, NY

10:00 Break

10:20 Equipment Cleaning and Sanitization – C. PARKER, Ecco Lab., Inc., Mendota Heights, MN

10:50 Overcoming the "All or Nothing Approach" to HACCP Implementation at the Retail Level – J. MARCELLO, The Educational Foundation of the National Restaurant Association, Chicago, IL

Fresh-Cut Packaged Vegetables

8:30 Fresh Produce Processing – A Global Industry Perspective – K. OLSON, Dole Foods, San Jose, CA

9:00 The Effect of Farm Management Practices on the Microbial Condition of Fresh-Cut Packaged Vegetables – J. TAMAGNI, European Vegetable Specialty, Salinas, CA

9:30 Fresh Produce Processing – Retail Industry Perspective – Dr. R. STOVICEK, Primus Labs, Santa Maria, CA

10:00 Break

10:20 What is New in Modified-Atmosphere Packaging of Fresh-Cut Packaged Vegetables – Dr. G. MUDAHAR, Research Manager, Food Science, DNA Plant Technology Corp., Oakland, CA

10:50 Presence and Public Health Implications of Food-borne Pathogens on Fresh-Cut Packaged Vegetables – J. FARBER, Health Canada, Ottawa, Ontario, Canada

11:20 Present and Emerging Control Measures for Fresh-cut Packaged Vegetables – L. BEUCHAT, University of Georgia, Griffin, GA

Alternative Processing Strategies for Pasteurization of Foods

8:30 Radurization – The Pasteurization of Foods by Ionizing Radiation – J. DICKSON, Iowa State University, Ames, IA

9:00 High Pressure Processing as an Intervention Strategy for Food Safety – E. MURANO, Iowa State University, Ames, IA

9:30 Chemical Treatments for Decontamination of Poultry – A. WALDRUP, University of Arkansas, Fayetteville, AR

10:00 Break

10:20 Electrical Properties of Foods and the Application of High Voltage Pulsed Electric Fields Technology – H. ZHANG, The Ohio State University, Columbus, OH

10:50 Oscillating Magnetic Field Stabilization of Foods – B. SWANSON, Washington State University, Pullman, WA

11:20 Product Development Considerations for OHMIC Processing – P. SWEARINGEN, Land O'Lakes, Arden Hills, MN

New Emerging Food-borne Disease Agents – Are They for Real?

8:30 The *Campylobacter* Family *(Arcobacter, Campylobacter, and Helicobacter)* – R. GRAVANI, Cornell University, Ithaca, NY

9:00 The Mycobacteria Group *(Mycobacterium Tuberculosis and M. Paratuberculosis Revisited)* – A. LAMMERDING, R. J. Irwin, Agriculture Canada, Guelph, Ontario, Canada

9:30 New Issues in Food and Environmental Virology – D. CLIVER, University of Wisconsin-Madison, Madison, WI

10:00 Break

10:20 Food and Waterborne Parasites in the 90's – D. JURANEK, CDC&P, Atlanta, GA

10:50 What's new in Food-borne Disease Around the World – E. TODD, Health Canada, Ottawa, Ontario, Canada, and M. POTTER, CDC, Atlanta, GA

Wednesday, August 2, 1995 – Afternoon

Current Issues in Food Services
A Practical Symposium – Part 2

1:30 *Escherichia coli* O157:H7 – A Current Review – J. SCHRADE, FDA, Brooklyn, NY

2:00 Communicable Diseases - Bare Hand Contact With Food "Why Isn't Hand Washing Good Enough?" – J. GUZEWICH, New York State Department of Health, Albany, NY

2:30 Microbiological Concerns with Vacuum Packaging – E. RHODEHAMEL and L. Jackson, FDA, Washington, DC

3:00 Break

3:20 OSHA in the Food service Industry – R. HARRINGTON, National Restaurant Association, Washington, DC

Seafood Symposium

1:30 Update on Seafood HACCP and Current Regulations – M. SNYDER, Office of Seafood, FDA, Washington, DC

2:00 HACCP Training for Seafood Processors – G. FLICK, Virginia Polytech Institute University, Blacksburg, VA

2:30 Microbiological Seafood Safety: What's New – C. HACKNEY, Virginia Polytech Institute University, Blacksburg, VA

3:00 Break

3:20 The Seafood Hotline: What Questions do Consumers Ask? – R. WELCH, FDA, RFPD, Washington, DC

3:50 The Safety of Mail Order Seafood – T. SCHWARZ, FDA, Washington, DC

ILSI N.A. – Sponsored Research Update

1:30 Use of Carrot Extract to Control *Listeria monocytogenes* – L. BEUCHAT, R. Brackett, M. Doyle, University of Georgia, Griffin, GA

1:50 A Reduced-Time Procedure for Detecting Heat-Injured *Listeria monocytogenes* in Foods – M. DOYLE, J. Patel, C. Hwang, L. Beuchat, R. Brackett, University of Georgia, Griffin, GA

2:10 Establishment of a Bovine Surveillance Program for *Escherichia coli* O157:H7 in Washington State – D. HANCOCK, Washington State University, Pullman, WA

2:30 Lipid Compounds as Novel Barriers for Control of *Listeria monocytogenes* – E. JOHNSON, University of Wisconsin, Madison, WI

2:50 Break

3:10 Application of Novel Bacteriocins as Biocontrol Agents Towards *Listeria monocytogenes* in Foods: Properties and Inhibitory Effectiveness – P. MURIANA, Purdue University, West Lafayette, IN

3:30 Evaluation of Penicillin-binding Proteins for Subtyping *Listeria monocytogenes* and Examination of Current Trends in Antimicrobial Resistance in Clinical and Food Isolates – – M. REEVES and D. Rheinhardt, CDC, Atlanta, GA

3:50 Insertion Sequence Finger-Printing: A New Subtyping System for *Escherichia coli* O157:H7 Strains – T. WHITTAM, The Pennsylvania State University, University Park, PA

4:10 Discussion

The Workshops

Workshop 1 — Applications and Development of Microbiological Criteria for Foods

Workshop Instructors

John H. Silliker
Russell S. Flowers

Fees

Member: $375; After June 30, 1995: $405
Non-member: $440; After June 30, 1995: $470

Workshop Agenda

Saturday, July 29, 1995
8:00 am - 5:00 pm

Sunday, July 30, 1995
8:30 am - 12:00 pm

Workshop Overview

The workshop begins with a series of presentations relating to various aspects of microbiological criteria. Each of these will be approximately 45 minutes in length, with 15 minutes allowed for questions and discussion following the formal presentation. The topics are as follows:

1. **Introduction to Microbiological Criteria:** This will include a definition of microbiological criterion with a definition of its elements. The various types of criteria will be delineated. The relationship between risk, product use and sampling plan will be discussed.

2. **Attributes vs. Variables—Sampling Plans:** This will include a description of the two types of sampling plans. Consideration will be given as to purpose, i.e., whether for regulatory or process control, raw material evaluation, in-process control or finished product analysis. Under what circumstances are variables, plans and attributes most appropriate?

3. **Development of Indicator and Utility Criteria:** Under what circumstances are tests for indicator organisms useful in monitoring processing effectiveness? To what degree do tests for indicator organisms give reliable information relative to produce safety, e.g., as substitute for direct tests for pathogens? What types of criteria may be used to access the utility of a finished product or raw material for a particular purpose, e.g., the analysis of starch for thermophilic spores, the testing of beds from which shellfish are harvested for fecal coliforms? How are the criteria for these purposes developed?

4. **Development of Microbiological Criteria for Pathogens:** Where are criteria involving direct tests for pathogens warranted, e.g., the testing of raw materials and finished product for salmonellae using the sampling plans recommended by the Committee on *Salmonella* of the National Research Council? Under what circumstances are their use probably not cost effective, e.g., the routine testing meat for *Escherichia coli* O157:H7? How are such criteria developed?

5. **The Relationship of Microbiological Criteria to GMPs and HACCP:** To what extent are criteria useful in accessing conformance to GMPs? What are the limitations of criteria for this purpose? How are such criteria developed? To what extent are microbiological criteria useful in the development of HACCP programs? Where are they useful in monitoring CCPs? What role do they play in verification?

Following the above presentations, the participants will be divided into working groups, one of the presenters being assigned to each group as a facilitator. Each of the groups will be given a flow sheet in connection with the steps involved in the manufacture of a particular product. The groups will study the process and determine where criteria are appropriate. They will determine how the criteria would be developed and how applied.

The work groups will be assembled with the class as a whole. A member of each group will then present to the class the results of its deliberations, including justification for its findings.

Each participant will receive a workbook with detailed outlines of the presentations, copies of overheads presented, and references to pertinent reading material.

The workshop will conclude with a short wrap-up session.

About the Instructors

Dr. John H. Silliker is the founder of Silliker Laboratories Group, Inc., one of the nation's leading independent food testing and consulting laboratories, and a widely respected food industry consultant.

In a food science career spanning five decades, Dr. Silliker has made valuable contributions to the food industry as an educator, researcher, writer, and private entrepreneur. Prior to founding Silliker Laboratories in 1961, he served as Chief Microbiologist and Associate Director of Research for Swift & Company in Chicago, IL. During the early 1960s, Dr. Silliker gained national and international acclaim for his groundbreaking research studies on *Salmonella*.

Dr. Russell S. Flowers is president of Silliker Laboratories Group, Inc., and a leading researcher, lecturer, and writer on the development of rapid methods for the detection of food-borne pathogens.

Dr. Flowers received his Ph.D. in food science and microbiology from the University of Illinois and joined the Silliker organization in 1979. Prior to joining Silliker Laboratories, he served as an Assistant Professor of Microbiology at the University of Arizona. Dr. Flowers has authored or co-authored over 30 scientific refereed research articles, presented over 100 seminars and scientific presentations to professional associations, and participated in a number of collaborative studies.

Workshop 2 — Microbial Food Safety Risk Assessment Workshop

Workshop Agenda

Saturday, July 29, 1995
8:00 am - 5:00 pm

Fees

Member: $180; After June 30, 1995: $210
Non-Member: $245; After June 30, 1995: $275

Workshop Instructors

Charles N. Haas
Christopher Crockett
Anna M. Lammerding

The application of risk assessment principles in microbial food safety provides a systematic, objective framework for the compilation and evaluation of data to describe and quantify the risks associated with foods and food manufacturing processes.

Risk assessment is an applied discipline based on scientific principles, and a new approach in microbial food safety. The process can facilitate consistent and uniform decisions on the safety of foods in determining optimal intervention strategies, establishing critical control points in a HACCP Program, and defining priorities for resource allocation. Microbial risk assessment is needed to achieve the goals of the Codex Alimentarius Commission and international food trade agreements.

This workshop will present an overview of the risk analysis process, encompassing risk assessment, risk management, and risk communication, and introduce participants to the elements of risk assessment: hazard identification, dose-response assessment, exposure assessment, and risk characterization. Topics will include: a description of dose-response models and curves and how to use them; an introduction to the Maximum Likelihood Estimation method: identifying and understanding sources of uncertainty and variability in data sets and quantitative microbial risk assessment models; techniques of pooling and separating data to evaluate statistical differences within and between data sets; growth modeling applications; the use of Monte Carlo analysis to integrate uncertainty of multiple inputs in dose-response and exposure estimates. Supporting computer programs will be demonstrated, and case studies of waterborne and food-borne outbreaks presented for discussion. Participants will be provided with a comprehensive workshop manual.

About the Instructors

Charles N. Haas is LD Betz Professor of Environmental Engineering at Drexel University. He received his BS and MS degrees at Illinois Institute of Technology and his Ph.D. at the University of Illinois at Urbana-Champaign. He has been involved in quantitative microbial risk assessment work since 1982, and also has interests in water and waste treatment and disinfection.

Christopher Crockett received his M.S. at Drexel University, and is currently an Assistant Engineer for McLaren Hart Environmental Engineering ChemRisk Division in Warren, NJ. He also received his B.S. from Drexel University. His graduate research emphasized microbial occurrence and risk in water and food, including fitting, development and verification of dose-response models.

Anna M. Lammerding is Chief, Food Safety Risk Assessment (FSRA) Unit, Agriculture and Agri-Food Canada (AAFC). She received her B.Sc. and M.S. at the University of Guelph, and her Ph.D. at the University of Wisconsin-Madison.

82nd IAMFES Annual Meeting
Spouse/Companion
Tours and Special Events

A Day of Discovery
Monday, July 31 - 9:00 a.m. — 3:00 p.m.
Cost: $30 ($35 on-site) Lunch on your own

Our tour begins atop Mt. Washington, where the spectacular view of the whole Pittsburgh scene unfolds, a view that prompted Frank Lloyd Wright to call this the world's most beautiful setting for a city. Tourgoers may ride down the hill in an incline, a veritable museum on wheels, and be picked up by the coach at the base.

The Strip, center of the wholesale produce market in Pittsburgh, offers a true potpourri of scents, sights, and sounds. The Society for Art in Crafts, recently moved to The Strip, exhibits an international array of crafts in clay, fiber, metal, wood and a variety of other materials, all created since 1985.

The North Side of Pittsburgh was originally platted as Depreciation Land Grant settlement. Later, in 1848, a group of streets was laid out and named to commemorate battles and personalities of the Mexican War of 1846...Taylor, Resaca, Palo Alto, Buena Vista, Monterey, Sherman and the like. Known as the MEXICAN WAR STREETS, the area was a pleasant, middle-class, residential area with distinctive row-like homes reflecting Italienate, Second Empire, Queen Anne, Richardsonian Romanesque and other Victorian architectural styles. A major decline within the area was reversed in the 1960s to the point that this intriguing neighborhood was placed on the National Register of Historic Places by 1975.

Before returning to the Hilton, one further stop is made: at THE AVIARY, the world's largest birdhouse, where free flying feathered friends in brilliant hues present a dazzling display. Now, whoever said Pittsburgh was for the birds is proven to be correct!

Amish Country
Tuesday, August 1 - 9:00 a.m. - 5:00 p.m.
Cost: $30 ($35 on-site) Lunch on your own

The Amish is one of the most distinctive societies in America today. In 1693 Jacob Amman, their founder, brought these gentle people to this country from Switzerland. By the mid-18th century, hundreds had settled in Pennsylvania. The rolling countryside of this area of the state attracted the Amish with its fertile land. They befriended the Lenape Indians who had long ago settled here, and today you can witness their still-thriving existence.

This visit among the Amish includes shopping at an Amish home where quilts made by the Amish from as far away as Wisconsin are displayed to tempt the discriminating buyer. In nearby Volant, a 19th Century mill now serves as a country store containing toys, gifts, Amish quilts and furniture sharing space with old mill machinery. In addition to the mill there are over 80 shops and small restaurants that will meet anyone's needs.

Five miles south, the holidays come early at the Country House Christmas Shop, a restored Victorian home brimming with enough ornaments, gifts and decorations to make one forget December is several months away. A cool drink is served on the return trip to Pittsburgh.

A Day at the Carnegie & Station Square
Wednesday, August 2 - 9:00 a.m. - 3:00 p.m.
Cost: $30 ($35 on-site) Lunch on your own

Andrew Carnegie's gift to the people of Pittsburgh, THE CARNEGIE, houses four cultural centers under one roof. The MUSEUM OF ART is highly regarded for its permanent collection ranging from the old masters to the contemporary, with a fine representation of The Impressionists. A specially-arranged one hour tour, conducted by a trained museum docent, gives insight and enhancement to the fabulous works of renowned artistic masters. With time to explore on one's own (one-half hour) following the tour, a wealth of treasures await at The Carnegie. The Hillman Hall of Minerals and Gems displays over 2000 dazzling specimens and the world famous dinosaur collection is but a short walk away.

Then it's All Aboard for STATION SQUARE, the lively riverfront restoration of the former P. & L.E. Railroad, now a complex of exciting shops, boutiques, historic memorabilia and fine restaurants.

Following this delightful respite, guests will enjoy shopping on their own in the Freight House Shops before returning to the Hilton.

Children's Activity Room
July 31 - August 2 - 8:30 a.m. - 4:00 p.m.
Cost: Free

A children's activity room will be available for children ages 4 - 12. The children's room will consist of adult supervision and structured activities.

Monday Night Social Event
An Ethnic Evening on the Three Rivers
July 31 - 6:00 p.m. - Cruise until 10:30 p.m.
Cost: $45 ($50 on-site)

The ethnic variety of Pittsburgh's people contributes to its cultural richness. Influenced by the more than seventy distinct nationality groups that have claimed Pittsburgh as their home, an unforgettable dinner cruise has been created to combine the music and food representing a selection of the countries that have so enhanced this area.

At the Hilton, we will escort you through Point State Park to board the magnificent sternwheeler, the Gateway Clipper Fleet's Party Liner. Pittsburgh's three rivers set the stage for an unforgettable event, as the evening sun, glistening on the waters and reflecting on the majestic buildings of this vital city, creates a rare backdrop for this festive evening.

Following dinner, guests will be entertained by Don Brockett's Company, an action packed frolicking family variety show that everyone is sure to enjoy?

The evening draws to a close as guests view the spectacular evening lights of the city and are returned to Point State Park for the guided walk back to the Hilton.

Traditional IAMFES Gatherings
Ivan Parkin Lectureship
Sunday, July 30 - 7:00 p.m.

Followed by the Cheese and Wine Reception for the Opening of the Education Exhibits. An opportunity to greet old friends, make new ones and view the excellent technical displays.

IAMFES Annual Awards Reception and Banquet
Wednesday, August 2
Reception: 6:00 p.m. Banquet: 7:00 p.m.
Cost: $30 ($35 on-site)

IAMFES Kids Pizza Banquet
Wednesday, August 2 - 6:30 p.m. - 9:30 p.m.
Cost: $15 ($20 on-site)

Adult supervised for children ages 4 and up. Pizza, pop and activities will be provided.

Editor's Note: Correction from page 350.

TABLE 7. Bioburden on soiled food service equipment and selected utensils in the field before and after application of the waterless sanitation system (wipes).

	Average CFU/in²			
	Before WSS		After WSS	
Equipment	Bacteria	Molds	Bacteria	Molds
Cake Pan	47	0	8	1
Countertop	10	0	8	2
Grill	20	1	0.3	0
Pot (mashed potatoes)	–	–	3	0.5
Pot (rice)	–	–	6	0
Serving spoon (grits)	11	0	2	0.3
Table top	>200	0.25	2	0
Table top	>200	4	48	1

82nd IAMFES Annual Meeting Registration Form

Hilton Hotel & Towers — Pittsburgh, PA — July 30 - August 2, 1995
(Use photocopies for extra registrations)

FOR OFFICE USE
Date Rec'd. _____ First initial _____ Last name _____
Registration # _____

First Name (will appear on badge) (please print) Last Name

Title Employer

Mailing Address (Please specify: Home or Work)

City State Country Postal/Zip Code

( ) ( )
Telephone # Fax #

Please check where applicable:

___ IAMFES Member
___ Non-Member
___ Local Arrangements
___ 30 Yr. Member
___ 50 Yr. Member
___ Past President
___ Executive Board
___ Speaker
___ Honorary Life Member
___ Exhibitor
___ IAMFES Sustaining Member
___ IAMFES Program Advisory Committee

Credit Card payments may be sent via Fax today!
515-276-8655

Sign up to become a NEW member
and take advantage of the member discount.

REGISTRATION:	MEMBERS	NON-MEMBERS	AMOUNT
Registration (Banquet included)	$170 ($205 on-site)	$250 ($285 on-site)	_____
Student Member	$ 20 ($ 25 on-site)	Not Available	_____
One Day Registration (Circle: Mon/Tues/Wed)	$ 90 ($110 on-site)	$120 ($140 on-site)	_____
Spouse/Companion (Name): _____	$ 25 ($ 25 on-site)	$ 25 ($ 25 on-site)	_____
Children (14 & Under), Name: _____	FREE	FREE	_____

NEW MEMBERSHIP FEES:		
Membership with *Dairy, Food & Environmental Sanitation*	$ 60	_____
Membership with *Dairy, Food & Env. Sanitation* & *Journal of Food Protection*	$ 90	_____
*Student Membership ❒ *Dairy, Food & Env. San.* or ❒ *Journal of Food Protection*	$ 30	_____
*Student Membership with *Dairy, Food & Env. San.* & *Journal of Food Protection*	$ 45	_____
SHIPPING CHARGES: OUTSIDE THE U.S. - SURFACE RATE	$ 22.50 per journal	_____
AIRMAIL	$ 95.00 per journal	_____

*Full-time student verification required.

OTHER FEES:	PER PERSON		
Cheese and Wine Reception (Sun., 7/30)	FREE	_____	_____
An Ethnic Evening on the Three Rivers (Mon., 7/31)	$ 45 ($ 50 on-site)	_____	_____
IAMFES Awards Banquet (Wed., 8/2)	$ 30 ($ 35 on-site)	_____	_____
Children's Banquet (Wed., 8/2)	$ 15 ($ 20 on-site)	_____	_____

SPOUSE/COMPANION EVENTS:	PER PERSON		
A Day of Discovery (Mon., 7/31)	$ 30 ($ 35 on-site)	_____	_____
Amish Country (Tues., 8/1)	$ 30 ($ 35 on-site)	_____	_____
A Day at the Carnegie & Station Square (Wed., 8/2)	$ 30 ($ 35 on-site)	_____	_____

❒ Please indicate here if you have a disability requiring special accommodations.

Credit Card Payments: Please Circle: VISA/MASTERCARD/AMERICAN EXPRESS

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Total Amount Enclosed $_____
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Registration Information

Send payment with registration to IAMFES, 6200 Aurora Avenue, Suite 200W, Des Moines, IA 50322-2838. Make checks payable to IAMFES. Pre-registration must be post-marked by June 30, 1995. The pre-registration deadline will be strictly observed. For additional information contact Julie Heim at 1-800-369-6337.

Refund/Cancellation Policy

The IAMFES policy on refunds and/or cancellations is as follows: Registration fees, minus a $35 processing fee, will be refunded for written cancellations post-marked by July 15, 1995. No refunds will be made for cancellations post-marked after July 15, 1995, however, the registration may be transferred to a colleague with written notification to IAMFES.

Exhibitor Information

An exhibition of products and consulting services will be a Hilton Hotel & Towers. For more information on exhibiti the conference, please contact Rick McAtee at 1-800-369-6

1995 IAMFES Workshops
· Registration Form ·

❑ **WORKSHOP 1: Applications and Development of Microbiological Criteria for Foods**
Hilton Hotel and Towers, Pittsburgh, PA — Saturday, July 29, and Sunday July 30, 1995

First Name (will appear on badge) PLEASE PRINT Last Name

Title Employer

City State/Province ZIP/Postal Code

Area Code & Telephone # FAX #

Charge Card Payments: VISA · MASTERCARD · AMERICAN EXPRESS

Account #: _____

Name on Card: _____

Expiration Date: _____

Signature: _____

For further information, please contact IAMFES at (800) 369-6337 (U.S. and Canada), (515) 276-3344, FAX (515) 276-8655.

❑ **WORKSHOP 2: Microbial Food Safety Risk Assessment Workshop**
Hilton Hotel and Towers, Pittsburgh, PA — Saturday, July 29, 1995

First Name (will appear on badge) PLEASE PRINT Last Name

Title Employer

City State/Province ZIP/Postal Code

Area Code & Telephone # FAX #

Charge Card Payments: VISA · MASTERCARD · AMERICAN EXPRESS

Account #: _____

Name on Card: _____

Expiration Date: _____

Signature: _____

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· REGISTRATION ·

WORKSHOP 1: Applications and Development of Microbiological Criteria for Foods

	Before 6/30/95	After 6/30/95
IAMFES Member	**$375**	**$405**
Non-Member	**$440**	**$470**

WORKSHOP 2: Microbial Food Safety Risk Assessment Workshop

	Before 6/30/95	After 6/30/95
IAMFES Member	**$180**	**$210**
Non-Member	**$245**	**$275**

NOTE: IAMFES reserves the right to cancel workshops if minimum enrollment is not met by **June 30, 1995.**

TOTAL AMOUNT ENCLOSED: $_____
(U.S. Funds on U.S. Bank)

Guest Room Commitment
GOOD UNTIL JUNE 30, 1995
Make Your Reservation Now

HOTEL RESERVATIONS
IAMFES

82nd Annual Meeting
July 30-August 2, 1995
Hilton Hotel & Towers
Pittsburgh, PA

Please check accommodation requested:

❑ Single (1 person) ❑ Triple (3 persons)
❑ Double (2 persons) ❑ Quad (4 persons)

Bed type:

❑ King Bed
❑ 2 Queen Beds

Special Requests _____

❑ Please indicate here if you have a disability requiring special accommodations.
All room rates are subject to prevailing taxes.
Reservations must be received by hotel prior to arrival.

NAME _____

SHARING WITH (Name) _____

COMPANY NAME _____

ADDRESS _____

_____ CITY _____

STATE/PROVINCE _____ COUNTRY _____ ZIP _____

TELEPHONE _____

ARRIVAL DATE _____ (Check-In Time is after 3 p.m.) DEPARTURE DATE _____ (Check-out Time is 12 p.m.)

SPECIAL REQUESTS _____

After June 30, 1995 reservations will be accepted on a space availability basis only. Reservations will be held until 6:00 p.m. on the date of arrival, unless guaranteed by one night advance deposit, payable by certified check or a Major Credit Card.

CREDIT CARD # _____ CREDIT CARD _____

EXPIRATION DATE _____

CARD HOLDERS SIGNATURE _____

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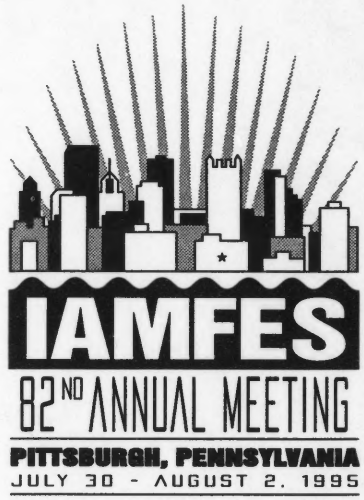

MAIL DIRECTLY TO:

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MEMBERSHIP APPLICATION

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☐ Membership with JFP and DFES $90
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◀ BEST VALUE

☐ Membership with DFES $60
(12 issues of *Dairy, Food and Environmental Sanitation*)

☐ Check here if you are interested in information on joining your state/province chapter of IAMFES

SUSTAINING MEMBERSHIP

☐ Membership with BOTH journals $450
(Includes exhibit discount, July advertising discount, company monthly listing in both journals and more)

STUDENT MEMBERSHIP

☐ Membership PLUS including both journals $45

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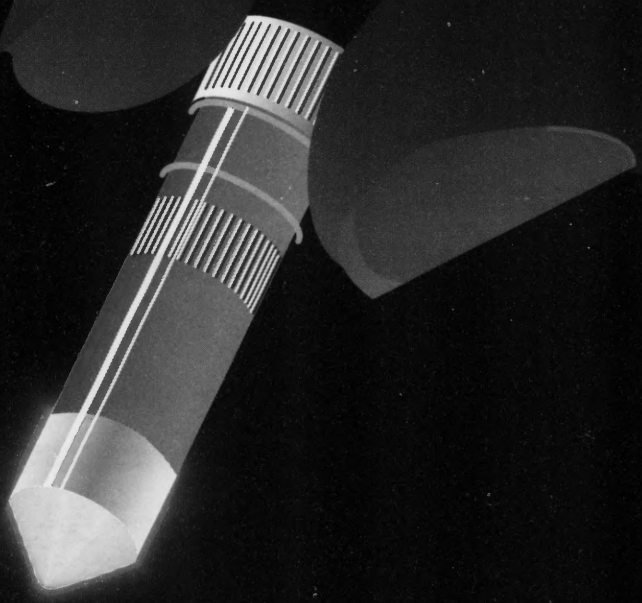

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