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DAIRY, FOOD AND ENVIRONMENTAL

Sanitation

A PUBLICATION OF THE INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC. JULY 1998

• IAMFES 85th Annual Meeting Issue

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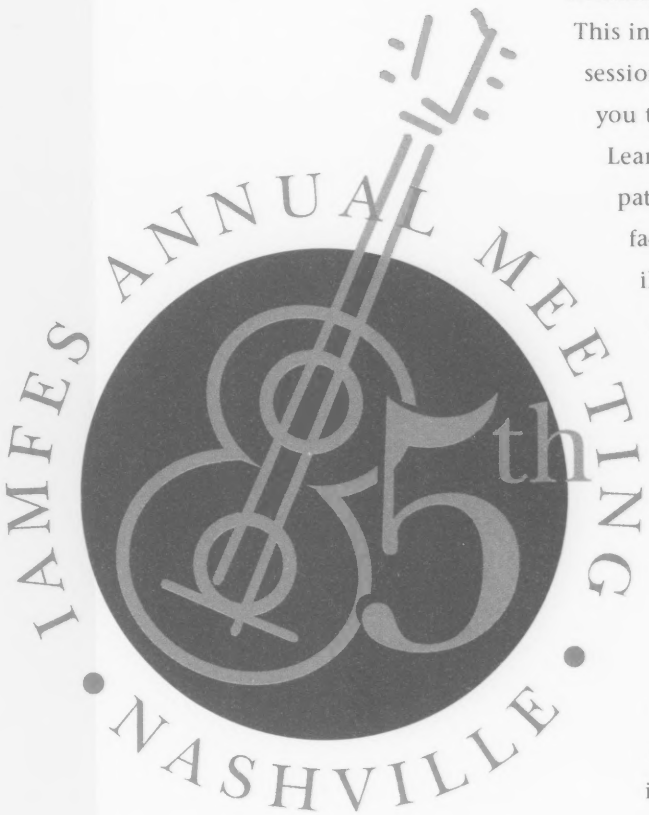

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August 16-19, 1998

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The Nashville Skyline. Photo courtesy of the Nashville Convention and Visitors Center.

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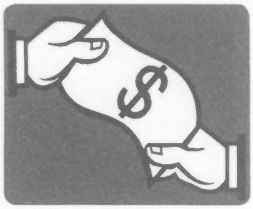
COMMENTS

FROM YOUR PRESIDENT

By GALE PRINCE
IAMFES President

"My check is in the mail..."



Yes Lisa, I mailed my check last week... My contribution to the IAMFES Foundation Fund has been made to help the Fund reach the $100,000 level by the year 2000. The IAMFES Foundation Fund was formed with a vision of providing a resource in carrying out the IAMFES' mission of *"To provide food safety professionals worldwide with a forum to exchange information on protecting the food supply."* The Foundation Fund does just that in providing funding for the Ivan Parkin Lecturer; the Developing Scientist Awards; travel for some speakers at the Annual Meeting who do not have other financial support to attend our Annual Meetings; and distribution of Journals in developing countries. The Foundation Fund is separate from IAMFES operating budgets and is administered by the Foundation Fund Support Group.

SILENT AUCTION
Sh... Sh... Sh...

This year the IAMFES Foundation Fund Support Group will be holding a Silent Auction to raise money at the Annual Meeting. The Silent Auction will have items on display which you are allowed to enter a bid on by using a sign up sheet. The highest bidder at the close of the auction will get the item at their bid price We need your donations to make this a success. I encourage industry members to contribute company collectibles – watches, clocks, blankets, equipment, product, etc. No cows, horses, or other live animals will be accepted due to sanitary requirements. Affiliates, bring or send your state specialty product such as wine, cheese, syrup, etc. If you would like to send item(s), contact Lisa Hovey at the IAMFES office 800.369.6337 for shipping details.

Your spouse is welcome to use your credit cards to bid on any or all of the items. Let's surprise Harry Haverland in how much stuff we can pack into the Silent Auction in an attempt to boost the Foundation Fund balance over the top long before 2000 arrives!

Basic Food Safety Seminars – should we? Where do you go for some basic seminars in food safety? As a member service we have considered offering some basic food safety seminars for the dairy and food industry. Currently we are looking at a Basic Dairy Plant Processors workshop for new supervisors and another workshop on *Listeria* Control in a Food Plant. Let me hear who has interest in attending such workshops.

President Clinton's Food Safety Initiative provides many opportunities for training of not only members of the food industry but also the regulatory agencies. The recent proposal on juice labeling and juice HACCP will require training of an industry. The Initiative on produce also requires a need for training. It is interesting to note that once you digest many of our food safety challenges you have a common denominator – training. What role should IAMFES play in fulfilling the food safety training needs? Let me hear your comments!!!

THANK YOU!

IAMFES THANKS THE FOLLOWING INDIVIDUALS FOR THEIR SUPPORT OF THE IAMFES FOUNDATION

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- Reginald W. Bennett
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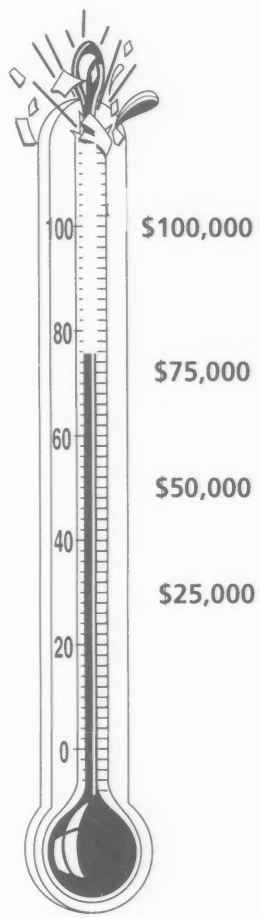

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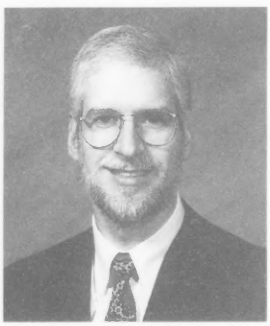
The above list represents individual contributors to the IAMFES Foundation Fund through May 29, 1998. In addition, a portion of the Sustaining Member dues are allocated to support this Fund. Your contribution is welcome. Call the IAMFES office at 800.369.6337 or 515.276.3344 for more information on how you can support the Foundation.

COMMENTARY

FROM THE EXECUTIVE DIRECTOR



By DAVID W. THARP
IAMFES Executive Director

"I hope you agree that your IAMFES Membership offers an exceptional value for the cost of your dues."

Today I want to report on items that were approved at the most recent IAMFES Executive Board meeting held on May 17. The first item will allow our International Members and Subscribers to receive Journals much sooner than currently possible. The Executive Board approved a change in our distribution method for Journals sent outside of North America. The new delivery method uses air delivery from the United States to distribution points around the world where the Journals will then continue through the local postal systems.

We estimate the delivery time using the new system will range from two to three weeks versus the current delivery time of up to 10 weeks! This is a very exciting change for IAMFES and it is our hope that our International Members and Subscribers will benefit greatly by receiving their Journals much more timely. We anticipate being converted to the new system with the September issues.

Another item of business was the approval of a budget for our fiscal year ending August 31, 1999. This budget called for revenues exceeding expenses by approximately $12,000. That excess is only .8 % of our total budgeted revenues of $1.4 million. There is not a lot of room to spare in the budget as it was approved.

One place I thought the Board used their creative genius was when it came to the discussion of our Membership dues. Realizing we haven't revised Member dues since September of 1996, the Executive Board knew something had to give. The Board also felt that a dues increase might be harmful to the health of the Association. What could be done? Discussion took place to find a solution – a new approach. One that allows our Members to help reduce our costs and thus reduce their dues.

The Board agreed to a Membership dues increase – with the provision that any current Member paying their dues within 30 days of the first invoice date would be granted a "discount" for prompt payment. For our *Dairy, Food and Environmental Sanitation* Members, the discount reduces the Membership dues to our current level, and the same as it was in September of 1996! The rationale behind giving such a discount is that the Association can avoid expense if you pay your dues on the first notice. We save by not having to send additional notices to you. We encourage you to take advantage of this early payment discount and feel this will not only benefit you, but will allow our office to operate more efficiently.

Over the last few years, we have increased the content matter of both our Journals. *Dairy, Food and Environmental Sanitation* added feature columns on such topics as 3-A Sanitary Standards and Internet usage for food safety information. We also increased the number of articles presented in the *Journal of Food Protection (JFP)*. Our page count in *JFP* increased from an average below 100 pages to our present average of 140 pages per issue. These are examples of how we continually search for ways to improve our Journals and provide you, our Members, with additional value for your Membership dollars.

I hope you agree that your IAMFES Membership offers an exceptional value for the cost of your dues. Both the Executive Board and our IAMFES staff are working hard to continue providing important information to you at the lowest possible cost. Thank you for your continued support of IAMFES!

Dairy, Food and Environmental Sanitation, Vol. 18, No. 7, Pages 418-423

The Role of Prerequisite Programs in Managing a HACCP System

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SUMMARY

Sound prerequisite programs are essential to successful development and implementation of a HACCP plan. In addition to those related to the GMPs, prerequisite programs can include systems such as ingredient specifications, consumer complaint management, ingredient-to-product traceability programs, and supplier approval programs. Prerequisite programs are not part of the formal HACCP system. They frequently function across product lines and are often managed as facility-wide or company-wide programs rather than being product or process specific, as is the case with HACCP systems. Although occasional deviation from a prerequisite program requirement would not by itself be expected to create a food safety hazard or concern, prerequisite programs play an important role in controlling potential health hazards.

INTRODUCTION

Since the first use of HACCP in American food plants over twenty-five years ago, it has been learned that HACCP cannot be successfully applied in a vacuum. Rather, HACCP must be supported by a strong foundation of prerequisite programs *(15)*. It cannot be overemphasized that sound prerequisite programs are essential to successful development and implementation of a HACCP system.

Food processors in the United States recognize that many of the prerequisite programs are based upon the current Good Manufacturing Practices (GMPs) listed in the Code of Federal Regulations *(8)*. In addition to those related to the GMPs, prerequisite programs can include other systems such as ingredient specifications, consumer complaint management, ingredient-to-product traceability programs, and supplier approval programs.

Prerequisite programs are not part of the formal HACCP system. They frequently function across product lines and are often managed as facility-wide or company-wide programs rather than being product or process specific, as is the case with HACCP systems. Prerequisite programs can include objectives other than food safety, and it may not be easy to associate performance of a prerequisite program element, e.g., pest control or chemical storage programs, with specific production lots or batches. Consequently, it is usually more effective to manage them within a quality system rather than including their performance and control as part of the HACCP plan. This is appropriate provided that uninterrupted adherence to the prerequisite program is not essential for food safety. Occasional deviation from a prerequisite program requirement would not by itself be expected to create a food safety hazard or concern.

Nevertheless, prerequisite programs play an important role in controlling potential health hazards. For example, supplier control programs and chemical control programs can be used to minimize potential chronic health hazards such as those from mycotoxins or pesticides. Similarly, foreign material contamination in many food processes can be minimized by

TABLE 1. Summary of prerequisite program activities

FACILITIES
- Adjacent properties
- Building exterior
- Building interior
- Traffic flow patterns
- Ventilation
- Waste disposal
- Sanitary facilities/handwashing
- Water, ice, culinary steam
- Lighting

RAW MATERIALS CONTROLS
- Specifications
- Supplier approval
- Receipt and storage
- Testing

SANITATION
- Master schedule
- Pest control
- Environmental surveillance
- Chemical control

TRAINING
- Personal safety
- Personnel GMPs
- HACCP

PRODUCTION EQUIPMENT
- Sanitary design/installation
- Cleaning/sanitation
- Preventive maintenance
- Calibration

PRODUCTION CONTROLS
- Product zone controls
- Foreign material control
- Metal protection program
- Allergen control
- Glass control

STORAGE & DISTRIBUTION
- Temperature control
- Transport vehicle cleaning & inspection

PRODUCT CONTROLS
- Labeling
- Product trace
- Complaint investigations

preventive maintenance programs and by upstream control devices such as sifters or magnets.

Deviations from compliance with a prerequisite program usually do not result in action against the product. In contrast, potential acute health hazards such as the presence of *Salmonella* are usually controlled in a HACCP system where, in most cases, definitive Critical Control Points to eliminate the hazard are available. Deviations from compliance in a HACCP system normally result in action against the product, such as evaluation of product to determine appropriate action. This is a key consideration that can aid in distinguishing between control points within prerequisite programs and critical control points that should be covered by a HACCP plan.

Regulatory agencies in North America have recognized the importance of prerequisite programs and have incorporated them into regulatory programs and new regulations. The Canadian Food Inspection Agency includes prerequisite programs in its Food Safety Enhancement Program *(1)*. In the United States, similar inclusions were made in new HACCP regulations for seafood processing *(6)* and meat and poultry processing *(11)*.

In 1995, the U.S. Food and Drug Administration (FDA) began a pilot program in collaboration with the U.S. food industry to study the use of HACCP systems in many types of food processing operations *(7)*. Industry participants reported that FDA focused a great deal of attention on the existence and maintenance of prerequisite programs (Sperber, personal communication; *7*).

Prerequisite programs are the foundation upon which the HACCP plan is built *(15)*. In the hazard analysis, the likelihood of hazards occurring is assessed with an expectation of consistent performance of the prerequisite programs. If a prerequisite program is not conducted adequately, then the hazard analysis may be in error, and the HACCP plan may be inadequate. If the HACCP team cannot depend on consistent control of the prerequisite program, then additional CCPs may need to be added to the HACCP plan, increasing the plan's complexity. In short, reliance on well developed and consistently performed prerequisite programs can simplify the HACCP plan. Reliance on poorly developed or performed prerequisite programs can be detrimental to food safety. Therefore, in the interest of food quality, food safety, and regulatory compliance, it is imperative that all food processors establish, document, and maintain effective prerequisite programs to support their HACCP systems.

PREREQUISITE PROGRAMS

Many activities can be considered part of a prerequisite program. For this reason, it is quite likely that no two companies or plants will have identical prerequisite programs (Table 1). In this paper we have organized the many potential prerequisite activities into eight main areas. Depending on individual preference, either the individual activities or even the main areas could be rearranged to suit a given plant's prerequisite program needs. The information below is meant only to introduce basic information; for details, consult the references provided.

Facilities

Sanitary design principles should be observed in the planning, construction, and maintenance of all facilities *(13)*.

Adjacent properties

Plants should be located so that contamination by microbes or chemicals from adjacent properties is unlikely. Typical properties to be avoided would include facilities that

manufacture noxious chemicals, animal feed lots, and waste disposal areas.

Building exterior

All grounds and roads should have adequate drainage. Grounds should be paved to minimize dust. There should be no vegetation immediately adjacent to buildings. All debris and garbage should be contained.

Building interior

The building should be designed to prevent pest entry. It should have the necessary sanitary design features to facilitate cleaning.

Traffic flow patterns

A linear product flow should be established so that raw materials are received at one end of the plant and finished products are shipped from the opposite end. Where necessary, workers, equipment and hand tools should be restricted to either raw or finished product areas so that the possibility of cross-contamination is minimized.

Ventilation *(18)*

Intake air should be filtered. Air intakes should be on the roof or at least six feet above the ground. They should not be able to pick up dust, noxious odors, or exhaust air from the plant. Positive air pressure should be maintained in finished product areas to prevent contamination from exterior or raw material handling areas.

Waste disposal and waste management *(14)*

The plant should have proper sanitary sewers. Waste containment and removal procedures should be in place.

Sanitary facilities and hand washing

The plant should have adequate washroom facilities for each gender. The washrooms must not enter directly onto the production area. Handwash stations should be available so that employees can wash their hands before entering the production area. Handwash stations can also be conveniently located throughout the production area. Each station must have potable hot and cold running water, hand soap, and hand sanitizer. Preferably, the faucets should be foot or electric eye operated. Hands should be dried with single-use disposable towels or hot air dryers.

Water, ice, and culinary steam *(14, 18)*

Potable water should be used in most applications. Water testing records must be maintained. Water should be chlorinated. Adequate controls and documentation must be in place when in-plant chlorination systems are used. There must be no cross-connections between potable and non-potable water lines. Only approved boiler compounds can be used in the generation of culinary steam *(9, 18)*.

Lighting

Lighting should be adequate to carry out plant operations and protected so that broken glass will not be a potential hazard.

TRAINING

Training may be done by outside organizations but more frequently will be done in-house. Training materials may include videos and interactive CD-ROMs. The training must be documented and a record should be included in the employee's personnel file. Periodic refresher training should be part of the overall training program.

Personal safety

Written procedures should be in place so that all employees can be trained in the safe operation of the equipment with which they work. All employees should understand what initial actions to take should an accident occur.

Personnel GMPs *(18)*

Employees should receive documented training in the plant's procedures to assure personal hygiene. Procedures will include hand washing, hair containment, and appropriate clothing and shoes. Employees must not wear jewelry or eat, drink or smoke in production areas. Employees who are sick or have a disease that is transmissible via food may not handle food or work in a food production area.

HACCP

All employees must receive documented training in the plant's HACCP system. At individual work stations the employees must be aware of the hazard(s) being controlled, the location of critical control points, the critical limits to be met, the monitoring procedures used, records to be kept, and the corrective actions to be initiated should a deviation occur. The employee should also be made aware of the potential consequences to consumers if a failure occurs.

RAW MATERIAL CONTROLS

Specifications

Written specifications should be in place for all chemicals, pesticides, food ingredients and packaging materials. The specification should include product description; transportation and storage requirements; required analytical tests, etc.

Supplier approval or certification

All suppliers should be approved for compliance with GMPs, HACCP, etc., and for the ability to produce the specified material. Auditing a supplier's control programs (HACCP plan, prerequisite programs) is the best means of approving suppliers and assuring compliance. Some end-product testing may be appropriate as a verification of the control program. In such cases, suppliers may be certified to perform end-product testing to minimize the need for testing at the receiving plant. A Certificate of Analysis (COA) will suffice in this instance. This can be an important tool for management of ingredients that may contain hazards. However, it must be recognized that end-product testing is a

very poor means of assuring the absence of a hazard, especially for hazards expected to be present at low levels or absent.

Receipt and storage

The raw material receipt and storage area should be separate from the processing area and ideally will also be separate from the shipping area. The receipt and storage area must be maintained in sanitary condition. In some cases, raw materials should be quarantined until the required tests are completed with satisfactory results. The materials can then be released to production. Raw materials should be stored at the appropriate temperature and relative humidity and kept separate from finished products.

Testing procedures

Each raw material should be subjected to an acceptance test. The tests may be subjective organoleptic tests for visual or odor characteristics. In some cases specific tests, e. g., *Salmonella* testing, may be necessary to verify the effectiveness of the supplier's HACCP and quality programs. Generally these tests are random rather than routine.

PRODUCTION EQUIPMENT

Sanitary design and installation

Sanitary design principles should be used in the design and manufacture of food production equipment *(13)*. The equipment should be designed to prevent the contamination of food or the growth of microorganisms during production. All lubricants must be food grade *(10)*; the supplier should be able to provide verification that lubricants are food grade.

Cleaning and sanitation

Written procedures should be in place for the cleaning and sanitation of all food processing equipment. The proper steps should be followed for the use of detergents and sanitizers *(14, 18)*. Separate color-coded utensils should be used for raw and cooked food equipment.

Preventive maintenance

A predetermined schedule for the servicing of all equipment should be in place. Preventive maintenance can be key in ensuring that equipment functions properly during production. Maintenance procedures should specify checks to ensure that no extraneous parts or maintenance tools or materials are left behind to contaminate products.

Calibration

Equipment should be calibrated as necessary. Generally, a schedule for calibration will be established based upon manufacturers' recommendations or upon experience. Equipment to be calibrated includes various types of thermometers or thermocouples, pH meters, and relative humidity sensors. The standard or reference used in calibration must be documented for traceability. Calibration is particularly important for instrumentation used to monitor critical control points. In this case, the calibration process may be considered part of the HACCP verification step.

SANITATION

Master sanitation schedule

A master sanitation schedule should be developed and rigorously applied to assure good housekeeping and minimize product exposure to contamination. This schedule applies to floors, walls, ceilings, lights, overheads, and all other areas that are cleaned on a less-than-daily frequency. A control program for storage and use of cleaning and sanitation chemicals should be included.

Pest control *(14, 18)*

All doors and windows should be adequately screened to exclude pests. The walls and roofs should have no other openings that would permit pest entry. Rodent bait stations and traps are typically used. Each is numbered and indicated on a map of all such devices. All bait stations should be checked at some frequency and the date each trap is checked should be documented. Poisoned bait is not permitted inside the plant. All pesticides should be properly labeled and stored and should be used only by a certified pesticide applicator.

Environmental surveillance

The environmental surveillance program consists of monitoring for microbiological contamination to verify the effectiveness of the plant sanitation programs. Examples of such programs include monitoring for *Listeria* spp. in areas where cooked, refrigerated, perishable products are packaged; monitoring for *Salmonella* spp. in areas where dried dairy products are handled; and determination of total microbial counts as a general indication of sanitizer effectiveness. ATP bioluminesence methods are gaining acceptance as a means of rapidly identifying areas where sanitation has not been done effectively *(3, 4, 5, 12)*.

Chemical control

All non-food chemicals must be properly labeled and stored in an area separate from food storage areas. The chemicals should be mixed, dispensed, and used only by properly trained personnel.

PRODUCTION CONTROLS

Many plants have in place quality management programs that can be used to manage production controls. Examples include Good Manufacturing Practices programs, ISO-9002, and statistical process control programs.

Product zone controls

All areas where products are handled must be maintained at the proper temperature. The control of employee and equipment traffic may be necessary to prevent the contamination of finished products. In some finished product packaging rooms, positive air pressure is necessary to minimize product contamination.

Foreign material control

Many devices such as sifters, screens, and filters can be used to detect or eliminate foreign material from a food process. These are usu-

ally located in production lines before critical control points.

Metal protection program

Magnets are a specific example of a foreign material control device. In some cases they may be managed as a critical control point. In other cases they can be located in the process before the final metal detector, in which case the magnets would be control points and the metal detector would serve as the critical control point, provided that metal contaminants in the product pose a significant health risk.

Allergen control

It is necessary to prevent cross contamination of allergenic materials to foods that do not contain the allergen. This is accomplished by rework control, production sequencing, equipment clean-outs between products, and strict attention to product labeling *(2)*.

Glass control

An acceptable glass quality program is necessary to assure that the package can be adequately sealed and processed. It is also important to maintain a program that prevents or detects in glass containers glass fragments that could occur through manufacturing defects or through distribution. Electronic empty-glass-container inspection systems are available for 100% inspection of incoming glass for foreign glass and/or manufacturing defects. Glass containers are also typically washed prior to filling to remove any foreign debris from the package. In addition to these precautions, a rigid program is needed to manage glass breakage on the processing line, including inspecting the filling and capping line for breakage at set intervals.

STORAGE AND DISTRIBUTION

Temperature control

Where proper temperatures during storage and distribution are necessary for product quality and safety, temperatures must be monitored and documented. It is the manufacturer's responsibility to establish the specific temperatures at which products must be transported and stored. In most cases, these temperatures are set to ensure the quality needed to meet consumer expectations and are much more stringent than needed for safety.

Transport vehicle cleaning and inspection *(16)*

Vehicles used for the transportation of food must be clean and sanitary. This is especially important in bulk transportation by truck, rail car, or ship. Proper cleaning and sanitation procedures must be followed and documented. Records of the prior three cargoes and the most recent cleaning of the conveyance should be available. The transportation equipment must be inspected and approved before loading.

PRODUCT CONTROLS

Labeling

It is essential to have the correct label on each package for compliance with food-labeling regulations and to reduce the risk of inadvertent allergens in foods *(2)*.

Product trace, hold, and retrieval

Each plant must be able to trace all raw materials and finished products in order to conduct a product retrieval. A crisis response plan and a crisis response team should be in place to handle such incidents *(17)*. Proper lot coding of all materials is necessary to limit the amount of material to be retrieved. Complete distribution records should be maintained so that the geographical extent of the retrieval is known. It is important to remove the implicated material from commerce as quickly as possible. Once retrieved, the manner of product disposition, e.g., rework or destruction, should be determined.

Complaint investigations

Consumer complaints should be reviewed carefully, because feedback from customers or consumers may identify problem areas that can be corrected, leading to improved effectiveness of the affected prerequisite program.

IMPLEMENTATION AND VERIFICATION

There are several aspects to managing a prerequisite program: written Standard Operating Procedures, or SOPs; training; documentation; validation of the program's adequacy; and verification of compliance with the written program.

The existence and performance of prerequisite programs must be well documented. Prerequisite programs are established and managed separately from HACCP systems. However, the existence of a prerequisite program does not preclude the use of specific activities within a HACCP system. For example, while sanitation procedures are normally part of a prerequisite program, some manufacturers have chosen to manage selected sanitation procedures as CCPs in their HACCP systems. This has been done frequently in the meat and dairy industries, where sanitation procedures for meat slicers, ice cream fillers, etc., were established as CCPs to help prevent recontamination of cooked products by *Listeria monocytogenes*.

How a plant manages its prerequisite programs will have a direct impact on verification of the prerequisite programs. For example, if a plant manages its prerequisite programs as verbal practices, without regular documentation, then compliance will be very difficult to verify. If a plant manages its prerequisite programs systematically with written procedures, assigned responsibilities, measurable acceptance criteria, defined record keeping activities, and procedures to be followed when acceptance criteria are not met, then verification can also be systematic and performed in a more objective manner.

As with a HACCP plan, a well written prerequisite program clearly communicates what is expected to be performed and at what frequency,

who has responsibility, and what actions are to be taken if the activity is not performed according to procedure or does not have the expected outcome.

Management of a prerequisite program can be the responsibility of any of a number of departments. For example, responsibility for a plant's equipment calibration and preventive maintenance programs usually will reside with Maintenance or Engineering. Quality Assurance usually has responsibility for ingredient testing programs, hold and release programs, and recall systems, while Production has responsibility for sanitation programs and personnel hygienic practices.

For some programs, joint management may be most effective. For example, because control of raw materials relies on purchasing specifications and on inspection of materials upon receipt, a company may find it most effective for that program to be jointly managed by Purchasing, Quality Assurance, and Production. Purchasing sets up the initial procurement of the material according to a contract or agreement with the supplier. Quality Assurance, or Production inspects the material at receipt and takes appropriate actions (e.g., accepts or rejects material) based upon the specification. Quality Assurance or Production informs Purchasing of any out-of-specification material, and Purchasing takes appropriate action with the supplier.

Each SOP related to a prerequisite program should include procedures for routine verification. This activity, usually conducted by a supervisor, should verify that the SOP is being performed, monitored, and recorded in the manner intended. Periodically, the prerequisite programs must be independently audited, usually by Quality Assurance, to verify and document that the overall program is being performed as intended. Outside auditors may also be used periodically.

Prerequisite programs are established and managed separately from HACCP systems. Because of the importance to HACCP, the satisfactory implementation of prerequisite programs must be verified. Reports of audits of prerequisite programs provide valuable information for the HACCP team to use in evaluating the nature and effectiveness of the individual prerequisite programs.

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Isolation of Catalase-negative *Listeria monocytogenes* from Foods

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SUMMARY

Catalase production, a characteristic of *Listeria* species, is among the tests used routinely for laboratory identification of these species. Concern about detection in food products of catalase-negative isolates with colony appearance typical of *Listeria* spp., prompted a study for their confirmation. The tests performed included phage-typing, the Christie-Atkins-Munch-Peterson test (CAMP), serology, MICRO-ID® Listeria biochemical reactions, motility, ß-hemolysis, Gram reaction, and polymerase chain reaction. All these tests, performed independently by five analysts and as described in the literature on current food analysis methodology, confirmed the presence of catalase-negative *L. monocytogenes*. Further evaluation of the isolates, with various procedures suggested for detection of catalase production, also verified their lack of catalase activity.

INTRODUCTION

Listeria monocytogenes is a recognized cause of invasive infection in humans, and catalase production is a characteristic that among others, is typically used to distinguish *Listeria* spp. from similar bacteria in isolation procedures *(5, 6)*. Bergey's Manual® *(8)* classifies *Listeria* as catalase-positive and indicates that practically all strains are catalase-positive when grown on the usual laboratory media but may give a negative reaction if cultured on media containing low concentrations of meat and yeast extract. It also states that a few truly catalase-negative strains have been observed and that catalase activity is depressed in media containing relatively high (10% w/v) concentrations of glucose *(8)*. Furthermore, it indicates that the genus *Listeria* may be confused with streptococci but that the problem should be resolved by the catalase test and states that *Listeria* spp. may be distinguished from *Erysipelothrix rhusiopathiae* and lactobacilli by the catalase test *(8)*. However, a case of adult meningitis has been attributed to a catalase-negative *L. monocytogenes* isolate *(10)*. Another published study *(11)* has reported on differences in the rate of intracellular killing of catalase-positive and catalase-negative *L. monocytogenes* by normal and interferon-gamma-activated macrophages. Leblond-Francillard et al. *(7)* reported that they had two catalase-negative mutants of *L. monocytogenes* by chromosomal insertions of the conjugative transposon Tn*1545* and that the loss of catalase activity did not reduce the virulence of these mutants in mice. Other reports *(12, 13)* have indicated that catalase-negative strains of *L. monocytogenes* may be able to detoxify the oxygen-dependent microbiocidal products of phagocytic cells because of their increased superoxide dismutase activity.

The purpose of this paper is to report on catalase-negative *L. monocytogenes* cultures isolated from two food samples.

MATERIALS AND METHODS

Routine analysis of food samples involved application of the *L. monocytogenes* isolation procedure described in the Bacteriological Analytical

TABLE 1. Characteristics of known and unknown isolates as determined by five analysts

Characteristics	Culture tested				
	L. innocua ATCC33090	*L. monocytogenes* ATCC1709	Carrot isolate	Pasta isolate-1	Pasta isolate-2
Colony appearance	TY[a]	TY	TY	TY	TY
Catalase reaction	+	+	-	+	-
Wet mount motility	+	+	+	+	+
Gram-reaction	+	+	+	+	+
ß-hemolysis	-	+	+	+	+
CAMP-test/*S. aureus*	-	+	+	+	+
CAMP-test/*R. equi*	-	-	-	-	-
MICRO-ID® Listeria	44044[b]	44044	44044	44044	44044
Serotype	4	4	1	1	1

[a]Typical on LPM, OXA and TSAYE agar plates.

[b]Octal code (in one of 25 tests the code was 44045 and in another 44046; *Listeria*).

Manual *(5)*. The procedure involved enrichment in enrichment broth (EB; *1)* at 30°C for 48 h, followed by isolation on lithium chloride phenylethanol moxalactam and Oxford agar (LPM; OXA; Difco Laboratories, Detroit, MI; *1)* plates at 35°C for 24 to 48 h. At least five colonies with the appearance typical of *Listeria* spp. on OXA (black with a black halo) were streaked for purity on trypticase soy agar with 0.6% yeast extract (TSAYE; Difco; *1)* and incubated at 35°C for 24 to 48 h. Purified isolates were identified according to classical tests of appearance by Henry's oblique illumination technique, wet mount motility, catalase activity, positive Gram reaction, ß-hemolytic activity on sheep blood (5%) agar plates (BBL), the CAMP test, biochemical reactions of the MICRO-ID® Listeria system (Organon Teknika, Durham, NC; presently distributed by Remel, Lenexa, KS), and serology (Difco; *3, 5)*. Catalase activity was detected by picking typical isolated colonies from the TSAYE agar plate, putting the needle with the colony in the middle of a drop of 3% hydrogen peroxide solution, and observing for gas bubbles. Testing for Gram reaction followed testing for catalase activity. Additional information about the testing procedures is presented in the Results and Discussion section.

RESULTS AND DISCUSSION

Two analysts isolated bacterial colonies on OXA plates that had morphology resembling *Listeria* (black with a black halo) and that also had typical morphology (Henry's illumination technique) when transferred to TSAYE. The isolates were derived from frozen pasta with vegetables and from frozen carrot products. When tested for catalase activity, some of the colonies were catalase-positive, whereas others were catalase-negative. Both catalase-positive and catalase-negative isolates were tested for confirmation. The catalase-positive isolates were confirmed as *L. monocytogenes* serotype 1a *(1, 2)*. Testing of the catalase-negative isolates indicated that they were oxidase-negative and motile, and that their hemolytic activity was enhanced near *Staphylococcus aureus* on the CAMP test. Furthermore, they were identified as *L. monocytogenes* by the MICRO-ID® Listeria system. It should be noted, however, that a study evaluating the MICRO-ID® Listeria system *(2)* indicated that catalase-negative cocci should not be tested, because 12 out of 19 catalase-negative strains (all enterococci) tested were misidentified as *Listeria* spp.

The catalase-negative cultures had the same serotype, 1a *(1, 2)*, as the catalase-positive isolates. The catalase-negative isolates were then tested using the polymerase chain reaction procedure described by Ferreira *(4)*. Visualization after electrophoresis on agarose gel with ethidium bromide showed the presence of two bands characteristic of *L. monocytogenes* (a 131 bp gene fragment coding for an invasion-associated protein, *iap*, and a 234 bp fragment from the gene coding for listeriolysin O, *hyl*A) on the test isolates and on catalase-positive control cultures. *Listeria* phage-typing, also performed at our laboratory, showed that the bacteriophage profiles of the catalase-negative isolates were similar to the phage profiles of the catalase-positive *L. monocytogenes* isolated

from the same samples (personal communication, Robert E. Haymond).

Further study was then undertaken to further confirm the identity of the isolates. Five analysts were given pure cultures of five isolates and were asked to identify them by the *Listeria* procedure of the Bacteriological Analytical Manual *(5)*. The cultures were: *L. innocua*, ATCC 33090 (catalase-positive); *L. monocytogenes* ATCC 1709 (catalase-positive); a catalase-negative *L. monocytogenes* from the carrot sample; a catalase-positive *L. monocytogenes* from the pasta sample; and a catalase-negative *L. monocytogenes* from the pasta sample. Each analyst tested each culture for typical morphology on OXA, LPM, and TSAYE agar plates and also for catalase activity, motility, ß-hemolysis, Gram reaction, identity by MICRO-ID® Listeria, hemolytic activity by the CAMP test, and serology. Results (Table 1) showed that the isolates in question were typical of *L. monocytogenes* in all tests, except that all five analysts found them to be catalase-negative. Testing for catalase activity was repeated on cultures grown on TSA without added yeast extract, and catalase-negative isolates retained this characteristic. Furthermore, after frozen storage, following which they were cultured under aerated conditions in broth and on agar slants and plates, the cultures were still found to be catalase-negative by the above test and by procedures described by Smibert and Krieg *(9)*. Additional work is needed to confirm the presence, extent of occurrence, and significance of catalase-negative *L. monocytogenes* strains.

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Emerging Infectious Diseases of Particular Relevance to Environmental Health Professionals

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SUMMARY

Emerging infectious diseases whose natural history and/or epidemiology is associated with the environment are discussed. After general aspects of disease emergence are considered, attention is given to the classic epidemiologic triad of the agent, the host and the environment and how changes in each of these could influence emergence. Attention is then focused on individual diseases whose emergence is environmentally associated. The etiologic agents of the diseases considered include bacteria, viruses, protozoa, a helminth, a fungus, a prion, and an alga. An understanding of these diseases and their environmental aspects must be of particular concern to environmental health professionals who are, and will continue to be, called upon to help control these conditions and similar conditions that emerge in the future. Environmental health continuing education programs should include information on worldwide emergent diseases and not focus attention only on regional and/or national problems, because modern transportation and travel can result in rapid dissemination of disease agents from one part of the globe to another.

INTRODUCTION

Emerging infectious diseases are of critical importance in the field of Public Health. Familiarity with these conditions must be of particular concern to Environmental Health Professionals, because the natural history and/or epidemiology of many of these diseases are directly linked to the environment. Hence, an understanding of these environmental aspects is imperative if effective control measures are to be implemented.

Various definitions for Emerging Infectious Diseases are given in the literature, but they generally are defined as diseases

a. with increased incidence in the past two decades,
b. that threaten to increase in the near future,
c. that are spreading to new areas,
d. that are newly appearing diseases, and
e. that have developed resistance to previously effective antibiotics or chemotherapeutic agents.

BACKGROUND

In 1992, The Institute of Medicine, which was chartered by The National Academy of Sciences in 1970 to examine policy matters pertaining to the public, published a report entitled, "Emerging Infections – Microbial Threats to the United States" *(20)*. This report was compiled by a multidisciplinary committee that included experts from several fields, including infectious diseases, epidemiology, microbiology, several other biology specialty areas, public health, food science, among others *(20)*. The report discussed factors of emergence, recognition (surveillance), and intervention and contained listings of emerging infectious agents and global resources for infectious disease surveillance. Subsequently, in 1994, the Centers for Disease Control and Prevention published a report entitled "Addressing Disease Threats: A Prevention Strategy for the United States" *(4)*. This plan emphasized surveillance, research, and preventive activities.

In 1996, The World Health Organization published a report entitled "The World Health Report, 1996 – Fighting Disease and Fostering Development" *(30)*, which pointed out that between 1973 and 1995, 30 new infectious diseases had emerged throughout the world. Fourteen of them were caused by viral agents, nine by bacteria, six by protozoa and one by a non-conventional agent, that is, bovine spongiform encephalopathy in cattle *(32)*. These conditions did not occur only in remote parts of the globe; six of the 30 had first appeared or were first identified in the United States. These were cryptosporidiosis and Legionnaires's diseases in 1976, acquired immunodeficiency syndrome in 1981, Lyme disease and *Escherichia coli* O157:H7 infection in 1982, and hepatitis C in 1989.

Regardless of where a new infectious disease first appears, with international travel being as rapid as it is today, infectious disease agents can move throughout the world in a relatively short period of time. The importance of travel as a factor in the emergence of infectious disease is emphasized in the statement, "Today's massive movement of humans and materials set the stage for mixing diverse genetic pools at rates in combinations previously unknown. Concomitant changes in the environment, climate, technology, land use, human behavior and demographics converge to favor the emergence of infectious diseases caused by a broad range of organisms in humans as well as in plants and animals" *(29)*.

In the 1994 CDC article *(4)* that deals with prevention strategies for the U.S., one of the goals that was set forth points out the need to enhance communication of public health information about emerging infectious diseases. With this in mind, the main purpose of this paper is to point out some of the factors that influence emergence and to discuss briefly some diseases whose natural history and/or epidemiology is in some way associated with the environment. Some of these diseases are caused by newly recognized agents, while others are caused by long-established pathogens that were thought to have been somewhat quiescent but are demonstrating a resurgence in disease causation.

THE EPIDEMIOLOGIC TRIAD IN RELATION TO EMERGING INFECTIOUS DISEASES

Factors leading to emergence are many, multifaceted, and often interrelated. Many such catalytic factors manifest their effects by altering the equilibrium between the constituents of the classic epidemiologic triad – that is, the natural balance between the host, the agent, and the environment is somehow changed so that more disease results.

Host changes in relation to emerging infectious diseases

More disease will result in a host population if more individuals show increased susceptibility to a particular agent. This is illustrated by the deterioration of public health infrastructures following the relaxation of diphtheria immunization programs in the countries of the former Soviet Union. The subsequent diphtheria epidemic began in Russia in 1990 and has since spread to other newly independent countries.

Also, the human immunodeficiency virus weakens the immune system in victims of AIDS, making them more susceptible to infectious agents easily warded off by a normal immune system such as the yeast *Candida albicans*, non-tuberculosis type *Mycobacteria*, and other opportunistic microorganisms.

Changes in social behavior and certain stressful social changes, such as increased poverty, increased urbanization, and unstable political situations resulting in boundary and territorial disputes that lead to migration of large numbers of refugees, are all circumstances that have a tendency to make hosts more susceptible to disease and thereby foster conditions favorable to emergence of new infectious agents.

Agent changes in relation to emerging infectious diseases

Regarding changes in disease agents themselves, some have developed resistance to antimicrobial agents that had been used to control them. This has become a worldwide problem. *Staphylococcus aureus* has developed resistance to many antibiotics, including methicillin. Quite recently, reduced susceptibility to vancomycin has been reported; this now poses a very serious threat, particularly in causing outbreaks in hospital environments *(14)*.

In addition, *Mycobacterium tuberculosis* has developed some resistance to antimicrobial agents, and tuberculosis therapy is now problemed. Other factors also play a role in this disease, such as the increase in the homeless population in our large cities, which makes case follow-up and proper long-term therapy almost impossible in this segment of society that is so prone to this disease. The latter example involves relationship of emergence not only to a change in a pathogenic

bacterium, but also to a societal change (increased homeless population) influencing proper therapy, which in turn aids in the development of resistance in *Mycobacterium tuberculosis*. In addition, difficulty in case follow-up in this population undoubtedly is related to increased dissemination of this disease.

In addition, the tuberculosis incidence rate has increased during the past decade. For example, in 1991, the incident rate in one California correctional institution was 10 times greater than the state rate. This is primarily due to exposure of prisoners to tuberculosis risk factors at a higher rate than the general population. These risk factors include AIDS infection, high likelihood of coming from a segment of society that received poor health care, and frequently being housed in crowded conditions, often with poor ventilation *(8)*.

Other bacterial agents of disease showing increased drug resistance include enterococci, pneumococci, *Hemophilus influenzae, Neisseria gonorrhoeae, Shigella dysenteriae and Salmonella typhi (30)*.

Streptococcus pyogenes, the Group A streptococcus, is another example of a pathogen now causing increased problems in man, namely necrotizing fasciitis and streptococcal toxic shock syndrome *(25)*.

Environmental changes in relation to emerging infectious disease

Alteration of the environment can also affect emergence, especially if the changes result in an increase of insect vector habitats and/or disease reservoir animals. For example, reforestation in some parts of the northeastern United States resulted in an increase of wild rodent and deer reservoirs of *Borellia burgdorferii* as well as the ixodid ticks that are the vectors that transmit this organism to man *(2)*. This led to the emergence of a hitherto unrecognized disease, namely Lyme Disease.

On the other hand, deforestation for agricultural use or dam construction can also result in environmental changes that favor emergence. The first major outbreak of Rift Valley fever, a mosquito-borne virus disease, occurred in Egypt in 1977. The epidemic is believed to have been linked to ecological changes that favored mosquito breeding as a result of construction of the Aswan Dam *(20)*. A similar situation was noted in 1987, after the construction of the Dramico Dam in Mauritania, when an epidemic of Rift Valley fever occurred in a village upstream of the dam *(20)*.

Global warming is another environmental factor that could affect infectious disease patterns, in that insect vectors could establish themselves in areas that were previously too cold for their survival *(18)*.

The outbreak of Hantavirus pulmonary syndrome that occurred in 1993 in the Four Corners area of Arizona, Colorado, New Mexico, and Utah *(17)* is another example of how a meteorological phenomenon helped influence the emergence of an infectious disease hitherto unrecognized in this region. This outbreak began in May 1993. The meteorological phenomenon involved a severe five-year drought that ended during the winter of 1992 to 1993, when the Four Corners area recorded record snow falls, followed by a moist spring. This resulted in an unusually large piñon nut crop, which in turn favored an increase in the deer mouse (*Peromyscus maniculatus*) population, for which piñon nuts are a favored food. The deer mouse was found to be an excellent carrier of the viral etiologic agent of this disease, which these rodents secrete in their saliva, urine and feces. Man in turn contracts the virus by inhaling aerosolized particles contaminated with viral-laden rodent excreta *(17, 22)*.

A more subtle environmental effect followed the Northridge earthquake in California in 1994. Following this disaster, there was an increase in cases of coccidioidomycosis, which was speculated to have been caused by increased inhalation of dust particles bearing arthroconidia of *Coccidioides immitis*. Because this disease is not transmitted from person to person, it was felt that the increase was directly attributable to the increase in airborne arthroconidia-laden dust particles generated by the earthquake *(5)*.

EXAMPLES OF OTHER ENVIRONMENTALLY RELATED EMERGING INFECTIOUS DISEASES BY TYPE OF ETIOLOGIC AGENT

Bacterial agents

The genus *Aeromonas*. Bacteria in this genus are Gram negative bacilli capable of causing acute onset gastrointestinal disease, usually of short duration, and wound infections. The natural habitat of aeromonads is the soil and both fresh and brackish water. Gastrointestinal disease is felt to be contracted through the ingestion of water containing these agents, and wound infection through contact with such water *(20)*. One species of this genus, namely *Aeromonas hydrophila*, is a normal flora bacterium found in the gut of the medicinal leech *Hirudo medicinalis*. This leech, which has been used to release venous congestion of skin grafts following plastic surgery, has been shown to be the source of *Aeromonas* infections following such usage *(24)*.

Campylobacter jejuni. This Gram negative bacillus is the etiologic agent of *Campylobacter* enteritis, which is transmitted to man via contaminated water, raw milk, and under-cooked chicken. The reservoirs of this microorganism include poultry, cattle, swine, sheep, rodents, and birds. The increase in poultry consumption and improved methods of detecting this agent are probable factors in its emergence *(20)*.

The genus *Ehrlichia.* Ehrlichiae are rickettsia-like obligate intracellular bacteria that are the cause of human ehrlichiosis, which was first recognized as a human disease in 1986 *(28)*. There are two types of this disease: human monocytic ehrlichiosis (HME), caused by *E. chaffeensis*, and human granulocytic ehrlichiosis (HGE), caused by an agent closely related to *E. equi*. Both types

are transmitted to man through tick bites, the Lone Star tick being the vector of HME and the deer tick the vector of HGE *(7)*. Both are moderate to severe illnesses, with fever being the predominant symptom. HMC has a case fatality rate of approximately 2 to 3% and HGE about 5% *(28)*. Emergence is probably due to increased clinical recognition of these two infections and a possible changing host-vector relationship *(28)*.

***Escherichia coli* O157:H7.** This organism, first reported in 1982, is a Gram negative bacillus that is the etiologic agent of hemorrhagic colitis, thrombocytopenia, and hemolytic uremic syndrome. It is transmitted to man through the ingestion of undercooked ground beef, raw milk, unpasteurized apple juice and apple cider, alfalfa and radish sprouts, and other foods contaminated with fecal matter from infected cattle *(12, 13)*. Increased awareness and improved methods of laboratory recognition of this agent are resulting in identification of more cases *(30)*.

***Helicobacter pylori*.** This agent is a Gram negative bacillus, a cause of gastric and peptic ulcers in man, possibly related to stomach cancer, and transmitted to man through the ingestion of contaminated food, water, and unpasteurized milk *(20)*. An increased awareness of this agent as a cause of disease, coupled with improved technology in recognition of this agent, are factors related to its emergence.

***Legionella pneumophila*.** This organism, a Gram negative bacillus, that is the etiologic agent of Legionnaire's disease, is transmitted to man through the airborne route from aqueous reservoirs such as air conditioner cooling towers, evaporative condensers, humidifiers, produce misters, and hot and cold water taps *(2)*. An increased awareness of this disease and improvements in technology in the identification of this agent are factors in its emergence.

***Listeria monocytogenes*.** This agent is a Gram positive, nonsporeforming bacillus and is the etiologic agent of listeriosis, which is usually manifest as a meningoencephalitis or septicemia in immunocompromised individuals or in miscarriages in pregnant females. Reservoirs of the agent include soil, water, silage, forage, and infected domestic and wild animals. It has been transmitted to man through contaminated vegetables, milk, and cheese *(2)*.

The genus *Mycobacterium*. Organisms in this genus are Gram positive, acid fast bacilli. *Mycobacterium tuberculosis*, the etiologic agent of tuberculosis, is but one of 54 recognized species in this genus *(1)*. Increased infection rates have been reported in AIDS patients not only with *M. tuberculosis*, but also with other species of mycobacteria such as *M. avium* and *M. bovis*. The tuberculosis caused by the latter mycobacterium in cattle, bison, deer, elk and other exotic cervids can also be passed on to man. Captive cervids have been determined to be a source of tuberculosis infections in animals. Therefore, the U.S. Department of Agriculture proposed a rule which would require mandatory testing of animals in the cervid breeding and production industry *(31)*.

The genus *Salmonella*. *Salmonella enteritidis* and *Salmonella typhimurium* are two of the most commonly isolated serotypes of salmonellae in the United States. Both can be considered emerging infectious agents.

***S. enteritidis*.** Sporadic and outbreak-associated cases of *S. enteritidis* have substantially increased since 1985. In 1989 it was established that eggs could become contaminated with salmonellae through the transovarian route before the shell was put on the egg. Prior to this time, it was felt that eggs became contaminated with these agents on the outer surface of the shells initially, after which the agent entered the egg through cracks or some other means. Because of this, the latest public health recommendations include thorough cooking of eggs as well as the use of pasteurized eggs whenever possible and the caution of never eating any food that contains raw unpasteurized eggs *(6)*.

***S. typhimurium*.** Definitive type 104 (DT104), first reported in the United Kingdom in 1984, has emerged as an increasing cause of *Salmonella* infection in the U.K. It is highly resistant to antimicrobial agents, frequently showing resistance to ampicillin, chloramphenicol, streptomycin, sulfonamides, and tetracycline (R-type ACSSuT). In the U.K. this organism has been found in a variety of animal species, including poultry, sheep, pigs, cats, wild birds, rodents, foxes, and badgers. In 1995 an outbreak was found to be associated with the consumption of beef *(9)*.

This agent has also been reported in the U.S. In 1996 *S. typhimurium* with the ACSSuT resistance pattern was found in 90 (32%) of 282 human isolates tested at the Centers for Disease Control and Prevention in Atlanta, Georgia. In 1995 the pattern was found in 28% of a national sample of 276 isolates of *S. typhimurium*, compared with 7% in 1990. The ecology and epidemiology of this agent has not yet been worked out in the U.S. However, an outbreak in Nebraska, in 1996, suggested a possible association with animal reservoirs, that is, through milk or contact with animals. The resistance pattern of some isolates in the U.K. has been extended to include resistance to trimethoprim and fluoroquinolones. The emergence in the United States of this pathogen with such resistance capabilities does present a formidable public health threat *(9)*.

The genus *Vibrio*. Microorganisms in this genus are Gram negative bacilli. Following are two organisms in this genus that fit into the category of emerging infectious agents.

***Vibrio cholerae*.** This microbe is the etiologic agent of cholera in man, that is usually contracted through the ingestion of water contaminated with this agent or by contact with fecal matter from an infected person or by ingestion of food contaminated with the agent. The seventh recorded and current pandemic, caused by *V. cholerae* O1 biotype *El tor*, began in 1961 in Indo-

nesia, spread through Asia and Africa, and reached Latin America in 1991. Through 1994, it spread to 21 countries on the American continent, mainly through contaminated water, food and seafood mechanisms of transmission *(26)*. In 1992, a new strain, labeled *V. cholerae* O139, emerged in India, and by 1993 it had spread to Pakistan, China and Bangladesh, although it has not rapidly spread since then *(30)*. Though a disease of antiquity, cholera still wreaks havoc when it shows up in areas of the world where sanitary conditions are compromised, even though as early as 1855, John Snow described ways in which it could be contained by paying attention to fecal pollution of water and sanitary conditions in general *(23)*.

Vibrio vulnificus. This microorganism, a normal inhabitant of some marine environments, can infect wounds or cause illness in humans who ingest raw or undercooked seafood, especially oysters. Individuals most susceptible to infection with this agent include those having chronic liver disease, or chronic alcoholism, or those who are immunosuppressed in some way. The mortality rate can be as high as 50% or more in patients who demonstrate primary septicemia and over 90% in those who become hypotensive *(2)*.

Viral agents

Chikungunya virus. This arthropod-borne virus is transmitted by the mosquito *Aedes aegypti*. It causes a febrile type disease that is usually self limiting, with polyarthritis, lasting from days to months; a rash on the trunk and limbs; and a leukopenia. It is found in Africa, southeast Asia, and India *(2)*. The reason for its emergence is unknown *(20)*.

Dengue fever virus. This is another arthropod-borne virus that is transmitted by the mosquito *Aedes aegypti (27)*. It is endemic in the Caribbean and is also called breakbone fever. Classic dengue fever is a mild disease; however, a more serious form, called dengue hemorrhagic fever, can occur. Control measures include elimination of the *Aedes* vector. There has been an increase in the number of cases in countries surrounding the Caribbean, and cases have been imported into the United State by travelers from these areas. *Aedes aegypti* is present in the Gulf region of the United States; however, *Aedes albopictus* (the Asian Tiger Mosquito), which transmits dengue in Asia, was found in Texas in 1986 *(27)*. It is felt that this latter mosquito was transported into the United States in used tire casings from Asia and has since become entrenched in many areas, where it does present a public health threat as a possible vector of dengue in this country.

Filoviruses. The group of viruses known as Filoviruses includes the Ebola and Marburg viruses, both of which cause human infections having a high mortality rate. In 1967, in The Federal Republic of Germany and Yugoslavia, an outbreak of Marburg disease involved 31 persons, including seven fatalities, following exposure to African green monkeys imported from Uganda *(2)*. Since 1976, when Ebola was first recognized in Sudan and Zaire, outbreaks have occurred in 1979 in Sudan and in 1994 in the Ivory Coast; a major outbreak occurred in Kitawit, Zaire, in 1995 *(2)*. Ebola-related viruses have been isolated from chimpanzees in the Ivory Coast in 1994 and from cynomolgus monkeys imported into the United States in 1989 and 1990, as well as in Italy in 1992 *(2)*.

Transmission of these viruses is from person to person by direct contact with infected blood, semen, body secretions and organs. Reuse of needles also plays a role in transmission. Nosocomial transmission is common during outbreaks *(2)*.

Hantaviruses. Hantaviruses cause two types of infections in man, both of which are transmitted by inhalation of aerosolized, virus-contaminated rodent excreta. The first type of infection is a hemorrhagic fever with a renal syndrome called epidemic hemorrhagic fever, Korean hemorrhagic fever, nephropathic epidemica, and hemorrhagic nephrosonephritis. It has hemorrhagic and kidney involvements. It is prevalent in Asia and the Balkans and has a case fatality rate of about 5%. The reservoirs are field rodents. Man is an accidental host *(2)*.

The second type of infection that these viruses cause, called Hanta adult respiratory distress syndrome, involves the respiratory system and leads to respiratory distress and cardiac shock. The mortality rate is reported to be between 40 to 50%. In the United States, two Hanta viruses have been found to cause this syndrome. The first, the *Sin Nombre* virus, caused an epidemic in the southeastern United States in 1993; and the second, called the Black Creek Canal virus, was first isolated from a case in Florida. The reservoir of the *Sin Nombre* virus is the deer mouse, and that of the Black Creek Canal virus is the cotton rat. Man is an accidental host *(2, 22)*.

Hepatitis E virus. This virus causes a disease in man that has been called enterically transmitted non-A non-B hepatitis and also fecal-to-oral non-A non-B hepatitis *(2)*. It is found in areas of the world having poor environmental sanitary conditions. However, cases have been reported in industrial countries in travelers returning from these areas. Transmission is fecal to oral and also waterborne. The disease produced is similar to hepatitis A but has a higher mortality rate, especially in pregnant females where it has been reported to have a fatality rate as high as 20% *(2, 27)*.

Japanese encephalitis virus. This mosquito-borne virus causes an acute inflammatory central nervous system disease in man. The vector is *Culex tritaeniorhynchus*, which is associated with rice growing regions and has spread to new parts of Asia following the introduction of rice growing agricultural fields in these new areas. Case fatality rates for mosquito-borne arboviral encephalitides range from 0.3% to 60%, with the Japanese encephalitis rates being among the highest *(2)*.

Lassa virus. This virus is the etiologic agent of Lassa fever, an acute viral illness having a case fatality rate of about 15% in hospitalized patients. It is especially severe in pregnancy, resulting in fetal loss in about 80% of such cases. It is endemic in Sierra Leone, Liberia, Guinea, and Nigeria. Its reservoir is wild rodents, especially mice of the *Mastomys* species. It is transmitted to man through contact with excreta of infected rodents and can also be spread through person-to-person contact, especially in hospital environments, through contact with secretions, urine, and blood of infected patients *(2)*.

Norwalk virus and Norwalk-like viruses. These agents cause mild to moderate disease with gastrointestinal symptoms lasting from 24 to 48 hours. Their occurrence is world wide, and the disease they produce is known by various names, including Norwalk agent disease, Norwalk-like disease, epidemic viral gastroenteritis, acute infectious nonbacterial gastroenteritis, viral diarrhea disease, winter vomiting disease, and epidemic nausea and vomiting disease. Examples of Norwalk-like viruses include the Hawaii, Oklahoma, and Snow Mountain agents, among others. Man is the only known reservoir of these agents, which can be transmitted from person to person. Outbreaks have been associated with the consumption of contaminated drinking water and food, especially raw or undercooked shellfish *(2)*.

Rabies virus. Rabies is a virally caused disease that usually results in a fatal encephalitis. Transmission to man is usually through the bite of an infected animal, which introduces virus-laden saliva into a host. The virus has been known to have been contracted through inhalation of virus-contaminated dust particles in bat caves in South America *(2)* and also through a corneal transplant from a person who died of rabies that was not detected at the time of death. Rabies claims an estimated 35,000 to 40,000 lives per year, with almost all of these cases occurring in developing countries *(2)*. Since 1980, about 24 deaths have occurred in the United States, of which nine were contracted outside of this country. It is a disease mainly of animals, with racoons, skunks and bats being the main reservoir in the United States, followed by cats, foxes, cattle, dogs, and wild and domestic animals *(27)*. However, worldwide the dog is still the major reservoir *(30)*.

Since the early 1990s there has been a migration of racoons from the southeastern to the northeastern part of the United States. This migration introduced infected racoons into new areas, which facilitated the spread to uninfected racoons *(30)*. Novel immunization methods that have been used in an attempt to halt this spread include the use of an oral vaccine in special bait that was distributed by helicopters and light aircraft or spread on the ground in areas known to be inhabited by infected animals. In Europe, such campaigns have lead to a decline of about 80% in rabies cases since 1990 *(30)*.

Ross river virus. This mosquito-borne virus causes Ross river fever, which is usually a self-limiting disease characterized by a rash affecting the trunk and limbs and an arthritis that can persist for several months. The vector is *Culex annulirostris* and a few *Aedes* species. The kangaroo is suspected as being a reservoir *(20)*. The condition occurs in Australia, New Guinea, Fiji, and other South Pacific Islands *(2)*. Factors promoting emergence include irrigation projects and dam construction, which result in the establishment of new mosquito habitats *(20)*.

Venezuelan equine encephalitis virus. Venezuelan equine encephalitis is an arthropod-borne febrile viral disease transmitted to man by the bite of an infected mosquito. The etiologic virus has been isolated from mosquitoes belonging to the following genera: *Culex, Aedes, Mansonia, Psorophora, Haemagogus, Sabethes, Deinocerites* and *Anopheles (2)*. Most human cases are mild, although some cases result in central nervous system involvement, including encephalitis and paralysis, and can end in death *(2)*. Horses serve as the major source of the virus for mosquitoes, which in turn transmit the agent to man. The virus is endemic in northern South America, Trinidad and Central America. In 1970 to 1971 it spread to Texas during an epizootic, which resulted in human cases. Introduction of infected horses and mosquitoes into new regions is a factor in the emergence of this disease *(20)*.

Yellow fever. Yellow fever is an arthropod-borne viral hemorrhagic febrile disease that can range from an inapparent infection to jaundice, hemorrhagic complications, renal failure and death. The case fatality rate ranges from less than 5% in indigenous populations in endemic areas to over 50% in epidemics in nonindigenous areas *(20)*. The natural history of this disease involves two transmission cycles. First, the sylvatic or jungle cycle is found in tropical regions of Africa and Latin America, where species of *Aedes* and *Haemagogus* mosquitoes serve as vectors in monkey populations. Second, the urban cycle involves infected *Aedes aegypti* mosquitoes that transmit the disease to man. There is no human-to-human transmission; man serves as an amplifying host in the urban cycle *(2)*.

In 1992, Kenya suffered its first epidemic since 1943, with 54 cases that resulted in 28 deaths. Also in 1992, Peru had a serious outbreak in which 440 cases were experienced in the first half of that year *(30)*. No outbreaks of urban Yellow fever have been transmitted by *Aedes aegypti* in the Americas since 1942. However, many cities have become re-infested with this species, which now pose a potential threat in serving as vectors of this disease *(2)*. In addition, since its introduction into Brazil and the United States from Asia, the mosquito *Aedes albopicticus* now poses a threat as a possible vector in these countries *(2)*.

Factors that play a role in the emergence of Yellow fever include lack of effective mosquito control programs, urbanization in tropical areas, and establishment of vector mosquitoes in new areas *(20)*.

Helminth agent

The genus *Anisakis*. Anisakiasis is an infection of the human intestinal tract caused by the ingestion of raw or undercooked fish containing larval stages of the nematodes (roundworms) *Anisakis simplex* or *Pseudoterranova decipiens*. Infections caused by the latter roundworm are not a serious threat to human health, since this agent does not penetrate the gastrointestinal tissue and is usually coughed up by the patient within 48 hours after ingestion *(21)*. However, infections caused by *A. simplex* are more serious in that this agent penetrates the gastrointestinal tissue and causes disease that is difficult to diagnose, being confused with acute appendicitis, Crohn's disease, gastric ulcers, and gastrointestinal cancer *(21)*.

The primary hosts of these agents are warm blooded marine mammals such as seals, walruses, and porpoises *(16)*. The roundworms release eggs that hatch in seawater, and which are then ingested by krill, which in turn are eaten by fish. Larvae then encyst in the fish muscle, to be passed on to man if infected fish are eaten raw or undercooked. Fish most often associated with infection are cod, pollack, halibut, rockfish, flat fish, mackerel, salmon and herring. Treatment involves surgical removal of infected human gastrointestinal tissue *(20)*.

The disease is common in Japan, where it is associated with the consumption of sushi and sashimi, and also in other countries where raw fish are consumed. It is rare in the United States. However, with the increased consumption of fish, including the "trendy" acceptance of raw fish dishes, the possibility exists that more cases may be forthcoming.

PROTOZOAL AGENTS

The genus *Cryptospiridium*. *Cryptospiridium parvum*, recognized as a human pathogen since 1972, is a coccidian protozoan that causes cryptosporosis in man; symptoms include fever, diarrhea, abdominal pain, and anorexia. The disease usually subsides in less than 30 days but can be prolonged in immunodeficient individuals and may contribute to death. It has been found worldwide. The reservoirs include man and domestic animals, including cattle. The mode of transmission is fecal to oral, including waterborne and foodborne means. Outbreaks have been associated with water, including public water supplies, swimming pools, and lakes. Oocysts are produced in an infected host's epithelial cells, which pass out in the feces and can survive in the environment for long periods of time. They remain infective and are capable of resisting chemical agents used to purify drinking water *(2)*. However, they can be removed from water supplies by filtration.

The genus *Giardia*. *Giardia lamblia*, a flagellated protozoan, is the cause of human giardiasis, which is manifest as an infection of the upper small intestine. It is often asymptomatic, but can be manifest as a chronic diarrhea and other intestinal symptoms.There are usually no extragastrointestinal involvements *(2)*.

It is usually transmitted to man by the ingestion of the cyst form in surface water or shallow well water that has been contaminated with the feces of infected persons or animals. It is less often transmitted through contaminated food. Transmission can also be from person to person, especially in day care centers where children have poor toilet training. It resists the usual levels of chlorine used to treat drinking water but can be controlled through proper filtration systems. Man is the reservoir of the agent, with beavers and other animals also possibly being involved *(2)*. Environmental factors involved in emergence of this disease include the lack of filtration of water systems and possibly infections in animal populations such as beavers *(20)*.

The genus *Toxoplasma*. *Toxoplasma gondii* is a protozoan that causes toxoplasmosis in man, which often produces mononucleosis-type symptoms. However, in immunocompromised individuals it can cause pneumonitis, myocarditis, meningoencephalitis, hepatitis or chorioretinitis, or combinations of these. Cerebral toxoplasmosis is often seen in AIDS patients *(20)*.

The agent occurs worldwide and is found in many birds and mammals, with human infections being common. The primary hosts are cats, which contract the agent by eating tissue of infected mammals, usually rodents, or birds. Cats harbor the agent in the intestinal tract, where the sexual stage of the parasite takes place and results in the production of oocysts. This can produce human infection when contact is made with such infected feces. Human infection can also take place by the ingestion of raw or undercooked meat from intermediate hosts bearing encysted tissue. Intermediate hosts include rodents, swine, cattle, goats, sheep, chickens and birds. Human infections can also occur transplacentally, which can result in fetal death if it occurs early in pregnancy. Blood transfusion and organ transplantation transmission have also been reported *(2)*. Factors favoring emergence of this agent include an increase in the number of immunocompromised humans as well as an increase in the cat pet population *(20)*.

The genus *Cyclospora*. The coccidian protozoan *Cyclospora cayentanensis*, which causes the human diarrheal disease, cyclosporosis occurs in tropical waters worldwide *(19)*. It was first identified in association with diarrheal illness in Peru in 1985. The following year it was isolated from U.S. residents who had traveled to Mexico and Haiti. In 1990, a contaminated drinking water fountain in the house staff quarters of a Chicago hospital was the source of several cases of this diarrheal illness *(19)*. In 1996 and 1997, outbreaks of cyclosporosis in the U.S. and Canada were linked to eating raspberries imported from Guatemala. In addition, two outbreaks in Florida in 1997 were linked to the consumption of musculun *(10)* which is also known as spring mix,

field greens, or baby greens. Fresh basil was implicated as the probable vehicle of infection in another outbreak of cyclosporosis in northern Virginia, Washington, D.C., and Baltimore, MD, during June and July, 1997 *(11)*.

The average incubation period of cyclosporosis is about one week after ingestion of the contaminated food. The microorganism infects the small intestine and causes a watery and sometimes explosive diarrhea. The agent is shed in the feces. In one study done on Peruvian children, this shedding lasted for up to 23 days *(2)*. The infection can be treated with appropriate antibiotics but can be protracted if not treated.

Algal agent

The algal dynoflagellate *Pfiesteria piscicida* and morphologically related organisms were recently implicated in fish kills in estuarine waters in Maryland. In addition, they have been reported to have been associated with illness in some individuals who had contact with these waters during the fish kills *(15)*. These organisms were originally described in 1982 by Burkholder while she was investigating fish kills in estuarine waters in North Carolina *(3)*.

A workshop to consider the public health response to *Pfiesteria*, held in Atlanta, GA, in September, 1997, was attended by representatives from eight eastern states, and the District of Columbia, as well as from the U.S. Food and Drug Administration, the National Institutes of Health, and the Centers for Disease Control and Prevention *(15)*.

Because of their high toxicity, these agents are felt to pose a significant public health threat in that they represent both an occupational and a recreational hazard.

Unconventional agent

Bovine spongiform encephalopathy (BSE), also referred to as "Mad Cow" disease, is a chronic degenerative disease of the central nervous system of cattle. It is caused by an agent that is not well understood, and that has been referred to as an unconventional virus or a prion. Epidemiological data suggests that BSE in Great Britain may have been caused by feeding cattle rendered protein produced from scrapie-infected sheep.

Both scrapie and BSE as well as Creutzfeldt-Jakob Disease (CJD), a human disease, are classified as transmissible spongiform encephalopathies. In England in early 1997, 16 cases of a variant form of CJD occurred in humans, which may have been linked to the consumption of meat derived from cattle that may have been fed rendered protein produced from scrapie-infected sheep.

To eradicate BSSE, agricultural officials in Great Britain have taken several steps to eradicate BSE which have included prohibiting the inclusion of mammal-derived protein in feed for all food producing animals and destroying all animals showing signs of BSE *(32)*.

CONCLUSION

All of the diseases considered in this paper are associated with the environment in some way, have increased within the past two decades, and are of contemporary public health significance. Therefore, they must be of particular concern to environmental health professionals, who are and will continue to be called upon to help control these and similar conditions that emerge in the future.

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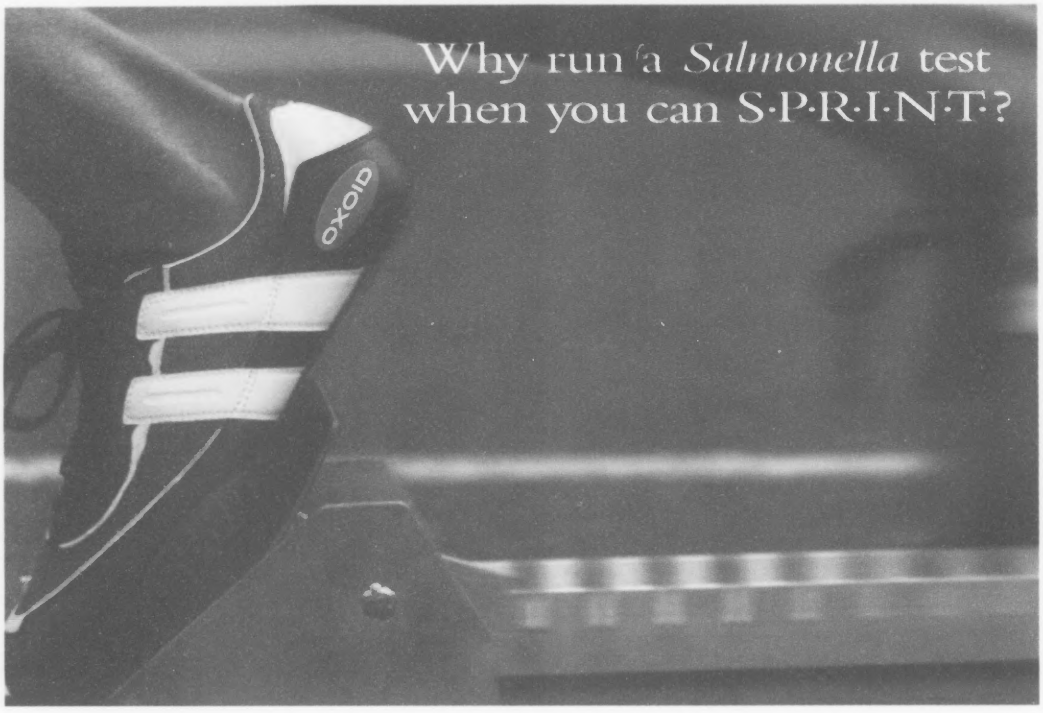

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Botulism in Flavored Oils — A Review

Anne LaGrange Loving

Nine years ago, the FDA mandated addition of an acidifying agent to all garlic-in-oil preparations to prevent the growth of *Clostridium botulinum*. The popular media, as well as food trade publications, continue to print recipes for oils that contain garlic and other produce that may be contaminated with soil. Most of these recipes fail to mention the botulism risk or contain misleading and dangerously incorrect "safety" precautions. The FDA does not govern foods that are served in restaurants or private households. Although the scientific community may be well informed of the connection between botulism and flavored oils, the general public needs to be educated about this potentially deadly risk.

INTRODUCTION

Botulism, one of the oldest recorded diseases, is caused by *Clostridium botulinum*. This disease strikes infrequently in the United States, but unfortunately for the few victims, it may be fatal. *C. botulinum* is capable of producing several very potent poisons (collectively called botulism toxin or botulin). The lethal dose of botulism toxin is approximately one nanogram *(3, 26, 38)*; it has been suggested that one gram of purified botulin could kill all the humans on Earth *(49)*.

C. botulinum is an anaerobic, spore-forming bacillus that commonly inhabits the soil. It produces highly resistant spores that can survive in the presence of oxygen, as in soil, for extended periods of time. Although people are likely to ingest some of these spores throughout their lifetimes, this usually presents no health risk, as *C. botulinum* is generally unable to grow and produce toxins when it must compete with large numbers of microbes. If a few spores are ingested on, for example, raw produce, they would be unable to colonize in the presence of the resident intestinal flora.

When a spore of *C. botulinum* enters a suitable environment, i.e., one that is anaerobic, lacks competing bacteria, and is at a compatible temperature and pH, it will transform into a vegetative bacillus and begin to multiply. As its metabolic activity and cell numbers increase, it will begin elaborating toxin. If *C. botulinum* begins to flourish in a food, such as a stew or soup, the food ultimately becomes poisoned. A proteolytic strain of *C. botulinum* that grows in food, will eventually cause the food to appear and smell "spoiled"; this is not the case with the nonproteolytic strains, many of which can flourish and elaborate toxin at temperatures as low as 3°C. A person who eats this food becomes ill, not because of ingestion of bacteria, but because of ingestion of toxin.

Botulism toxin is a neurotoxin that blocks the release of acetylcholine at the neuromuscular junction and in much of the autonomic nervous system, resulting in an irreversible inhibition of muscle contraction. Within 18 to 36 hours (as little as four hours, or as much as eight days), a victim will begin to exhibit marked lethargy, weakness, and vertigo, usually followed by diplopia, blurred vision, progressive disphasia, and dysphagia paralytica. The tongue becomes very dry and feels furry. Dyspnea, increased muscle weakness, abdominalgia, nausea, vomiting, constipation, dizziness, and headache also commonly occur. The paralysis progresses symmetrically downward, usually starting with the eyes and face, to the throat, chest, and extremities. When the diaphragm and chest muscles become fully involved, respiration is inhibited, causing death from asphyxia and cardiac arrest. Throughout the

progression of these symptoms, the patient will be afebrile, with no loss of mental acuity. If the patient is not treated promptly and correctly, the mortality rate is somewhere between 30 and 75% *(10, 16, 33)*. The death rate varies with the specific type of toxin/s, toxin distribution in the food, and the patient's size and general health. Sublethal doses of botulism toxin may result in crippling disease and coma that may linger for many months, or even years. Timely administration of trivalent ABE antitoxin will significantly improve a victim's chances of complete recovery; this assumes that correct and prompt diagnosis are coupled with availability of the antitoxin.

The botulism toxin is thermolabile, although sources disagree as to the exact temperature and time needed for inactivation. Recommendations range from as little as 5 minutes at 80°C to 10 minutes at 100°C (boiling) *(15, 16, 26, 38)*. Therefore, the toxin in even a highly tainted soup, stew, or sauce will be rendered harmless if the food is allowed to bubble on a stove for at least ten minutes and then served promptly. This heating does not kill the organism, which, however, will die in an autoclave or in the autoclave conditions of a stovetop pressure cooker. In response to the increased temperature, the organism sporulates in order to survive. The toxins, however, are destroyed by the heat. If the food is allowed to cool it will eventually reach a temperature at which the spores will once again germinate and begin reproducing, and the poison-producing cycle will recur.

BOTULISM FROM FLAVORED OILS

The public is generally aware of the potential danger of botulism in food in dented cans and homemade canned foods; knowledge regarding soups, stews, and sauces may be less widespread. Commercial canning is done under carefully controlled circumstances, which significantly minimizes incidences of botulism. There is, however, a relatively new and dangerous source for botulism, one about which many people are unaware: flavored oils, or oil infusions.

In recent years, flavored oils have become increasingly popular in restaurants as well as in household kitchens. Practically any fruit, vegetable, herb, or spice can be immersed in a variety of oils; some chefs even use the shells of lobster and crab as an infuser. The essential flavors infuse into the oil, providing a convenient way to add some "zing" to a recipe. The most popular ingredient in these infusions is garlic. Frequently these preparations are not heated prior to consumption; they may be used on salad, bread, or pasta that is cooling on a plate.

Vegetables, herbs, and fruits, especially those that grow on or under the ground, are very likely to have some degree of soil contamination. This introduces the possibility that *C. botulinum* spores may be added to the recipe. If the produce is put into an anaerobic environment, such as a bottle of oil, botulism may result. In the 1980s, several cases of botulism involving garlic-in-oil preparations dramatized this hazard. During 1985 in Vancouver, BC, 37 people acquired botulism from a garlic-in-oil preparation *(45)*. This was followed by a 1988 laboratory investigation into the survival of and toxin production by *C. botulinum* in garlic-in-oil preparations *(41)*. Then, in February of 1989, three people in Kingston, NY, became ill, also from a garlic-in-oil infusion *(25)*. The FDA issued a ruling, ordering the removal from store shelves of all commercial garlic-in-oil preparations that lacked an acidifying agent, followed by a mandate requiring addition of an acidifying agent (such as phosphoric or citric acid) to all commercial garlic-in-oil preparations *(12)*. Acid usually prevents the growth of *C. botulinum*, so any spores present in an infusion would not be able to flourish and produce toxin. Ironically, if the environment does allow the toxin to form, a subsequent low pH (3.5 to 6.8) will actually favor preservation of the toxin *(16)*. Therefore, the acid must be added as the recipe is being prepared. Studies have also demonstrated that although *C. botulinum* generally prefers to grow in a competition-free environment, the presence of certain other microbes not only allows it to grow, but also to elaborate toxin at a lower pH than usual. In addition, some of these other microbes may produce metabolic byproducts that will increase the pH, thereby enabling a pH-sensitive *C. botulinum* to grow *(1, 14, 28, 47)*.

HOMEMADE AND RESTAURANT-PREPARED INFUSIONS

The FDA mandate does not encompass homemade and restaurant-prepared oil infusions or commercial preparations distributed outside the United States; in 1993, in Italy, there were seven cases of botulism from commercially prepared eggplant-in-oil *(48)*. Professional and homemaker cooks might not be aware of the risk involved when flavored oils are not prepared properly.

Restaurant reviews from all over the country sing the praises of oil infusions, specifying ingredients such as truffles, roasted sweet peppers, tomatoes, herbs, snow peas, red peppers, garlic, curry, and sun-dried tomatoes. Each of these grows in, on, or near the soil, and each is immersed in oil, in an oxygen-free environment *(9, 11, 17, 18, 24, 29, 36, 39, 42* to *44)*. One rave review speaks of "jewel-toned oil infusions poured from bottles on display" *(42)*, implying that they are on a shelf, unrefrigerated. Perhaps some, or all, of these restaurants prepare fresh infusions daily, discard unused infusions that are more than a day old, add acidifying agents, or refrigerate the bottles to retard bacterial growth, but, because the published reviews do not indicate whether any precautions are taken, a reader who is not educated in microbiology would remain uninformed of the risks.

Many recipes that are published in the media come directly from restaurant chefs and do not mention the botulism risk *(5, 6, 8, 13, 21, 23, 27, 32, 34, 35, 37, 40, 46)*. One such reference, which includes "Healthier Eating Habits" in the title, says: "A basic recipe could read: 'take any aromatic substance, such as a vegetable. Chop it up,

add some pepper, put the ingredients in a jar, and cover with oil. Let steep for a few hours or days, and presto! The variations can be endless'" *(8)*. This same article continues, "Moreover, infused oils have a long shelf life, as much as six months, depending on the ingredients." Another mentions leaving the ingredients in the oil for a week to "rest" *(27)*. Certainly the word "botulism" would likely make most readers turn the page to another recipe, but the need to add an acidifying agent could be stressed, without including the gory details of muscle paralysis and death from asphyxia.

NEED FOR PUBLIC EDUCATION

Some published references do address the botulism issue but fall short of the safety mark in one way or another *(2, 4, 7, 20, 30)*. A popular cookbook *(46)* suggests leaving a garlic-in-oil preparation uncovered, so that botulism won't develop, erroneously suggesting that air on the surface of the oil will provide an oxygen-rich atmosphere. An article in the *New York Times (27)* correctly indicates that oil is no longer sterile after being infused, but wrongly states that when tightly covered and stored in the refrigerator these infusions are safe for several weeks or months. *Parade Magazine* published a correction to an oil infusion recipe, suggesting that one tablespoon of white vinegar should be added per cup of oil, after which the mixture should be shaken, stored in the refrigerator, and kept for only three days *(20)*. This correction is commendable, but botulism is never mentioned, so again the uneducated reader remains uninformed of the urgency involved with this critical step. Only rarely does an article mention the botulism risk and address it correctly *(19, 22, 31)*.

Food editors, chefs, cookbook authors, and restaurant critics need to understand the potentially life-threatening hazard of oil infusions, while keeping perspective and realizing that many people will continue to make these preparations in spite of any possible risks. Readers should be educated about the risks and advised about certain precautions, that will greatly decrease the risk of botulism (Table 1).

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Dairy, Food and Environmental Sanitation, Vol. 18, No. 7, Pages 442-444

Reprinted from *California Morbidity*, March 1998

Health Hazards of Ozone-generating Air Cleaning Devices

Ozone-generating devices are being marketed to the public as a solution to indoor quality problems. Ozone generators are available in three forms: in-duct units for central air systems, portable indoor units, and personal units that are worn on the body. They are promoted as effective "air purifiers," especially to people sensitive to indoor air pollutants. Manufacturers often refer to the ozone as *activated oxygen, trivalent oxygen* or *nature's air purifier* to suggest that it is safe. They advertise ozone's ability to oxidize indoor air pollutants and "leave only carbon dioxide, water, and breathable oxygen." However, independent studies have shown that ozone generators do **not** effectively destroy microbes, remove odor sources, or reduce indoor pollutants enough to provide any health benefits. More alarming, these devices can generate excessive levels of ozone and may contribute to eye and nose irritation or other respiratory health problems for users.

HEALTH HAZARDS OF GROUND-LEVEL OZONE

Ozone in the upper atmosphere (or stratospheric ozone) is naturally occurring and environmentally beneficial; it shields the earth's surface from the sun's harmful ultraviolet light. It is important not to confuse this with the fact that ozone in the earth's lower atmosphere, where we live and breathe, is a harmful air pollutant. Ground-level ozone is regulated by Federal and State Clean Air legislation. The California Ambient Air Quality Standard for ozone is 90 parts per billion (ppb) averaged over one hour. The federal regulation is in transition; a new standard of 80 ppb for 8 hours is being phased in to replace the existing one-hour standard of 120 ppb.

The state and federal standards are supported by documented health effects of ozone measured in human and animal studies; these are summarized in a number of government reports *(1, 2, 3)*. Exposures to ozone concentrations can cause various health effects *(4, 5)*:

- Moderate levels can irritate the eyes, nose, throat, and lungs;
- Low-level exposures have been shown to cause significant temporary decreases in lung capacity in healthy, exercising adults.
- Some asthmatic individuals are especially susceptible to ozone toxicity, which includes constricting airways.
- Short-term exposures can cause increased sensitivity to airborne allergens and other irritants, and it can impair the body's immune system.
- Summertime ozone episodes in the northeastern U.S. lead to 10 to 20% increases in hospital admissions and emergency room visits.
- Human population studies of long-term exposures to low-level ozone indicate that it may lead to permanent reduction in lung capacity; animal studies have shown chronic high-level exposures can cause lasting structural damage in the lungs.
- Children, especially asthmatics, are most at risk from exposure to ozone.

ARE OZONE-GENERATING AIR CLEANERS SAFE AND EFFECTIVE?

The permissible exposure limit for ozone in the workplace is 100 ppb for 8 hours *(6)*. The U.S. Food and Drug Administration (FDA) has set the limit for ozone produced by medical devices at 50 ppb. Ozone is often used **in water** to kill microbes. However, it is not effective **in air** as a biocide (i.e., killer of bacteria and fungi), except at extremely high, unsafe levels *(7)* (e.g., more than 3000 ppb). Ozone's effectiveness to oxidize chemical air pollutants "to leave only carbon dioxide, water, and breathable oxygen" is also unproven. A number of independent studies have concluded that safe levels of ozone **do not** effectively

oxidize air pollutants or improve indoor air quality *(8, 9, 10)*. Over the last 20 years, billions of dollars have been spent in this country to reduce levels of smog and its main ingredient, ozone. Ironically, ozone generators are being marketed heavily as a means to "purify" indoor air.

An even greater concern about the use of ozone generators is that they can readily produce **unsafe** ozone levels in the rooms they are used. Numerous studies on commercial and residential units have found that the devices produce room concentrations far in excess of the FDA, worker, and outdoor air standards *(11, 12, 13, 14)*. While most units on the market can produce dangerous levels of ozone, few include controllers to prevent ozone levels from exceeding safe limits. Some new models have "ozone sensors," but their effectiveness has not been independently evaluated. Ozone gas initially produces a sharp odor; however, it dulls the sense of smell after a brief period of continuous use. Hence, perceived odor is not a reliable indicator of ozone's presence.

Questions often arise whether ozone air cleaners are appropriate for use in **unoccupied** spaces. They are sometimes promoted to treat homes, furniture, and clothing after fires to remove smoke odors. Ozone is a strong oxidizer that will accelerate the degradation of rubber, upholstery, paints, and other materials. Hence, even when used in unoccupied areas, ozone generators can cause damage to building materials and electronic devices.

RECENT ACTIONS

The California Department of Health Services (DHS) issued a warning about ozone air cleaning devices in April 1997 *(15)*. In recent years, Minnesota, North Carolina, and Florida have taken a variety of actions to prevent public health hazards from ozone generators in their states. On December 30, 1997, the Federal Trade Commission (FTC) filed suit against the industry's leading manufacturer (Alpine Industries, Inc.) for violating their 1995 consent order with FTC *(16)*. The 1995 order required that ozone generator manufacturers halt their practice of making unsupported, misleading health claims about the ability of their products to remove indoor air pollutants and prevent or relieve allergies, asthma and other conditions. In addition, the manufacturers had been required to stop making unsupported claims that their devices are more effective than other air cleaning methods and that they do not create harmful by-products. The current FTC action alleges that Alpine Industries has continued these practices. Related complaints can be directed to the FTC *(17)*.

SAFER, MORE EFFECTIVE AIR CLEANERS ARE AVAILABLE

The **best** way to resolve indoor air quality problems is to remove the pollutant sources or prevent emissions in the first place. Improving fresh-air ventilation is also beneficial. When an air cleaner is needed, safe and more effective models are available that can remove air contaminants **without** the health risks caused by ozone. These devices can use high efficiency particle arrestance (HEPA) filters, activated carbon, electrostatic precipitators, and/or particle ionizers (Note: precipitators and ionizers can generate low levels of ozone). Evaluations of household air cleaners have been published by the *Consumers Report (14)*, the American Lung Association (ALA) *(18)*, and U.S. Environmental Protection Agency (EPA) *(19)*. The former two reports give explicit warnings against ozone-generating devices. *The Consumer Reports'* authors conclude, after performing tests, that they "wouldn't recommend an ozone generator even as a last resort."

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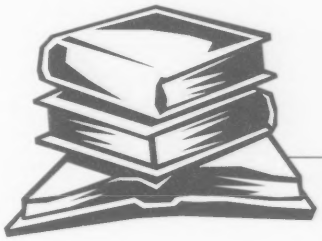
Reported by: Jed M. Waldman, Ph.D. Indoor Air Quality Section, California Department of Health Services, 2151 Berkeley Way, Berkeley, CA 94704; E-mail: waldman@wenet.net; and Tom Phillips, Indoor Air & Exposure Assessment Program, California Air Resources Board, P.O., Box 2815, Sacramento, CA 95812; E-mail: tphillip@arb.ca.gov.

Dairy, Food and Environmental Sanitation, Vol. 18, No. 7, Page 445

Book reviewed by: Ebenezer R. Vedamuthu, Ph.D., Chief Microbiologist, Quest International Flavors & Food Ingredients Co., Rochester, MN

Book Review



Applied Dairy Microbiology

Edited by: Elmer H. Marth and James L. Steele, University of Wisconsin, Madison, Wisconsin

As the editors state in their introduction, this book is intended to serve as an update to earlier books on dairy microbiology. The last edition of the two standard texts on dairy microbiology came out in 1957. So there is a definite need for a book to update information on this branch of science. The book includes selected topics where new developments and emphasis have taken place because of market trends and breakthroughs in science and technology. The selected topics are addressed in individual chapters written by different authors, who are recognized experts in those areas. The chapters are well organized and written in lucid style, and are very informative. In general, this book largely meets the intent of the editors.

The largest chapter in the book deals with the pathogens found and transmitted through dairy products. Although the issues addressed in this chapter are important, the chapter could have been considerably shortened by emphasizing only the newly emerging pathogens. More emphasis could have been given to the two topics covered in Chapter 7 in the book. With the explosive growth in the knowledge on the physiology, metabolism and genetics of dairy starter bacteria over the past two decades, metabolism could have been treated in one chapter, and genetics in another. This way these two topics could have been discussed in greater detail and depth. Because worldwide interest in the genetics of dairy starter bacteria is a relatively recent phenomenon, an introduction to molecular biology and a historical account of the development of this exciting area of study would have been valuable for undergraduate students, and interested workers in the dairy industry. Physiological studies on starter bacteria, expanding understanding of their metabolism, fundamental knowledge of their enzymatic systems, and emerging possibilities in metabolic engineering of starter bacteria could have been discussed in a separate chapter devoted to metabolism and physiology. But on a whole, this book will fill the void that has been felt over the years in prescribing a suitable updated text for dairy microbiology, and as a reference for those working with dairy products in the industry.

For copies of *Applied Dairy Microbiology*–

Mail requests to: Marcel Dekker, 270 Madison Ave., New York, NY 10016-0602; Phone: 212.696.9000; Fax: 212.685.4540.

Highlights of the Executive Board Meeting
May 17-18, 1998
Des Moines, Iowa

Following is an unofficial summary of Executive Board actions from the IAMFES Executive Board Meeting:

Approved the following:

- Minutes of February 1-3, 1998 Executive Board Meeting.
- Minutes of February 1 and 2 Executive Session.
- Votes taken by E-mail since the February 1998 Meeting.
- Co-sponsorship of the NSF Food Safety Conference.
- Budget for Fiscal Year Ending August 31, 1999.
- Implementation of short and long-term disability coverage for IAMFES employees.
- Deferred setting a contribution percentage for the IAMFES' employees' retirement plan until the fall 1999 Executive Board meeting.

Discussed the following:

- Long range planning.
- Update on the timeline for a proposed Association name change to International Association for Food Protection.
- Secretary election results – James Dickson, Iowa State University elected.
- Membership update – Member cards and certificates, tiered level program for Sustaining Members, recognition for 30 + year Members.
- Quality check procedures for Journal mailing labels.
- IAMFES' Web site – Annual Meeting program and information, links, listserv, and Membership directory online.
- Update on the role of IAMFES in the fall '98 ILSI sponsored conference.
- Report from the IAMFES advertising sales representatives.
- Revisions to the IAMFES Employee Manual.
- *Journal of Food Protection* MS #97-68.
- Improvements in *Journal of Food Protection* copy-editing backlog.
- Annual Meeting Commercialism Policy and if it applies to IAMFES Journals.
- Executive Board Member attendance and presentations at Affiliate Meetings.
- Suggestions for June 1998 Affiliate newsletter.
- Recognition of Affiliate-sponsored students at the Annual Meeting.
- Good response received from Affiliates of their required Annual Reports.
- Update on progress by the Committee on Communicable Diseases Affecting Man on revising the Procedures to Investigate Foodborne Illness manual.
- IAMFES Members to chair Committees, Professional Development Groups, Task Forces, and Support Groups.
- Agenda for the Past Presidents' Advisory Committee meeting.
- Report on the IAMFES HACCP Workshop held in San Francisco, California.
- 1998 IAMFES Annual Meeting Workshops.
- 1998 IAMFES Annual Meeting planning.
- Planning for 1999, 2000, 2001, 2002 and 2003 IAMFES Annual Meetings.

THE IAMFES FOUNDATION FUND WILL BE SPONSORING A SILENT AUCTION AT THE 85TH ANNUAL MEETING!

WATCH FOR ADDITIONAL INFORMATION ON THE SILENT AUCTION

We are looking for members to donate items for the Silent Auction. All proceeds go to the IAMFES Foundation Fund.

What is the IAMFES Foundation Fund?

The Foundation Fund is supported by membership of IAMFES sustaining members and from individual members. Sustaining members are corporations, companies, and individuals whose business interests reflect the goals and mission of IAMFES. Funds in the Foundation are kept separate from the operating funds of IAMFES and are used for worthy causes which enrich the Association.

The Foundation Fund supports:

- Ivan Parkin Lecture
- Audio-Visual Lending Library
- Co-sponsorship of the Crumbine Award
- Developing Scientist Oral and Poster Competition
- Shipment of volumes of surplus *JFP* and *DFES* journals to developing countries through FAO in Rome
- Recruitment of exceptional speakers for the IAMFES Annual Meetings

Why should I contribute to the IAMFES Foundation Fund?

Any contribution, no matter how large or small will help build a secure Foundation for the future of IAMFES. The future of IAMFES depends on how well we can meet the needs of our membership in providing educational programs, journals, products, and services, and on how well IAMFES fulfills its mission. The Foundation Fund was created to provide a long-lasting legacy of information and service for protecting the milk, food, water, and environment throughout the world.

If you would like to donate to the Foundation Fund and/or the Silent Auction, please contact Lisa Hovey at 800.369.6337; 515.276.3344; Fax: 515.276.8655; or E-mail: lhovey@iamfes.org.

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UpDates

The Educational Foundation Announces Appointments of Product Development Managers

The Educational Foundation of the National Restaurant Association announces the appointments of Tim Darden, Manager, New Media Development and Randall Towns, Product Development Manager-Instructional Design.

Tim Darden comes to The Foundation from the McDonald's Corporation, where he served as New Media Producer. He currently serves as an instructor of multimedia production classes at the College of DuPage in Glen Ellyn, Illinois. In his new role, Darden will manage the design, development and maintenance of technology-based training products, as well as ensure that all educational product development efforts meet industry standards. Darden holds a bachelor of science degree in communications from Indiana University, Bloomington, IN.

Randall Towns joins The Foundation from NUMETRIX, where he served as Senior Solutions Instructor implementing training programs for such clients as Procter & Gamble, Starbucks, Kimberly-Clark, Nabisco, Kraft, and General Electric. In his new position, Towns will provide direction to product development staff and oversee new and continuing training and educational products to better meet and serve the needs of both the industry and academic markets. Towns received both his master's degree in industrial technology and bachelor of science degree in organizational leadership from Purdue University.

Osmonics Announces New District Manager for Asia-Pacific

Osmonics recently announced their new District Manager, James P. Labonte, with their new liaison office in Japan. With the introduction of Mr. Labonte, Osmonics is focusing on serving its customers better, as well as expanding its network of distribution. The office is located in a busy area called Chiyoda-Ku, just minutes by train from the heart of Tokyo.

James graduated from the University of Massachusetts with degrees in electrical engineering and Japanese. Prior to joining Osmonics, James has been living in Japan for four years and has worked for IES, Kenwood, and Sanko Trading Ltd., a distributor of Desal™ products.

Walker Stainless Equipment Names Ron Larson General Manager for Stationary Products Group

Walker Stainless Equipment Co., Inc., announces the appointment of Ron Larson as General Manager of the Stationary Products Group. Ron Larson is currently Vice President of Walker Stainless and also serves as the General Manager of Walker's Stainless Steel Components Group. He was also the Operations Manager for the Stationary Products Group prior to this appointment.

Walker Stainless Equipment Company, Incorporated is a subsidiary of Carlisle Companies, Incorporated headquartered in Syracuse, New York. Carlisle is a diversified manufacturer of products for transportation equipment, general industry equipment, and construction materials.

Sensitech Inc. Names Eric B. Schultz as Chairman and CEO

Sensitech, Inc. Chairman and CEO, Ernest M. (Sandy) Santin announced that Eric B. Schultz, President and CEO, has been named his successor. The promotion will take effect immediately.

Founded by Santin in 1991, Sensitech is now the leader in providing innovative, knowledge-based systems for ensuring product quality.

"I am pleased both by the promotion and by the fact that Sandy will remain on Sensitech's Board and serve the company in a consulting capacity," says Schultz. "We have an excellent management team in place and we see strong continued growth in all of our major segments in 1998."

Serac, Inc., Promotes Patrick A. Johnson to Regional Sales Manager for Midwest

Serac, Inc. announces the promotion of Patrick A. Johnson to Regional Sales Manager. In his newly appointed position, Johnson will assume all communication responsibilities with current and potential customers throughout the Midwest. During the past two years, Johnson has served Serac as Sales Engineer. Johnson's in-depth knowledge of Serac filling capabilities and services will be of great benefit as he works directly with customers and manufacturer's representatives.

Johnson obtained his bachelor of science degree from Eirnhurst (IL) College. Johnson's extensive knowledge of the packaging industry will enhance the Serac commitment to solve customer problems.

In working directly with the end user, Johnson will be continuously monitoring the ever-changing requirements of Serac customers. Through this pro-active position, Johnson will provide Serac the information required to better serve and react to customers' specific needs.

O'Dea Named IAFIS Director of Communications

The International Association of Food Industry Suppliers have announced the promotion of Mary G. O'Dea to Director of Communications. O'Dea has been with the association as Manager of Communications since 1993.

O'Dea's responsibilities include editing the association's monthly newsletter The Reporter, promotion of Worldwide Food Expo, and generating publicity for the association and its programs and activities. She is also very instrumental in the association's Internet activity including IAFIS.Org and WorldFood Net.Com.

O'Dea began her career at CBS News in New York in 1980, worked at Mediamark Research from 1989 to 1992, and then joined the National Information Technology Center as Director of Public Relations.

A resident of Vienna, VA, O'Dea received her bachelor of arts in communications from the State University of New York at New Paltz. She and her husband John have two children, Danny and Clare.

International Food Safety Council Appointment of Elizabeth Shaw Gescheidle as Vice President

The International Food Safety Council announces the appointment of Elizabeth Shaw Gescheidle as Vice President.

In her new role, Gescheidle will report to and work closely with President John Farquharson, FMP, and will have responsibility for the day-to-day management of the Council and for maintaining sponsor relationships. Previously, Gescheidle was the Manager of Industry Relations for the Council.

She holds a bachelor's degree in communications from the University of Michigan, and is the Past President of the University of Michigan Club of Chicago and the past National Secretary for the university's Alumni Association in Ann Arbor, Michigan. Gescheidle has also served on the board of directors for the Multicultural Foodservice and Hospitality Alliance, is a member of the Women's Foodservice Forum (WFF), and is active in the International Foodservice Manufacturers Association (IFMA).

Blum Joins Elgin Dairy as Commerical Sales Manager

Chicago-based Elgin Dairy Foods, Inc. has announced the appointment of Daniel A. Blum as Commercial Sales Manager. He will handle the in-store bakery, distributor and ingredient manufacturing segments of the whip topping market in the Western United States for Elgin.

Blum joins Elgin with 14 years experience in the dairy and non-dairy toppings business, covering the North American foodservice, bakery and ingredients industries. In addition, he has been a member of the board of directors of the Chicago Foodservice Marketing Association and a committee member of the IFMA Small Business Advisory Board. Born and raised in East St. Louis, IL, he holds a bachelor's degree in business administration from Benedictine College in Atchison, KS. He, his wife, Patti and their two children reside in suburban Glen Ellyn.

Ruda to Head ADPI Cheese Division

Mr. Kevin J. Ruda, President, Beatrice Cheese, Inc. Waukesha, WI, unanimously was reelected Chairman of the cheese division of the American Dairy Products Institute at the Division's meeting held on April 28, 1998. The meeting was attended by representatives and friends of members of the cheese division.

The Division cooperates with government agencies and other interested organizations on matters of mutual interests. Among programs initiated and now ongoing on behalf of its members are the following: Codex International Standards for cheese products; consideration of microbiological standards for cheese; evaluation of existing Standards of Identity and Grade Standards for cheese and cheese products; and, initiation of an industry-wide program to assist USDA in reliably reporting cheese storage data.

Smith Receives IAFIS Distinguished Service Award

Dick Smith, currently with the American Dairy Products Institute, was selected by The International Association of Food Industry Suppliers (IAFIS) to receive the industry's Distinguished Service Award at the IAFIS Annual Conference on April 7th.

Dick Smith is a professional Engineer with more than 35 years of experience with Kraft Foods in the refrigerated food and dairy product industry. During his career with Kraft he developed extensive knowledge in process engineering for natural and processed cheese and became an expert in 3-A Sanitary Standards. It is for his work on the 3-A Standards Committees that he has been honored with the Distinguished Service Award.

Smith began his participation in 3-A activities in 1965 by participating in task committee work to write standards for batch pasteurizers, batch processors and silo milk tanks. In 1987, he became the National Cheese Institute's representative to 3-A and then in 1992, was appointed Chairman of 3-A, a position that he still holds.

New Data on *Salmonella* Seen as Proof of Broiler Industry Commitment to Improvement

New Department of Agriculture data showing the lowest levels ever for *Salmonella* on raw chickens are proof of the industry's commitment to continuous improvement in microbiological quality, according to Kenneth N. May, Ph.D., Technical Advisor to the National Broiler Council.

Tom Billy, Administrator of the USDA's Food Safety and Inspection Service, announced at a congressional hearing that government testing showed only 9.44 percent of the chickens sampled were positive for *Salmonella*, down from 16 percent last year. The tests are extremely sensitive, and a single *Salmonella* cell on the chicken can trigger a positive finding. Under current USDA rules, processing plants are expected to produce chickens of which no more than 20 percent are positive. *Salmonella* rates have dropped from 50 percent in the 1980s to 20 percent in the USDA baseline study in 1996 to 16 percent in 1997 to less than 10 percent now.

Dr. May said processing plants have achieved better results by installing new equipment, modifying their procedures, and adopting new antimicrobial interventions.

In his comments, Billy gave the industry credit for its success under the Hazard Analysis and Critical Control Points (HACCP) program. "Industry has stepped forward and accepted the challenge by developing new technologies and programs for their HACCP plans," Billy told the subcommittee on dairy, livestock and poultry of the House Agriculture Committee. "The industry has risen to the occasion every time, and commend them for that."

NEWS

Study Shows Chlorinated Water Dramatically Cuts Strawberry Contamination

Washing strawberries with chlorinated water significantly cuts levels of bacteria, hepatitis A virus and other viruses that indicate possible contamination by animal or human wastes, according to a new study.

The research, conducted at the University of North Carolina at Chapel Hill (UNC-CH), showed that after five minutes' exposure to water containing 10 parts per million of chlorine, between 90 and 99 percent of the disease-causing contaminants had disappeared. Graduate student Michael J. Casteel and his mentor, Dr. Mark Sobsey, Professor of Environmental Microbiology at the UNC-CH School of Public Health, performed the study. They presented their findings May 21 at an American Society for Microbiology meeting in Atlanta. "Contaminated produce has become an important source of foodborne disease in the United States and worldwide," Sobsey said. "Many produce commodities that could become contaminated with human and animal wastes are eaten raw and unprocessed." Raspberries, strawberries, lettuce, and basil leaves have caused outbreaks of foodborne viral and parasitic diseases such as gastroenteritis and infectious hepatitis. Last spring, for example, contaminated strawberries, distributed through U.S. Department of Agriculture-sponsored school lunch programs, caused an outbreak of infectious hepatitis A that sickened more than 150 children and school workers in Calhoun County, MI.

In their experiments, the UNC-CH researchers washed strawberries in the chlorine solution and then used a simple but efficient method of recovering any remaining microbes to determine how effective washing had been. They

found their method "highly successful" in eliminating most viruses and bacteria. "Our work is important because it demonstrates for the first time that hepatitis A virus can be inactivated on strawberries by a simple chlorination procedure," Sobsey said. "This will make it possible to reduce levels of the virus and contamination from bacteria like *E. coli* on strawberries and probably other produce as well and in so doing dramatically cut the risk of infectious enteric diseases from fecally contaminated fruits and vegetables."

The strawberry industry has begun implementing the chlorination procedure the UNC-CH researchers identified as effective. In California at least, the treatment may become standardized and required. Sobsey recommends that consumers wash fruits and vegetables that will be eaten raw, especially those from developing countries in Central and South America, for up to 10 minutes in a gallon or two of cold water containing a half teaspoon of Clorox bleach. After soaking, the produce should be thoroughly rinsed in cold tap water. "We believe that this research needs to be expanded to determine chlorination efficiency against other disease-causing organisms like *Salmonella* bacteria and other viruses and to other types of produce such as tomatoes and apples," he said.

The Clorox Co. and Ramsey-SIAS, an agricultural processing company, supported the UNC-CH research in cooperation with the California Strawberry Commission and the Processed Strawberry Advisory Board of California.

Fight BAC Campaign

In support of the President's National Food Safety Initiative, FIGHT BAC™, a new multi-year campaign to reduce the incidence of foodborne illness by educating Americans about safe food handling practices, was created by the Partnership for Food Safety Education, a public-private partnership composed of government, industry, and private organizations.

The campaign was launched last fall with an initial goal of conveying four key principles of food safety: washing hands and cooking utensils; preventing cross-contamination; cooking to proper temperatures; and storing food correctly. The following site and materials are available on the WWW.

FIGHT BAC Campaign, URL is: www.fightbac.org; Community Actions Kits, available in Adobe Acrobat; Portable Document Format (PDF) Files; URL is: www.fightbac.org/new/index.html; Supermarket Kits, available in Adobe Acrobat PDF; URL is www.fightbac.org/new/index.html Adobe Acrobat Reader, free software available for Macintosh, Windows, DOS, and UNIX systems, is required to read Portable Document Format (PDF) files. With Acrobat Reader, PDF files can be seen on the screen (and printed) in the exact format created by the document developer. The Adobe Acrobat Reader is freely available to the public and may be redistributed and can be obtained from either of the following URLs: www.adobe.com.proindex /acrobat readstep.html; www.fda.gov/~frf/pestload.html.

HACCP Implementation Update

Since January 26, 1998, the Food Safety and Inspection Service (FSIS) is requiring that the nation's largest meat and poultry plants implement new science-based Pathogen Reduction and Hazard Analysis and Critical Control Point (HACCP) Systems. The approximately 312 plants now under HACCP regulations represent 75 percent of slaughter production and 45 percent of processed meat and poultry products such as frozen dinners, weiners, or hams. Another 3,000 small plants will come under HACCP regulations in January 1999, and the remaining approximately 3,000 very small plants will implement HACCP in January 2000. This Update addresses FSIS efforts to refine its HACCP implementation strategy to assist plants coming online or currently operating under HACCP regulations. The URL is: www.usda.gov/fsis/haccpup2.htm.

HACCP and Retail

Managing Food Safety: A HACCP Principles Guide for Operations of Food Establishments Retail Level A new draft document intended to guide operators in voluntarily applying HACCP principles in food establishments in the retail segment, will be trial tested in a structured FDA pilot. The URL is: www/fda.gov~dms/hret-toc.html FDA Announces Pilot Food Safety Program for Retail Settings Press Announcement Expanding on the Clinton Administration's initiatives to ensure the safety of America's food supply, the FDA has asked for volunteers from the retail sector of the food industry to participate in a pilot program designed to reduce the risk of foodborne illness. The URL is www.fda.gov/bbs/topics/NEWS/NEW00638.html.

National Food Safety Initiative

The1999 National Food Safety Initiative and the executive summary "Food Safety From Farm to Table: A National Food Safety Initiative" which describes the consolidated multi-agency plan for improving food safety can be obtained at www. cfsan.fda.gov~dms/fs-bud99.html.

On October 2, 1997, President Clinton announced a plan, entitled "Initiative to Ensure the Safety of Imported Fruits and Vegetables," to provide further assurance that fruits and vegetables consumed by Americans imported from other countries meet the highest health and safety standards. In response

to this directive, FDA and USDA have issued "Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables" which addresses microbial food safety hazards and Good Agricultural Practices (GAPs) common to growing, harvesting, packing, and the transporting of most fruits and vegetables that are sold to consumers in an unprocessed or minimally proceesed (raw) form. This can be obtained at www/fda.gov/~dms/prodguid.html HACCP FOR JUICES.

Illinois Firm Agrees to Reopen Under USDA Terms

Foremost Packing Co., an East Moline, IL, meat slaughter and processing firm has entered into a Consent Decision and Order under which the firm was allowed to resume operations, the U.S. Department of Agriculture's Food Safety and Inspection Service said.

William McDermott, Foremost's President, agreed to terms set out in a Consent Decision, entered March 27, 1998, with FSIS. Operations at the establishment shut down by USDA on Dec. 11, 1997 resumed on March 31, 1998.

Prior to the resumption of inspection, Foremost provided FSIS with a revised written sanitation standard operating procedure (SSOP) and collection procedures for generic *E. coli*, and the firm destroyed for human food purposes about 58,338 pounds of pork products that had been detained by FSIS. Also, all Foremost employees responsible for the handling of swine are to be trained in the applicable requirements for the humane handling of swine.

Beginning 60 days from the issuance of the Consent Decision, Foremost will have monthly assessments of its food safety control systems conducted by a qualified independent third party. The monthly assessments will include the implementation of Foremost's SSOP, *E. coli* testing procedure, and compliance with sanitation regulations. The assessment will include a report of findings and any recommendations, which will be made available to FSIS. The provisions of the Foremost Consent Decision will apply for 10 years.

If certain provisions are violated during that time, FSIS can summarily withdraw inspection. The USDA regulatory action resulted from the decision by FSIS officials to withhold the use of the marks of inspection at the firm in December, based on their determination that there were system failures that led to unsanitary conditions such that any meat or meat food product produced would be adulterated.

Naturally Occurring Substances Exhibit Antimicrobial Activity in Food

According to the Council for Agricultural Science and Technology (CAST), an international consortium of 36 scientific and professional societies, many biologically derived substances exhibit antimicrobial properties in the foods in which they normally are found or may be developed for commercial use as additives to other foods requiring preservation.

Food preservation is becoming ever more critical to the survival and well-being of humans. The importance of food safety to the public is evidenced by major actions taken by U.S. federal, state, and local health and regulatory authorities in recent years. These include the new regulations for meat, poultry, and seafood inspection, as well as President Clinton's 1997 Food Safety Initiative. Among the approaches employed in achieving food preservation by inhibiting growth of undesirable microorganisms, is the use of chemical agents exhibiting antimicrobial activity. These chemicals may be either synthetic compounds intentionally added to foods or naturally occurring, biologically derived substances.

"Consumer perception that use of industrially synthesized food antimicrobials may be associated with potential toxicological problems has generated interest in the food industry for the use of naturally occurring compounds," states Dr. John N. Sofos, Professor of Animal Sciences at Colorado State University and Chair of the recently released CAST task force report *Naturally Occurring Antimicrobials in Food*. "Commonly used synthetic antimicrobials also are found naturally in many food products, and their toxicological safety as food additives is ensured by regulatory authorities." However, interest in so-called *natural foods* has generated interest in, and incentive for, development and use of naturally occurring antimicrobials in foods.

Numerous naturally occurring antimicrobial agents are present in animal and plant tissues, where they probably evolved as part of their hosts' defense mechanisms against invasion by microorganisms. Natural antimicrobials can be derived from barks, stems, leaves, flowers and fruits of plants, various animal tissues, or from microorganisms. Noted sources of natural antimicrobials are herbs, spices, fruits, milk, eggs, and lactic acid bacteria used in food fermentation.

Naturally occurring antimicrobials could be useful as individual factors or hurdles in multifactor food preservation systems. The CAST report discusses the chemistry, occurrence, activities, mecha-

nisms of action, uses, application potential, and research and development needs of naturally occurring antimicrobials.

Examples of antimicrobials of natural origin that have been approved and have found certain uses include egg-white lysozyme, hydrogen peroxide, ethanol, the antibiotic natamycin, and the bacteriocin nisin.

For more extensive use of natural antimicrobials, there is a need for research to examine their efficacy and functionality in models of food systems and foods; toxicology and safety in food formulations; interactions with food components and other preservative systems; mechanisms of action against microorganisms; influences on food quality (e.g., nutritional and sensory); methods for application in commercial formulations; and extraction, isolation, and economical production.

Naturally occurring antimicrobials are abundant in the environment. The desire for expanded use is obvious, especially in light of consumer demands for minimally processed, safe foods of adequate shelf life and convenience, and the global need for increasing the supply of food. With availability of economical food preservation systems based on natural antimicrobials, the world will have an additional weapon in the struggle against hunger.

AFFI Applauds Efforts to Streamline Meat and Poultry Inspection Process

In comments submitted to the U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS), the American Frozen Food Institute (AFFI) endorsed a proposed policy change which will remove some federal regulations within the meat and poultry inspection process, allowing processors to have greater flexibility in the day to day operations of their businesses.

Under the change, FSIS intends to consolidate sanitation rules further by eliminating prior approval requirements for all nonfood compounds and proprietary substances, such as cleaning agents and pesticides, used in federally inspected meat and poultry establishments. AFFI indicated its support of FSIS' effort to reduce federal regulatory layering, while working with the food industry to maintain the United States' reputation for a safe and most wholesome food supply.

AFFI also addressed potential concerns which may arise once the policy change is implemented. AFFI wrote, "Inspected establishments cannot continue to be subjected to *de facto* requirements at the plant level after this policy shift enters into effect. Such additions would undercut the agency's efforts to place responsibility for these decisions on industry, where it properly belongs."

AFFI will remain committed to charting the agency's progress in reducing burdensome and unneccessary regulations. In concluding comments, AFFI offered its assistance on other issues of mutual interest to FSIS and the frozen food industry.

Industry**Products**

La-Man Corporation

La-Man Now Offering Filter Replacement Service Kits

La-Man Corporation is now offering convenient and complete filter replacement service kits for its line of Extractor/Dryers®. Routine filter replacement keeps compressed air systems running efficiently, and maintains optimum operational effectiveness. If filters are not changed regularly the air pressure entering air-operated equipment gradually decreases and, consequently, tools do not perform up to normal standards. Also, clogged filters are ineffective at removing oil, water and contaminants. An optional slider gauge is available from La-Man that indicates via a color change, when filters need to be replaced.

Kits are available for La-Man's complete line of filtration products and include first and second stage elements, a base core and all gaskets and seals. For added flexibility, La-Man's kits are also compatible with DeVilbiss units D1053 and D1103.

The filters in all La-Man Extractor/Dryers are easy to replace, with no need to remove the Extractor/Dryer to replace the elements. Simply loosen the top bolts a few turns, remove the comer bolts and the tubes containing the elements inside slide right out. Insert the new elements, return them to the Extractor/Dryer and retighten the bolts.

All modularly designed La-Man Extractor/Dryers feature a three-stage filtration system that removes harmful moisture, oil and contaminants from compressed air lines. In the first stage, a coalescing effect occurs as compressed air passes through a cartridge mesh filter that captures larger contaminants and causes moisture to form larger droplets. In the second stage, the air enters a quiet zone with a honeycomb base where the water droplets collect for drainage. In the third stage, air passes through a wire supported fiber filter cartridge where any remaining moisture and contaminants are dried and filtered. The result is clean and dry exhaust air that won't disrupt air equipment operation.

All La-Man Extractor/Dryers come standard with a 5-micron rating, with lower micron ratings available.

La-Man Corporation, Port Orange, FL

Reader Service No. 301

New Tecra® *S. aureus* Kit Offers Superior Sensitivity, Next-Day Results in Convenient Microtiter Format

An estimated 14% of all foodborne outbreaks and 1 to 2 million cases of food poisoning in the U.S. each year are caused by the toxins produced by *Staphylococcus aureus*. Meat, meat products, prepared salads, cream-filled baked goods, and cheeses have all been implicated as sources of *S. aureus* contamination. Particularly vulnerable are foods processed without heat treatment, such as fermented meats and dairy products. Even very low levels of toxicity induce illness in humans, requiring a highly sensitive detection method to identify contaminated product.

Testing for this critical food pathogen has traditionally been time-consuming and cumbersome, requiring 2 or more days via the culture method. International BioProducts announces a better way, the new Tecra® *S. aureus* via. This latest Visual Immunoassay kit from TECRA Diagnostics delivers results in only 24 hours, while increasing detection sensitivity as much as 250 times over traditional direct plating methods. The kit detects coagulase-positive and coagulase negative *S. aureus* strains, both of which produce toxins hazardous to humans.

The *S. aureus* via continues the Tecra® tradition of rapid, convenient, sensitive and specific pathogen testing. The kit uses just one overnight enrichment, followed by a simple 1.5 hour ELISA test in a microtiter well. Results may be read visually, or through the use of a microtiter plate reader. A fully-automated system to run the *S. aureus* via kit alongside other Tecra Via kits is also available.

If *S. aureus* is detected, positive results can be immediately assayed for toxins from the same enrichment, using the Tecra® Staphylococcal enterotoxin set via kit. Alternatively, all enrichment samples can be tested using the set kit as a means of detecting all enterotoxin-producing Staphylococci, including non-*S. aureus* strains. This allows the analyst to determine in just one day if the *S. aureus* strains present are capable of producing toxins. These strains are of the greatest concern for public safety.

The *S. aureus* via is part of a full line of Tecra's diagnostic tests available from International BioProducts, which also includes kits for the rapid detection of *Salmonella* spp., *Listeria* spp., *E. coli* O157, and Bacillus diarrhoeal and Staphylococcal enterotoxins.

International BioProducts, Redmond, VA

Reader Service No. 302

IDEXX Food Safety Net™

The IDEXX Food Safety Net is an expanding network of products, consultants and services designed to help improve food quality programs. It includes laboratory, consulting and educational services. It also includes products such as *LIGHTNING*® ATP-bioluminescence system for verifying plant cleanliness; SimPlate™ family of rapid, easy-to-read micro tests for total bacteria, coliforms/*E. coli*, and yeast and mold; BIND® 22-hour *Salmonella* test; and 350 Acumedia™ high-quality dehydrated culture media.

IDEXX Laboratories, Inc., Westbrook, ME

Reader Service No. 303

Complete Text of the 1997 FDA Food Code Available on Disk

All Quality Assurance Products is introducing the complete text, all 900 pages, of the Food and Drug Administration's 1997 Food Code, on disk. The software is available for Windows 3.1 and up or Windows '95. It is easy to use, no computer experience is necessary to find information fast. To run the food code software, a PC with a 486 processor, 8 MB Ram and a hard drive with at least 8 MB free space is necessary.

The text of the food code is cross-referenced. Simply enter a subject and selections appear. The user can either research from the list of selections or search from related topics. No matter what area is chosen, the original selection is always visible on the right half of the screen. The 1995 food code is also included on the software. Users will be able to switch from the 1995 version to the 1997 version with one click of the mouse.

All QA Products, Inc., Gainesville, FL

Reader Service No. 304

QMI Introduces Aseptic Septum System for Water Purification

QMI® has introduced the Safe-Septum®, an aseptic septum system for use in the water filtration and purification process for the bottled water industry. The Safe-Septum's innovative design allows for aseptic transfer of small volume or low flow rate materials into and out of a water tank or pipe during processing.

QMI aseptic transfer and inoculation systems are currently in use in dairy processing, fermentation/brewing and pharmaceutical/biotechnology facilities throughout the world. The company's newest product, which features a rubber or silicone base and either seven or 12 single-track needle ports, can be used with water purification chambers. The Safe-Septum is installed in water tanks or fluid transfer lines.

According to Darrell Bigalke, President of QMI, the Safe-Septum was developed in response to the stringent quality requirements of modern bottled water purification and the increasing cost of processing – which are lost if contamination occurs during samplings or transfers.

Two methods currently being used for water sampling are syringe sampling and through a tap in the water tank. Both methods risk contamination.

Current sampling ports are made of wire mesh that holds a rubber disk in place, through which a needle can penetrate. Such ports can be inadequate because the metal mesh can cause a needle tip to break off. And,

when the rubber disk is punctured randomly, because the tester cannot tell where it has been previously penetrated, it can core and cause leakage of both air and fluid.

The testing through the tap method can cause the introduction of bacteria into the tank and comprise the purity of the fluid as it flows through a difficult-to-sterilize tap. In addition, the sterilization of the tap is usually completed with an open flame. This can be dangerous to employees and equipment.

Other features of the QMI system include a low-profile design that secures a positive surface seal for in-place sanitation. All QMI aseptic ports are pre-sterilized by ethylene oxide and have been tested at temperatures of up to 280°F and pressures of up to 150 psi.

QMI, St. Paul, MN

Reader Service No. 305

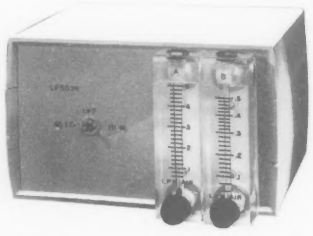
Detection of Microbial Genes with Sequence Capture – PCR Method

Magnetic capture of sequence specific DNA will improve the sensitivity of PCR methods for the detection of bacterial or viral DNA in clinical samples. A 10- to 100- fold increase in sensitivity has been demonstrated using Dynabeads® M-280 Streptavidin to capture oligonucleotides prior to PCR. Dynabeads® M-280 Streptavidin are superparamagnetic microspheres with streptavidin molecules bound to their surface. Briefly, biotinylated capture oligonucleotides are added to crude extracts of tissues or cells. After hybridization between the target sequence and the capture fragment, Dynabeads® M-280 Streptavidin is added for magnetic separation. The hybridized fragment binds to the Dynabeads® M-280 Streptavidin and is isolated by placing the sample in a magnetic tube holder (Dynal® MPC). Subsequently, all irrelevant DNA and potential PCR inhibitors can be removed from the sample prior to PCR amplification. The method has been shown to detect as little as one genome of Mycobacterial bacterial DNA in 750mg of total DNA (Manglapan, G., et al. JCM, May 1996).

Dynabeads® products can also be used to isolate microorganisms from samples. ImmunoMagnetic Separation (IMS) can be used to rapidly concentrate target organisms prior to lysis and hybridization and to enrich the target organism in the small volumes usually required for PCR analysis. Dynabeads® products can be easily coated with antibodies specific to your target organism. Dynabeads® products are also available precoated with antibodies to *Salmonella*, *Listeria*, and *E. coli* O157.

Dynal, Lake Success, NY

Reader Service No. 306



Dual Laminar Gas Controller—Model 5020

Micro Devices, Inc.

Micro Devices Introduces Dual-Gas Controller for Microscopy

Micro Devices, Inc., introduced a Dual Gas Laminar Flow Controller (Model 5020) for microscopy applications where there is a requirement to isolate the sample site from the environment without restricting, access to the sample. With this device, up to two gases can be ratioed to create the required atmosphere conditions.

This device is part of the NIDI Constant Temperature and Controlled Atmosphere System for microscopy.

Micro Devices, Inc., Newtown, PA

Reader Service No. 307

New Flume and Wash Water Treatment Improves Safety of Fresh-Cut and Post-Harvest Produce

Fresh produce growers and processors now have a new way to improve the safety of their fresh-cut and post-harvest produce: Ecolab's Tsunami®. Used as an alternative to traditional additives in flume and wash water systems, Tsunami helps to reduce total coliform and aerobic plate counts in the water and on fruit and vegetable surfaces.

Tsunami is a patented broad spectrum, peroxyacetic acid-based control agent for deposits, odors and microbes. First introduced in 1997 for further processed fruits and vegetables, it has now been EPA approved for use in transport, storage and processing of fresh-cut and postharvest fruits and vegetables without a potable water rinse.

Tsunami offers a safer alternative for workers and the environment. Because it's completely water soluble at use concentrations, Tsunami eliminates potential off-gassing in heavily soiled systems, therefore, reducing the risk to plant workers. After use, Tsunami rapidly breaks down into water, oxygen and acetic acid so that effluent concerns are minimized.

Tsunami is supplied as a single product liquid, ready to feed from the shipping container. No precursor chemicals or pH control are required, making it simple to start up and maintain.

Tsunami also helps to improve plant economics. Equipment stays

cleaner with Tsunami, so it does not need to be cleaned as frequently. This helps to reduce labor and water costs, and improve operational efficiency.

Ecolab, St. Paul, MN

Reader Service No. 308

Quantitative Histamine Test Now Available from Neogen

Neogen Corporation announced the introduction of a quantitative histamine test for seafood, Veratox® for Histamine.

The new product does not replace the company's existing qualitative histamine test, but gives customers an option when testing for histamine in fish and fish products.

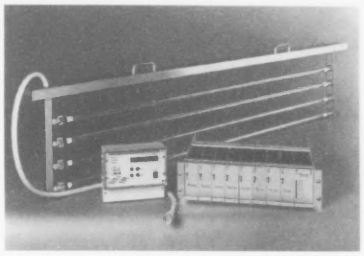
Neogen's Veratox for Histamine test kits include standards at zero, five, 10, 20 and 50 parts per million.

Histamine is produced in certain types of fish when microbes break down the amino acid histidine. When fish are not properly chilled after harvest, the growth of microorganisms normally present in fish is accelerated, increasing the breakdown of histidine to histamine. Human scombroid poisoning, which is potentially lethal, is caused by consuming fish and fish products with high levels of histamine.

Histamine production is common in such fish as tuna, mahimahi, bluefish, mackerel, anchovies and sardines when they are not properly refrigerated and stored.

Neogen Corporation, Lexington, KY

Reader Service No. 309



Capital Controls Company, Inc.

Capital Controls Introduces New Scorpion™ Open Channel Ultraviolet Disinfection System

Capital Controls Company, Inc., introduces the new *Scorpion*™ ultraviolet disinfection system.

The *Scorpion* UV system has been designed specifically for wastewater flows of less than 5 mgd (788 m^3/h).

The Scorpion system features a back-to basics approach to wastewater disinfection including: High efficiency, plug-in electronic power supplies; lightweight stainless steel lamp modules; UV intensity monitor; easy installation, operation and maintenance; and user-friendly automatic control options.

Capital Controls Company, Inc., Colmar, PA

Reader Service No. 310

Hygiene Guard™ Clean Hands Program™ Proves Superior in Hand Wash Comparison Test

Net/Tech International, Inc. developer of the patented Hygiene Guard Hand Wash Reminder and Verification System, announced that test results had confirmed that the hands of employees using the Hygiene Guard Clean Hands Program were 8.21 times cleaner than those who were not using the Hygiene Guard System. Cleanliness was measured by aerobic bacteria count on the hands of foodservice workers and was confirmed by independent laboratories.

The tests conducted by Prepchek Food Safety Consultants included hand samples from 350 workers in 55 locations. Some of the workers who did not use the Hygiene Guard System were using disposable gloves. Samples were analyzed in different laboratories throughout the country including Silliker Laboratories in New Jersey.

The results indicated the average number of colony forming units of aerobic bacteria listed: Employees using Hygiene Guard Clean Hands Program, aerobic plate count 33,225; Employees not using Hygiene Guard System, aerobic plate count 272,660.

Net/Tech develops and markets health and food safety products and solutions to the food service, food manufacturing and health care industries with a targeted focus on employee hand washing in any environment where hygiene is critical to the public health. Net/Tech is the developer of the patented Hygiene Guard Hand Wash Reminder and Verification System and exclusive distributor of the HyGenius Verification System. The Company's product line is designed to help satisfy federal, state and local health and food safety regulatory compliance.

Net/Tech International, Inc., Red Bank, NJ

Reader Service No. 311

BusinessExchange

Services/Products

Exhibitors

of the IAMFES 85th Annual Meeting

(Companies scheduled to exhibit as of June 5, 1998)

3-A Sanitary Standards Symbol Council
3020 Bluff Road
Columbia, SC 29209
Phone: 803.783.9258; Fax: 803.783.9265

3M Microbiology Products
3M Center, Bldg. 275-4E-1
St. Paul, MN 55144
Phone: 612.733.0942; Fax: 612.737.7678

AATI (Advanced Analytical Technologies, Inc.)
2501 North Loop Drive, Suite 613
Ames, IA 50010
Phone: 515.296.6187; Fax: 515.296.9910

ABC Research Corporation
3437 S.W. 24th Ave.
Gainesville, FL 32607
Phone: 352.372.0436; Fax: 352.378.6483

Advanced Instruments, Inc.
Two Technology Way
Norwood, MA 02062
Phone: 781.320.9000; Fax: 781.320.8181

All Quality Assurance Products
3427 S.W. 42nd Way
Gainesville, FL 32608-2399
Phone: 352.335.5161; Fax: 352.335.4980

AOAC International
481 N. Frederick Ave., Suite 500
Gaithersburg, MD 20877-2417
Phone: 301.924.7077; Fax: 301.924.7089

Applied Research Institute
8 Blanches Walk, P.O. Box 810
Newtown, CT 06470
Phone: 888.324.7900; Fax: 888.324.7911

Aquionics, Inc.
21 Kenton Lands Road, P.O. Box 18395
Erlanger, KY 41018
Phone: 606.341.0710; Fax: 606.341.0350

Atkins Technical, Inc.
3401 S.W. 40th Blvd.
Gainesville, FL 32608-2399
Phone: 352.378.5555; Fax: 352.335.6736

Audits International
1899 Second St.
Highland Park, IL 60035
Phone: 847.433.0900; Fax: 847.433.7873

Becton Dickinson Microbiology Systems
7 Loveton Circle
Sparks, MD 21152
Phone: 410.316.4472; Fax: 410.316.4906

BioControl Systems, Inc.
12822 S.E. 32nd St.
Bellevue, WA 98005
Phone: 425.603.0080; Fax: 425.603.1123

Biolog, Inc.
3938 Trust Way
Hayward, CA 94545
Phone: 510.785.2564; Fax: 510.782.4639

bioMérieux Vitek
595 Anglum Drive
Hazelwood, MO 63042-2320
Phone: 314.506.8073; Fax: 314.506.8097

Capitol Vial, Inc.
151 Riverside Drive
Fultonville, NY 12072
Phone: 518.853.3377; Fax: 518.853.3409

Celsis, Inc.
1801 Maple Ave.
Evanston, IL 60201
Phone: 847.467.6620; Fax: 847.467.6602

Charm Sciences Inc.
36 Franklin St.
Malden, MA 02148
Phone: 781.322.1523; Fax: 781.322.3141

Chemunex, Inc.
1 Deer Park Drive, Suite H-2
Monmouth Junction, NJ 08852
Phone: 732.329.1153; Fax: 732.329.1192

Cogent Technologies Ltd.
11140 Luschek Drive
Cincinnati, OH 45241
Phone: 513.469.6800; Fax: 513.469.6811

Copesan Services
3490 N. 127th St.
Brookfield, WI 53005
Phone: 414.783.6261; Fax: 414.783.6267

Decagon Devices, Inc.
950 N.E. Nelson Court, P.O. Box 835
Pullman, WA 99163
Phone: 509.332.2756; Fax: 509.332.5158

DiverseyLever Inc.
255 E. Fifth St., Suite 1200
Cincinnati, OH 45202-5508
Phone: 513.762.6794; Fax: 800.433.5508

DQCI Services, Inc.
5205 Quincy St.
Mounds View, MN 55112
Phone: 612.785.0484; Fax: 612.785.0584

DYNAL, Inc.
5 Delaware Drive
Lake Success, NY 11042
Phone: 516.326.3270; Fax: 516.326.3298

Ecolab Pest Elimination
370 Wabasha
St. Paul, MN 55102
Phone: 612.293.2590; Fax: 612.225.3088

Educational Foundation
250 S. Wacker Drive, Suite 1400
Chicago, IL 60606
Phone: 800.765.2122; Fax: 312.715.0807

Elsevier Science
655 Ave. of the Americas
New York, NY 10010
Phone: 212.633.3756; Fax: 212.633.3764

Food and Drug Administration, Inc.
HFS-32, Food Safety Initiative Staff
200 C St., S.W.
Washington, D.C. 20204
Phone: 202.205.4566; Fax: 202.205.5025

Food Processors Institute
1401 New York Ave. N.W., Suite 400
Washington, D.C. 20005
Phone: 202.637.4808; Fax: 202.639.5991

Food Quality Magazine
208 Floral Vale Blvd.
Yardley, PA 19067
Phone: 215.860.7800; Fax: 215.860.7900

Food Testing & Analysis Magazine
P.O. Box 5244
Glendale, CA 91221-1081
Phone: 818.842.4777; Fax: 818.769.2939

Foss North America, Inc.
10355 W. 70th St.
Eden Prairie, MN 55344
Phone: 612.941.8870; Fax: 612.941.6533

GENE-TRAK Systems
94 South St.
Hopkinton, MA 01748
Phone: 508.435.7400; Fax: 508.435.0025

Gist-brocades
N93 W14560 Whittaker Way
Menomonee Falls, WI 53051
Phone: 414.255.7955; Fax: 414.255.7732

Glo-Germ Company
150 E. Center St., P.O. Box 537
Moab, UT 84532
Phone: 435.259.5693; Fax: 435.259.5930

Great Western Chemical Company
5700 N.W. Front Ave.
Portland, OR 97210
Phone: 503.227.1616; Fax: 503.227.7377

IDEXX Laboratories
One IDEXX Drive
Westbrook, ME 04092
Phone: 207.856.0300; Fax: 207.856.0630

IHS Health Information
15 Inverness Way East
Englewood Cliffs, CO 80112-5776
Phone: 303.858.6475; Fax: 303.754.3940

International BioProducts, Inc.
14780 N.E. 95th St.
Redmond, WA 98052
Phone: 425.883.1349; Fax: 425.881.6880

International Food Hygiene
P.O. Box 4
Driffield, East Yorkshire YO25 9DJ UK
Phone: 44.1377.241724; Fax: 44.1377.253640

Lloyd's Register Quality Assurance
33-41 Newark St.
Hoboken, NJ 07030
Phone: 201.963.1111; Fax: 201.963.3299

Madison Chemical Company
P.O. Box 1599
Madison, IN 47250
Phone: 812.273.6000; Fax: 812.273.6002

Malthus Diagnostics, Inc.
35888 Center Ridge Road
North Ridgeville, OH 44039
Phone: 440.327.2585; Fax: 440.327.7286

Medallion Laboratories
9000 Plymouth Ave.
Minneapolis, MN 55427
Phone: 612.540.4453; Fax: 612.540.4010

Michelson Laboratories, Inc.
6280 Chalet Drive
Commerce, CA 90040
Phone: 562.928.0553; Fax: 562.927.6625

Microbac Labratories, Inc.
4580 McKnight Road
Pittsburgh, PA 15237
Phone: 412.931.5851; Fax: 412.931.0473

MicroBiologics, Inc.
217 Osseo Ave. North
St. Cloud, MN 56303
Phone: 320.253.1640; Fax: 320.253.6250

Microbiology International
10242 Little Rock Lane
Frederick, MD 21702
Phone: 301.898.1369; Fax: 301.989.8055

NASCO
901 Janesville Ave.
Fort Atkinson, WI 53538-0901
Phone: 920.563.2446; Fax: 920.563.8296

Nelson-Jameson, Inc.
2400 E. 5th St., P.O. Box 647
Marshfield, WI 54449
Phone: 715.387.1151; Fax: 715.387.8746

Neogen Corporation
620 Lesher Place
Lansing, MI 48842
Phone: 517.372.9200; Fax: 517.372.9004

New Horizons Diagnostics Corporation
9110 Red Branch Road
Columbia, MD 21045
Phone: 410.992.9357; Fax: 410.992.0328

Norton Performance Plastics Corp.
2664 Gilchrist Road, P.O. Box 3660
Akron, OH 44309-3660
Phone: 330.798.9240; Fax: 330.798.6968

NSF International
3475 Plymouth Road
Ann Arbor, MI 48105
Phone: 313.769.8010; Fax: 313.769.0109

Organon Teknika
100 Akzo Ave.
Durham, NC 27712
Phone: 919.620.2377; Fax: 919.620.2615

Oxoid, Inc.
217 Colonnade Road
Nepean, ON K2E 7K3 Canada
Phone: 613.226.1318; Fax: 613.226.3728

PathCon Laboratories
270 Scientific Drive, Suite 3
Norcross, GA 30092
Phone: 770.446.0540; Fax: 770.446.0610

PRISM
8300 Executive Center Drive
Miami, FL 33166
Phone: 800.888.5777; Fax: 305.594.9280

Q A Life Sciences, Inc.
6645 Nancy Ridge Drive
San Diego, CA 92121
Phone: 619.622.0560; Fax: 619.622.0564

Q Laboratories, Inc.
1400 Harrison Ave.
Cincinnati, OH 45214
Phone: 513.471.1300; Fax: 513.471.5600

Qualicon, Inc.
P.O. Box 80357/1024A, Building 357
Wilmington, DE 19880-0357
Phone: 302.695.9400; Fax: 302.695.9027

Raven Biological Labs
8607 Park Drive
Omaha, NE 68127
Phone: 402.593.0781; Fax: 402.593.0995

REMEL, Inc.
12076 Santa Fe Drive
Lenexa, KS 66215
Phone: 913.888.0939; Fax: 800.447.5750

R-TECH Laboratories
P.O. Box 64101
St. Paul, MN 55164-0101
Phone: 800.328.9687; Fax: 612.481.2002

Silliker Laboratories Group
900 Maple Road
Homewood, IL 60430
Phone: 708.957.7878; Fax: 708.957.8449

Sparta Brush Co.
402 S. Black River St.
Sparta, WI 54656
Phone: 608.269.2151; Fax: 608.269.3293

Spiral Biotech, Inc.
7830 Old Georgetown Road
Bethesda, MD 20814
Phone: 301.657.1620; Fax: 301.652.5036

Sterilex Corporation
1450 S. Rolling Road, 4th Floor
Baltimore, MD 21227
Phone: 800.511.1659; Fax: 410.455.5503

TRI-DIM Filter Corporation
999 Raymond St.
Elgin, IL 60120
Phone: 847.695.2600; Fax: 847.695.7938

VICAM, L.P.
313 Pleasant St.
Watertown, MA 02172
Phone: 617.926.7045; Fax: 617.923.8055

Warren Analytical
650 'O' St., P.O. Box G
Greeley, CO 80632
Phone: 800.945.6669; Fax: 970.351.6648

Weber Scientific
2732 Kuser Road
Hamilton, NJ 08691
Phone: 609.584.7677; Fax: 609.584.8388

ZEP Manufacturing Company
1310 Seaboard Industrial Blvd.
Atlanta, GA 30318
Phone: 404.352.1680; Fax: 404.350.6232

GENERAL INFORMATION

IAMFES 85th ANNUAL MEETING
AUGUST 16-19, 1998
NASHVILLE, TENNESSEE

IMPORTANT! Please read this information before completing your registration form.

■ Meeting Information

Register today to obtain valuable information on advancing food protection worldwide through the most contemporary methods of food microbiology, processing, safe handling, and current regulatory aspects of food safety. Registration fee includes all technical sessions; symposia; poster presentations; a Cheese and Wine Reception; admittance to the exhibit hall; and a program and abstract book containing general program information and abstracts of symposia, technical papers, and posters. Appropriate dress for the Meeting is business casual.

■ Registration Information

Please mail the registration form with payment today. Registrations post-marked after July 15, 1998 must pay the late registration fee. Checks should be made payable to: IAMFES, Inc., 6200 Aurora Avenue, Suite 200W, Des Moines, IA 50322-2863, U.S.A. For faster service, use your credit card and call 800.369.6337, or fax the completed registration form with credit card information to 515.276.8655.

■ Refund/Cancellation Policy

Requests for cancellations must be received in writing no later than July 31, 1998 (registration fee less a $50 processing charge will be refunded). Cancellations received after July 31, 1998 will not receive a refund, but the registration may be transferred to a colleague with written notification.

■ New Membership Fees

$ 75.00 *Dairy, Food and Environmental Sanitation*

$ 120.00 *Dairy, Food and Environmental Sanitation* and *Journal of Food Protection*

$ 37.50 *Student Membership with *Dairy, Food and Environmental Sanitation* or *Journal of Food Protection*

$ 60.00 *Student Membership with *Dairy, Food* and *Environmental Sanitation* and *Journal of Food Protection*

**Full-time student verification required.*

SHIPPING CHARGES: OUTSIDE THE U.S.
SURFACE RATE – $ 22.50 per journal title
AIRMAIL – $ 95.00 per journal title

TICKET INFORMATION

■ Cheese and Wine Reception (August 16, 1998)

Share in what has become an IAMFES tradition for Annual Meeting attendees and guests. The Cheese and Wine Reception begins immediately following the Ivan Parkin Lecture on Sunday evening in the IAMFES exhibit hall. Enjoy conversation with exhibitors, colleagues, and friends.

■ Monday Night Social Event Hot Country Night — (August 17, 1998)

There's no time like a good time, and the Wildhorse Saloon is just the place to find it. The evening includes dinner, music, dancing, and a few surprises. Children ages 14 and under must be accompanied by an adult.

■ Awards Banquet — (August 19, 1998)

The IAMFES Annual Meeting concludes with an evening of recognition for deserving food safety professionals. A reception opens the evening outside the banquet hall. Dinner is served in an elegant setting prior to the award presentations. Additional tickets are available. Business attire is requested for this special evening.

■ Other Events

Grand Ole Opry — Saturday, 8/15
IAMFES Golf Tournament — Sunday, 8/16
Music City Sites — Sunday, 8/16
Historic Nashville — Monday, 8/17
Jack Daniel's Distillery — Tuesday, 8/18
Children's Banquet — Wednesday, 8/19

HOTEL INFORMATION

For reservations, call 800.327.6618 and identify yourself as an IAMFES attendee to receive a special rate of $116 per night, single or double.

Renaissance Nashville Hotel
611 Commerce Street
Nashville, Tennessee 37203
Phone: 615.255.8400; Fax: 615.255.8163

CHILD CARE

Adult supervised activities for children ages 4 to 12 will be available Monday through Wednesday, 8:30 a.m. to 12:00 p.m. and 1:30 p.m. to 5:00 p.m. A pre-registration fee of $20.00 per day for each child is required; snacks will be provided. The room is subject to a minimum attendance. Participants will be notified if cancellation is necessary by July 24, 1998.

REGISTRATION FORM

❒ Please register me for the IAMFES 85th Annual Meeting – Nashville, Tennessee – August 16-19, 1998

FOR OFFICE USE
Member # _____
Registration # _____
First initial _____ Last name _____
DFES

First Name (please print — will appear on badge) M.I. Last Name

Title Employer

Mailing Address (Please specify: ❒ Home ❒ Work)

City State/Province Country Postal/Zip Code

Telephone # Fax # E-mail

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

Status (Please check applicable boxes)

❒ 20 Yr. Member ❒ 30 Yr. Member ❒ 50 Yr. Member ❒ Past President ❒ Speaker ❒ Honorary Life Member ❒ Sustaining Member

REGISTER BY JULY 15, 1998 TO AVOID LATE REGISTRATION FEES

REGISTRATION:	MEMBERS	NONMEMBERS	AMOUNT
Registration (Awards Banquet included)	$ 230 ($280 late)	$335 ($385 late)	
Student IAMFES Member	$ 35 ($ 45 late)	Not Available	
Retired IAMFES Member	$ 35 ($ 45 late)	Not Available	
One Day Registration: ❒ Mon. ❒ Tues. ❒ Wed.	$ 115 ($140 late)	$150 ($170 late)	
Spouse/Companion (Name): _____	$ 35 ($ 35 late)	$ 35 ($ 35 late)	
Children (15 & Over, Names): _____	$ 25 ($ 25 late)	$ 25 ($ 25 late)	
Children (14 & Under, Names): _____	FREE	FREE	
Child Care (Ages 4 to 12): ❒ Mon. ❒ Tues. ❒ Wed.	$ 20 per child/per day		

OTHER EVENTS:			
Grand Ole Opry (Sat., 8/15)	$ 25		
IAMFES Golf Tournament (Sun., 8/16)	$ 80 ($ 95 late)		
Music City Sites (Sun., 8/16)	$ 28 ($ 33 late)		
Historic Nashville (Mon., 8/17)	$ 41 ($ 46 late)		
Hot Country Night (Mon. Night Social, 8/17)	$ 36 ($ 41 late)		
Children's Rate (14 & Under)	$ 21 ($ 26 late)		
Jack Daniel's Distillery (Tues., 8/18)	$ 29 ($ 34 late)		
IAMFES Awards Banquet (Wed., 8/19)	$ 40 ($ 45 late)		
Children's Banquet (Wed., 8/19)	$ 20 ($ 25 late)		

JOIN IAMFES TODAY AND SAVE!!! (Attach a completed membership application) _____

TOTAL AMOUNT ENCLOSED _____
(CHECK PAYABLE TO IAMFES — U.S. FUNDS DRAWN ON U.S. BANK)

International Association of Milk, Food and Environmental Sanitarians
6200 Aurora Avenue, Suite 200W
Des Moines, IA 50322-2863, U.S.A.
Phone: 800.369.6337; 515.276.3344
Fax: 515.276.8655; E-mail: iamfes@iamfes.org

Credit Card Payments:

❒ VISA ❒ MasterCard ❒

Card # _____
Exp. Date _____
Name on Card _____
Signature _____
Total Amount Enclosed $ _____

EXHIBITORS DO NOT USE THIS FORM

The Workshops

August 15, 1998 – Nashville, Tennessee

WORKSHOP I — Proper Cleaning and Uses of Stainless Steel in the Food and Beverage Industries

This workshop will discuss the proper uses and cleanability of stainless steel as related to the food and beverage industries. Discussions will include guidelines for the use in sanitary services including metallurgy, physical and mechanical properties, and corrosion resistance of stainless steel commonly used in the food and beverage industries. Also included will be proper procedures for quality welding of stainless steel equipment; manual and automatic shielded metal arc, tungsten metal arc and gas metal techniques; and the influence of welding, forming and post-fabrication cleaning on corrosion. Other topics include the significance of the surface finish on cleanability and product purity; various surface cleaning and sanitizing steps needed in order to obtain clean surfaces; metal ion contamination after cooking; and health and environmental effects of nickel.

WORKSHOP PRESENTERS:

Richard Avery, Nickel Development Institute and Avery Consulting Associates, Inc.

Mr. Avery is a consultant for the Nickel Development Institute. His industrial experience includes several years with Inco Alloys International in Huntington, WV. His specialty is the fabrication and joining of stainless steels and nickel alloys. He has authored over 20 articles on welding and metallurgy.

Roger Covert, Nickel Development Institute and Covert Consulting, Inc.

Mr. Covert is a consultant for the Nickel Development Institute. He has been involved with the properties and applications of metals for almost 50 years. He retired as Vice President of Marketing from International Nickel, Inc. after 30 years of working in a variety of technical and marketing areas. Special interests for Mr. Covert were metallic corrosion, nickel electroplating, and material selection.

WHO SHOULD ATTEND:

Quality Control Managers, Sanitation Inspectors, Plant Engineers, Plant Design Engineers, Plant Managers, Regulatory Officers or anyone interested in expanding their knowledge and understanding of the applications for stainless steel in the food and beverage industries.

WORKSHOP II — ICMSF's Proposal for the Management of the Microbiological Safety of Foods

The International Commission on Microbiological Specifications for Foods (ICMSF) is a nonprofit, scientific advisory body established in 1962. ICMSF membership consists of microbiologists from more than 10 countries. Since its founding, ICMSF has had a profound impact on the field of food microbiology by addressing such issues as methods development, sampling plans, microbiological criteria, and Hazard Analysis and Critical Control Points.

The ICMSF has recommended six steps for the management of microbiological hazards in foods in international trade. These same principles can be applied to food in domestic trade. The steps incorporate existing Codex documents that can be applied in a logical sequence. This workshop will discuss the six steps for management of the microbiological safety of foods. The relationships of acceptable or tolerable risk, food safety objectives, and performance criteria will be discussed in detail. Examples of how to establish FSOs based on risk assessments, and industry's development of performance criteria to assure FSOs are met will be presented. A significant portion of the workshop will be dedicated to the application of HACCP, GMP/GHP and microbiological criteria to assure performance criteria are met.

WORKSHOP PRESENTERS:

Russell S. Flowers, Ph.D., Silliker Laboratories Group, Inc.

Dr. 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 Foodborne Pathogens." He has authored numerous article, seminars, and presentations.

R. Bruce Tompkin, Ph.D., ConAgra Refrigerated Prepared Foods

Dr. Tompkin joined ConAgra in 1997 as Vice President of Product Safety of ConAgra Refrigerated Prepared Foods. He began his career with Swift & Company in 1964 as a research microbiologist moving up to Vice President of Product Safety.

Robert L. Buchanan, Ph.D., Food and Drug Administration

Dr. Buchanan is a Senior Scientist with the Food and Drug Administration's Center for Food Safety and Applied Nutrition and a member of the U.S. Public Health Service's Senior Biomedical Research Service. Prior to this appointment, Dr. Buchanan was a senior investigator with USDA-ARS in Philadelphia, PA.

WHO SHOULD ATTEND:

Microbiologists, Quality Assurance and Control Managers, HACCP Coordinators and Team Members, Food Safety Managers, Food Safety Auditors, Risk Management Coordinators or anyone interested in learning more about ICMSF and its Proposal for the Management of the Microbiological Safety of Foods.

1998 IAMFES Workshops
• Registration Form •

❑ **WORKSHOP 1: Proper Cleaning and Uses of Stainless Steel in the Food and Beverage Industries**

❑ **WORKSHOP 2: ICMSF's Proposal for the Management of the Microbiological Safety of Foods**

Renaissance Nashville Hotel, Nashville, Tennessee — Saturday, August 15, 1998

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

Title Employer

Address City State/Province Zip/Postal Code

Area Code & Telephone Fax E-mail

Charge Card Payments: VISA · MASTERCARD · AMERICAN EXPRESS

Account #: _____

Name on Card: _____

Expiration Date: _____

Signature: _____

For further information, please contact IAMFES at 800.369.6337; 515.276.3344; Fax: 515.276.8655; E-mail: jcattanach@iamfes.org.

Refund/Cancellation Policy

Registration fees, minus a $50 processing fee, will be refunded for written cancellations post-marked by July 31, 1998. **No refunds will be made for cancellations post-marked after July 31, 1998,** however, the registration may be transferred to a colleague with written notification to IAMFES. **NOTE:** IAMFES reserves the right to cancel workshops if minimum enrollment is not met by July 15, 1998.

• REGISTRATION •

WORKSHOP 1: Proper Cleaning and Uses of Stainless Steel in the Food and Beverage Industries

	Before 7/15/98	After 7/15/98
IAMFES Member	$180	$210
NonMember	$245	$275

GROUP DISCOUNT: Register 3 or more people from your company and receive a 15% discount. Registrations must be received as a group.

WORKSHOP 2: ICMSF's Proposal for the Management of the Microbiological Safety of Foods

	Before 7/15/98	After 7/15/98
IAMFES Member	$295	$325
NonMember	$360	$390

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

Tours and Special Events
of the IAMFES 85th Annual Meeting

Saturday, August 15, 1998 — 5:00 p.m. - 9:30 p.m.
The Grand Ole Opry
Registration: $25

Experience a true Southern tradition with a night at the world famous Grand Ole Opry. With your reserved seating at the Opry you can sit back and relax or jump in and clap along as renowned musicians, singers and comedians delight you with their talents. You never know who you'll see at the Grand Ole Opry.

Sunday, August 16, 1998 — 6:00 a.m. - 1:30 p.m.
IAMFES Golf Tournament
Registration: $80 (Late $95)

Join your colleagues for a great round of golf. Board the bus to travel to the Hermitage Golf Course located near President Andrew Jackson's stately Hermitage along the banks of the Cumberland River. Enjoy a continental breakfast before teeing off in the IAMFES BEST-BALL golf tournament. After your game, join us for prizes while eating lunch. Golf, breakfast, lunch and transportation all included! Tournament is open to golfers of all skill levels. To request a golf registration form, call IAMFES at 800.369.6337 or 515.276.3344.

Sunday, August 16, 1998 — 9:00 a.m. - 1:00 p.m.
Music City Sites
Registration: $28 (Late $33)
Lunch on your own

Don't miss this exciting tour of downtown Nashville, Second Avenue, Tennessee State Capitol, Governor's Mansion, and numerous other points of interest. The tour will also include a drive down the world famous Music Row and a stop at the Country Music Hall of Fame.

Sunday, August 16, 1998
Opening Session — 7:00 p.m.
Ivan Parkin Lecture

Lecture: *Communicating Food Safety to the Consumer* presented by Christine Bruhn, University of California-Davis, Center for Consumer Research, Davis, CA.

Cheese and Wine Reception — (Exhibit Hall)
8:00 p.m. - 10:00 p.m.

Join friends and colleagues for complimentary refreshments while viewing the educational exhibits.

Exhibit Hall Hours

Sunday, August 16 — 8:00 p.m. - 10:00 p.m.
Monday, August 17 — 9:30 a.m. - 1:30 p.m.
3:00 p.m. - 6:30 p.m.*
Tuesday, August 18 — 9:30 a.m. - 2:00 p.m.

**Social Reception — 5:00 p.m. - 6:30 p.m.*

Monday, August 17, 1998 — 9:00 a.m. - 3:00 p.m.
Historic Nashville
Registration: $41 (Late $46)
Lunch included

This historic view of Nashville begins with a stop in Centennial Park and a tour of the Parthenon. You will then enjoy a wonderful buffet lunch at the Hermitage, the beloved home of President Andrew Jackson. Following lunch you will tour the Hermitage and its grounds.

Monday, August 17, 1998 — 6:00 p.m. - 9:00 p.m.
Hot Country Night
Registration: $36 (Late $41)
Children's Rate (14 & Under) $21 (Late $26)

There's no time like a good time, and the Wildhorse Saloon is just the place to find it. The evening includes dinner, music, dancing, and a few surprises. Children ages 14 and under must be accompanied by an adult.

Tuesday, August 18, 1998 — 9:00 a.m. - 4:30 p.m.
Jack Daniel's Distillery
Registration: $29 (Late $34)
Lunch on your own

Settle back as you wind through the beautiful Tennessee countryside to Shelbyville, home of Tennessee walking horses and the Walking Horse Museum. Then you will travel on to Lynchburg where you will step back in time on the historic square. You'll have a chance to stroll around the square and grab a bite to eat before your entertaining tour of the world famous Jack Daniel's Distillery.

Wednesday, August 19, 1998
IAMFES Annual Awards Banquet
Reception: 6:00 p.m. - 7:00 p.m.
Banquet: 7:00 p.m.
Registration: $40 (Late $45)

Wednesday, August 19, 1998
IAMFES Children's Banquet
Time: 6:30 p.m. - 9:30 p.m.
Registration: $20 (Late $25)

Child Care

Adult supervised activities for children ages 4 to 12 will be available Monday through Wednesday, 8:30 a.m. to 12:00 p.m. and 1:30 p.m. to 5:00 p.m. A pre-registration fee of $20.00 per day for each child is required; snacks will be provided. The room is subject to a minimum attendance. Participants will be notified if cancellation is necessary by July 24, 1998.

Thoughts on Today's Food Safety, *continued* from page 480

Freezing. Freezing may preserve or destroy protozoan cysts and oocysts, depending on temperature, speed of freezing, time in the frozen state, and suspending medium. There is no epidemiology that implicates frozen raspberries or other commercially frozen produce in cyclosporiosis. However, one study noted survival of *Cyclospora* oocysts in feces shipped with dry ice. The related *Cryptosporidium parvum* fails to infect after treatment at -70°C/1 h or -20°C/24 h. Another study indicated that snap freezing killed *Cryptosporidium* oocysts but slow freezing to -22°C did not kill, even after 750 hours.

Heating. Again, there is direct evidence only for *Cryptosporidium* that pasteurization (71.7°C for 5 sec in a water or milk suspension) eliminates the infectivity of *Cryptosporidium* oocysts in the highly sensitive mouse assay.

Ozone. Protozoa's cysts and oocysts, though generally resistant to routine chlorination, seem to be inactivated by ozone. The precise conditions (concentration, temperature, time, suspending medium) have not yet been determined even for *Cryptosporidium* because of strain variability and the effect of different amounts of organic matter in the medium. A possibility under consideration for drinking water is sequential treatment with ozone (2.5 mg/min/liter residual ozone) followed by chloramine or chlorine dioxide (which are not effective by themselves). Ozone has been approved for treating drinking water and might have potential for treating washable produce. Raspberries, however do not withstand washing well.

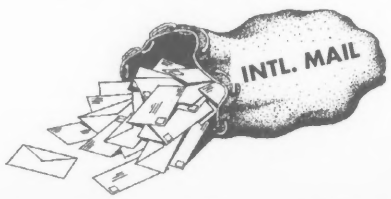
Irradiation. Coccidia (the group of parasitic protozoa that includes *Cyclospora, Eimeria, Cryptosporidium, Toxoplasma, Isospora,* and *Sarcocystis*) vary in their susceptibility to gamma radiation. *Toxoplasma gondii* is inactivated by practical doses of irradiation (0.5 kGy) in the sensitive mouse infectivity test but *Eimeria bovis* is not fully inactivated by higher doses (2.0 kGy) in cattle infectivity tests. *Cyclospora*, being more closely related (genetically and in its environmental needs) to *Eimeria* than to *Toxoplasma*, may require impractically high irradiation doses for full inactivation.

Cultivation. Development of an infection model in host tissue culture that results in oocyst production has proven difficult with *Cyclospora cayetanensis*. Conventional tissue culture using mammalian intestinal cell monolayers has resulted in oocyst adherence and excystation, but oocyst production has been limited. This suggests that conventional techniques may not support the complete life cycle of *Cyclospora*. A new tissue culture system (the rotating wall bioreactor vessel) has been used to culture *Cyclospora* in differentiated intestinal cell lines from excised tissue. Using this system, several asexual stages have been identified and oocyst numbers have increased 4-fold over the initial inoculum. These results suggest that bioreactor-grown intestinal cells can support the life cycle of *Cyclospora*. Work is continuing at FDA and NIH on determining the infectivity of oocysts recovered from the bioreactor, and increasing the yield of oocysts from culture.

ATTENTION INTERNATIONAL MEMBERS

Faster delivery service for IAMFES journals coming soon!

With this new service expect *Dairy, Food and Environmental Sanitation* and *Journal of Food Protection* to be delivered within 2 to 3 weeks from the publication date. This is a dramatic improvement over our current delivery method of 6 to 10 weeks.



ADVERTISING INDEX

ComingEvents

AUGUST

· **1, 3, 5, HACCP Workshop,** St. Louis, MO. For further information, contact Christine VerPlank or Vorrie Strong, ASI Food Safety Consultants, 7625 Page Blvd., St. Louis, MO 63133; Phone: 800.477.0778; Fax: 314.727.2563.

· **11-13, Food Microbiological Control Food Safety Course.** This course covers demonstration and application of basic microbiology, Good Manufacturing Practices, food code, and sanitation when conducting food inspections at the processing and retail levels. For further information, contact Gary German at Fax:301.594.1966; Voice Mail: 301.594.2263.

· **15, IAMFES 85th Annual Meeting Workshops, Nashville, TN. Workshop I – Proper Cleaning and Uses of Stainless Steel in the Food and Beverage Industries.** Speakers provided by the Nickel Development Institute (NiDI). This workshop will discuss the proper uses and cleanability of stainless steel as related to the food and beverage industries. **Workshop II – ICMSF's Proposal for the Management of the Microbiological Safety of Foods.** Speakers provided by Silliker Laboratories Group, Inc. This workshop will discuss the six steps for management of the microbiological safety of foods. For additional information, see pages 470 and 471 in this issue or visit our Web site at: www.@iamfes.org or Phone: 800.369.6337; 515.276.3344; Fax: 515.276.8655; E-mail:jcattanach@iamfes.org.

· **16-19, IAMFES 85th Annual Meeting,** in Nashville, Tennessee at the Renaissance Nashville Hotel. Registration information is available on pages 468 and 469 in this issue or on our Web site at: www.@iamfes.org or Phone: 800.369.6337; 515.276.3344; Fax: 515.276.8655; E-mail:jcattanach@iamfes.org.

· **24-28, The 10th International Conference on Production Diseases in Farm Animals,** Utrecht, The Netherlands. For additional information, contact the Congress Secretariat: Royal Netherlands Veterinary Association, P.O. Box 14031, 3508 SB Utrecht, The Netherlands; Phone: 31 30 251 01 11; Fax: 31 30 251 17 87; E-mail:knmvd@pobox.ruu.nl; Internet: www.knmvd.nl.

SEPTEMBER

· **6-9, InterMopro 98, International Trade Fair for Dairy Products,** in Düsseldorf, Germany. For further information, contact Dusseldorf Trade Shows, Inc., 150 N. Michigan Ave., Suite 2920, Chicago, IL 60601; Phone: 312.781.5180; Fax: 312.781.5188; Web site: www.dtsusa.com/dts/.

· **9-10, Microbiological Concerns in Food Plant Sanitation & Hygiene,** Chicago, IL. For further information contact Silliker Laboratories, Phone: 800.829.7879; Fax: 708.957.8405.

· **13-17, The National Society for Healthcare Foodservice Management 10th Annual National Training Conference,** at The Homestead, Hot Springs, VA. For additional information, contact Michael Giuffrida or Sheila Crowley at 202.546.7236.

· **22-24, New York State Association of Milk & Food Sanitarians 75th Anniversary Annual Conference,** Sheraton University Hotel, Syracuse, NY. For more information, contact Janene S. Lucia, NYSAMFS, 172 Stocking Hall, Ithaca, NY 14853; Phone: 607.255.2892; Fax: 607.255.7619; E-mail: jgg3@cornell.edu.

· **23-25, Microscopy/Photomicrography Workshop,** sponsored by the American Type Culture Collection. For more information, contact ATCC, Workshop Coordinator, 12301 Parklawn Dr., Rockville, MD 20852; Phone: 301.231.5566; 800.359.7370; Fax: 301.816.4364; E-mail: workshops@atcc.org.

· **25-29, China Brew & Beverage '98,** at China International Exhibition Centre, Beijing, China. For details, contact Rebecca Chan or Ling Chan of Business & Industrial Trade Fairs Ltd., Unit 1223, 12/F Hongkong International Trade & Exhibition Centre, 1 Trademark Dr., Kowloon Bay, Hong Kong or Phone: 852.2865.2633; Fax: 852.2866.1770, 2866.2076.

OCTOBER

· **5-9, Laboratory Methods in Food Microbiology,** South Holland, IL. For further information contact Silliker Laboratories, Phone: 800.829.7879; Fax: 708.957.8405.

· **14-16, Conference on The National Food Safety Initiative: Implications for Microbial Data Collection, Analysis, and Application,** Doubletree Hotel National Airport, Arlington, VA. For additional information, contact Catherine Nnoka at 202.659.0074.

· **18-19, Selection and Fabrication of Stainless Steel for Sanitary Service,** Hotel Sofitel, Rosemont, IL. The International Association of Food Industry Suppliers (IAFIS) and the Nickel Development Institute (NiDI) are sponsoring a program on the properties and proper use of handling of stainless steel for equipment for the dairy, food, and beverage industries. For further information, contact Dorothy Brady, Conference Coordinator at Phone: 703.761.2600; Fax: 703.761.4334; E-mail: info@iafis.org.

· **21-23, 18th Food Microbiology Symposium and Workshop,** University of Wisconsin-River Falls,

River Falls, WI. The symposium Current "Concepts in Foodborne Pathogens and Rapid Methods in Food Microbiology" will feature international speakers to discuss the latest research and developments regarding foodborne pathogens, regulatory and industry trends, HACCP implementation, predictive microbiology, and validation of laboratory methods. The workshop, "Rapid and Automated Methods in Food Microbiology" will involve demonstrations and discussions of various tests, instruments and kits available for detection and characterization of foodborne organisms, for assessment of food quality and shelf life and rapid hygiene monitoring in food processing facilities. For further information, contact Dr. Purnendu C. Vasavada, Animal and Food Science Dept., University of Wisconsin-River Falls River Falls, WI 54022, U.S.A. or Phone: 715.425.3150; Fax: 715.425.3372; E-mail: Purnendu.C.Vasavada@uwrf.edu.

• **22-23, Introduction to Microbiological Criteria and Sampling Plans,** Ft. Worth, TX. For further information contact Silliker Laboratories, Phone: 800.829.7879; Fax: 708.957.8405.

• **26-29, Penn State Foodborne Fungi and Mycotoxins Short Course** at the Berks Campus of the Pennsylvania State University, University Park, PA. For additional information, contact The Pennsylvania State University, 306 Ag Administration Bldg., University Park, PA 16802-2601; Phone: 814.865.8301; Fax: 814.865.7050; E-mail: shortcourse@psu.edu.

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• **2-6, Aseptic Better Process Control Certification School and Aseptic Symposium,** at North Carolina State University, Raleigh, NC. For further information, contact Lisa Gordon at 919.515.2956; Fax: 919.515.7124; E-mail: lisa_gordon@ncsu.edu.

• **8-12, 1998 International Exposition for Food Processors,** Chicago, IL. For more information, contact Cheryl Clark at Phone: 703.684.1080; Fax: 703.548.6563; E-mail: fpmsa@clark.net.

• **9-11, ASI Food Safety Consultants HACCP Workshop,** held at the Holiday Inn-Downtown Riverfront, St. Louis, MO. For further information, contact ASI Food Safety Consultants, Inc., Vorrie Strong or Christine VerPlank, Phone: 314.725.2555; 800.477.0778; Fax: 314.727.2563.

• **16-18, 1st NSF International Conference on Food Safety: HACCP — Science, Art, and Industry,** Hyatt Regency Albuquerque, Albuquerque, NM. For additional information, contact Wendy Raeder at Phone: 734.769.8010, ext. 205; Fax: 734.769.0109; E-mail: raeder@nsf.org.

• **22-26, 5th Latin American Congress on Food Microbiology and Hygiene, (COMBHAL 98)** held in Águas de Lindoia, São Paulo, Brazil. COMBHAL 98 is organized by the Brazilian representatives in the Latin American Subcommission (LAS) of ICMSF (International Commission on Microbiological Specifications for Foods) and is sponsored by the Brazilian Society for Microbiology (SBM), Brazilian Society for Food Science and Technology (SBCTA) and International Life Science Institute (ILSI-Brazil). For further information, contact COMBHAL 98 Secretariat, Av. Prof. Lineu Prestes 580, 05508-900, São Paulo-SP-Brazil; Phone: +55.11.8187991; +55.11.8187999; Fax: +55.11.8154410; E-mail: combhal@edu.usp.br.landgraf@usp.br.

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THOUGHTS on Today's Food Safety...

Problems and Progress in the Detection, Inactivation and Cultivation of *Cyclospora*

George J. Jackson, Darcy E. Hanes, and Jeffrey W. Bier
Center for Food Safety and Applied Nutrition, U.S. Food and Drug Administration, Washington, D.C.

Two peak seasons of an illness in the U.S.A. and Canada have focused public and professional attention on *Cyclospora cayetanensis*, a recently recognized parasitic protozoa (Ortega Y. R., R. H. Gilman, and C. R. Sterling. 1994. Journal of Parasitology 80:625-629). Occurring in the early summer of 1996 (Herwaldt, B. I. and M. I. Ackers, et al. 1997. New England Journal of Medicine 336:1548-1556) and again in '97, clustered cases of long-lasting diarrhea with *Cyclospora*-positive stools were associated epidemiologically with the consumption, often at banquets, of the "spring crop" of fresh (not frozen) raspberries imported from Guatemala. The "fall crop" was not associated with illness although, on occasion, other fresh produce – mesclun lettuce and basil – and drinking water have been linked epidemiologically to smaller North American outbreaks of cyclosporiosis.

Prior to these food-or-drinkborne outbreaks, cyclosporiosis was considered a rainy season, tropical zone infection that travellers from other latitudes sometimes took back home. Direct person-to-person transmission of the illness probably doesn't occur because the organism's environmental survival form – an 8 to 10 micron, epifluorescent oocyst – isn't infectious when shed in the feces but takes, at minimum, several days to sporulate (develop a pair of internal cysts (sporocysts) and, inside these, the infective sporozoites – 2 per sporocyst, 4 per oocyst).

Unanswered questions concerning *Cyclospora* and cyclosporiosis abound. How does *Cyclospora* contaminate food? Because frozen berries have not been associated with the illness, does this mean that the oocysts can not survive in terrain where annual freezing occurs and the infection will not become endemic there? Can *C. cayetanensis* infect animals other than primates and thus establish itself between illness seasons? What is the infectious dose of oocysts and what physical or chemical treatments eliminate infectivity? To control cyclosporiosis, answers to these and related questions are needed, and research – particularly on methods of detection, inactivation and cultivation – has been undertaken.

Detection. Methods for detecting *Cyclospora cayetanensis* on produce have been developed and used with limited success. On average, 30% of *Cyclospora* oocysts seeded onto produce can be recovered with methodology that involves removal of oocysts by washing, and identification by epifluorescence microscopy as well as by a DNA polymerase chain reaction (FDA Bacteriological Analytical Manual (Edition 8, Revision A). 1998. AOAC International, Gaithersburg, MD 20877-2504, U.S.A.). However, the range of recovery is wide – as high as 80% (usually with the freshest produce) and as low as 0% (often with decomposing or damaged produce). While no *Cyclospora* has been found on samples of commercial produce, a low and sporadic incidence on imported berries of *Eimeria* (a closely related parasite of certain animals only) has been observed (Table 1), indicating that the method works.

TABLE 1. FDA Berry Testing Results

1996	*Cyclospora*	*Eimeria*
Microscopy	0/94 samples	2/94
PCR	0/94 samples	2/94
1997		
Microscopy	0/192 samples	0/192
PCR	0/192 samples	3/192

Detection of seeded *Cyclospora* and naturally occurring *Eimeria* also suggests that sampling, not the detection methodology, may be the greater problem in testing foods. Both timeliness and quantity are factors mitigating against successful sampling. Due to the approximately one week incubation period prior to the onset of clinical cyclosporiosis, shipments implicated in illness outbreaks are no longer extant by the time epidemiological investigations begin. The low quantity of recovered *Eimeria* and the infrequency of *Eimeria* positive samples suggest that larger volumes of produce should be tested, although that would make sample processing difficult. Work on improving both the recovery and identification steps of the procedure are in progress at FDA, CDC and other labs.

The infrequent presence of low numbers of *Eimeria* on the spring crops of imported raspberries implies that there is occasional direct or indirect contact with avian or mammalian feces.

Inactivation. Information on the inactivation of *Cyclospora* is largely by inference from its epidemiology and data on related coccidia. The scarcity of "healthy" *Cyclospora* oocysts (available only from infected humans not yet treated with the appropriate sulfa drug) and the lack of an established culture system or model host to test developed (sporulated) oocysts for infectivity, account for this dearth of information.

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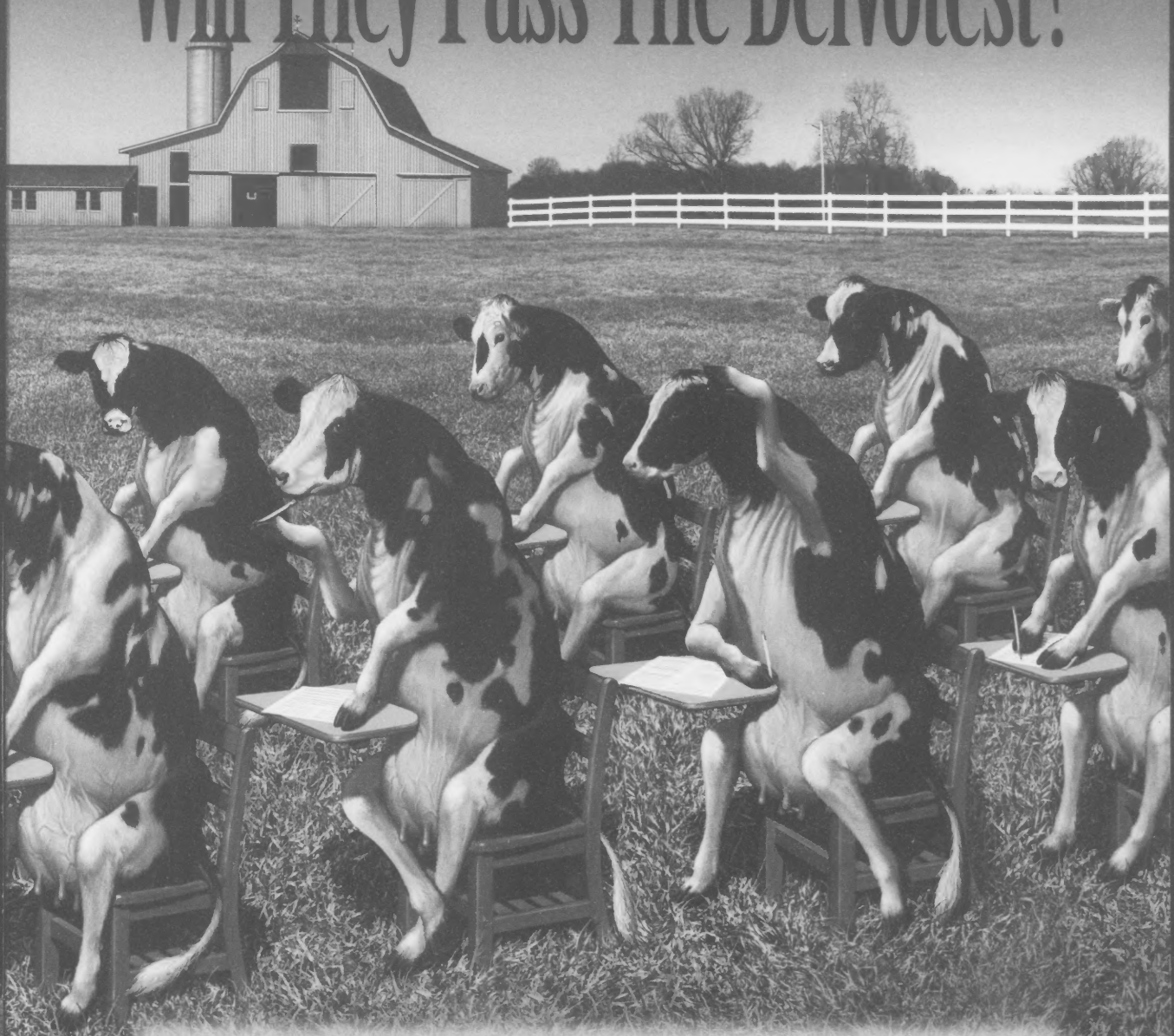

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