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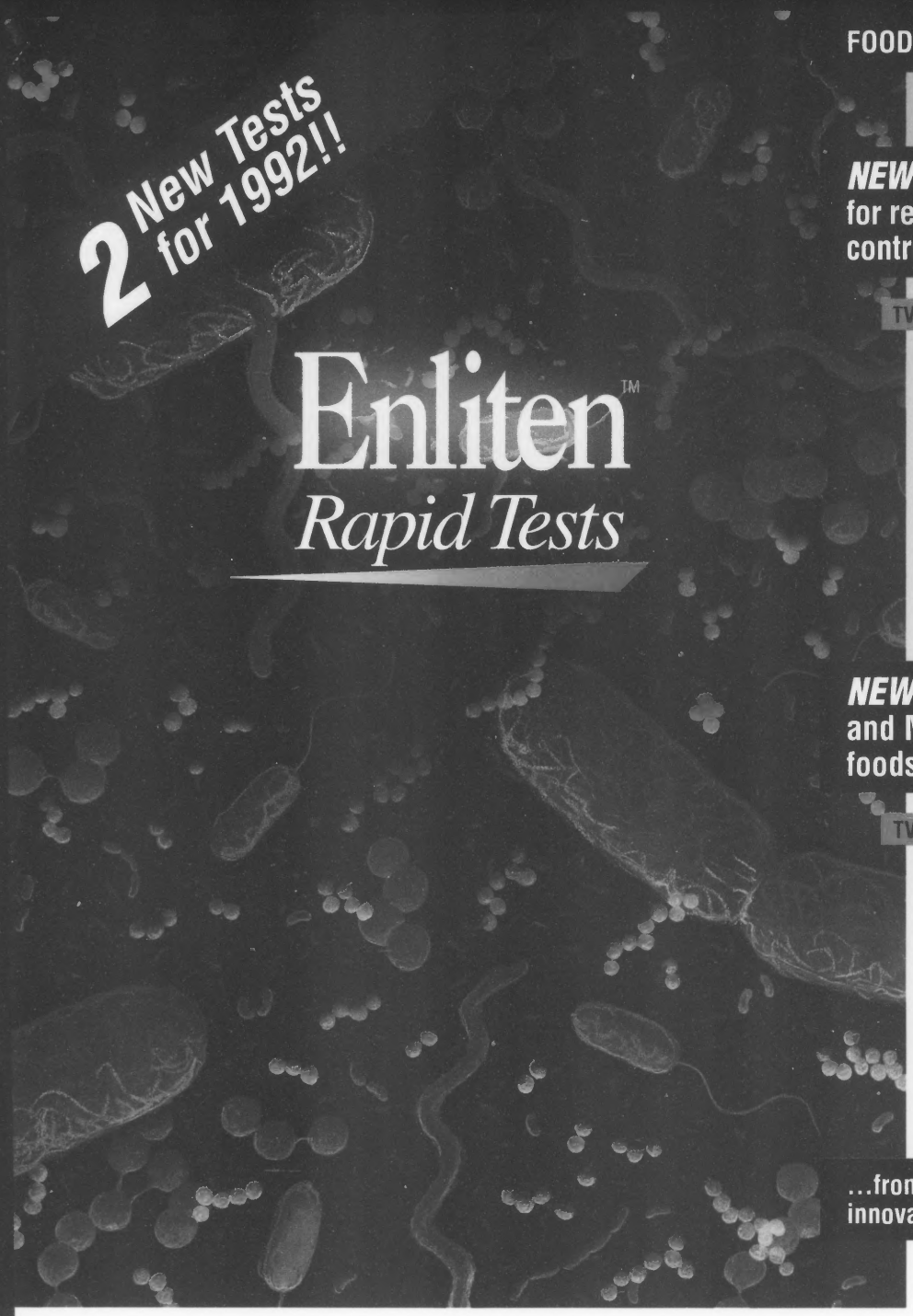
DAIRY, FOOD AND ENVIRONMENTAL

SANITATION

JUNE 1992

A Publication of the International Association of Milk, Food and Environmental Sanitarians, Inc.



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Thoughts From The President . . .

By
Damien A. Gabis
IAMFES President

The Annual Meeting is little more than a month away — July 26-29 at the Sheraton Centre in Toronto, Ontario. I hope that you will be attending to take advantage of the excellent technical program developed by Mark Banner and the Program Advisory Committee. I have no qualms in telling you that this year's technical program is the best that IAMFES has ever offered! Indeed, the food protection content of the program is very intense.

For you who are still undecided about attending, allow me to present some of the benefits of coming to Toronto. "Global Issues in Food Safety" is the emphasis of this year's meeting, and the program provides much in the way of authoritative information and interpretation from the speakers. The topics are important and timely, and the speakers are highly qualified, respected colleagues. Because of the relatively small size of our meeting, there are many more chances to meet one-on-one with speakers and fellow members. The Ontario meeting venue provides a rare opportunity for our American and Canadian members to exchange ideas and information about food protection issues. Our colleagues from the National Mastitis Council are co-sponsoring the Symposium on Milk Quality and the Canadian College of Microbiologists is our co-sponsor for the Symposium on an Update on Foodborne Pathogens. Members of the United States National Advisory Committee on Microbiological Criteria for Foods will be presenting the results of their most recent work. Experts will be presenting papers on standards issues on the international dairy scene, food standards in Japan and Europe, and international labeling requirements. Seafood safety is highlighted in two symposia. Food irradiation, a reborn controversial topic, is covered in two important symposia.

The Sheraton Centre is an ideal location for our meeting because of the convenience in moving from session to session. The hotel is also close to many interesting sights. The exhibitors are eager to tell you about their new products and new applications for their existing lines.

Michael Brodsky, Local Arrangements Chairperson, and the members of the Ontario Food Protection Association have worked like beavers all year preparing for the meeting. The IAMFES Meeting is always a great chance to catch up on the news from old friends, make new ones, and have fun at the special social events that have been planned for your enjoyment. Vibrant Toronto is ready to show you and your family a great time!

I want to announce that the Executive Board met by teleconference on May 8, and voted to move the association's office to new headquarters in the Merle Hay Centre in Des Moines. The work environment has been overcrowded for some time, and there is a chronic shortage of parking space for staff and visitors. The Board believes the present building is no longer suitable as the home of our professional association. The Merle Hay Centre is a new office building in a professional environment with a favorable cost. The specific timetable for moving has not been established, but will be after the Annual Meeting. Steve Halstead worked for several months gathering information about the office real estate market around Ames and Des Moines. Dee Clingman and I visited with Mr. Halstead in late April to study the data, look at the candidate offices, and meet with the owners before the Board took decisive action.

In other Board action, Lawrence-Leiter and Company, Kansas City, Missouri, was chosen as the consultant to help us develop the IAMFES Strategic Plan. The Lawrence-Leiter firm has many years of experience working with professional associations such as IAMFES. The Lawrence-Leiter firm was chosen after obtaining proposals and interviewing three firms, all of whom were well qualified. The Board believes that Lawrence-Leiter will best meet the needs of IAMFES. Mr. Gary LaBranche, a principal in the firm will be the primary person to work with us. The Long Range Planning Task Force will first convene at the Toronto meeting.

Pre-Meeting Workshops for the 1992 IAMFES Annual Meeting

Hazard Analysis at Critical Control Points (HACCP)

Conducted by **Frank L. Bryan, Ph.D., M.P.H.**

This day and a half workshop will provide step-by-step instructions to develop, implement and refine the HACCP system in the food processing and foodservice sectors.

The procedures and practices to be discussed will include:

- Evaluation of Operations for Hazards and Risks
- Measurement of Time-Temperature Exposures
- Measurement of pH Level of Foods
- Collection of Samples
- Testing of Samples for Pathogens
- Measurement of Water Activity (a_w)
- Analyses of Measurements
- Flow Diagrams of Food Production Processes
- Determination of Critical Control Points
- Establishment of Control Criteria
- Monitoring Data at Critical Control Points
- Verification of HACCP Systems Effectiveness

Workshop Hours will be:
Friday, July 24th - 1:00pm to 5:00pm
Saturday, July 25th - 8:00am to 5:00pm

Costs:	Member		Non-member	
	$200(US)	$230(CN)	$225(US)	$260(CN)

Monitoring/Measuring Environmental Sanitation in Food & Dairy Plants

Conducted by **J. Russell Bishop, Ph.D.**

This one day workshop is designed to provide participants with a working knowledge of proper monitoring of environmental sanitation. The workshop will present the hows and whys, as well as the interpretation and consequences, of proper monitoring.

Issues will be addressed from four perspectives:

Chemical (Sanitation) Industry
Testing Methods Manufacturers
Food Processing Industry
Environmental Services Laboratory

Representatives of these areas will share their experience and expertise with workshop participants.

Specific topic areas to be covered will include:

- Environmental Sanitation
- Monitoring of Quality Assurance Programs
- Various Testing Methods, ie.: Air, Swab, ATP, Petrifilm®
- Acceptable Bacterial Loads
- Sanitation Consequences

Workshop Hours will be:
Saturday, July 25th - 9:00am to 5:00pm

Costs:	Member		Non-member	
	$175(US)	$200(CN)	$200(US)	$230(CN)

For Further Information contact: Mr. Steven K. Halstead, CAE, Executive Manager
International Association of Milk, Food and Environmental Sanitarians
502 E. Lincoln Way Ames, Iowa 50010
(800)369-6337 (U.S.), (800)284-6336 (Canada),FAX (515)232-4736

REGISTRATION FORM

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Sheraton Centre — Toronto, Ontario — July 24-25, 1992

or

❑ **Monitoring/Measuring Environmental Sanitation in Food & Dairy Plants**
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Signature: _____

On My Mind . . .

By
Steven K. Halstead, CAE
IAMFES
Executive Manager

is Tele-conferencing . . .

The IAMFES Executive Board met recently via tele-conference. This was the first time we had used this form of technology to conduct the business of the association. We found it to be a convenient, cost-effective technique.

It was convenient from the standpoint that the participants can be anywhere that there is a telephone. As it happened Ron Schmidt, Harold Bengsch and Mike Doyle were in their offices; Damien Gabis, Dee Clingman and I were in Chicago for another meeting, but Bob Sanders was attending a square dance convention!

Even though the phone call cost about $210, it was cost effective for us because no one had to lose work time to travel; we had no plane tickets to buy; we had no meals; we had no sleeping rooms. I conservatively estimate that a face to face meeting would have cost us $2,300.

Our agenda for the meeting had ten items. I was concerned that this was too many, but since we had only allowed an hour and a half for the meeting, everyone kept focused on the agenda. I have been on conference calls that fell apart because they tried to do too much. That didn't happen this time.

I have also been on conference calls that didn't work because there were too many people on the line. I'm not sure what the magic numbers is— I've seen 9 member committee meetings go very well but 18 member Board Meetings disintegrate. Clearly, the greater the number of individuals involved, the more limited the agenda must be.

I think I can safely say that we will use the telephone for future meetings. This will allow your elected officers to take a more active role in the governance of IAMFES. This is in keeping with increasing the professional stature of IAMFES.

and Professionalism . .

Two actions taken by the Board during the tele-conference will also move us toward that goal. The first involves a change of address; the second a look at our future. Let me go into some detail on each of these.

The Headquarters of IAMFES left Shelbyville, Indiana for Ames, Iowa when Earl Wright became the Executive Manager. In those days, the Executive Manager was the only paid employee and part time at that!

Over the years, the association grew. So did the number of staff and the amount of space needed to house the association. We moved to our current location in 1987 and have found it necessary to expand twice since then.

As we put together our "want list" for the new office, space quickly moved to number one on the list. The staff argued, and I had to agree, that private offices, more storage and space to spread out projects, would increase our morale and efficiency.

Image also became a factor. We have few members who come to visit, but a great number of outsiders. It is hard for the staff to be proud and for outsiders to take us seriously when our office is next door to a auto mechanic and a concrete contractor.

We will be sharing our new office building with a neighborhood medical clinic, a bank, and a credit card processing center. The professional level of the neighbors will help us see ourselves in a more professional light and this in turn will help us do a more professional job for our members.

We will be moving to the Merle Hay Centre in Northeast Des Moines. This building will provide us with all the things we were looking for. It will however, cause us to change our local phone number and our fax number as well as our address.

We haven't decided when we will make the move except that it will be sometime after the Annual Meeting. We will do everything we can to minimize the disruption, but are confident that you will bear with us.

In our search for a facilitator for our long range planning task force, we talked to three companies. We discussed with them the history of IAMFES, the composition of our membership; the member services we provide; the headquarters staff; the constitution and bylaws; the affiliates; the committees; and the officers. We also discussed the work that Mike Weir's Long Range Planning Committee had done back in 1987-88.

After our discussion, we invited the three firms to submit proposals. In these proposals we were looking not only at the fees but also at the program that would be offered to meet our goals.

Following an extensive discussion of these proposals, the Board voted to engage the Kansas City firm of Lawrence-Leiter and Company. Gary LaBranche, CAE, will be the team leader and will have a staff of nearly 45 to back him up, should they be needed.

President Gabis has written several columns on long range planning and I will not take this space to repeat those ideas (See Presidents' Column, *Dairy, Food and Environmental Sanitation* March, April and June 1992).

Our plans call for the task force to meet in Toronto with the hope of being able to present at least a progress report at the Business Meeting on July 28.

Let me simply say that I expect this process and its results to help us take a giant step toward the level of quality and professionalism we dream about.

IAMFES Sustaining Members

ABC Research, PO Box 1557, Gainesville, FL 32602; (904)372-0436

Acculab, Inc., 700 Barksdale Road, Newark, DE 19711; (302)292-8888

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Alfa-Laval Agri, Inc., 11100 North Congress Avenue, Kansas City, MO 64153; (816)891-1565

AMPCO Pumps, Inc., 1745 S. 38th Street, Milwaukee, WI 53215; (414)645-3750

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Dean Foods, 1126 Kilburn Avenue, Rockford, IL 61101; (815)962-0647

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Diversey Corp., 1532 Biddle Avenue, Wyandotte, MI 48192; (313)281-0930

EG &G Berthold, 472 Amherst Street, Nashua, NH 03063; (603)889-3309

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Vol. 12 No. 6 JUNE 1992

Dairy, Food and Environmental Sanitation CONTENTS

Articles:

Association News:

ABOUT THE COVER .... *Results that have previously taken hours or even days are available in minutes using technology developed for the food processing industry. An entirely new concept in residue detection and microbiology encompassed in a single, computer-integrated system is pictured in use by technician Gail DiStefano. The Charm II System is used for antibiotic and aflatoxin detection, hygiene monitoring, shelf life prediction, microbial counts in raw milk, pesticide monitoring, and alkaline phosphatase testing. Photo courtesy of Charm Sciences Inc., Malden, MA.*

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Dairy, Food and Environmental Sanitation, Vol. 12, No. 6, Pages 334-340 (June 1992)

Prevention and Control of Foodborne Listeriosis

J. M. Farber,
Microbiology Research Division, Bureau of Microbiol Hazards, Food Directorate, Health and Welfare Canada, Ottawa, Ontario K1A 0L2

Methods used to control *L. monocytogenes* are not new, but involve the implementation of basic quality assurance systems such as hazard analysis critical control point (HACCP) procedures from raw material acquisition, through to finished product handling. Many of the problems in food plants linked to final product contamination with *L. monocytogenes* have been due to post-processing contamination. It is known that once *L. monocytogenes* contaminates a food processing plant, it can survive there for a long time if the temperature is low and the organism is protected by food components (54). In addition, when suspended in saline or milk *L. monocytogenes* can survive on fingertips for up to 1 h, and as long as 5 h, respectively. Hand washing with soap usually failed to decontaminate the fingertips (62). It has also been recently shown that post-pasteurization contamination of food products with *Listeria* can occur in processing plants via aerosol formation of the organism (35), and that the organism, when present in large numbers can survive in aerosol suspensions for greater than 3 h (64). Environmental and in-line sampling has played a large role in pinpointing trouble areas and revealing plant conditions that may contribute to final product contamination. With this knowledge in hand, much effort has been expended by the dairy, meat and fish industries to improve sanitation, hygiene and general cleanliness inside food processing operations. Although much of the early effort aimed at controlling *L. monocytogenes* occurred in the dairy industry, both the meat and seafood industry are now providing information to individual processors on ways to control the organism. The following segment is divided into three parts, but the individual sections can apply almost equally as well to the whole of the food industry.

Control in Dairy Industry

Raw milk is contaminated either by *L. monocytogenes* being secreted directly into the milk because of a mastitic cow (34) or an asymptomatic carrier (27), or by environmental contamination of the udder occurring via soil, and animal waste in the barn area.

Control at farm level (16,20,66).

- Moldy silage and silage of pH > 5.0 should not be fed to the cattle.
- Areas in the vicinity of aborted cows should be disinfected.
- Any cow with slightly hardened quarters should be treated promptly with antibiotics.
- Mastitic cows should be separated from the rest of the herd.
- Drinking water for cattle should be of good microbiological quality.
- Fields should not be irrigated with effluents from sewage treatment plants, or fertilized with unheated sludge from sewage treatment plants.
- Barn and milking equipment should be kept as clean as possible; i.e. practice good farm hygiene. This includes keeping other farm animals out of milking barns and away from milking equipment.
- Milk truck drivers should not be allowed entry into the barn.
- Practice sound milk-collection techniques including teat-dipping, and drying and sanitization of all milk contact surfaces just before use.
- Monitor temperature of bulk-tank and keep temperature as low as possible.

Control at the dairy plant (16,20,49,50,66). There are four major ways of introducing *L. monocytogenes* into the dairy plant (i) via the contaminated milk itself (ii) via contaminated materials and equipment, (iii) via the environment such as air or by pests, or (iv) via plant workers, truck drivers or visitors carrying the organism into the plant. It is necessary to make sure that milk trucks are properly disinfected, and that milk truck drivers do not walk through the production facilities of a plant. In addition since it is known that *L. monocytogenes* can be present and grow in naturally-contaminated raw milk (27), the temperature of milk silos should be monitored with a view to keeping the milk as cold as possible. Within the processing plant there are four major areas which require attention.

1. *Isolation of processing areas of the plant from raw product areas.*

Implicit in this isolation is the control of traffic flow within the plant and possibly the rethinking of material handling systems presently employed in dairies. Generally, unauthorized personnel should not be allowed into the plant.

Personnel within the plant should not walk from the raw product area to the processing area. For those employees who must travel between these two areas, footbaths should be installed and managed properly. All outer garments worn in the plant including boots should be sanitized daily. Color coding outer garments is an easy way of identifying which area of the plant, personnel are assigned to. Attention should also be paid to air-flow patterns within a plant, with air-flow always moving from finished product area to the outside or to the raw receiving area. Raw materials should never be stored with finished product. Only those products which have not left the direct control of the dairy should be reworked. No dairy product with an expired date code should be reworked. Reworked products should be set aside in a separate area until they are reprocessed. A general principle is to treat reworked products as raw product.

Employee education programs are crucial to success. Personnel need to be aware of why they must practice good personal hygiene and why it is so important to pay attention to traffic flow in the dairy plant.

2. *Processing controls* (16,49,50,66).

Process controls are an important part of the total strategy in controlling *L. monocytogenes*. The proper use and maintenance of pasteurizers is of primary importance. Accurate records on pasteurizer performance must be kept and inspected daily. Sweetwater should be treated with biocide. Air entering a plant should preferably be filtered (gross filters) and the air intake located away from any outside area which may harbour *Listeria* spp., such as the raw milk receiving or refuse-containing areas. In addition it is important to consider the source of makeup air, since it may be taken from dirty areas. Air incorporated into dairy products such as ice cream should be filtered through bacterial or HEPA filters. Aseptic packaging/processing areas should also be supplied with HEPA filtered air.

Processing room walls and floors should be kept clean, without any cracks or openings, as *L. monocytogenes* can accumulate in these areas. Although not always practical, the processing area should be kept as dry as possible, since *L. monocytogenes* is very frequently found in wet areas of the plant (41). This indicates a need for concern for condensation (dehumidifiers, air conditioners) in processing and packaging areas.

Cross-connections between finished and raw product (including C.I.P. lines) should be tracked and eliminated. All processing environments should also be kept as cold as possible.

3. *Cleaning and sanitizing* (16,49,50,66).

This is also a very important part of the strategy to control the survival and/or growth of *L. monocytogenes* in a dairy plant. Recent studies have shown that there are numerous sources of *Listeria* contamination in the environment of processing plants (14,41,52). In addition, Walker et. al. (70), upon examination of 39 frozen milk plants in California found that those plants with above average sanitation had a much lower rate of recovery of *Listeria* spp., as compared to plants with below average sanitation. Thus, cleaning and sanitizing must be given a high priority, and personnel chosen to oversee the effectiveness of the program. Areas which should be given close attention include: walls, ceilings, floors (including sanitizing floor mats and foot baths), drains, pallets, conveyor belts (tracks), milk cases, case washers and cold storage areas (14, 41, 70). However, priority should generally be given to product contact surfaces. Any spilled dairy products should be wiped up and the immediate area cleaned and sanitized. Items which absorb water such as rags and sponges are known to be potential sources of *L. monocytogenes* contamination and should not be re-used for cleaning without being sanitized. The use of color-coded brushes for different areas of the plant (e.g., raw receiving and finished product areas) should be considered.

Effective sanitation guidelines for dairy plants have been published (16,50). In addition, consultation and guidance from the chemical manufacturer is highly recommended. Each processing plant usually has different requirements for cleaning agents and therefore compound formulations may be designed for each type of cleaning operation. As well, no single hygiene program will fit all the different types of production and processing facilities. In general, the use of a foaming chlorinated manual type cleaner is recommended for walls, ceiling and floors, chlorinated cleaner on a daily basis for drains, equipment sanitizing with iodine or acid-type sanitizers, and a quarternary ammonium sanitizer (300 ppm) for flooding floors before start up each day. Operation of a fogging system (800-1000 ppm QUAT sanitizer) during the absence of plant personnel is also considered effective.

4. *Environmental and product sampling.*

Environmental sampling should be done to test the efficacy of the sanitation program and also to pinpoint possible "hot spots" in the plant where *L. monocytogenes* may colonize (31,72). In this regard, a recent study has demonstrated a high incidence of *Listeria* at fluid milk conveyor sites (14). *Listeria* spp. were isolated most often from the packaging-filling room location within a plant, and least frequently from the raw milk receiving room, implying that the dairy farm may not be the primary means of introducing the organism into the dairy plant. Drains were found to be good "indicator sites" of the environmental status of the plant (14). Guidelines both for taking and analyzing environmental swabs and in-line samples for the presence of *L. monocytogenes* in meat plants have recently been published (31).

Testing for *L. monocytogenes* in finished product as the sole means of control is not an efficient way of ensuring a safe product. The HACCP system which is slowly being implemented by industry as a total quality assurance system does make use of finished product testing but only as a means of verifying that good manufacturing practices are in place.

Control in Meat Industry

Many of the points outlined in the section on the dairy industry also apply to the meat industry. In addition both the Canadian Government and the American Meat Institute have

published information handbooks on the control of *L. monocytogenes* in ready-to-eat meat products (2,31). Some of the places where *L. monocytogenes* has been found in meat plants include: 1) product contact surfaces such as conveyor belts, transport containers, cutting tables, equipment and boards, 2) air above fans and air conditioners, and from humidifiers, 3) employees clothing and hands (32,33); 4) exhaust hoods, 5) drains and gutters, 6) pickling systems, and 7) cleaning equipment (2,33,72).

Because it is nearly impossible to completely eliminate *L. monocytogenes* from raw meat products most control procedures aim at minimizing levels of *L. monocytogenes* in raw meat, avoiding cross-contamination of processed product, preventing multiplication of the organism in the particular product, and preventing its establishment and growth in the environment of the meat plant (68). Control measures aimed at accomplishing the above include (2,31,68);

- Improvement of slaughterhouse hygiene e.g., clean animals coming into slaughterhouse, no piercing of intestinal wall of animals.
- Separation of raw meat and thermally processed meat areas, including personnel and washing areas.
- Regular, proper and effective cleaning and sanitation programs. Equipment should be designed and constructed so that it is easily cleaned, and without "corners" which may become a focus for *Listeria.*
- Disinfection of hands, especially in the processing and post-processing areas is very important. Regular changing of gloves has been suggested (32,33).
- Common sense should be followed during cleaning operations, e.g. pressure hoses should not be used to clean drains, since aerosols can be created which can spread contamination throughout the room.
- Identify and establish procedures to deal with possible high risk circumstances (e.g., introduction of new product onto line).
- There should be no direct access from outside the plant to the production and packaging areas, for personnel or equipment such as fork lifts.
- Effective processing schedules should be followed. The need for immediate cooling after processing should be stressed. The proximity of the product to known environmental sources of *L. monocytogenes* should be considered during cooling procedures. Product hanging on racking systems may have to be raised to avoid recontamination during cooling procedures such as showering. The showering operation creates splashes and aerosols from underlying floor surfaces and drains. Drains located within a smokehouse itself, are often overlooked for daily scrubbing and sanitizing.
- Re-contamination of cooked meat products should be avoided and more widespread use of cook-in-the bag processing or immediate aseptic packaging of finished product is recommended (40). Most cases of final product contamination are caused by recontamination after cooking. In this regard, the concept of clean rooms consisting of several compartments and different barriers, to prevent re-contamination of heated meat products has recently been developed (43).
- Packaged product falling to the floor should not be put back onto conveyer belts. Unpackaged product which falls should be garbaged.
- A dry environment should be maintained within the meat plant. Plants should be encouraged to avoid wet mid-shift cleanups. At the same time, wet processing steps should be isolated to contain the moisture.
- There should be management commitment to provide education and training to plant personnel. In a recent study, environmental sampling of a turkey frank plant, whose product has been linked to a case of listeriosis, found that contamination of the majority of frankfurters occurred at a single point during the peeling process, just prior to packaging (72). In this situation, an environmental HACCP based sampling plan, may have been able to pinpoint this "hot spot" in the plant, and thus eliminate contamination of final product.
- Establish an effective sampling program to assess control procedures.

Adoption of the HACCP system is recommended for all meat manufacturers. An additional control procedure being considered in some European countries is the use of starter cultures such as the lactic acid bacteria to control the growth of *L. monocytogenes* in cooked meat products (see Table 2). As well, the direct addition of bacteriocin to beef has been shown to be effective in controlling the growth of *L. monocytogenes* (53). The effectiveness of the bacteriocin treatment appeared to depend on the bacteriocin concentration, initial levels of *Listeria* present and the time of application of the bacteriocin. Even after 28 d of refrigerated meat storage, the bacteriocin was still stable (53). Recently reported work has also shown that acid dips may be effective in controlling the growth of *Listeria* on frankfurters at 5°C. The most effective dips were 1% acetic acid or a mixture of 1% acetic and citric acids (3).

Control in Seafood Industry

Many of the recommendations in the previous two sections also apply to the seafood industry, and only control points not mentioned previously will be discussed. Fisheries and Oceans Canada has prepared working documents on the control of *L. monocytogenes* in processed seafood (lobster, shrimp, crab and smoked salmon). Some of the concepts which have been developed specifically for the seafood industry or that have not been mentioned in the previous section include:

- The establishment of a sanitary room or area where entry of *L. monocytogenes* is controlled, mainly by eliminating cross-contamination. All items entering the sanitary zone must be cleaned and non-food compounds should not be moved through this zone and other raw shellfish products should not be brought into this area during processing.
- Potable water should be used in the plant or in the manufacture of ice.
- Uncooked crustaceans should be heat processed to a center temperature of at least 80°C (176°F). The processing parameters of time and temperature should routinely be monitored once the process has been validated to meet the temperature requirements above.

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- All fish products that are not shelf-stable should be stored at 4°C or lower.
- Freezing of all packaged goods with efficient plate or blast freezers should start within 1 h after packaging.
- If possible, cooking in brine solutions should be instituted as a possible control measure. Brine solutions should be discarded at the end of the day or shift.
- Unpackaged cooked products should not be stored in chill rooms with unprocessed product. Chill rooms should be cleaned and sanitized at least once a week.
- Frozen storage areas should be cleaned and sanitized at regular intervals.

Compounds used to inhibit or inactivate L. monocytogenes.

Compounds which are used most commonly by the food industry and which have been found to be effective against *L. monocytogenes* include iodophors such as iodine (25 ppm), acid sanitizers (130 - 200 ppm), chlorine at a wide range of concentrations (20 ppm for water treatment, 200 ppm for CIP cleaning, walls, stainless steel equipment and nonporous surfaces, and 1000 ppm for wooden crates and fogging of the atmosphere) and quaternary ammonium compounds (QUAT's) at 200 ppm. (17,23,45,51).

There has been much research into inhibitory compounds that are present naturally in food or that can be added to it (Table 1). In addition, the antimicrobial activity of bacteria against *L. monocytogenes* has been described by various authors (Table 2). Although there has been rather limited testing of these largely bacteriocin producing bacteria in food products, recent work by Berry et al. (9) has shown that the addition of high levels (at least 10^7 cfu/g) of *Pediococcus acidilactici* to frankfurters can be effective in controlling the growth of *L. monocytogenes*. The degree of inhibition observed was dependent upon the initial levels of *Pediococcus* cells, the package atmosphere and the storage temperature (9). Although many different types of bacteria can inhibit the growth of *L. monocytogenes* (Table 2), the organism can be an effective competitor when in the presence of common spoilage organisms such as the *Pseudomonas* spp. (28). In addition, stimulation of the growth of *L. monocytogenes* by bacteria, e.g. *Flavobacterium* spp., can also occur in certain foods (29).

Various factors affect the efficacy of disinfectants against *L. monocytogenes*. Two of the more important ones are the presence of organic material, and the attachment of microorganisms to surfaces. Best et al. (10) recently found that out of the 14 disinfectants tested against *L. innocua* and *L. monocytogenes* attached to stainless steel, only three (povidone-iodine, chlorhexidine gluconate and glutaraldehyde) were effective in the presence of serum, and only one (sodium dichloroisocyanurate) in the presence of milk. *Listeria* dried onto the stainless steel surfaces were more resistant to disinfectants, than those cells in suspension (10). Similarly, Mustapha and Liewen (51) found that *L. monocytogenes* attached to stainless steel surfaces exhibited a greater resistance to both sodium hypochlorite and a quaternary ammonium compound. Interestingly, cells incubated for 1 h on steel surfaces were more resistant to the lethal effects of sodium hypochlorite than those remaining for 24 h. The authors hypothesized that this may have been due to

Table 1. Some examples of compounds or systems found to be bacteriostatic or bactericidal towards *L. monocytogenes*.

Compound or system	Growth temperature (°C)	Concentration	Comment	Reference
Sodium benzoate	13,35°C	0.15%,0.3% (pH 5.0) 0.15%, 0.30% (pH 5.6)	generally bactericidal generally bacteriostatic	(26)
lactic acid, acetic acid, propionic acid	NK[a] NK NK	0.3, 0.65 0.23, 1.00 0.15, 1.10	MIC, MBC[b] MIC, MBC MIC, MBC	(6)
Clove Clove Cinnamon	4 35 4,35	0.5% 0.5%	bactericidal bacteriostatic bacteriostatic	(7)
Apo-Lactoferrin	35	15,30 mg/ml	bacteriostatic	(56)
Sodium propionate	4, 13, 21, 35	0.25, 0.3% (pH 5.0)	partial inactivation (4°C) slight growth (13°C); no growth (21°C); no growth (0.25%, 35°C) or complete inactivation (0.3%, 35°C)	(25)
Potassium sorbate	4 13	0.25%, 0.3% (pH 5.6) 0.2, 0.25, 0.3 (pH 5.0)	inactivation inactivation	(24)
Bovine pepsin-rennet extract	7	commercial preparation	inactivation	(22)
Tertiary butylhydroquinone	35	64 µg/ml	MIC	(55)
Egg white lysozyme	Mainly 5	100 mg/kg	in vegetables-mainly[c] bactericidal; sausage and cheese mainly bacteriostatic	(39)
Egg white lysozyme	5, 12, 19, 37°C	50 µg in 3 ml	cells grown at 37°C were 1.8-2.5 fold more resistant to lytic action of lysozyme than cells grown at 19, 12 or 5°C.	(61)
Nisin	37 4,37	1.85 to 10^3 IU/ml[d] 2.55 x 10^3 IU/g	MIC's inactivation in cottage cheese	(8)
Nisin	37	100 IU/ml	inactivation when cell concentration $<10^3$ cells/ml	(48)
glucose oxidase-glucose systems	37	0.5-1.0 mg/ml glucose; 0.5-1.0 IU/ml glucose oxidase	growth inhibition occurred but not as much as with other pathogens tested	(67)
Liquid smoke	room temp and 4	0.25, 0.5%	bactericidal in liquid culture aand in beef franks	(47)
Chlorine	25°C room temperature	0.5-10 ppm > 50 ppm in phosphate buffer	mainly bactericidal[e] bactericidal[f]	(23) (12)
H_2O_2	15°C	0.0495%	bactericidal[g]	(21)
Acetic citric, lactic acids	7, 13, 21, 35	≥0.3%	inactivated	(1)
Lactoperoxidase (LP) system	4, 15	various concentrations	broth and UHT milk- bacteriostatic or bactericidal[h]; cheese-bactericidal	(18,19)
Lactoperoxidase system	g, 20, 30	14.5 ppm SCN 5 ppm LP 8.5 ppm H_2O_2	Essentially bacteriostatic in skim milk	(11)
Plant extracts	28	500 to 5000 µg/ml	only some extracts effective; inhibition prevented by addition of protein	(15)
Maillard reaction products	37	unknown	organisms only slightly inhibited by high pH Maillard reaction products	(65)
Sodium or potassium lactate (lactate ion)	Broth 35°C Meat -5, 20; 35°C	up to 10.5% by weight- sodium or potassium lactate	broth - levels >5% delayed growth: in meat growth suppression at all temperatures by 4% lactate	(60)
Fatty acids and monoglycerides	4, 30, 37°C	0 to 300 ppm	monolaurin bactericidal at low temperature in skim milk but in whole milk was not inhibitory; CLA bacteriostatic at levels tested	(71)

[a]NK, not known.
[b]MIC, Minimum inhibitory concentration; MBC: minimum bactericidal concentration.
[c]EDTA plus lysozyme was required for maximum activity in certain foods.
[d]Usinq MRS agar.
[e]The presence of 0.05 or 0.1% peptone caused a rapid loss of available chlorine.
[f]For Brussels sprouts dipped into 200 ppm chlorine for 10 s, only 1 log reduction in numbers of LM observed, as compared to control.
[g]Bactericidal effect not observed with LM in raw milk or in milk containing *S. aureus* or *S. faecalis*.
[h]Complete inactivation was dependent upon initial inoculum, culture medium and storage temperature.

Table 2. Some examples of bacteria found to have inhibitory activity against *Listeria monocytogenes*.

Organism	Temp (°C)	Comment	Reference
Lactobacillus plantarum	30°C	• tempeh fermentation	(5)
Brevibacterium linens	30°C	• protein-like compounds	(69)
Arthrobacter nicotianae		• sensitive to heat	
A. nucleogenes		• small m.w.	
(red smear cheese isolates)			
Leuconostoc gelidum	25°C	• heat resistant, protease sensitive	(36)
		• > 1000 D	
		• bactericidal, narrow spectrum of activity	
Pediococcus acidilactici	32°C	• non-acid effect	(38)
P. pentosaceus		• relatively few pediococci produced strong inhibitory effect	
P. damnosus		• resistant sub-populations of *Listeria* were observed	
Streptococcus lactis	35-37°C	• bacteriocin-like substances	(13)
		• bactericidal	
		• sensitive to proteolytic enzymes	
Lactobacillus sp.	37°C	• bacteriocinogenic strains of lactic acid bacteria	(37)
Lactococcus lactis			
Leuconostoc sp.			
P. acidilactici			
P. pentosaceus			
Lactic acid bacteria including	32°C	• inhibition > at 25 than at 32°C	(57)
L. acidophilus		• mainly bacteriostatic	
		• acid played some role in antibiosis	
Streptococcus faecium	not known	• bacteriocin-like activity	(6)
		• strong bactericidal activity	
		• effect eliminated in experiments with soft cheese	
L. casei	37°C	• inhibitory effect not due to pH	(58)
L. acidophilus		decrease or action of acids	
L. sake (sausage isolate)	32°C	• not active against Gram-negatives	(63)
		• heat resistant, protease sensitive	
		• bacteriostatic effect	
Lactobacillus spp.	30°C	• protease sensitive	(44)
Pediococcus spp.		• bacteriocins	
Leuconostoc spp.		• activity against *Aeromonas hydrophila* also observed	
Carnobacterium piscicola			
(meat isolates)			
Enterococcus faecium	37°C	• inhibition effective against all *Listeria* spp. tested	(46)
(cheese and silage isolates)			
Enterococcus faecalis	37°C	• strong activity	(4)
		• protease sensitive	
L. sake	8, 15°C	• inhibition of *Listeria* in meat shown to be due to bacteriocin	(59)
(meat isolate)		• no sensory changes with use of *L. sake* on fresh Mettwurst	
		• sakacin A more effective inhibitor in broth than in meat system	

the higher moisture levels remaining on the stainless steel surface after 1 h incubation, in contrast to the dry film of liquid which was seen after the 24 h incubation.

Recent interest has focused on the action of disinfectants against microbial biofilms, which are deposits of attached microorganisms combined with organic and inorganic materials. Biofilm bacteria are generally more resistant to physical and chemical antimicrobial factors than freely-suspended bacteria. For example, Frank and Koffi (30) found that attached (glass slides) single cells of *L. monocytogenes* were more resistant to chemical sanitizers than freely suspended planktonic cells, and that when attachment was followed by growth (biofilm formation), additional resistance developed. In addition, adherent microcolonies were much more heat resistant than planktonic cells (30). It has also been shown that 8 d adherent (stainless steel) *L. monocytogenes* cells were greater than 100 times more resistant to a 30 s exposure to 200 ppm hypochlorite than similar levels of 4 h adherent populations (42). These results indicate that on surfaces which are irregular or difficult to reach, i.e. inadequately cleaned surfaces, survivors might form biofilms with increased resistance to sanitizers and heat which could then contaminate foods.

Complete adherence to the guidelines presented in this section would still not guarantee the elimination of *L. monocytogenes* from all products; however, the potential for contamination would be greatly reduced. It is important to remember that control is required at all stages in the food chain not just during processing; HACCP procedures should be applied equally enthusiastically at the retail level and in the home. Because *L. monocytogenes* can grow, albeit slowly, at chill temperatures, a product that may have contained very low numbers immediately after leaving the processing plant, could contain very large numbers by the time the food is consumed. This is especially true in the case of the new generation refrigerated-type foods with extended shelf-life. For these foods it becomes necessary to add additional barriers or hurdles to control the growth of *L. monocytogenes*. Controls at both the retail and consumer levels include prevention of cross-contamination, and maintaining chill cabinets and refrigerators at as low a temperature as possible.

Unfortunately, control measures for *L. monocytogenes* in foods are also influenced by differing worldwide government policies regarding the presence of the organism in food - a problem compounded by the lack of knowledge regarding the numbers of cells which must be ingested to cause illness. Whether or not food regulatory agencies worldwide should tolerate low levels of *L. monocytogenes* in foods in which the organism cannot grow is debatable at this point. However, every effort should be made to inhibit multiplication of the organism when it is present in a food in which the organism can grow. Despite the unknowns, the HACCP approach as a total quality control system is the most reasonable path to follow to reduce and/or eliminate *L. monocytogenes* in foods.

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Toxoplasma gondii in Meats — A Matter of Concern?

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Toxoplasma gondii is an obligate intracellular protozoan parasite which can infect warm-blooded animals. Toxoplasmosis is probably the most widespread zoonotic disease in the world. It is believed that approximately 50% of the population in the United States have been exposed to *T. gondii* (i.e., they are serologically positive) and at least 500 million people in the world are infected with the organism. In healthy adults and children, toxoplasmosis is generally asymptomatic. However, during pregnancy, an infection can be quite destructive, resulting either in fetal death or in a child with physiological, physical or neurological deficits. In immunocompromised individuals, an infection by the organism or reactivation of the disease resulting from an earlier exposure can be life threatening.

Life Cycle of *T. gondii*

T. gondii has three infectious stages:

1. tachyzoites (trophozoites), rapidly multiplying forms;
2. bradyzoites, present in tissue cysts;
3. and sporozoites, present in oocysts found only in feline feces.

The definitive host is the feline; thus, the sexual cycle of *T. gondii* is completed only in members of the cat family. The disease is acquired by both cats and intermediate hosts through carnivorism, ingestion of cat feces, and/or by congenital infection. Generally, the cat is infected through ingestion of cysts present in prey or uncooked meats. The cyst wall is then dissolved by enzymes present in stomach and small intestine. The released bradyzoites penetrate the epithelial cells of the small intestine where a few cycles of asexual reproduction of the parasite takes place. Following asexual development, gametes are produced and after fertilization, a wall is formed resulting in the oocyst which are shed by the cat during defecation. Freshly shed oocysts are *non-infectious* but upon exposure to air, they sporulate in 1-5 days and become infectious. Anaerobic conditions, heat (>45°C), or cold (≤4°C) inhibit sporulation. The sporulated oocyst contains two sporocysts each of which consist of 4 sporozoites.

In the intermediate host, infection occurs via ingestion of tissue cysts or oocysts (or congenitally during pregnancy). Bradyzoites released from tissue cysts or sporozoites released from oocysts penetrate intestinal cells and multiply as tachyzoites and eventually spread via lymph and blood to other parts of the body. Tachyzoites can multiply in most cells and eventually destroy the invaded cells. Cell lysis is followed by invasion of new cells. As immunity develops, replication of tachyzoites decrease and tissue cysts develop which do not normally produce a host reaction. The cysts (each cyst may contain > 1000 bradyzoites) are found in brain, muscle, heart, and visceral organs of both cats and intermediate hosts and persist for life. The encysted organisms are protected from circulating antibodies. Cysts may occasionally rupture but the released bradyzoites are inactivated by the immunocompetent host and as long as the immune system is intact, the encysted bradyzoites are inactive. Oocysts are never shed by intermediate hosts.

Survival of *T. gondii* Oocysts

Cats prefer to defecate in soft soils (gardens, sandboxes), water, animal feeds, hay or animal bedding. The sporulated and infectious oocyst is very hardy and can survive extremes of environmental conditions. Oocysts retain their infectivity in soil or water for 150-400 days at temperatures ranging from 4 to 37°C. They are less resistant to drying, with loss of infectivity occurring within 30 days at relative humidities of 50-80% and within 3 days at 0-37%. Freezing does not eliminate oocysts from soils. Oocysts are killed by ammonia solutions; exposure to 10% ammonia for 10 min or to 5% for 30 min completely eliminates infectivity. Treatment with boiling water for 5 min is also effective in destroying oocysts.

Distribution of *T. gondii* Nature

Oocyst survive well in water and toxoplasmosis can result in animals if they drink water from oocyst-contaminated sources such as streams.

Infectious *T. gondii* oocysts have been isolated from soils from all over the world. Rodents and birds may become infected when they are exposed to oocyst-contaminated soils since they may ingest oocysts during grooming or by eating coprophagous insects or earthworms. Earthworms transfer oocysts from deeper to upper layers of soil and oocysts present in earthworms are infectious. Flies, cockroaches and other coprophagous insects contacting cat feces also contain infectious oocysts in and on their bodies. These insects can contaminate human food or act as food for rodents and birds

and infect them. By eating these infected animals, foraging uninfected cats become infected in turn and the cycle of oocyst production and contamination of the soil with *T. gondii* oocysts is repeated.

Children, playing in sand or dirt where cats have defecated are at risk for exposure. Small children are not very sanitary-conscious and may put their hands in their mouths in an indiscriminate manner while playing. Children or adults with geophagy (pica) can readily be infected by eating soils containing oocysts.

Among food animals, *T. gondii* infection is widely prevalent in pigs. In pregnant sows, an infection may induce abortion or congenital toxoplasmosis. While most pigs acquire a subclinical infection upon exposure to the parasite, clinical toxoplasmosis can occur in neonates, often leading to death. Thus, toxoplasmosis in swine can represent an important economic loss to farmers. Swine can become infected through cannibalism, ingestion of tissue cysts when eating rodents or birds, eating uncooked garbage, and probably through ingestion of soil oocysts due to the rooting nature of pigs. Studies on the seropositivity of swine to *T. gondii* indicate that the extent of infected pigs on farms in the U.S. can range from < 1 to 69% with a national prevalence of approximately 23%.

Infection of sheep with *T. gondii* is usually subclinical; however, goats are much more susceptible to toxoplasmosis and clinical symptoms may be observed. Infection with *T. gondii* is an important cause of abortion in both goats and sheep and the results can be economically devastating to the farmer. Seropositive females can be expected to deliver normal young even if they have aborted once; therefore, seropositive ewes and does should be kept as breeding animals. A recent survey indicated that approximately 37% of sheep and 20% of goats are seropositive for *T. gondii*. Most sheep and goats acquire the parasite from eating oocyst-contaminated hay, ground feeds and drinking contaminated water.

Under natural conditions, *T. gondii* is not an important cause of abortion or clinical disease in cattle. While *T. gondii* can multiply in bovine tissue, it is quickly eliminated. The role of beef in the epidemiology of human toxoplasmosis is uncertain but it appears to be a minor source of infection to humans. However, more studies are needed to determine the extent of *T. gondii* infections in cattle and the role of beef as a source of human toxoplasmosis.

Clinical cases of toxoplasmosis in horses and other equids are rare. Limited surveys indicate that approximately 15% of the horses in the U.S. are positive for *T. gondii*. Edible American wild game animals show seropositivity for *T. gondii*, also. Both wild and domestic birds are susceptible to *T. gondii* infections; however, the prevalence of toxoplasmosis in chickens is not known because chickens do not develop antibodies against *T. gondii* that can be detected by the commonly used methods.

Mice, rats, raccoons, squirrels, opossums, and other small wild animals that live close to the human environment show *T. gondii* seropositivity. Zoo animals such as felines, marsupials, canines, ungulates (hoofed mammals), and birds show seropositivity, also. Zoos are easily accessed by feral domestic cats and oocyst-shedding cats can contaminate feed and bedding of zoo animals. Newly infected zoo felines can shed oocysts which may be spread throughout the zoo population by keepers moving from cage to cage. Feeding of raw meats to zoo carnivores may also lead to infected animals if the meat contains tissue cysts. Only thoroughly cooked meats should be fed to zoo animals. If cooking is not practical, all meats should be frozen before feeding to animals.

Generally, dogs do not show clinical signs when infected by *T. gondii*. Fatal toxoplasmosis has been observed in dogs concurrently infected with the immunosuppressive distemper virus. In the U.S., approximately 17% of dogs are seropositive for the parasite and 29% are positive world-wide. Other canines (fox, coyote, wolf) are susceptible to toxoplasmosis, also. There is no direct route of *T. gondii* infection from dogs to humans; therefore, playing with the family pet will not lead to toxoplasmosis.

Members of the cat family are the only animals known to shed *T. gondii* oocysts. In terms of human infection, the common house cat, both pet and feral, is the most important source of oocyst contamination of foods and the environment. Limited studies indicate that approximately 30% of the house cats in the U.S. are seropositive; world-wide, the figure is approximately 37%. Kittens become infected soon after weaning, usually by sharing prey with its mother. Infections generally are subclinical. Oocysts are shed for 1-2 weeks and in general, cats that have excreted oocysts do not do so again. The house cat should not be allowed to hunt and should never be fed uncooked meats.

Occurrence of *T. gondii* In Foods

In industrialized countries, raw and undercooked meats containing *Toxoplasma* cysts probably serve as the major source of human toxoplasmosis. While some people prefer raw or undercooked meats, changes in eating habits, i.e., foods eaten away from home more often may expose consumers to undercooked meats which might not occur if meals were prepared at home. Modern cookery methods such as microwave ovens may not expose meats to proper time-temperature relationship to ensure destruction of cysts. As the U.S. population becomes more sophisticated in their food preferences, there will be a willingness to try new food combinations which may include raw or undercooked meats.

Beef and veal seem to be less contaminated with *T. gondii* than other meats but tissue cysts have been found in edible tissue of beef and consequently, the eating of raw or rare beef could expose the individual to infection. Even if the presence of *T. gondii* in beef and veal is low, these meats could be contaminated in another way. *T. gondii* cysts present in pork, mutton or lamb may be ruptured during grinding or cutting with ensuing contamination of equipment with bradyzoites. If thorough cleaning is not performed, these bradyzoites can cross-contaminate other meats that are processed using the equipment.

In the U.S., eating undercooled or raw pork containing *T. gondii* cysts is believed to be the major meat source of toxoplasmosis in humans. Tissue cysts persist in swine for several months and cysts have been demonstrated in edible tissue of swine. During butchering, wounds, particularly on the hands, should be covered to prevent entry of bradyzoites

from ruptured cysts. Tasting raw pork (or other meats) during the preparation of sausage should be avoided.

The prevalence of *T. gondii* in U.S. market lamb is unknown but is estimated to be more than 5%. Viable *T. gondii* has been isolated from edible tissues of lamb, goat and sheep; there are reports of transmission of *T. gondii* by drinking goat milk. Lamb and goat meat are not important meat foods in the U.S. and mutton is rarely consumed but it is used in pet foods and should be thoroughly cooked before use. Lamb, mutton or goat meat may be major meat items in certain ethnic groups in the U.S. and for people in other countries. These individuals are at risk for toxoplasmosis if the meats are not thoroughly cooked.

Horse meat is not an important meat item in the U.S. but since tissue cysts persist in horses for several months, people who reside in areas where horse meat is consumed may contact toxoplasmosis if the meat is not well-cooked. Horse meat is a common ingredient of pet foods in the U.S. and pets should be only fed thoroughly cooked horse meat.

Small game animals such as squirrel and rabbit may be sources of *T. gondii*. The parasite has been found in tissues of large wild game animals such as deer and toxoplasmosis has been associated with eating undercooked venison. Caution should always be exercised in the preparation of wild game to ensure that bradyzoites from ruptured cysts do not enter a wound or contaminate butchering equipment.

T. gondii has been isolated from tissues and organs of chickens and pigeons but not from eggs. Poultry is probably not an important source of toxoplasmosis to humans since poultry is normally served well-done.

T. gondii oocysts may be present on vegetables, particularly root vegetables that are not cooked. Cats are known to defecate in garden soil and it is very possible that vegetables could be contaminated with infectious oocysts and pose a health risk if they are not well washed. Leafy vegetables may be contaminated by insects that have come in contact with cat feces.

While few studies have been performed concerning the incidence of *T. gondii* in market meats, studies have shown that *T. gondii* is present in the tissues of warm-blooded food animals. Except perhaps in the case of cattle, the parasite appears to persist in animals as tissue cyst for long periods if not for life. It may be possible that a significant part of the raw meats appearing in markets today contain *T. gondii* and there is obviously a need for market surveys to determine the incidence of the parasite in raw meats. One of the reasons for the lack of knowledge concerning the presence of *Toxoplasma* in market meats is due to the difficulty of the assay: tissue from suspect meat is fed to cats and observing for oocyst excretion or by intraperitoneal inoculation of tissue digests into mice and then searching for tissue cysts. Some of the newer techniques such as enzyme linked immunosorbent assay (ELISA) or DNA probes linked to the polymerase chain reaction (PCR) may be useful tools in future market surveys.

Destruction of *T. gondii* in Foods

When tissue from pigs infected with *T. gondii* was ground and mixed with ground brain tissue from infected mice (mixing pork with mice brain increases the number of tissue cysts several fold) and heated to various internal temperatures, D-values obtained for the inactivation of bradyzoites were 53.5 min at 49°C, 5.8 min at 55°C, 3.8 min at 61 °C and 3.6 min at 67°C. A similar mixture of porcine and mouse tissue were frozen and stored for various intervals to determine the effect of freezing temperatures on *T. gondii* viability. There was no survival of the parasite at -8.0°C stored ≥3 days, nor was there survival at -6.7°C stored ≥17 days. At freezing temperatures ranging from -1.0 to -8.0 C, storage for ≥34 days rendered the tissue cysts non-infectious. *T. gondii* cysts are more sensitive to heating and freezing than *Trichinella spiralis*; therefore, heating and freezing temperatures that inactivate *T. spiralis* will inactivate *T. gondii* also. It is believed that *T. gondii* is more sensitive to present day meat curing processes than is *T. spiralis* and since cured meat products are processed to ensure destruction of *T. spiralis* cysts, it is assumed that *T. gondii* cysts are destroyed also. However, no real information is available concerning the effect of commercial cured meat processing on *T. gondii*. Research is needed to determine the effect of cured meat processes (including curing salts, drying, fermentation, smoking, etc.) on the lethality of *Toxoplasma* cysts present in meats.

When pork tissue containing approximately two *T. gondii* cysts/100 g or mouse brain tissue containing at least 10,000 cysts/100 g were irradiated with a Cs-137 or Co-60 source, 20 krad (200 Grays) inactivated the cysts present in pork tissue whereas 50 krad (500 Grays) were necessary to inactivate those in mouse brain. Therefore, a dose of at least 100 krad (1000 Grays) would ensure that pork tissue is free of infectious *T. gondii*. Unlike heating and freezing, it appears that *T. gondii* cysts are more resistant to radiation than are the cysts of *T. spiralis*.

Limited studies indicate that, in general, conditions that rid pork of infectious *T. spiralis* larvae also frees pork (and presumedly other meats) from infectious *T. gondii*. However, more information is needed to determine if commercial cured meat processing conditions actually eliminate the parasite from meats.

Human Toxoplasmosis

Individuals can develop toxoplasmosis through the ingestion or inhalation of oocysts, by ingestion of tissue cysts present in meats or wound infection by bradyzoites from cysts ruptured during butchering. However, the importance and extent of oocyst ingestion or inhalation in causing disease is not known. Congenital infection occurs also.

When a "normal" individual is initially infected with *T. gondii*, there is parasitemia followed by dissemination and encystment of the parasite in various parts of the body. There are usually no clinical symptoms and the presence of infection can be detected only by serology. If there are clinical symptoms, the disease is usually mild and self-limiting and fatalities are rare. The symptoms may present as fever, malaise, skin rash, pneumonia, myocarditis, hepatitis, involvement of the lymph glands, encephalitis or a combination of these.

The disease in immunocompromised individuals is usually recrudescence, i.e., reactivation of a latent *T. gondii* infection. The immune system of the seropositive

immunocompromised individual can no longer maintain the parasite as benign cysts and bradyzoites are released into the system leading to an active disease. In seronegative immunocompromised individuals, a newly acquired infection is possible if the individual eats raw or undercooked meats or comes in contact with oocysts. Acquired immune deficiency syndrome (AIDS) or other immunocompromised patients generally present with central nervous system (CNS) infections but sometimes myocarditis or pneumonitis among other symptoms may be seen. Recipients of organ transplants are necessarily immunocompromised and it is important to determine prior exposure to *T. gondii*. The seropositive recipient is susceptible to his own *Toxoplasma* cysts and the seronegative recipient may be infected by receiving an organ from a seropositive donor. It is even possible that blood transfusions may lead to toxoplasmosis.

Congenital toxoplasmosis may occur if the placenta is invaded by *T. gondii*. Organisms may be shed in the fetal circulation and cause a fetal infection. Women who are seropositive for the parasite before pregnancy (approximately 30% of the women of child-bearing age in the U.S. are seropositive) do not transmit *T. gondii* to the unborn child but this may not be true of the immunocompromised seropositive pregnant woman.

Since the immune system of the fetus is poorly developed, a large number of fetal infections result in clinical symptoms. If the infection occurs in the first trimester and spreads to the CNS of the fetus, abortion and stillbirth may result. Living babies may demonstrate microcephaly, hydrocephaly, cerebral calcifications, convulsions, and psychomotor retardation with an estimated mortality rate of 12%. A milder disease results if the fetus is infected during the second or third trimester. Many of the babies infected later *in utero* are born asymptomatic but may develop epilepsy, retardation, or vision problems later. The most common delayed manifestation of congenital toxoplasmosis is retinochoroiditis, leading to loss of visual acuity or blindness and may show up when the child is a teenager or even when an adult.

A combination of sulfonamides and pyrimethamine is used in the treatment of human toxoplasmosis. These compounds react synergistically against multiplying forms, the tachyzoites. These compounds are effective because they block metabolic pathways involved in the synthesis of p-aminobenzoic acid and folic-folinic acid cycles. Both pyrimethamine and sulfonamides have toxic side effects and are teratogenic. Therefore, they must not be administered during the first trimester of pregnancy. Spiramycin, not available in the U.S., is effective against tachyzoites and is often used during pregnancy. In cases of ocular toxoplasmosis, clindamycin has shown effectiveness. AZT (azidothymidine), commonly used in treatment of AIDS, inhibits the anti-toxoplasmic effect of pyrimethamine and complicates the treatment of AIDS patients infected by *T. gondii*. A number of macrolides, purine analogues, and immunomodulators (interferons, interleukins) are currently being investigated for their effects against *T. gondii*. The combination of an antimicrobial agent with an immunomodulator may hold promise in future treatment of toxoplasmosis. At the present time, there is no treatment or drug available on the market that will attack and destroy bradyzoites in cysts. Therefore, new drugs must be found that can combat toxoplasmosis by eliminating both tachyzoites and bradyzoites. In the absence of a drug that can destroy bradyzoites in cysts, there can be no elimination of *T. gondii* from the host.

There is no vaccine against *T. gondii*. Ideally, a vaccine should be effective in both animals and humans. Such a vaccine would protect kittens against infection and eliminate the excretion of oocysts. Vaccination of food animals would prevent infection and meats would be free of *T. gondii* cysts. There will be no complications due to toxoplasmosis during pregnancy or in immunocompromised individuals if humans could be vaccinated routinely. But until the public sector learns more about toxoplasmosis and become interested in its control, there will be no economic incentive for developing a vaccine.

Economics of Toxoplasmosis

The actual number of congenital toxoplasmosis cases that occur each year in the U.S. is unknown but it has been estimated to range from 400 to 9,500 with a death rate of approximately 2%. Cost (income loss, special education, institutional care, medical treatment) of congenital toxoplasmosis has been estimated at $270 to 9,000 million each year. For the U.S., the number of clinical cases of non-congenital toxoplasmosis has been estimated at 1-2 million/year with a death rate of at least 0.0001%. The dollar cost has been estimated at 75 million/year.

Nothing is known about the cost of toxoplasmosis to the food animal industry in the U.S. *T. gondii* infections induce abortions or lead to neonatal deaths in swine, sheep and goats. Such losses contribute to the cost of meat. Toxoplasmosis is an expensive disease whether it is apparent or not. There is incalculable fetal wastage in congenital toxoplasmosis as well as deaths in early infancy due to the effects of severe toxoplasmosis. The number of deaths from toxoplasmosis occurring in immunocompromised individuals is unknown but it will escalate since the number of immunocompromised individuals increase each year due to the increasing age of the population and due to advances in medical technology. Aside from death, the cost of medical care for infants, children and adults with clinical toxoplasmosis must be considerable.

At the present state of technology, it is impossible to produce *Toxoplasma*-free livestock and meat. Drugs capable of destroying bradyzoites in cysts combined with an effective vaccine would eliminate *T. gondii* from both animals and man but these approaches appear to be far in the future. For now, the best prevention against *T. gondii* infection would appear to be education. How many physicians talk to their pregnant patients about the danger that toxoplasmosis poses to their unborn babies? It makes good sense that physicians should routinely discuss toxoplasmosis with their pregnant and immunocompromised patients. Veterinarians should talk about *T. gondii* and oocyst excretion by cats with pet owners and give them information on how they can protect the cat as well as themselves from infection. Farm organizations could play an important role in the dissemination of information to farmers and other individuals involved in raising livestock concerning the dangers of cat

defecation in animals feeds and bedding. Commodity trade organizations and public health and regulatory agencies could provide useful information to the public about the potential presence of *T. gondii* in meats and how to prepare meats that are safe for consumption. Consumers knowledgeable about the dangers of *T. gondii* infection (to themselves if they become immunocompromised or to their babies if they become pregnant) will be able to protect themselves.

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Qualification Inspection Procedure for Leased Food Warehouses

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Introduction

Effective preventive sanitation of food warehouses involves more than sweeping the floors and "hiring an exterminator" these days. Storage of raw commodities, packaging supplies and finished goods as well as structures must be maintained in ways to prevent damage or contamination by dirt, water or chemicals, or by bird, rodent or insect pests.

Most large corporations issue their own procedures for warehouse sanitation and pest prevention designed to protect their specific ingredients or products. This paper will serve as a guideline for smaller firms wishing to do this.

Selected Reference Material

Manuals and papers about warehouse sanitation have been published by industry associations (Grocery Manufacturers of America, 1979), pest control and consulting firms (American Institute of Baking, 1979) and by government agencies (FDA, 1984). The US Food & Drug Administration's instructions to its personnel on how to conduct Establishment Inspections of multiple food warehouses are found in the *Inspection Operations Manual* (US Dept of Commerce, 1991). This IOM, so-called, is available for subscription from the National Technical Information Service.

Gerberg described the role of private consultants in sanitation consulting, while Scott reported updated recommendations for rodent-proofing structures both as chapters of the excellent, usable text *Ecology and Management of Food Industry Pests* edited by Dr. J. Richard Gorham (1991).

Applicability

Usually, on-site warehouses at a manufacturing plant receive better sanitation maintenance than those managed by a public warehouse located miles distant. And despite the availability of the publications listed above, smaller firms nationwide seek assistance in structuring programs for initial and follow-up inspections of remote, leased warehouses.

This Qualification Inspections Procedure's standards are applicable for most storage facilities, but used here the term "qualification" addresses warehouse as a whole rather than the inspection of goods at the time of receipt. Such incoming goods inspection of ingredients must often be made daily in locations near processing or production locations.

Food distribution centers with thousands of different products in shelf-racked or refrigerated storage require program standards greater than the ones listed below, and large grain storage facilities have unique characteristics not addressed here.

Sections which follow can be organized into outline form with additional items as might apply to your specific operations.

Qualification Inspection Procedure

Purpose

This Procedure is to assure all products including raw commodities, ingredients, finished goods and any packaging materials are warehoused so they remain undamaged and uncontaminated. Mail a cover letter from your President or Chief Executive Officer to suppliers, vendors and customers stating your firm's commitment to quality, and its intent to comply with applicable "pure food" regulations.

Responsibility

Top management bears ultimate responsibility for ensuring product integrity. It must believe in preventive, protective procedures and understand the costs and loss of company image and market share if products are permitted to become contaminated. Sufficient time and labor must be budgeted to support the Procedure's implementation.

Plant managers are responsible, usually, for the acceptance of leased or rented warehouses and for ensuring continuing good sanitation in these. Other management people such as the directors of quality assurance or plant sanitarians may have operational responsibility, however, as well as the authority to direct the program through personnel who perform inspections.

Once a program has been approved and standards defined, executives need to adhere to these and extend variances rarely, if ever. Decisions made for the sake of production or sales expediency which over-ride standards negatively affect employee morale and renders a program meaningless. Examples of this include acceptance of even slightly out-of-specification ingredients or packaging materials, or the shipping of finished goods known to be damaged or contaminated.

Personnel

The prospective lessee's plant sanitarian or quality assurance supervisor or a production superintendent with specific training or experience may perform inspections. Commercial consultants — also with proven competence through training and experience — can be retained to perform qualification or follow-up inspections, too, but these shouldn't be affiliated with pest control service vendors or suppliers of equipment, cleaning chemicals, or pesticides or pest control products. Using disinterested, third party consultants minimizes vested interest or bias on part of any vendors' personnel.

Today, pesticide procurement, storage and use recommendations are best made by a food firms or some unbiased agency. Why? Because the ultimate responsibility for safe use is that of the food firm — not that of any vendor—and because revenues of supplier-consultants are frequently related to amounts of pesticides they sell.

Qualification Inspection

Give the lessor's warehouse supervisor a copy of the Qualification Inspection Procedure at least two weeks prior to an initial inspection. Explain it so necessary corrective action can be taken.

Describe the format of the inspection report and the way it will be scored. Both scoring systems and rating systems are arbitrary and these are sometimes difficult to define. Numerically-scored reports require quantifying what are actually subjective, or value judgements by an inspector. The validity of observations relates to the consideration of the potential the pose for contamination, which in turn depends on the inspector's training and experience.

An example might be the seriousness of two 6-inch diameter holes near a wall base of a large warehouse in an older metropolitan industrial zone. On the one hand this finding is innocuous. On the other, since rats and mice frequent such neighborhoods they might enter here. The number of "points" deducted for this isn't important; knowing where to look, making the observation, recognizing the threat and then rodent-proofing the holes is.

Subjective Rating Levels

We must err on the side of safety when dealing with food production or warehousing sanitation, and with this Procedure we can rate a warehouses at one of three levels:

- An ACCEPTABLE rating can be assigned when the warehouse meets all or most of the standards described below.
- A PROVISIONALLY ACCEPTABLE rating is appropriate when in the inspector's opinion corrective measures can and will be taken to attain compliance with the standards. Warehouses rated PROVISIONALLY ACCEPTABLE can be upgraded to ACCEPTABLE, usually.

This is the "tough" category since an inspector must be convinced that needed corrections will be made rather than merely accepting any promises by the lessor. It helps to obtain a written estimate from the warehouse manager of anticipated dates of completion.

- UNACCEPTABLE ratings result from observing any of several conditions listed at the end of this section or a combination of deviations from the standards as a whole. Conditions triggering this rating can rarely be corrected sufficiently to upgrade the warehouse to ACCEPTABLE. If the unit is UNACCEPTABLE don't use it — search for an alternative facility.

Sanitation Standards

Inspect all the warehouse including locked or bonded sections (accompanied by warehouse representative), employee personal service areas, any mezzanine storage and so forth, not merely those sections intended for your storage needs.

Grounds and premises

Bases of walls and yard areas must be free of weeds, brush, trash, litter and insect or rodent pest harborages. Yards are to be free of stagnant water (or widespread, active fire ant colonies in southern States). Grass or decorative vegetation is to be mowed or trimmed, respectively.

Other exterior sites such as sheds, trash dumpsters and pallet storage lots are to be in good sanitary condition. What does this catch-all, ambiguous phrase "good sanitary condition" mean? Well, the presence of trash and litter including old boards, lumber, rusting equipment, rolls of wire, jumbled or spilled palletboards, rank weeds, uncleaned (out-of-service) incinerators or trash-burning barrels, puddles of water, old roofing materials, old spillage beneath removable trash dumpsters, etc., are some examples of **poor** sanitary condition. Such conditions also serve as biological indicators of what you may find within warehouses, all too frequently, and are moot evidence of a lessor's own sanitary "standards."

Sodium (not mercury) vapor lights shouldn't be located above doors to minimize attraction of night-flying insects. Sodium lights attract fewer insects than mercury ones (Gilbert, 1985). No insect electrocution light traps should be used or located outside any warehouse.

Shipping-receiving docks and building exterior

Driveways are to be blacktopped or paved, free of weeds, trash, puddled stagnant water and be swept or vacuumed regularly to keep dust from blowing into the warehouse through open dock doors.

No birdlime, roosting birds or nests should be on dock overhangs, eaves, or shrouds attached to loading doors. Rainwater can collect in shroud folds, incidentally, and aquatic insects (or frogs!) can breed here. Mud-daubers or other wasps may nest beneath eaves: remove nests.

Warehouse interior

No water leaks nor evidence of prior leaks are to be present through the roof nor walls, on vertical supports, beneath doors nor in latrines or lunchrooms.

Personnel doors are to be fitted using self-closing devices (hydraulic or spring hinges) and screened. Gaps at door bases aren't to exceed 1/4 inch. Use 1/2-3/4 in. mesh hardware cloth wire to reinforce insect screening (20 mesh

minimum) and to extend screen door life.

Roll-up or sliding doors must be undamaged with sill cracks no greater than 1/4 inch. Keep these closed when not in service. Fit doors which must remain open for ventilation using hardware cloth (wire mesh)- reinforced insect screening.

Door air curtains are less effective than wire screening for insect exclusion. If used, they should be switched to activate when a door begins to open and should be oriented so the air blast is down and outward.

Hydraulic dock floor plates' ("levelators") pits should be free of old deposits of trash, dirt or pallet splinters. Gaps at their sides are to be gasketed or fitted with dust, insect or rodent-excluding brushes anchored to sidewalls of pits.

Floors must be free of heavy deposits of dirt or forklift-tracked spillage, wide cracks or concrete dust abraded from these. Expansion cracks or joints can be sealed using flexible silicone caulk to prevent cockroaches, or ants or termites which can enter from sub-floor areas. (Don't use foam sealant since its pores can become mold and bacteria traps.)

Windows or skylights shouldn't be broken nor missing panes. Cracked panes can be a source of shards of glass. Use pre-cut replacement panels of translucent, unbreakable polycarbonate which are available in various sizes.

Separate maintenance shops and forklift vehicle repair areas from storage areas by frame (not poly sheeting) walls.

Containers of oils and solvents are to be stored in closets or cabinets a minimum of 50 feet remote from food areas. Don't store pesticides near these, either—even in locked, labeled cabinets. Nor rubber tires including those on small tractors, ride-on lawn mowers, motorcycles, etc., in warehouses containing palletized empty beverage cans. Store these behind walls and closed doors to minimize risk of absorption of rubber odor by coatings of cans (and by some foodstuffs such as bulk chocolate, nuts or raisins).

Pest presence or evidence

Warehouses must be free of widespread evidence of pests or their evidence such as; live or dead birds, birdlime, feathers or nest material; mice (live or dead), mouse nest material or widespread presence of mouse excreta pellets. The mouse excreta pellet issue is subjective — inspectors must use discretion. Careful inspection of older public warehouses — even those in above average sanitary condition — will usually reveal a few mouse excreta pellets along floor-wall junctures, beneath stairs to storage areas or offices, in employee personal service areas and so forth. In this paper, widespread presence means hundreds of easily-found mouse excreta pellets indicating mouse infestation several months old.

The presence of live or dead rats, their excreta pellets, gnaw or rub marks, nest material or rat burrows at warehouse exterior automatically results in an UNACCEPTABLE rating for a warehouse. Rats are a much more serious pest than mice since they range farther, cause more damage and are much harder to control. It isn't in the best interests of a food firm to conduct business with any warehousing firm which has tolerated conditions conducive to a rat infestation.

No feral cats or their stools are to be present. Look for cat feces along floor perimeters or in absorbent granules which may be strewn on the floor beneath compressors.

Neither bats nor their excreta pellets are to be present, either. Bat excreta pellets are similar to mouse pellets. They'll fall from roost sites to pile on the floor in large numbers; sometimes they stick to wall surfaces.

Pest prevention, exclusion and control

A structured program of bird, insect and rodent pest prevention and control shall be conducted either by the warehouse or a licensed commercial PC service vendor. Pesticides including insecticides, rodenticides or avicides used shall be restricted to those on the lessee's Approved List of Pesticides, and pesticide use at the warehouse is to be approved by the lessee. Only EPA-registered insecticides suitable for food plants or processing areas are to be used in compliance with Directions for Use on their labels.

Sample (Specimen) Labels along with Material Safety Data Sheets (MSDSes) for every pesticide formulation used are to be retained by both lessee and lessor.

If mist-sprays (mechanically-generated aerosols) are used apply them per Directions for Use at no more frequent intervals than monthly during May through October inclusive. Mist spray active ingredients should be restricted to synergized pyrethrins or pyrethroid insecticides only. Dosage rates are to be calculated for actual, i.e., non-storage, cubic foot volume rather than by nominal volume of the structure to avoid over-treatment.

Insect light traps aren't to be suspended above product storage areas. Such "insectocutors" plus any stored product insect pheromone traps are to be carefully cleaned and monitored on a regular basis.

Chronological, legible printed copies of any PC technician's Service Reports are to be filed at the warehouse office (suspense date 2 years) and available for lessee's review. Service Reports are to include: number and location of rodents trapped, notes of insect sightings, the need for improved sanitation or accessibility, and a Pesticide Use Report (PUR).

The PUR is to include: the name of the active ingredient of the pesticide used (not merely its brand name); its formulation; an estimate of the quantity used; the end use concentration; where; and the reason the application was made.

A plot map of all rodenticide bait stations and automatic rodent traps (KetchAlls®, MouseMasters®, etc.) used is to be kept by the warehouse supervisor. Mouse snap traps or glueboard locations need not be mapped.

Use rodenticide baits outside the warehouse only and contain these within tamper-resistant stations (anchored, supplied with interior baffles, and secured lids). Don't use baits within the warehouse for three reasons. Their presence suggests the existence of rodent populations within the building which needs to be controlled, because out-of-condition rodenticidal baits (they contain no insecticide) will breed stored product pest insects and to avoid any possible risk of spillage of pesticide within a food storage facility.

A legible printed Service Tag is to be stuck beneath the lids, enclosed in water-resistant poly sleeves, or contained in waterproof vials within automatic mouse traps and exterior bait stations. Tags must include the date/technician's

initials, the chemical name of the rodenticide active ingredient, its concentration and an emergency telephone number.

Storage practices

Eighteen inch minimum perimeter setback spaces are to be provided around all food storage areas. White-painted floor striping of the setback spaces is desirable but not mandatory. There is no law nor code requiring width of spaces, nor is there any requirement for painted stripes. Both are sound, basic sanitary storage principles, however, which permit access for cleaning, pest control service and for ease in inspection.

Other than during receipt, food storage must be segregated or separated by walls from non-food storage other storage.

Extra wooden pallets are to be stored together and not scattered within food storage areas.

Segregate the following and don't store them adjacent to food products to avoid potential for cross-contamination by pests or the risk of absorption of malodors: agricultural commodities (in either bulk, palletized bags or tote bins) including but not limited to grains, rice, shelled corn, corn meals or pulses; any biologically-active materials including pesticides, fertilizers, petroleum-oil-lubricant (POL) products, paints, solvents, cleaning agents, aromatic hydrocarbons or even poly beads used for manufacturing packaging films.

Conditions Prompting UNACCEPTABLE Ratings

"Real world" protestations notwithstanding, there's no reason today to accept for storage warehouses where the following are observed during a qualification inspection:

- Prior or existing evidence of infestation by rats.
- Live ants or cockroaches at floor-wall junctures, floor areas, etc.
- Numerous live spiders or cobwebbing with egg sacs extending from walls onto storage.
- Any active or inactive dirt-walled termite tunnels (usually at bases of interior walls, but occasionally at bases of vertical supports]).
- More than 5 live birds sighted within the warehouse during an inspection, or evidence of long-standing bird roosting or nesting within buildings.
- Prior or existing water leaks through the roof or water puddles on floor within or close to food storage areas.
- Storage—or residual odors—of biologically-active chemicals or rubber, etc., in or within 100 feet of storage.

Other Inspections

Perform a follow up inspection not later than two weeks following an assignment of a PROVISIONALLY ACCEPTABLE rating. Corrections requiring more than two weeks may indicate a lessor's unwillingness to take action. Once corrections have been permanently made, i.e., in improving pest exclusion, in establishing routine cleaning procedures or in meeting requirements for a preventive pest control program, the warehouse can be considered ACCEPTABLE.

Inspections should be unannounced if possible, but announcing the audits usually ensures presence of the warehouse manager so he/she can accompany you and be briefed in person.

Don't store materials in a warehouse unless the initial inspection rating is ACCEPTABLE or until the follow-up rating is ACCEPTABLE.

Inspect the whole warehouse and premises at quarterly frequency to determine good sanitation maintenance, storage practices and effective pest control.

Reporting

A report style can be determined by the lessee so long as the standards are addressed. Checklist style report forms serve as reminders, but essay type reports are usually more effective.

Give a copy of field observation notes with brief recommendations for correction to the warehouse supervisor followed by typewritten CONFIDENTIAL reports to the lessor, your plant manager, quality assurance director or others. Today, senior executives of many food corporations require copies of such inspection reports be routed to them, too.

Discussion

Adherence to these standards is necessary to ensure good protection, and observations prompting UNACCEPTABLE ratings shouldn't be compromised. It's natural and commendable for food plant sanitarians or Q.C. personnel to be critical and to try to anticipate contaminatory conditions and work to prevent these. Rather than adopting or projecting any image of "imaginative pessimism," however, inspectors should strive for one of practical, positive and constructive criticism.

Not all public warehouses are of "food grade," condition even if they are advertised as such. A lessor's or a property broker's standards may be insufficient for **your** company. Be certain to clarify what constitutes an "approved food grade" warehouse to either your firm's property management or purchasing groups or by independent brokers in advance of any need for leasing. Advise brokers of your standards so they only refer available warehouses known to be acceptable.

Appreciate that charges for storage, by either warehouse units or square footage area, frequently include a lessor's estimated costs for maintenance of clean, pest-free conditions. The "cheapest" warehouse space is not always the most cost effective in terms of product protection and good sanitation.

Sanitation of remote units rarely receive the sanitation attention as do those at the producing plant. Immediate, or rushed, needs for storage area in a remote warehouse can threaten product integrity no less than can "forward buying" of large quantities of raw products or packaging supplies which must be stored for long periods of time so the cooperation of production services or purchasing departments with production or operations should be solicited for survey and evaluation of several warehouses well in advance of even temporary need.

Finally, in industry we must do the best we can with

what we have while accepting constraints of limited budgets, personnel and competition. And even in selecting or leasing warehouses we cannot afford the luxury of lengthy studies, referrals to committees, etc.

Develop and use a Qualification Inspection Procedure of leased public warehouses as a positive measure to protect the wide variety of food, beverage products and packaging supplies requiring storage.

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The Yogurt Story — Past, Present, and Future Part X

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(Part IX of The Yogurt Story - Past, Present and Future appeared in the April, 1992, issue of Dairy, Food and Environmental Sanitation, pages 220-221. This is the final paper of this series.)

Yogurt has emerged from a plain, high-acid, uniquely "green-flavored," semisolid fermented milk product to multi-flavored, sweetened products ranging in consistency all the way from liquid to semisolid to solid. And lately, yogurt is offered even in frozen form. Only the current plain yogurt bears some resemblance to the original product. These transformations have indeed helped to increase the consumption of yogurt. They have also brought recognition of the term yogurt among young and old alike around the world. Now the yogurt market has almost reached its crossroads. Is it possible to paint a scenario of things to come?

In a recent issue of *Dairy Foods*, Marty Friedman (5) highlighted the gradual decline in yogurt sales from the year 1988 to 1990. He has suggested a few ways yogurt sales could be boosted. He ended his piece by saying "The American market still has tremendous growth potential, if only dairy marketers can figure out the best way to get the category moving again."

New Directions

To maintain growth in sales of yogurt products, the industry has to look to new areas moving away from traditional markets. Two buzz words one sees quite often in trade and marketing magazines are *segmentation* and *targeting*. The beginning of segmentation of the yogurt market is exemplified by products specially aimed at children. Marty Friedman (5) listed some of these "Kid's Yogurt" products offered by various companies. These products plus the others he has highlighted still could be considered to be targeting segments of the traditional market. For sustained growth one has to veer off the beaten path. In a recent issue of *Food Business*, the major theme was the need for the food industry to target ethnic groups who have reached a high level of purchasing power (16). There is then the need for "ethnic yogurt products." The groups that traditionally consume yogurt products are people from the Middle East and South Asia. Among these groups, plain yogurt is consumed in regular meals with cereals such as rice and with traditional breads like *pita*, *chapati*, or *nan*. Yogurt is also used as a salad dressing with vegetables such as cucumbers, tomato or a mixture of finely cut tomatoes, onions, cucumbers, and hot green peppers. Yogurt thinned with water and embellished with spices called *raitha* is relished by South Asians. Yogurt is also the basic ingredient in the marinade used for *kababs* and *tandoori*. Yogurt is called for in many South Asian recipes. Yogurt drinks are also popular in South Asia. Yogurt or *dahi* is usually thinned with ice or cold water and fortified with spice mixture and in some cases sweetened with sugar and served as *mitta lassi*. In other instances, the diluted yogurt-spice mixture is salted and served as *namkeen lassi*. These products are consumed with gusto during the hot, sweltering summer months. In the Indian subcontinent, desserts made with yogurt-base are routinely included in the meals. *Sreekhand* is the yogurt dessert that is widely eaten in Western states of India. To make *sreekhand*, yogurt is sweetened, partially dewatered and flavored with nutmeg and/or saffron which also gives it a golden red tinge. Sun-dried balls of yogurt are made in rural areas in the Middle East. *Kashk*, a dried yogurt product, is popular in Iran. This long list of exotic products with strange names was described mainly to illustrate that yogurt is consumed in many forms by ethnic populace and more complete details on these products may be gleaned from Dr. Kosikowski's book *Cheese and Fermented Milk Foods*, and *Indian Dairy Products* written by Rangappa and Achaya (12,17). Current plain yogurt could be tailored to meet the needs of ethnic consumers by suitable adjustments of solids level, final titratable acidity, and supplementary starter organisms as needed. The yogurt could be offered either as plain yogurt or as "ready-to-use" mixtures for specific uses with the necessary spice combinations. A beginning in this direction has already been made. John Grossmann (6) in a recent report described a vegetable-containing yogurt product called *Yogurt Plus* developed by a Lebanese entrepreneur that is being targeted at ethnic as well as general consumers through Sloan's Supermarkets in New York city. The

product was even highlighted by *Health* magazine in its briefs on its *Trends* section. With patient cultivation of this market, yogurt sales could be expanded.

Another area that needs to be explored is the production of yogurt that is made with lactose-hydrolyzed milk. A large number of African-American population as well as senior citizens have problems with digesting lactose (lactose malabsorption). Lactose-hydrolyzed milk is now available for such consumers. Because yogurt bacteria also liberate lactose-splitting enzymes as they lyse in the gut, lactose-hydrolyzed yogurt will be an ideal dessert for lactose malabsorbers who otherwise will not be able to consume yogurt. If this concept is coupled with inclusion of other lactic acid bacteria which are an important part of normal gut flora, for example, selected human strains of *Lactobacillus acidophilus* and/or a mixture of *Bifidobacterium* spp., such a yogurt product could be included in the diets of patients during convalescence, or in retirement homes. Such products could also be offered for the general populace. Specialized cultures that play therapeutic and sometimes prophylactic roles could also be included. One such strain of *Lactobacillus casei* has been recently described (21).

Alternate Uses for Yogurt

The American consumer today prefers low-fat, low cholesterol, low-calorie products. The yogurt manufacturers have catered to this trend by offering low-fat, nonfat and artificially sweetened varieties. But these products still fall in the realm of traditional usage of yogurt. It is necessary to create alternate niches for yogurt. Could yogurt serve as a low-fat, low-calorie, low-cholesterol substitute for sour cream? According to John Grossmann (6), *Yogurt Plus*, the product referred to earlier, is offered for multipurpose use, doubling as a low-calorie topping for baked potatoes and as a salad dressing. Why not extend this to other applications? For example, in Mexican *Enchiladas* or Greek *Gyros*? Such applications would be a challenge to dairy technologists to develop suitable stabilizer systems to give the desired body, texture, spreadability and mouth-feel. It may also be necessary to work in a suitable fat substitute. A blend of sour cream and yogurt may be needed for some applications. From a flavor standpoint, the diacetyl note needs accentuation and the green, acetaldehyde flavor drastically muted. This may need the use of supplemental cultures. A suitable candidate could be dairy leuconostocs which, apart from producing diacetyl in milk systems, also scavenge acetaldehyde (10). Along these lines, yogurt could also be used in dips in the place of sour cream. To serve this purpose, modifications in the body, texture and flavor are needed. Periodically, food editors in major dailies around the country, and women's magazines, and extension home economists from the various land grant universities publish recipes for yogurt-based party dips and drinks. These recipes could be reproduced on the side panels of yogurt containers to entice customers to buy yogurt. Yogurt powders with good reconstituting properties, clean acid and other flavor notes and viable yogurt bacteria could be sold as such or as an ingredient for various mixes, which call for a tangy flavor. Recently, a product of this nature was described in a trade magazine (1).

A well-known fact that needs to be stressed here is that to assure a place for yogurt in the market, *consistency* in product quality with respect to body, texture, flavor, freshness and microbial content (presence of desirable starter bacteria and absence of undesirable flora) is needed day in and day out. Some dairy industry analysts recommend that more attention be paid in the merchandising management of the "dairy case." By allocating more space on the shelf to the most profitable products- yogurt, for example- retailer could boost sales and profitability.

Research Needs

A common refrain in yogurt circles is "We need a milder yogurt." This generally means that the end-product should not be very acidic or too green. In more technical discussions, one hears this: We do not want "post-acidification." In common parlance, this translates to: We prefer little or no acid development during refrigerated storage. How can we achieve this? Two possible approaches are obvious. One is to limit the substrate from which acid is derived, i.e. lactose, in the mix to a predetermined concentration. This can be achieved by ultrafiltration of milk followed by diafiltration to adjust the lactose level. A starting material such as the delactosed, high milk protein powder described by Mistry and Hassan (15) could used, and the lactose level adjusted by adding required volume of whey or lactose solution or fluid milk. Products made thus will not, however, conform to the Federal standards. The second approach would be to select for starter strains that would drastically retard or even cease producing acid at refrigeration temperatures. At the end of yogurt fermentation, the predominant starter organisms comprise of rods, which are principally involved in "post-acidification." Available *Lactobacillus bulgaricus* strains could be screened for slow or lack of acid production at refrigeration temperatures and tried in production trials. Another avenue would be to use classical mutations to select for desired strains. This could be tedious because it is difficult to control mutational events such that other desirable properties of the strain(s) are not affected. Now that biotechnology is here, engineering suitable strains could be pursued. Possible strategies that could be used have been reported by Mainzer and group (14). With the publication of several reports on bacteriocins produced by traditional starter bacteria, some of which affect lactobacilli (11), the use of such compounds to control continued metabolism of rods during cooler-holding may be possible. All these different routes should be actively investigated.

Although yogurt starter cultures are available in concentrated form - frozen in cups, frozen pellets and lyophilized powder - not all of them could be used for "direct setting" product vats so as to draw the product out every 4 hr. when incubated at 110 to 113°F. The technology to produce concentrated rod-coccus cultures with viability equivalent to mesophilic lactics and the required activity is still elusive. Further research on suitable propagation media, optimization of fermentation conditions, harvesting or cell separation procedures, and suitable means of preservation including drying is needed. Reviews on the production and lyophili-

zation of lactic cultures including rod-coccus strains have recently been published (3,30).

Culture management for rod-coccus combinations with reference to phage related delays or failures is to a large extent nonexistent. Although proper sanitation and plant design alleviate these problems, with continuous turnover of product needed in large volume plants, a suitable program of culture management is required. Basic knowledge on phages active against rod-coccus cultures is accumulating (19). Further refinements in phage enumeration methods to make them fail-proof, especially with different *L. bulgaricus* strains, will be helpful. A suitable monitoring procedure to rapidly assess phage titers under yogurt plant conditions as described for mesophilic starters (31) would be a boon to the industry. Strain substitution coupled with development of phage insensitive strains practiced in cheese plants (31) is a model that could be used in yogurt fermentations. The major phage-related problems in high temperature fermentations appear to be related to coccus strains. Hence, a start should be made in developing such strategies with *S. thermophilus* strains. Culture rotation or super-inoculation with phage unrelated coccus strains sometime during the middle of the work-day plant schedule may be useful. Recently, Sanders (19,20) reviewed the various aspects of genetic research on rod-coccus bacteria and their phages.

With the current interest in adding "health-promoting" lactic bacteria such as *L. acidophilus* and *Bifidobacterium* spp. to yogurt products, suitable differential counting methods for determining the relative numbers of the component organisms in the finished product and during storage of the product are necessary. At present, such procedures are unavailable. Some attempts, however, have been made in this regard (13). Also, technology to obtain better survivability of these cultures in frozen yogurt products needs investigation (22).

Information on the metabolism, physiology and genetics of rod-coccus cultures comparable to mesophilic lactics is still lacking. These gaps are being slowly filled. A good review of the carbohydrate metabolism of *S. thermophilus* was published a few years back (9). There is a need for an updated review. A dent in the dearth of up-to-date information on rod-coccus cultures was, to a certain extent, made by the papers presented at the Symposium on lactic cultures held during the 1991 Annual meeting of the American Dairy Science Association. Further research is needed to fully exploit the interactions of rod-coccus cultures in milk to produce yogurts with gradations of tartness and green flavor required, and to maintain these desired qualities throughout the maze of merchandising channels.

Genetic studies on rod-coccus cultures are being pursued in a few centers around the world. In the United states, genetic research on *S. thermophilus* was initiated by Somkuti and his team at the Eastern Regional Research Center (ARS, USDA), in Philadelphia. His group has studied the plasmids in various coccus strains and their inter-relatedness using restriction patterns and Southern blots (24,27). These basic studies would help in introducing desirable genes into coccus strains. A thrust in this direction was made when Somkuti et. al. (28) introduced streptomycete cholesterol genes into a coccus strain and demonstrated the expression of the genes. Although the degree of expression of these genes is not of immediate practical value, these studies have revealed the possibilities attainable through recombinant DNA techniques. The USDA group and others from France have studied the parameters required in introducing DNA into coccus strains through electrotransformation (25). Research in using natural restriction systems in *S. thermophilus* for developing methods to cope with phages virulent for coccus strains is promising with the detailed reports that have recently been published (23). Researchers working with Dr. Larry McKay have also contributed to the understanding of the genetics of lactose utilization by *S. thermophilus* (8). Using classical mutagenic techniques, useful mutants of *S. thermophilus* that have practical import have been produced (26).

Research on the genetics of lactobacilli is being pursued actively in the laboratories of Dr. Todd Klaenhammer at North Carolina State University. Other centers where related research is being conducted are in Japan, France, and Italy. Basic knowledge is being accumulated in all these laboratories, which would lead to the development of technology for new and improved yogurt products. The U.S. dairy industry should be cognizant of these developments and support centers of dairy research in the universities in the U.S. to keep up the technological edge needed in the competitive "global marketplace." The U.S. dairy industry should not only look to the domestic market for growth of yogurt sales, but also develop products for expanding markets in the economically booming areas in the Middle East and the Far East. This needs market research, documentation of regulatory laws and realistic projections.

Concluding Remarks

Yogurt, the age-old product from Biblical times, has metamorphosized into varieties, many of which have no resemblance to the prototype. The familiar jingle "you have come a long way" could aptly be applied to yogurt. With changing life-styles, tastes, nutritional awareness and sophistication of consumers, the demand for new and improved varieties will be the order of the day. This requires multi-disciplinary in-puts from dairy technologists, engineers, microbiologists, genetic engineers, flavor technologists and market researchers to meet the exacting demands of the discriminating consumers.

In this series of articles, an attempt was made to present practical aspects in the manufacturing and sale of yogurt. These papers are by no means comprehensive. For more comprehensive information on the technology and microbiology of yogurt, there are excellent reviews by Tamime and Deeth (29), Bottazzi (2), and Chandan (4). There is also an entire book devoted to yogurt by Rasic and Kurmann (18). Possible biotechnological improvements that could be made with yogurt flora are discussed by Harlander (7).

Last but not least, an anomaly that has crept into the literature dealing with the terminology used in connection with rod and coccus bacteria needs comment here. Although *Streptococcus thermophilus* and *Lactobacillus bulgaricus* are used in fermentations involving *relatively* higher temperatures, these bacteria are not "true" thermophiles. From

a functional viewpoint, especially in high-cook cheeses, it is undesirable for these organisms to behave as "true" thermophiles. These bacteria should be more precisely described as "thermotolerant." In recent literature, the term "thermophilic starters" is widely used to refer to these bacteria. In this respect, dairy microbiologists are confronted with a situation analogous to that, which led to the adoption of the term "psychrotrophic" to describe low temperature (refrigeration) flora of dairy products in the place of the term "psychrophilic." It is necessary to arrive at a suitable nomenclature to accurately refer to bacteria used in high temperature fermentations such as yogurt.

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Exchange Notes.

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Updates . . .

Conference for Food Protection
Baltimore, MD
April 25-29, 1992

Report by
Dr. Robert C. Strong
ASI Food Safety Consultants
IAMFES Representative to the Professional
Association Advisory Committee to the
Conference for Food Protection

The Conference for Food Protection was held in Baltimore, MD from April 25-29, 1992 and was attended by representatives of the regulatory agencies (federal, state, and local), industry and academia. The objective of CFP is to promote food safety and consumer protection by:

- Identifying and addressing problems in production, processing, packaging, distribution, sale and service of food.
- Adopting sound, uniform procedures.
- Establishing a working liaison among government, industry and consumer groups.
- Coordinating the dissemination of information regarding food safety.
- Focusing on food protection programs.

The conference executive board appealed for more involvement of food processors and professional associations so that all opinions are represented - food regulators, food retailers, and food processors. The keynote address was given by Dr. Douglas L. Archer, Deputy Director, CFSAN/FDA. Dr. Archer reviewed two emerging pathogens - *E. coli* O157:H7 and *Listeria*, and how various groups of people are more vulnerable to these pathogens resulting in death. He talked about a new education training program just finished for food preparation and service in nursing homes. He also expressed concern about the Cholera epidemic in South America that has been gradually moving north. (All eyes are on Mexico this summer). Dr. Archer said particular attention is being given to imported shellfish, fresh fruits and vegetables, and frozen fruit and vegetables for evidence of Cholera. He finished by recognizing HACCP as the way to go for food protection.

Dr. Ann Marie McNamara, Director, USDA, FSIS, S&T, Microbiology Division, reviewed USDA's programs for food protection. USDA is actively promoting HACCP and she felt the three current key issues for USDA are irradiation of foods, Aflatoxin, and accurate labeling.

The IAMFES representative serves on the Professional Association Advisory Committee to the Conference for Food Protection. The purpose of this committee is to identify food safety problems, review conference issues, establish committee priorities, provide consultants to councils, and develop strategies for promoting and implementing needed food safety initiatives through member organizations.

This committee met and discussed their role and how it needs to be *more active* involving more leadership on various topics. It was felt that member organizations of this committee should have their individual goals and programs identified so that they can be more involved with the conference on food protection on common goals and objectives.

The conference, over three days, deliberated a total of 49 issues that were referred to the three councils. As these councils met at the same time, it was not possible to attend each council and hear the deliberations on all issues.

Significant issues that were approved for voting on by the state regulatory delegates were:

- An accreditation system for regulatory inspectors.
- Acceptance of the review of the FDA/NOAA voluntary retail seafood inspection program.
- A nationally recognized training, testing, and certification of food retail managers.
- Approval of a memorandum of understanding between conference on food protection and the FDA.
- Approval of a recommendation on food safety education in schools.
- Approval of a recommendation on federal assistance to states on developing programs on food safety.
- Approval of a recommendation that FDA implement the unicode (high priority).
- Approval of a recommendation that FDA have sous vide equipment manufacturers provide "AFDO guidelines for reducing oxygen packaging of foods" with each piece of equipment.
- Approval of a recommendation that regulatory agencies support voluntary retail food HACCP programs and not use the results obtained for taking direct regulatory action against the facility being inspected.

For more information, please contact Leon Townsend, Executive Secretary, Conference for Food Protection, 110 Tecumseh Trail, Frankfort, KY 40601; Telephone/FAX (502)695-0253.

IAMFES IS MOVING!

Effective September 14, 1992, IAMFES' new address will be:

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Keep America Beautiful, Inc. to Recognize Outstanding Environmental Programs

Keep America Beautiful, Inc. is now accepting entries in its 1992 National Awards Program to recognize outstanding activities in waste handling and environmental improvement.

To be eligible, programs must have a goal of improving waste handling or environmental stewardship; be ongoing or emphasize the need for a sustaining effort; include activities that change attitudes about waste handling and prevent littering; and educate citizens about the waste issue.

Entries are being accepted in nine categories: state/federal agencies, civic organizations, youth groups, schools, local business/industry, national business/industry, communications, local government, and military.

Keep America Beautiful, Inc.'s annual awards program also includes the National Recycling Awards, which honor outstanding recycling programs; and the Iron Eyes Cody and Mrs. Lyndon B. Johnson awards to recognize individual voluntary achievements.

Applications may be obtained through Keep America Beautiful, Inc., 9 W. Broad Street, Stamford, CT 06902, (203)323-8987. Winners will be notified by mail before Nov. 1 and awards will be presented at Keep America Beautiful, Inc.'s 39th Annual Meeting in Washington, D.C. on Dec. 11. The deadline for entries is 5:00 p.m. on August 21, 1992.

Klenzade Offers New Safety Training Program

Sanitation chemicals are essential to help make sure food products are safe to eat and drink. But, they can also be dangerous to plant workers if mishandled. That's why Klenzade, a Service of Ecolab, St. Paul, MN, has developed a new sanitation chemical safety training program, "Take Five for Safety."

"The program is designed for processing plants to train the clean-up crew on proper handling of sanitation chemicals," says Ed Berglund, Manager of Klenzade Human Resources and Educational Services. "It consists of a ten-minute video tape, a hand-out/workbook and reminder posters to hang on the wall. And, it's available in both English and Spanish."

The program stresses five steps to safety in working with sanitation chemicals:

1. Be aware of safety.
2. Ask your supervisor if you have questions.
3. Be prepared.
4. Follow safe procedures.
5. Follow proper first-aid procedures.

"The tape covers each of the five points," says Berglund. "It is highly pictorial and broad enough in scope to be useful to all levels of plant workers. It covers a lot of material in ten minutes."

The material on the tape is also available in slide format for companies that want to tailor the safety information to their own needs, or want to translate the slide script into languages other than English or Spanish.

The concept behind the workbook is to give employees an opportunity to demonstrate their understanding of the material. A certificate of course completion is available for workers' files.

For more information on the "Take Five for Safety" program and Klenzade sanitation products, systems and services, contact the Klenzade account manager in your area or write Klenzade, Ecolab Inc., Ecolab Center, St. Paul, MN 55102 or call 612/293-2233.

Food Safety — Who is Responsible?

An Animal Source Food Safety Workshop

The Cooperative Extension Services of Indiana, Maryland, Texas, and Virginia are co-sponsoring a national workshop to discuss food safety issues from the standpoint of everyone's responsibility, and what is needed to fulfill these obligations. The meeting will be held September 9, 10, and 11, 1992 at the Quality Hotel, near the Capital Building, in Washington, D.C.

The scope includes all major food animal species. The discussion will focus primarily on responsibilities for dealing with microbial and chemical contaminants of foods from animal sources.

The audience will be primarily industry management, state and federal regulatory personnel, professional home economists and dieticians, university scientists, and consumers for Days one and two. Day three will also include, and is expressly intended for, members of Congress or their staff, and the media. Congressional personnel are invited to participate during the entire workshop at no charge, while media will have their registration fee waived only for Day 3. Consumer groups are encouraged to participate.

The purposes of the workshop include: 1. provide a forum for dialogue that may lead to objectively addressing food safety issues by all affected parties; 2. to present science-based information through presentations and educational displays; 3. to share information and viewpoints with representatives of the various groups participating in this national workshop.

Speakers who are leaders in their area, and having independent and objective viewpoints, have been invited and confirmed. A unique feature will be work groups that will develop a prioritized consensus concerning what should be done and by whom. There will be educational displays that focus on food safety material which is based on scientific facts, which have or could stand the scrutiny of scientific peer-review. A proceeding will be developed from papers submitted for the invited presentation, and from the educational displays.

The registration fee on or before August 1, 1992 is $140.00; after August 1, the registration fee is $170.00.

For further information, contact:

John Marcy, Food Science Dept., VPI & SU, Blacksburg, VA 24061-0332 (703) 231-5058

Jim Denton, Poultry Sci. Dept.(2472), Texas A&M Univ., College Station, TX 77843 (409) 845-1931

Jim Chambers, Food Science Dept., Purdue University, West Lafayette, IN 47907-1160 (317)494-8279

Sam Joseph, Dept. Microbiology, University of Maryland, College Park, MD 20742 (301)405-5452

Richard Reynnels, Advisor, USDA/ES, Room 3334-S, Washington, D.C. 20250-0900 (202)720-4087

Risks Misjudged in Cholera Epidemic

Health officials in Peru appear to have misjudged the relative risks of water chlorination on one hand and microbial contamination on the other, which may have helped begin a cholera epidemic that is now sweeping Peru and other countries in South and Central America.

The decision by Peruvian officials to halt chlorination of much of the country's drinking water is being blamed for the outbreak of cholera in January 1991. More than 300,000 cases of cholera have been reported and more than 3,500 lives claimed by the epidemic. Spread of the disease in South and Central America is expected to be a problem for years to come.

According to a report in *Nature,* Pan American Health Organization officials believe that the bacteria first arrived with a Chinese freighter that dumped its contaminated bilge water into the harbor of Lima, Peru. The organisms quickly spread to fish and shellfish and probably first contaminated humans in servings of raw fish called *ceviche.* Once humans were contaminated, the bacteria infected the water supply, which amplified its spread among the population.

Although Peru has good water-filtration technology and pumps safe water into the drinking water system, old pipes and unchlorinated open wells appear to have allowed the cholera bacteria to enter the water supply after filtration, *Nature* reported.

The U.S. Food and Drug Administration reports that cholera will not become an epidemic in the United States because clean drinking water flows into nearly every home, sanitation systems are available to the vast majority of the population and FDA laboratories test for the cholera bacteria in imported food.

However, the FDA has expanded its import sampling for cholera for products from Latin American countries.

In the past, there have been no known problems with food commercially imported to the United States from infected countries because Latin American exporters often rinse produce in chlorinated water. Also, cholera bacteria die on fruits and vegetables in 10 days or less, so they cannot survive the two-week trip from South America to U.S. ports. The bacteria can live somewhat longer in seafood.

Sampling for cholera initially has focused on fruits, vegetables, water/ice, and seafood products from Mexico and directed in only two districts-Dallas and Los Angeles. As an added precaution, FDA will conduct cholera sampling of Central American products directed toward three additional districts: New York, Orlando and New Orleans.

Chlorine's Risks and Benefits

Chlorine is a disinfectant that is capable of killing the bacterium that causes cholera, a marine organism called *Vibrio cholerae O1.* However, chlorine also can react with the byproducts of organic decay present in most water supplies to produce several suspected animal carcinogens, including chloroform.

The U.S. Environmental Protection Agency regulates levels of one class of these chlorine-based compounds, called trihalomethanes (THMs). Major water systems in the United States must not exceed 100 parts per billion (ppb) of THMs. EPA is currently reevaluating theoretical cancer risks associated with water disinfection. Yet, according to *Nature*, most epidemiologists agree that a relatively small risk of cancer is preferable to the possibility of a microbial epidemic.

Peru's Risk Analysis

Based on EPA's studies showing a theoretical cancer risk associated with THMs, Peruvian officials halted chlorination of many of Lima's wells. This apparent misjudgment of relative risks has focused attention on the balancing of microbial and carcinogenic risks in water treatment.

"Chlorination and disinfection of the water supplies are one of the major public health success stories of the century," said Carol Henry, Ph.D., director of the International Life Sciences Institute's (ILSI) Risk Science Institute, at a National Academy of Sciences meeting. "To start altering this in some way has very grave and immediate consequences." In August 1992, ILSI is convening an international conference on balancing chemical and microbial risks in water supplies.

The experience in Peru lends perspective to innumerable risk management situations. As *Nature* observed, "This sobering case of risk assessment gone wrong is forcing U.S. and international health officials to come to grips with the flaws in what most agree is a haphazard process of balancing real and theoretical public health risks."

Reprinted from Food Insight/January/February 1992

Food and Environmental Hazards to Health

Lead Poisoning in a Foundry—New Jersey, 1990

In May 1990, the New Jersey State Department of Health (NJSDH) received laboratory reports of elevated blood lead levels ([BLLs] ≥25 µg/dL) for 13 workers employed at a small foundry in New Jersey. Six of the workers had BLLs that exceeded 60 µg/dL; the highest was 277 µg/dL. According to the Occupational Safety and Health Administration's (OSHA) lead standard,* these six persons should have been removed immediately from further exposure to lead until their BLLs returned to acceptable ranges. NJSDH contacted the persons with elevated BLLs to obtain additional information about their lead exposures and health status. None of these persons had been evaluated medically or removed from the source of lead exposure.

After contacting company management, personnel from NJSDH and the local health department visited the foundry to assess lead exposures at the facility. The foundry, located in a residential area of a small community, manufactured valves and other small castings for the maritime industry and employed approximately 20 workers. About 60% of the casting operations involved brass and bronze alloys, which contained up to 8% lead; the remaining 40% involved pure aluminum.

On July 5, 1990, NJSDH personnel conducted medical examinations of the 15 workers who were present the day of the survey and whose jobs involved lead exposures. Blood lead and zinc protoporphyrin (ZPP) levels were obtained to assess lead exposure for the 15 employees. The highest BLL, 138 µg/dL, was present in blood obtained from the foreman (for whom the previous high level [277 µg/dL] had been detected); five other employees had BLLs >50 µg/dL. ZPP levels for all 15 employees ranged from 20 to 468 µg/dL (normal: <50 µg/dL). Eight workers who had BLLs of 40-69 µg/dL reported symptoms compatible with lead toxicity, including unusual irritability, fatigue, memory problems, frequent headaches, sleep disturbances, and muscle or joint pain. In two employees, blood pressure was elevated (>140/90 mm Hg), and a third employee had a pigmented gum line (i.e., "lead line"). All workers with symptoms or abnormal physical findings were referred for further medical evaluation. The foreman was referred for chelation therapy because of his highly elevated BLL; however, he refused treatment.

The company was referred to the OSHA area office because numerous apparent violations of the OSHA lead standard had been observed during the site visit. A subsequent OSHA investigation determined that the foundry was contaminated with lead dust and was in violation of many provisions of the lead standard. Sampling of air for lead fumes and dust performed by OSHA revealed that the OSHA permissible exposure limit of 50 µg/m^3 (as an 8-hour, time-weighted average) was exceeded in certain jobs. Measured airborne lead levels ranged from 66 µg/m^3 (8-hour sample) to 330 µg/m^3 (200-minute sample).

NJSDH made specific recommendations, including use of personal protective equipment, engineering controls, and medical screening, to address health and safety problems identified at the foundry. The company manager has reported that a lead-monitoring program has been implemented since the NJSDH investigation, and employees requiring medical removal under the OSHA standard have been relocated to areas of acceptable air lead levels. In May 1991, NJSDH offered follow-up medical evaluations for the 15 lead-exposed employees; the company management and individual employees declined further testing.

Editorial Note: In 15 states, laboratories are required to report elevated BLLs to the state health department. Even though an OSHA standard limiting lead exposure in the workplace has been in effect since 1978, cases of overexposure continue to occur. Foundries and metal-working industries have been the primary source of exposure for persons with elevated BLLs reported to state health departments; in 1988, these sites accounted for 25% of all such reports (CDC, unpublished data).

Since October 1985, NJSDH has conducted surveillance of occupational lead exposure under a state regulation that requires laboratories in the state to report all BLLs ≥25 µg/dL in persons ≥16 years old. The NJSDH compiles and computerizes these reports and conducts follow-up activities, including 1) medical consultations with affected persons and their private physicians; 2) industrial hygiene evaluations at workplaces identified as sources of exposure; and 3) educational efforts for affected persons, their employers, and physicians. From October 1985 through December 1990, NJSDH received 13,561 such reports for 3316 adults. Of these, 1083 persons (33%) had BLLs ≥40 µg/dL, a level at which OSHA requires annual medical evaluation; 484 (15%) had levels ≥50 µg/dL, an average level at which OSHA requires relocation to an unexposed job; and 103 (3%) had levels ≥70 µg/dL, a level that usually requires medical intervention.

Elimination of occupational exposures to lead that result in BLLs ≥25 µg/dL has been targeted by the Public Health Service as a national health objective for the year 2000. In 1990, the Council of State and Territorial Epidemiologists recommended that an elevated BLL be made a notifiable condition nationwide. The increasing number and prominence of blood lead surveillance activities in state health departments are important components in the effort to achieve these goals.

MMWR 11/29/91

*The OSHA lead standard requires medical removal of an employee from the worksite when his or her BLL exceeds 60 µg/dL on a single occasion or an average of 50 µg/dL on three separate occasions within a 6-month period.

When Is Food Fresh?

Because of confusion over the meaning of the term "fresh," FDA is reevaluating the use of the word on processed foods and has asked the food industry to refrain from using the term until new standards are developed.

Although the agency first addressed the issue 50 years ago, new technologies and new products have stretched the boundaries of what constitutes "fresh."

Beginning in the 1940s, FDA agreed to allow the term "fresh frozen" on produce that had indeed been frozen while still fresh. At the same time, it barred use of the designation on butter that had been churned previously and held in cold storage awaiting shipment.

FDA's current policy states that the term "fresh" should not be applied to foods that have been subjected to any form of heat or chemical processing. The agency recently issued letters to two firms because they misused the term on their products, one a pasta sauce and the other orange juice made from concentrate.

As outlined in a *Federal Register* notice published Feb. 12, 1991, the agency is currently surveying and reviewing food labels now on the market to identify issues that must be addressed in defining the term "fresh." The *Federal Register* notice also discussed a petition FDA received from the California tomato packers requesting the agency to issue a regulation that would, among other things, prohibit use of the term "fresh" on finished tomato products containing previously processed tomato ingredients.

Until a final regulation is issued, FDA asks manufacturers, packers, and others who label foods and who do not now use "fresh" on the label to refrain from using the term. The agency may examine all freshness claims. Companies that can prove their products are fresh will be allowed to use the designation.

FDA Consumer May 1991

Two New USDA Food Safety Pubs

Consumers concerned about proper cooking temperatures, time limits on cold storage of food, and other food safety items can find tips from a new publication from the U.S. Department of Agriculture.

A Quick Consumer Guide to Safe Food Handling offers advice to consumers on all aspects of food handling, from shopping to cooking to serving leftovers. In addition, two charts list proper cooking temperatures and recommended cold-storage time limits.

Single free copies of the guide may be ordered from the Consumer Information Center, Box 574-X, Pueblo. Colo. 81009. Bulk copies are not available, but black-and-white reproducibles can be provided for reprinting. The reproducibles are available from USDA, FSIS Publications Office, Room 1165-South Building, Washington, D.C. 20250.

A second publication from USDA, *Preventing Foodborne Illness*, is designed for professionals interested in food safety and provides more in-depth information about foodborne illnesses than the consumer's guide. It also offers guidelines on handling foods needing special care, such as ground meats, ham, poultry stuffing, and eggs.

Single free copies of *Preventing Foodborne Illness* may be ordered by calling USDA's Public Awareness Office at (202) 447-9351 or writing to USDA, FSIS Publications Office, Room 1165-South Building, Washington, D.C. 20250. Bulk copies are not available to the general public.

(See also "The Unwelcome Dinner Guest: Preventing Food-Borne Illness" in the January-February 1991 *FDA Consumer*.)

Recall Retrieves Rubbing Alcohol Labeled as Distilled Water

by Tom Cramer

Thousands of bottles labeled "Agua Destilada" (distilled water) were pulled from pharmacy shelves in Puerto Rico and the Virgin Islands after FDA investigators discovered that a number of the bottles contained rubbing alcohol, not distilled water.

Five days after the labeling error was discovered, the manufacturing plant responsible was closed and has not reopened.

The labeling mix-up could have killed or injured hundreds of children, since the distilled water was labeled for use in preparing infant formula and medicines. An infant can die after consuming formula containing less than half an ounce of rubbing alcohol. However, no injuries were reported in connection with the incident.

All the mislabeled bottles were recovered by FDA, which worked closely with Puerto Rico and Virgin Islands health authorities during the class I emergency recall.

FDA investigators Jorge L. Guadalupe and Rafael Nevarez, of the agency's San Juan district office, discovered the mislabeling during a routine inspection of Duqui, Inc., a newly opened manufacturing operation in Catano, Puerto Rico. Catano is a suburb of San Juan.

The company had three full-time employees and manufactured distilled water (considered a food product), isopropyl rubbing alcohol, and several other over-the-counter drug products, such as hydrogen peroxide, ammonia water, and other disinfectants. The firm's owner and president was Rodulfo Gauthier Portuondo, a dentist who practiced in nearby Carolina, Puerto Rico.

Gauthier ran Duqui, Inc., as a sideline venture and spent most of his time at his dental practice.

FDA investigators Guadalupe and Nevarez arrived at the plant on June 12, 1990. During the next two days, they uncovered 43 violations of good manufacturing practices.

"There were no written procedures for production and process controls.'' Guadalupe reported. "None of their products had lot numbers or control numbers. They were using uncalibrated equipment — in fact, the owner used a wooden ruler to measure liquid volumes."

"There was no one in charge of quality control," continued Guadalupe. "No one had been delegated the responsibility to inspect and reject defective products. No one kept records indicating when or how often the equipment was cleaned."

There were other signs of trouble at Duqui, Inc.

"Labels for the distilled water bottles and the rubbing alcohol bottles were the same size and color and they were being stored together." said Nevarez. "We then learned that the individual who filled the bottles and labeled them couldn't read."

After two days of inspections, Guadalupe and Nevarez returned to FDA offices in San Juan to write up their reports. The two also began putting together their recommendations concerning what changes needed to be made at Duqui, Inc., if the plant was to stay in business.

The following day, June 14, Nevarez was working on his report when he received a phone call from a medical supply firm in Puerto Rico. The caller told Nevarez that her firm was a customer of Duqui, Inc., and that at least one bottle in a shipment of distilled water recently purchased from the company contained rubbing alcohol instead of water.

Nevarez and Guadalupe contacted Gauthier and told him to stop production immediately. The two investigators then rushed to the medical supply firm and retrieved the mislabeled bottle. Gauthier promptly initiated a class I recall of every bottle of distilled water manufactured by Duqui, Inc.

At the same time, FDA's San Juan district office initiated a media campaign to warn consumers throughout Puerto Rico and the Virgin Islands about the potentially lethal labeling mix-up. Press releases in English and Spanish were issued to newspapers. Television and radio stations ran public service announcements, sometimes as often as every half hour.

Meanwhile, FDA employees converged on Duqui, Inc., and began poring over sales records to determine where the firm's distilled water might be headed. They identified 65 wholesalers and 5,800 consignees who might have received the product. Phone calls were made to the wholesalers. warning them to halt further distribution of Duqui's "Agua Destilada."

FDA personnel and local health authorities were soon visiting pharmacies and other retailers throughout Puerto Rico and the Virgin Islands, hunting down not only the "Agua Destilada," but every Duqui, Inc., product that might still be on a store shelf.

The recall was in effect until November 1990, when FDA was satisfied that all Duqui, Inc., products were off the market.

On June 19,1990, five days after the labeling error was discovered, Gauthier closed the doors of his plant, and on July 5, he signed an agreement with FDA and the Puerto Rico Department of Health promising to stay out of the drug manufacturing business until he could comply with FDA requirements.

FDA Consumer December 1991

Coconut Products Contaminated by Cholera

Consumers who have Asian Best frozen coconut milk or candy should take the foods to their local health department for safe disposal, because the products may be contaminated with cholera or other disease-causing organisms.

After three cholera cases in Maryland were linked to frozen coconut milk produced by Champ Group Enterprises Co., Ltd., of Bangkok, FDA began detaining all the firm's fresh, frozen and dried products containing coconut milk or coconut meat.

The three cases were traced to Asian Best Frozen Fresh Coconut Milk that had been used as a topping on a Thai rice pudding served at a picnic in Silver Spring last August. The strain—*Vibrio cholerae* O1, Ogawa, El Tor—is associated with epidemics in Asia, but not with the current epidemic in South America. Besides the cholera organism, FDA analyses found *Salmonella* in Asian Best frozen coconut candy.

FDA will not release the products for sale here unless evidence is provided that they are free of the microbial contaminants. As a further safeguard, the agency intensified port-of-entry testing of other foreign firms' fresh and frozen coconut-containing foods exported to the United States.

The implicated coconut milk is shipped frozen in 8-ounce plastic bags. Its label names Jack Hong Co., Ltd., Bangkok, Thailand, as the exporter and the Eastland Food Corp. of Columbia. MD, as the importer and distributor. Eastland on September 20 voluntarily began recalling the products from some 600 retail outlets in 23 states east of the Mississippi River, chiefly Asian specialty stores.

FDA Consumer December 1991

- **Proposed guidelines about genetically engineered organisms** were formulated by the U.S. Department of Agriculture's office of biotechnology. For additional information, contact Marilyn Cordle, Room 324-A, Administration Building, 14th St. and Independence Ave., S.W., Washington, D.C. 20250-2200; telephone (703) 235-4414. (*FR* Feb. 1)

  In a related move, the Animal and Plant Health Inspection Service (APHIS) announced that 18 applications for permits to release genetically engineered organisms into the environment are being reviewed. For further information, contact Mary Petrie, Biotechnology. Biologics and Environmental Protection, Biotechnology Permits, APHIS. U.S. Department of Agriculture, Room 844, Federal Building, 6505 Belcrest Road, Hyattsville, MD 20782; telephone (301) 436-7612. (*FR* Feb. 28)

  FDA Consumer May 1991

- **Controlling *Salmonelln enteritidis*** spread among commercial egg-producing chickens is the subject of regulations developed by the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture. For further information, call (301) 436-5777. (*FR* Jan. 30)

  FDA Consumer May 1991

HACCP - An Industry Food Safety Self-Control Program - Part VI

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CONTROL OF PATHOGENS FROM WORKERS

It was not until the late 1800s, that scientists began to show that disease was due to microorganisms in the environment and was spread through poor sanitation and sterilization procedures. Only in the last 100 years have research studies begun to focus on methods of preventing transfer of pathogenic microorganisms in hospitals, institutions, and communities.

Poor personal hygiene of workers involved in food processing and/or foodservice causes 25 to 40 percent of all foodborne-related illnesses (Bryan, 1974, 1978) (Troller 1983). Each year there are an estimated 12.6 million cases of foodborne illness in the United States. These foodborne illnesses result in the death of over 9,000 people. They cost over 8 billion dollars in medical charges, lost wages, lost business, legal fees, and insurance claims (Todd, 1989) (Bennett et al., 1987).

Microorganisms on and in the Human Body

Healthy human bodies carry microorganisms both on the surface and within the body. These microorganisms on the basis of human carriage can be divided into two distinct populations: **resident** and **transient**.

Resident Microorganisms

Resident microorganisms are the internal and external microflora that keep people healthy. These resident microorganisms are found on and within the skin, around mucous membranes, and within the intestinal tract. They perform valuable functions. For example, microorganisms on and within the epidermal layer of skin maintain the skin at a proper pH which prevents the colonization of the skin by foreign, sometimes pathogenic, microorganisms (Altemeier, 1983). Resident microorganisms within the colon aid in the digestion of food by breaking down consumed food so that it can be utilized by the body for energy and cell synthesis. The presence of resident microorganisms on the skin and in the colon aids in preventing pathogenic microorganisms from becoming attached and causing their specific illnesses or diseases.

Skin

Resident microorganisms are firmly attached to the skin and are more resistant to removal by soaps, detergents, and germicides during bathing and hand washing. Most resident bacteria are found on the superficial skin surface, but 10 percent to 20 percent of the total flora are found within the dermal layer of skin and in skin crevices, where skin oils and hardened skin make complete removal of all microorganisms from the skin impossible. Resident bacteria on and within the epidermal layer of the skin include non-pathogenic bacteria *Staphylococcus epidermidis* and micrococci, and pathogenic *Staphylococcus aureus* (Seligmann and Rosenbluth, 1975) (Steere et al., 1975). The population of *Staphylococcus epidermidis* far outnumbers *Staphylococcus aureus*.

Handkerchiefs

At least 40 percent of all people have *Staphylococcus aureus* in their nasal passages and can transfer these bacteria to their hands when they blow or touch their noses (Steere et al., 1975). Hands are the principal mode of cross-contamination of food from the nose. Handkerchiefs and disposable tissues used to catch nasal discharges must be banned in food handling environments.

Transient Microorganisms

Transient microorganisms are microflora found on and within areas of the body where they do not normally reside, as the name implies. Almost all disease-producing microorganisms belong to this category. They are organisms that may take advantage of some disturbance in the normal resident microflora to gain a foothold to cause symptoms of disease, illness, or infection.

Sources

Transient microorganisms (bacteria, yeasts, molds, viruses, and parasites) on the skin and hands can be of any type, from any source where body surfaces have had contact. Transient microorganisms are found on the palms of hands, fingers and fingertips, and under fingernail surfaces. Pathogens that may be present on the skin as transient types include: *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella* spp., *Shigella* spp., *Clostridium perfringens*, Norwalk virus, and Hepatitis A virus. These transients (both bacteria and viruses) attach to hand, fingertip, and fingernail surfaces when:

1. Infected cuts and boils are touched or picked
2. Contaminated raw products are touched
3. Fecal contamination remains on hands and fingertips after using toilet paper, changing diapers, or cleaning up after pets at home.

Transient microorganisms are loosely attached to skin by dirt and oils and can be removed by correct hand washing techniques that also remove debris and pathogens from under the fingernails.

Importance of Effective Hand Washing

To control transfer of foodborne illness related to personal hygiene, all food handlers must use correct hand washing procedures.

In 1951, Horwood and Minch reported the numbers and types of bacteria obtained from 34 hand washing samples obtained in 22 foodservice establishments in the Cambridge/Boston, Massachusetts area (cafeterias, lunch rooms, drug stores, and restaurants). The range in total plate count was 6,200 to 16,000,000,000 per ml. *Escherichia coli* was found in 13 of the 34 samples. Twenty-nine of the 30 samples showed hemolytic staphylococci; 19 showed hemolytic streptococci, and 19 showed a mixture of both hemolytic streptococci and staphylococci. The number of aerobic spore-forming bacilli ranged from 4 to 400 per ml. Over forty years ago, these authors concluded that: "The hands of food handlers must be kept clean and that food handlers should avoid contact with food whenever possible." They stressed that food handlers must be given instruction prior to working with food and that management must assume the responsibility for daily education and supervision.

Correct Hand Washing

When effective hand washing procedures are lacking and are not enforced, foodborne illness problems occur. While hand washing is a simple and easy task, studies have indicated that personnel in both health care and foodservice industries have poor hand washing habits. Sixty percent of foodservice personnel in one study were reported not to wash their hands (Emery, 1990) (deWit et al., 1984) as required by these types of positions. "The food handler is one link in the complex multiphase process of contaminated food - infection - enteric disease." (Seligmann, 1975).

Secondary Infection

Research studies have shown that secondary infection rates (transfer of pathogenic bacteria) have decreased when people are taught to wash their hands after defecation and before eating (Khan, 1982). Black et al. (1981) reported a decline in diarrheal illnesses (due to *Shigella*, *Giardia*, and rotavirus) in day care centers, when employees were trained to use correct hand washing procedures.

People in the food production and foodservice industry must be expected to use good personal hygiene practices, must be trained to use correct hand washing procedures, and must be expected to follow these procedures while working in order to prevent the spread of secondary infection.

Personal Hygiene

Employees must be trained to know the importance of good personal hygiene and to use this knowledge in preparation for work. Good personal hygiene practices for foodservice and food production employees include: bathing or showering on a daily basis; use of deodorants; and effective clipping, care and cleaning of fingernails.

Employees must also be expected to wear clean uniforms and effective restraints for beards as well as scalp hair in order to prevent body hair from falling into food products. People lose 50 to 100 hairs a day from their scalp. Hair in food creates an aesthetic aversion and can be a source of microbial contamination. However, the number of pathogens on a strand of hair is too few to constitute a problem.

Illness

Regulatory agencies say that: "Individuals with symptoms of illness should not work directly in the preparation and service of food." When this statement is practiced by employees and managers, transfer of pathogens to food can be minimized. However, in many instances, people shed pathogens in their urine and feces for hours to weeks before they have symptoms of illness (e.g., Hepatitis A), or they may be carriers of pathogens without showing symptoms of the illness itself. In many other instances, employees do not report illness symptoms to supervisors/managers. The reporting of illness symptoms as a control policy is simply ineffective in preventing foodborne illness transfer. Frequently, workers do not know when they are ill or when they have touched a source of high levels of pathogens. The only solution to preventing pathogen transfer to food is correct hand washing.

Infections

Minor cuts and scrapes can become infected with pathogens such as *Staphylococcus aureus*, which can then multiply to hazardous levels within the abrasions. All cuts and abrasions should be washed thoroughly and bandaged only until bleeding stops. Minor abrasions heal more rapidly when they are clean and exposed to the air. They must be checked to be sure that they are not infected.

Bandages harbor bacteria and cannot be kept clean. Surface dressings (band aids, finger coverings) often fall in the food. When a wound or infection must be bandaged, only the bandaged hand should be gloved. The purpose of the glove is to keep the bandage on the hand and to keep the wound dry so that it will form a scab. The gloved hand, in turn, can be washed along with the ungloved hand to keep it clean.

Gloves

Wearing gloves to prepare and serve food does not prevent cross-contamination of food and foodborne illness. Gloved hands touch as many contaminated objects as ungloved hands and must be changed frequently or washed as often and as thoroughly as ungloved hands.

When gloves are worn, the skin surface within the gloves may become wet with perspiration, encouraging an increase in the number of bacteria on the skin surface. Gloves may also become punctured, allowing the entrance of microorganisms. When gloves are removed, hands must be washed thoroughly.

INFECTED PERSONS AND PERSONAL HYGIENE HAZARD CONTROL

1. It must be assumed that everyone coming to work in a food production or foodservice facility is shedding 10^9 pathogens per gram in their feces and urine, and is discharging 1,000 *Staphylococcus aureus* per gram of nasal discharge.
2. Employees must be trained concerning habits of good personal hygiene and required to use this knowledge.

3. The most effective method of washing hands, the **double hand wash method**, must be used by all employees to prevent pathogen transfer. The Hospitality Institute of Technology and Management prescribes the following process for the reduction of high levels (more than 10,000,000 organisms) of pathogens to low levels (less than 10 organisms) on fingertips and underneath fingernails. (See Enclosure 1.)

Step 1

The first step is to turn on hot, flowing water (i.e., 100°F to 120°F; two gallons per minute) and **wet the hands**. The key to the reduction of high levels of organisms such as *Shigella dysenteriae* to a safe level is the volume of flowing water.

Steps 2 and 3

Next, **soap is applied** to the fingernail brush and onto the fingers. Sufficient soap, more than 1/2 teaspoon, is used in order to **develop a good lather**. Antibacterial soaps or other agents are not used because they interfere with the helpful resident bacteria that typically reside in the hands. Resident bacteria prevent colonization of pathogens on the hands, and keep the hands healthy. If resident bacteria are destroyed by antibacterial agents, the hands become dry and cracked, and dangerous.

Step 4

The **fingernail brush is used** to eliminate filth on the fingertips and underneath the fingernails. This is where fecal contamination is primarily found, not on the palms of the hands. All transient bacteria, which must be eliminated, are on the skin surface. (Fingernail brushes can be purchased from Anchor Advanced Products, Inc., or Sparta Brush Company, Inc.)

Step 5

Once the transient microorganisms have been loosened by the fingernail brush, **the brush and the hands are rinsed** in hot (110°F to 120°F), flowing (more than two gallons per minute) water. The brush is set down. This is a critical step because the loosened microorganisms must be removed.

Step 6

In order to ensure the removal of pathogens, **a second wash is completed, without the use of the brush**. Soap is added to the hands. The hands and arms are lathered up to the sleeves, or as far up the arms as necessary to clean any part that will make contact with food.

Step 7

The **hands and arms are again rinsed** in hot, flowing water.

Step 8

Finally, **paper towels** are used to **dry the hands and arms**. It has been shown that it is critical to eliminate the moisture from the hands, because the moisture can carry pathogens which could cross-contaminate the food during handling, following hand washing.

4. Regular soap (bar or liquid) or detergents formulated for skin use should be used by employees for lathering hands. Employees can be given a choice of acceptable hand soaps/detergents. Use of highly perfumed products is not recommended.
5. Amount and type of minerals in water (hard or soft water) affects the ability of soaps or detergents to form foams. Different soaps and detergents are required for various regions of the country. When "hard" water is used for hand washing, more soap or detergent is required to produce a lather. "Softened water" enable soaps and detergents to form foams readily and to be rinsed off easily.
6. A hand washing sink (for feces/vomit removal) must be located at the entrance to the kitchen, production area, or work station, where it can be used conveniently. If necessary, a recording video camera can be mounted above the sink to monitor each individual's technique. In this way remedial training can be provided, if required.
7. Hands must be kept away from the face, body, and hair while working with food.
8. Employees' hands should be inspected when they arrive to work. Cuts should be bandaged only until bleeding stops. Large bandaged cuts on hands must be covered with durable, latex examining gloves. These gloves should not be powdered, as the powder may cause skin irritation and drying. Gloved hands must be washed and sanitized as often as ungloved hands. If surface skin infection is severe, employees should be given other non-food related work to do or they should be sent home.
9. No one should be allowed to carry a tissue used for nose-blowing into the food area. Only disposable tissues should be used for nose blowing. A box of disposable tissues should be placed above the hand washing sink. **No cloth handkerchiefs used for blowing noses should be allowed**. All employees must be trained to sneeze away from food by sneezing into their shoulder or towards the floor, not into the front or back of the hand.

10. If an employee cuts his or her hand, and blood from the cut gets into food, that food must be discarded. While the hazard of transmitting a blood-borne disease, such as AIDS or Hepatitis B, in food is quite remote, no one wants to eat another person's blood. People who bandage cuts of injured employees should wear latex examining gloves to protect themselves from AIDS and Hepatitis B transmission.
11. Clean uniforms or other appropriate attire, and effective hair restraints must be worn by all food production and foodservice employees.
12. **Employees working in aseptic food production environments must wear:**
    - **Hair restraints which enclose any scalp or beard hair**
    - **Masks**
    - **Clean, sanitized uniforms (provided by the production area)**
    - **Gloves. (Gloved hands in these production units must be washed often and dipped in a sanitizing solution prepared with chlorine or iodine.)**

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Federal Register

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 180

Parasitic and Predaceous Insects Used to Control Insect Pests; Exemption from a Tolerance

Agency: Environmental Protection Agency (EPA).

Action: Final Rule.

Summary: This final rule establishes an exemption from the requirement of a tolerance for parasitic (parasitoid) and predaceous insects used to control insect pests of stored raw whole grains such as corn, small grains, rice, soybeans, peanuts, and other legumes either bulk or warehoused in bags. This regulation is issued with the consultation and cooperation of the U. S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA) and is intended to improve worker safety and effective grain pest control.

Effective Date: This regulation becomes effective April 22, 1992.

Addresses: Written objections, identified by the document control number, (OPP-300222A), may be submitted to: Hearing Clerk (A-110), Environmental Protection Agency, rm. M3708, 401 M. St., SW., Washington, DC 20460.

For Further Information Contact: By mail: Melissa L. Chun, Registration Support Branch, Registration Division (H7505C), Environmental Protection Agency, 401 M. St., SW., Washington, DC 20460. Office location and telephone number: Rm. 724A, CM#2, 1921 Jefferson Davis Highway, Arlington, VA 22202, (703)305-6354.

Supplementary Information: In the **Federal Register** of January 3, 1991 (56 FR 234), EPA issues a proposed rule to exempt from the requirement of a tolerance insect parasites (parasitoids) and predators used to control insect pests of stored raw whole grains such as corn, small grains, rice, soybeans, peanuts, and other legumes either bulk or warehoused in bags. The proposal limited the exemption to situations "where these insects are not expected to become a component of food." EPA believes that parasitic insect parts will generally be removed from the above-named commodities during processing. Nonetheless, at some point during the production, storage, or handling of food, especially prior to processing, EPA expects that some insect parts may be found mixed with commodities. Thus, to clarify this exemption for enforcement purposes the condition pertaining to the expectations of users of parasitic insects has been deleted. These insects may also be used as control agents in facilities and structures used for such storage, as well as general purpose food storage warehouses, for disinfestation where these insects do not become a component of food. The proposal was issued with the consultation and cooperation of the USDA and the FDA and is intended to improve worker safety and effective grain pest control.

There were no requests for referral to an advisory committee received in response to the proposed rule.

Comments on Proposed Rule and Agency Responses to Comments

The Agency received 11 comments in support of the proposed rule. Five significant comments were received from the following sources: Biofac, Inc. (Biofac), the Texas Department of Agriculture (TDA), the National Food Processors Association (NFPA), the Cooperative Extension Service (CES), and David K. Mueller, a registered professional entomologist. The substance of these comments and the Agency's responses to them are addressed below.

A. Additional Parasitic (Parasitoid) and Predatory Insects Proposed as Biological Control Agents

Comments received from Biofac and TDA suggested the addition of the parasitic mite, *Pyemotes tritici* and the genus *Plastanoxus*, a bethylid, to the list of exempted parasitic (parasitoid) and predaceous insects. However, these insects were not included in the proposal, and EPA believes it would be appropriate to obtain public comments on exempting these insects prior to granting an exemption. Biofac and TDA may petition EPA under section 408(e) of the FFDCA to exempt these insects from the requirement for a tolerance. Any petition must contain appropriate supporting documentation.

B. Definition of Term "Areas Not Accessible to Standard Control Measures"

NFPA commented that the proposed language "areas not accessible to standard control measures" is unclear and would not permit the use of parasites (parasitoids) or predators, since chemical pest control agents, such as grain fumigants, can be applied virtually everywhere. Further, NFPA suggests that such language be removed from the text. The applicable portion of § 180.1101 reads as follows in the proposed rule:

> These insects may be used as control agents in facilities and structures used for such storage, as well as general purpose food storage warehouses for disinfestation of areas not accessible to standard control measures where these insects do not become a component of food.

After consultation with USDA and FDA, EPA has amended § 180.1101 to delete this entire sentence from the regulation. This change is intended to eliminate any confusion about the use of these insects as pest control agents.

C. Regulation/Efficacy

Comments received from CES and David K. Mueller suggested that consideration should be given to certain factors which are related to the setting of a tolerance for the residue of chemical pesticides. The purpose of this rule is to provide an exemption from the requirement of a tolerance for the residues from the use of beneficial insects in the control of stored product pests. Many considerations pertaining to chemical pesticides are not applicable to beneficial insects used as pesticides.

D. The Presence of Beneficial Insects in Whole Grain

CES also raised the issue of whether the introduction of beneficial insects would increase the presence of insects and insect parts in whole grain.

The agencies are not aware of any evidence associated with the use of parasites (parasitoids) and predators of insect pests that would indicate an increase in fragment counts in processed products. As noted in the preamble to the proposed rule, adding biological control agents to stored grain will not lead to an increase in insect fragments, but may serve to reduce the total number of primary insect parts and therefore the amount of fragments in milled commodities.

In any event, the public is protected from excess amounts of insect fragments in food or animal feed by 21 U.S. C. 342(a)(3), which declares food consisting in whole or in part of "any filthy, putrid, or decomposed substance" to be adulterated. For the sake of clarification, EPA has added a reference to 21 U.S.C. 342(a)(3) in the final rule.

E. Human Health Effects to Workers

CES expressed concern that the parasites and predators that have been recommended for use as biological control agents are harmful to individuals working in food warehouses or grain storage facilities, but provided no data or other information suggesting that such concern would be justified.

As stated in the proposal, EPA, USDA, and FDA are not aware of any adverse human health effects associated with the use of parasites (parasitoids) and predators of insect pests of stored grain including those used for seed or animal feed purposes. Generally, they avoid humans and prefer insect prey, but if trapped against the skin, they may on rare occasions impart a mild bite. These insects are regarded as safe to raise in large numbers and to be handled and released by unskilled workers. They would typically be released in grain storage areas at times when few or no workers would be present to minimize their tendency to escape. Beneficial insects have been raised and sold by at least 60 companies in the United States, and there have been no reports of adverse human health effects associated with their production and sale.

F. Basis for Adoption of Final Rule

Based on the data and information considered, the Agency concludes that the exemption from the requirement of a tolerance will protect the public health. Therefore, EPA finds it is appropriate to make the rule final at this time.

Any person adversely affected by this regulation may, within 30 days after publication of this document in the **Federal Register**, file written objections with the Hearing Clerk, at the address given above. The objections submitted must specify the provisions of the regulation deemed objectionable and the grounds for the objections. If a hearing is requested, the objections must include a statement of the factual issue(s) on which a hearing is requested and the requestor's contentions on each such issue. A request for a hearing will be granted if the Administrator determines that the material submitted shows the following: There is a genuine and substantial issue of fact; there is a reasonable possibility that available evidence identified by the requestor would, if established, resolve one or more such issues in favor of the requestor, taking into account uncontested claims or facts to the contrary; and resolution of the factual issue(s) in the manner sought by the requestor would be adequate to justify the action requested.

The Office of Management and Budget has exempted this rule from the requirements of section 3 of Executive Order 12291.

Pursuant to the requirements of the Regulatory Flexibility Act (Pub. L. 96-354, 94 Stat. 1164, 5 U.S.C. 601-612), the Administrator has determined that regulations establishing new tolerances or raising tolerance levels or establishing exemptions from tolerance requirements do not have a significant economic impact on a substantial number of small entities. A certification statement to this effect was published in the **Federal Register** of May 4, 1981 (46 FR 24950).

Federal Register/Vol. 57, No. 78/Wednesday, April 22, 1992/Rules and Regulations.

Industry Products

Custom Control Products Inc. Unveils Integrating Tank Gauging System

Custom Control Products Inc. proudly announces the availability of an important enhancement for existing centralized control systems: CCPI's Tank Gauging System. The new Tank Gauging System constantly monitors tank and silo levels utilizing commercially available tank level sensors and a centralized PLC.

Custom Control Products' computer based screen system presents bar graphics, tank and silo graphics and numeric graphics in color, and is custom designed for flexibility. The monitoring system delivers information in both graphics and numeric readings, facilitating data collection and report generation on tank activities. In addition to its graphic features, Custom Control Products' Tank Gauging System can provide control via the PLC for automatic high and low level shutoff, agitator control, high and low level product transfer, and refrigeration interfacing.

Custom Control Products' Tank Gauging System is easily integrated into an existing PLC system with minimal investment, and can furnish monitoring for as many tanks as required. Compatibility with growth is a feature of every Custom Control Products system.

Custom Control Products Inc. provides exceptional quality control systems and auxiliary products, backed by personal and professional service to the dairy, food and industrial markets.

Custom Control Products Inc. - Racine, WI

Please circle No. 261
on your Reader Service Card

New Detacher Control Offers More Options

Babson Bros. Co. is introducing an automatic take-off control that allows the operator to program time intervals for key milking functions. The Surge Omni Detacher Control can read sensing signals from resistance and optic flow sensors, as well as the Dairy Manager milk meter. It can trigger either vacuum or air-powered retracting cylinders.

Advanced circuitry and built-in memory provides accurate sensing. The Omni recalibrates itself so that optic sensing signals are consistent, even though sensing conditions may change. Indicator lights show operating modes, warn of sensing problems or early retraction, and signals when milk flow ceases (in automatic or manual settings).

Its compact size make it easy to mount on all types of milking stalls. Convenient touch switches put the Omni's control functions at the operator's finger tips. The manual button overrides the milk let-down delay should reattachment be necessary.

The Omni's flexibility means that the dairy manager can program the control for present herd conditions and reprogram it should they change. Future modernization such as the addition of milk meters or conversion to air-powered retractors won't obsolete the control.

Babson Bros. Co. - Naperville, IL

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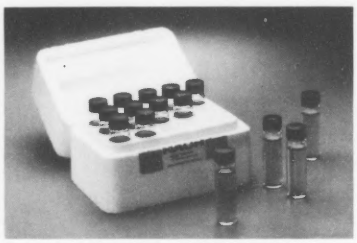

Quickly detect E. coli *in Drinking Water*

EC Medium with MUG easily determines *E. coli* in drinking water within 24 hours. After a positive coliform test using Presence/Absence, Membrane Filtration or Most Probably Number methods, analysts simply inoculate medium with bacteria from a positive test and incubate tubes at 44.5°C for 24 hours. Fluorescence under long-wave ultraviolet light verifies the presence of *E. coli*.

EC Medium with MUG is available with or without durham tubes (for gas collection). For drinking water, the USEPA recommends using the product without durham tubes to eliminate possible confusion when fluroescence occurs without gas production due to anaerogenic *E. coli*.

Recent USEPA requirements for drinking water require confirmation of either fecal coliform or *E. coli*, and Hach's EC Medium with MUG makes confirmation of *E. coli* fast and reliable. MUG reagent helps analysts: identify *E. coli* rapidly and economically; detect non-gas producing (anaerogenic) strains of *E. coli*; and identify *E. coli* in the presence of competitive organisms. When glucuronidase (an enzyme specific to *E. coli*) hydrolyzes MUG it produces a fluorogenic product, which verifies the presence of *E. coli*.

HACH COMPANY - Loveland, CO

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Pollution Abatement Sump Pump Handles Chemicals

Compliance with today's Federal regulations often requires overhead evacuation from sewers, pits and other deep tanks in an effort to achieve pollution abatement. Also, compliance with rules regarding shipment of hazardous materials has introduced bulk handling, which sometimes requires a low cost, inhouse distribution system.

SERFILCO's newly improved Series 'HB' sump pump can handle these applications. New design provides for assembly of modular parts so that lengths of up to 12 ft. can be accommodated, with flow rates up to 150 GPM or 130 Ft. TDH from its injection molded impeller. Original design received the chemical industry award for energy efficiency.

Pump is essentially constructed of solid CPVC, with fluoride resistent ceramic used for bearing surfaces along with Teflon guides, suitable for internal product lubrication or from an external water supply.

Materials of construction allow for use over a wide range of solutions, including strong acids used in general industrial applications, as well as the sulfuric acids used in the paper industry.

All models can be operated with float operated level controls and applied in custom designed simplex or duplex pump stations for alternative operation or back-up protection.

SERFILCO, Ltd - Northbrook, IL

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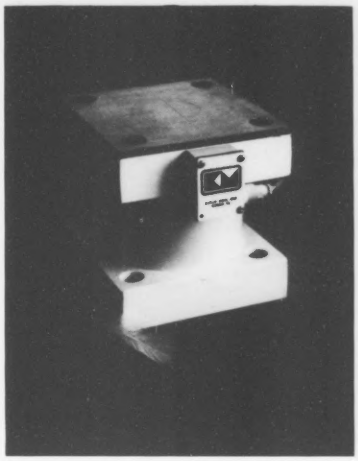

Self-Checking High Capacity Load Cell Provides Continuous Information of Bulk Material Inventories of Virtually Any Size

The Load Stand™ transducer is a highly sensitive direct support sensor which measures the weight of material stored inside large bunkers, tanks, or bins with dependable accuracy. Built to weigh massive loads up to *200,000 lbs per support*, the Load Stand™ transducer requires no pivots points, stay rods or checking hardware once installed and is practically maintenance-free.

Using the Kistler-Morse patented Microcell® strain gage sensor technology, these Load Stands™ provide a high level of electrical output, ensuring accuracy and providing effective noise immune system. Each Microcell® sensor, bolted directly to the pedestal of the Load Stand™, is individually temperature compensated and trimmed to match the thermal expansion of the steel, giving standard accuracies at 99.75% of rated capacity. These weighing systems are pre-calibrated at the factory, requiring only small adjustments upon installation. This transducer requires no periodic maintenance and is backed by the industry's longest warranty. Should sensor failure occur, the Microcell® sensor can be replaced on-site without putting the vessel or weighing system out of service. The design and construction of the Load Stand™ transducer is in accordance with applicable provisions of the 1988 Uniform Building Code satisfying the requirements for earthquake and wind loading for most applications.

The Load Stand™ signal has many display/output options available, including level information on an analog or LED bar graph display, weight information on a digital display scaled in engineering units, and batching control with ten-key pad and digital display.

Kistler-Morse - Redmond, WA

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Mocon Announces Non-Destructive Package Leak Detection System

The Pac Guard 400 is a non-destructive leak detection system designed for production line quality control and package development applications. Simple and fast system operation helps assure final product integrity. The Pac Guard 400 can detect weak heat seals, gross leaks, or small pinholes in finished packages. Packages that can be tested include blister packs, foil and plastic pouches, thermoformed cups, bottles, boxes and other small sealed packages.

The Pac Guard 400 works best with dry products where some internal headspace exists. Ideal applications include sterile medical supplies and a variety of products in the food and pharmaceutical industries.

Quality and service is backed by an established, award-winning company, with over 20 years of history involving measurement systems.

MOCON - Minneapolis, MN

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Seismic Secondary Containment Shelving Available Through Unified Safety Corp.

A new concept to provide safe shelf storage and more square footage for small containers holding five gallons or less of hazardous materials is being marketed by Unified Safety Corp. of Beverly Hills. The seismic secondary containment shelving, which is patented, was designed for use by laboratories, hospitals, household hazardous waste programs or businesses utilizing hazardous materials.

There is a continuous solid lip framing the shelves to prevent articles from falling off. Beneath each shelf is a sump to catch any spills or leaks, with a drain and cap for drainage should a leak occur.

The shelves themselves are suspended from a sub-roof frame assembly, with allthread rods to allow for total adjustability to hold any size containers. The allthread rods also provide seismic protection to items stored on the shelves. If the building is bumped by a forklift during loading or unloading, for instance, the shelves float free, thus preventing items from falling off or spilling.

The shelving is supplied in prefabricated facilities for indoor or outdoor use.

Unified Safety Corp. - Beverly Hills, CA

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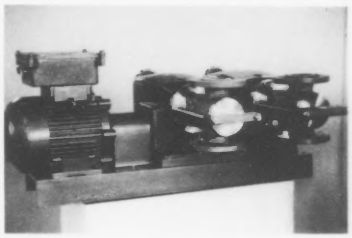

Unique Pump Eliminates Need to Preheat High Viscosity Fluids

MIS-ORLITA is now offering a DR Series valveless rotary piston pump capable of accurately metering highly viscous, abrasive fluids up to 500,000 cps without preheating prior to processing. The pumps are available in a range of sizes to handle suspensions up to 65%, pressures to 5,100 psi, temperatures to 1,300°F, and a precision flow range of .0002 to 2,100 gallons per hour. Control of metering is infinitely variable and, once set, discharge repeatability performance to 0.1%.

By eliminating the needs to preheat the media, energy costs are drastically reduced, and processing failures due to temperature fluctuations are nonexistent. A large number of products, such as glucose, honey, invert sugar, fats and greases, synthetic resins and other substances must be made flowable or pumpable before they can be metered. This is now accomplished by preheating.

Applications for the MSI-ORLITA DR pump series include the chemical processing of mineral oil, glue, latex and resins. In the food industry, products would include chocolate, bread, cheese, margarine and mayonnaise in both processing and packing.

MSI-ORLITA - Marietta, GA

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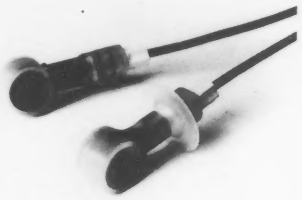

Wide Range, Small-Bore Electrodeless Conductivity Sensors

Introduction

GLI's wide range, small-bore electrodeless conductivity sensors eliminate polarization and coating problems — and the associated maintenance — common with conventional contacting electrode conductivity sensors. The measurement capability of these wide range electrodeless sensors extends from 0-200 microSiemens/cm up to 0-1,000 microSiemens/cm. Their small size makes mounting in small line sizes easy and economical.

Single Wetted Material

To simplify chemical resistance problems, these sensors are constructed such that only one material is wetted by the process. Polypropylene or PVDF material is available for compatibility with a broad range of solutions. Because these wetted materials are nonconductive, the sensor is electrically isolated from the process fluid, eliminating ground loops which can affect accuracy.

Sensor Styles and Mountings

Two sensor styles are offered: a "convertible" style and a sanitary clean-in-place style for dairy, food and beverage industry applications. The convertible style sensor may be attached to the end of a pipe for submersion mounting, threaded into a special bushing for pipe tee mounting or used with special union-mount hardware.

Flange or insertion mounting, via a tank fitting or ball valve assembly, is also possible.

The sanitary style sensor has an integral flange for mating to GLI's sanitary tee mounting hardware which includes a gasket (EPDM compound) and special cap. The gasket is also available separately for mounting to a 2-inch sanitary clamp-type ferrule or butt-weld tee.

Each style sensor has an integral temperature compensator to allow adjustment of the conductivity reading to a 25°C reference.

Optional mounting hardware assemblies are offered in selected materials and include a junction box. Interconnect cable (p/n 99X1W1103) must be used for wire runs between the junction box and instrument. Any other type of cable will degrade measurement performance.

Temperature/Pressure Considerations

The sensor and mounting hardware components used to install the sensor have independent ratings for temperature and pressure. However, the sensor and hardware combination acts as an integrated system and must be considered as such when evaluating the application. The mounting hardware material typically limits the temperature and pressure rating of this unified system.

Great Lakes Instruments, Inc. - Milwaukee, WI

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Hand Sanitation Made Simple

CleanTech™ Systems.
The hand cleansing solution.

This revolutionary new method of handwashing answers your sanitation requirements quickly and efficiently. The CleanTech System combines new hand sanitation technologies into a simple, easy-to-use process. Simply insert hands into the system. Water and cleansing solutions are automatically injected through the rotating cylinders and sprayed onto hands, removing microorganisms from fingertips to wrists.

CleanTech Systems offer instant benefits:

Frequency of handwashing

Because the CleanTech System is easy-to-use, enjoyable, and non-irritating, employee handwashing compliance increases.

Uniformity of handwashing

The CleanTech System's 10 second cleansing cycle insures that all employees receive the same high sanitation standards.

Effectiveness of handwashing

Specially formulated cleaning solutions and patented rotating cylinders and united to thoroughly clean hands. The CleanTech System removes and kills more microorganisms than typical manual handwashing.

MERITECH, INC. - Englewood, CO

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IAMFES Audio Visuals Libray

A Free IAMFES Members Benefit

DAIRY

❑ **The BST Debate: Biotechnology and the Dairy Case** - (13 minute videotape). Provides retail grocers with an overview of bovine somatotropin or BST...a biotechnology product now being used to enhance the efficiency of milk production in cows. This video report focuses on how BST fits into the overall biotechnology picture, what possibilities it is likely to present at the retail level, and offers some specific tactics retailers can use in addressing questions shoppers may have on BST. (Monsanto Agricultural Company)

❑ **Babcock Method for Determination of Butterfat in Raw Milk** - A videotape report that describes the purposes, procedures and refinements of The Babcock Method for determining fat content in raw milk. Revised test procedures are presented which will result in greater accuracy and reproducibility. Viewing is recommended by anyone in public health or the dairy industry who uses the Babcock test. (Ozark Film & Video Production, Inc.)

❑ **The Bulk Milk Hauler: Protocol & Procedures** - (8 minute videotape). Teaches bulk milk haulers how they contribute to quality milk production. Special emphasis is given to the hauler's role in proper milk sampling, sample care procedures, and understanding test results. (Iowa State University Extension)

❑ **Causes of Milkfat Test Variations and Depressions** - (140 slides-tape-script-30 minutes). This set illustrates the many factors involved in causing milkfat test variations or depressions in your herd, including feeding, management, stage of lactation, age of samples, handling of samples, and testing procedures. The script was reviewed by field staff, nutritionists, laboratory personnel and county extension staff. It is directed to farmers, youth and allied industry. (Penn State-1982)

❑ **Controlling Volumes and Fat Losses** - (110 slides-tape-script-30 minutes). Keeping milk volume and product loss from farm to supermarket of fluid dairy products is discussed. This set was done with the cooperation of the dairy industry who reviewed the script and provided opportunities to take pictures. It is designed to be used by milk plants for their processing personnel, regulatory representatives, field staff and milk haulers. (Penn State-1982)

❑ **Ether Extraction Method for Determination of Raw Milk** - (26 minute video). Describes the ether extraction procedure to measure milkfat in dairy products. Included is an explanation of the chemical reagents used in each step of the process. (CA-1990)

❑ **The Farm Bulk Milk Hauler** - (135 slides-tape-script-30 minutes). This set covers the complete procedure for sampling and collecting milk from farms. Each step is shown as it starts with the hauler entering the farm lane and ends when he leaves the milk house. Emphasis is on universal sampling and automated testing. Funds to develop this set were provided by The Federal Order #36 Milk Market Administrator. (Penn State-1982)

❑ **Frozen Dairy Products** - (27 minute videotape). Developed by the California Department of Food and Agriculture. Although it mentions the importance of frozen desserts, safety and checking ingredients; emphasis is on what to look for in a plant inspection. Everything from receiving, through processing and cleaning and sanitizing is outlined, concluded with a quality control program. Directed to plant workers and supervisors, it shows you what should be done. (CA-1987)

❑ **The Gerber Butterfat Test** - (7 minute video). Describes the Gerber milkfat test procedure for dairy products and compares it to the Babcock test procedure. (CA-1990)

❑ **High-Temperature, Short-Time Pasteurizer** - (59 minute videotape). Provided by the Dairy Division of Borden, Inc. It was developed to train pasteurizer operators and is well done. There are seven sections with the first covering the twelve components of a pasteurizer and the purpose and operation of each. The tape provides the opportunity for discussion after each section or continuous running of the videotape. Flow diagrams, processing and cleaning are covered. (Borden, Inc., 59-min.-1986)

❑ **The How and Why of Dairy Farm Inspections** - (110 slides-tape-script-15 minutes). This was developed at the request of seven northeast dairy cooperatives and with their financial support. Emphasis is on clean cows, facilities and equipment and following proper procedures. Regulatory agencies cooperated in reviewing the script and taking pictures. This was developed for farmers, youth and allied industry. (Penn State-1984)

❑ **Milk Plant Sanitation: Chemical Solution** - (13 minute video). This explains the proper procedure required of laboratory or plant personnel when performing chemical titration in a dairy plant. Five major titration are reviewed ... alkaline wash, presence of chlorine and iodophor, and caustic wash and an acid wash in a HTST system. Emphasis is also placed on record keeping and employee safety.

❑ **Milk Processing Plant Inspection Procedures** - (15 minute videotape). Developed by the California Department of Food and Agriculture. It covers pre and post inspection meeting with management, but emphasis is on inspection of all manual and cleaned in place equipment in the receiving, processing and filling rooms. CIP systems are checked along with recording charts and employee locker and restrooms. Recommended for showing to plant workers and supervisors. (CA-1986)

❑ **Pasteurizer: Design and Regulation** - (15 1/2 minute videotape). This tape provides a summary of the public health reasons for pasteurization and a nonlegal definition of pasteurization. The components of an HTST pasteurizer, elements of design, flow-through diagram and legal controls are discussed.

❑ **Pasteurizer Operation** - (10 1/2 minute videotape). This tape provides a summary of the operation of an HTST pasteurizer from start-up with hot water sanitization to product pasteurization and shut-down. There is an emphasis on the legal documentation required.

❑ **Processing Fluid Milk** - (140 slides-script-tape-30 minutes). It was developed to train processing plant personnel on preventing food poisoning and spoilage bacteria in fluid dairy products. Emphasis is on processing procedures to meet federal regulations and standards. Processing procedures, pasteurization times and temperatures, purposes of equipment, composition standards, and cleaning and sanitizing are covered. Primary emphasis is on facilities such as drains and floors, and filling equipment to prevent post-pasteurization contamination with spoilage or food poisoning bacteria. It was reviewed by many industry plant operators and regulatory agents and is directed to plant workers and management. (Penn State-1987)

❑ **Producing Milk of Good Quality and Flavor** - (114 slides-tape-script-25 minutes). The steps and corrective measures necessary to produce quality milk with good flavor are outlined. It is directed at dairy farmers, field staff, milk haulers and youth. (Penn State-1982)

❑ **Safe Milk Hauling - You're the Key** - (34 minute videotape). Recommended for anyone who samples, measures and collects milk from dairy farms. The purpose of this tape is to acquaint milk handlers with the proper procedures for sampling and picking up milk at the farm and delivering it safely to the handling plant. This tape provides an excellent review for experienced milk haulers and shows step-by-step procedures for novice milk haulers. (Cornell University)

❑ **Tests for Milk Quality and Composition** - (140 slides-tape-script-25 minutes). This set shows and describes in simple terms the various quality tests performed on milk samples. These include bacteria, antibiotics, freezing point, pesticides, somatic cells, flavor and others. The purpose, desirable results, and ways to improve poor results are outlined. It was developed for farmers, youth, field staff and allied industry. (Penn State, 1983)

❑ **3-A Symbol Council** - (8 minutes). A video which was developed to make people in the dairy and food industries aware of the 3-A program and its objectives.

FOOD

❑ **BISSC - A Sign of Our Times** - (50 slides-script-tape). The presentation was prepared by the Baking Industry Sanitary Standards Committee. The purpose of BISSC, formed in 1949 by six of the national organizations serving the baking industry, is to develop and publish voluntary standards for the design and construction of bakery equipment. Those Standards are now recognized as the definitive sanitation standards for equipment used in the baking industry.

❑ **Close Encounters of the Bird Kind** - (18 minute videotape). A humorous but in-depth look at Salmonella bacteria, their sources, and their role in foodborne disease. A modern poultry processing plant is visited, and the primary processing steps and equipment are examined. Potential sources of Salmonella contamination are identified at the different stages of production along with the control techniques that are employed to insure safe poultry products. (Topek Products, Inc.)

❑ **Food Irradiation** - (30 minutes). Introduces viewers to food irradiation as a new preservation technique. Illustrates how food irradiation can be used to prevent spoilage by microorganisms, destruction by insects, overripening, and to reduce the need for chemical food additives. The food irradiation process is explained and benefits of the process are highlighted. (Turnelle Productions, Inc.)

❑ **Food Quality, Food Safety, and You!** - (80 slides, script, and cassette tape). This is an educational program designed for consumers. The presentation deals with the role of the consumer in maintaining the freshness, quality and safety of food in the home. It is intended for use by home economists, dieticians, cooperative extension agents and others interested in food quality and safety. (Cornell University)

❑ **Food Safe - Series I** - (4-10 minute videos). (1) "Receiving & Storing Food Safely", details for food service workers the procedures for performing sight inspections for the general conditions of food, including a discussion of food labeling and government approval stamps. (2) "Foodservice Facilities and Equipment", outlines the requirements for the proper cleaning and sanitizing of equipment used in food preparation areas. Describes the type of materials, design, and proper maintenance of this equipment. (3) "Microbiology for Foodservice Workers", provides a basic understanding of the micro-organisms which cause food spoilage and foodborne illness. This program describes bacteria, viruses, protozoa, and parasites and the conditions which support their growth. (4) "Foodservice Housekeeping and Pest Control", emphasizes cleanliness as the basis for all pest control. Viewers learn the habits and life cycles of flies, cockroaches, rats, and mice. (Perennial Education)

❑ **Food Safe - Series II** - (4-10 minute videos). Presents case histories of foodborne disease involving (1) *Staphylococcus aureus*, (sauces) (2) *Salmonella*, (eggs) (3) *Campylobacter*, and (4) *Clostridium botulinum*. Each tape demonstrates errors in preparation, holding, or serving food; describes the consequences of those actions; reviews the procedures to reveal the cause of the illness; and illustrates the correct practices in a step-by-step demonstration. These are excellent tapes to use in conjunction with hazard analysis critical control point training programs. (Perennial Education)

❑ **Food Safe - Series III** - (4-10 minute videos). More case histories of foodborne disease. This set includes (1) Hepatitis "A", (2) Staphylococcus Aureus (meats), (3) Bacillus Cereus, and (4) Salmonella (meat). Viewers will learn typical errors in the preparation, holding and serving of food. Also included are examples of correct procedures which will reduce the risk of food contamination. (Perennial Education)

❑ **Food Safety Is No Mystery** - (34 minute videotape). This is an excellent training visual for food service workers. It shows the proper ways to prepare, handle, serve and store food in actual restaurant, school and hospital situations. A policeman sick from food poisoning, a health department sanitarian, and a food service worker with all the bad habits are featured. The latest recommendations on personal hygiene, temperatures, cross contamination, and storage of foods are included. (USDA-1987)

❑ **Food Safety: For Goodness Sake, Keep Food Safe** - (15 minute videotape). Teaches food handlers the fundamentals of safe food handling. The tape features the key elements of cleanliness and sanitation, including: good personal hygiene, maintaining proper food product temperature, preventing time abuse, and potential sources of food contamination. (Iowa State University Extension)

❑ **HACCP: Safe Food Handling Techniques** - (22 minute videotape). The video highlights the primary causes of food poisoning and emphasizes the importance of self-inspection. An explanation of potentially hazardous foods, cross contamination, and temperature control is provided. The main focus is a detailed description of how to implement a Hazard Analysis Critical Control Point (HACCP) program in a foodservice operation. A leader's guide is provided as an adjunct to the tape. (The Canadian Restaurant & Foodservices Association)

❑ **Is What You Order What You Get? Seafood Integrity** - (18 minute videotape). Teaches seafood department employees about seafood safety and how they can help insure the integrity of seafood sold by retail food markets. Key points of interest are cross-contamination control, methods and criteria for receiving seafood and determining product quality, and knowing how to identify fish and seafood when unapproved substitutions have been made. (The Food Marketing Institute)

❑ **Northern Delight - From Canada to the World** - A promotional video that explores the wide variety of foods and beverages produced by the Canadian food industry. General in nature, this tape presents an overview of Canada's food industry and its contribution to the world's food supply. (Ternelle Production, Ltd.)

❑ **Proper Handling of Paracidic Acid** - (15 minute videotape). Introduces paracidic acid as a chemical sanitizer and features the various precautions needed to use the product safely in the food industry.

❑ **Purely Coincidental** - (20 minute video). A parody that shows how foodborne illness can adversely affect the lives of families that are involved. The movie compares improper handling of dog food in a manufacturing plant that causes the death of a family pet with improper handling of human food in a manufacturing plant that causes a child to become ill. Both cases illustrate how handling errors in food production can produce devastating outcomes. (The Quaker Oats Company)

❑ **On the Front Tine** - (18 minute video). A training video pertaining to sanitation fundamentals for vending service personnel. Standard cleaning and serving procedures for cold food, hot beverage and cup drink vending machines are presented. The video emphasizes specific cleaning and serving practices which are important to food and beverage vending operations. (National Automatic Merchandising Association)

❑ **On the Line** - (30 minute VHS videocassette). This was developed by the Food Processors Institute for training food processing plant employees. It creates an awareness of quality control and regulations. Emphasis is on personal hygiene, equipment cleanliness and good housekeeping in a food plant. It is recommended for showing to both new and experienced workers.

❑ **100 Degrees of Doom ... The Time and Temperature Caper** - (14 minute videotape). Video portraying a private eye tracking down the cause of a salmonella poisoning. Temperature control is emphasized as a key factor in preventing foodborne illness. (Educational Communications, Inc.)

❑ **Pest Control in Seafood Processing Plants** - (26 minute videotape). Videotape which covers procedures to control flies, roaches, mice, rats and other common pests associated with food processing operations. The tape will familiarize plant personnel with the basic characteristics of these pests and the potential hazards associated with their presence in food operations.

❑ **Product Safety and Shelf Life** - (40 minute videotape). Developed by Borden Inc., this videotape was done in three sections with opportunity for review. Emphasis is on providing consumers with good products. One section covers off-flavors, another product problems caused by plant conditions, and a third the need to keep products cold and fresh. Procedures to assure this are outlined, as shown in a plant. Well done and directed to plant workers and supervisors. (Borden-1987)

❑ **Safe Food: You Can Make a Difference** - (25 minute videotape). A training video for foodservice workers which covers the fundamentals of food safety. An explanation of proper food temperature, food storage, cross contamination control, cleaning and sanitizing, and handwashing as methods of foodborne illness control is provided. The video provides an orientation to food safety for professional food handlers. (Tacoma-Pierce County Health Department)

❑ **Safe Handwashing** - (15 minute videotape). Twenty-five percent of all foodborne illnesses are traced to improper handwashing. The problem is not just that handwashing is not done, the problem is that it's not done properly. This training video demonstrates the "double wash" technique developed by Dr. O. Peter Snyder of the Hospitality Institute for Technology and Management. Dr. Snyder demonstrates the procedure while reinforcing the microbiological reasons for keeping hands clean. (Hospitality Institute for Technology and Management)

❑ **Sanitation for Seafood Processing Personnel** - A training video suited for professional food handlers working in any type of food manufacturing plant. The film highlights Good Manufacturing Practices and their role in assuring food safety. The professional food handler is introduced to a variety of sanitation topics including: 1) food handlers as a source of food contamination, 2) personal hygiene as a means of preventing food contamination, 3) approved food storage techniques including safe storage temperatures, 4) sources of cross contamination, 5) contamination of food by insects and rodents, 6) garbage handling and pest control, and 7) design and location of equipment and physical facilities to facilitate cleaning.

❑ **Sanitizing for Safety** - (17 minute video). Provides an introduction to basic food safety for professional food handlers. A training pamphlet and quiz accompany the tape. Although produced by a chemical supplier, the tape contains minimal commercialism and may be a valuable tool for training new employees in the food industry. (Indiana -1990)

❑ **Seafood Q & A** - (20 minute VHS). Anyone who handles seafood, from processor to distributor to retail and foodservice, must be prepared to answer questions posed by customers. This tape features a renowned nutritionist and experts from the Food & Drug Administration, the National Marine Fisheries Service, and the National Fisheries Institute who answer a full range of questions about seafood safety. Excellent to educate and train employees about seafood safety & nutrition. (National Fisheries Institute)

❑ **SERVSAFE® Serving Safe Food** - (Four videotapes). This video series illustrates and reinforces important food safety practices in an informative and entertaining manner. The material is presented in an easy to understand format, making it simpler for employees to learn and remember this essential information. Each video includes a leader's guide that provides all the information managers need to direct a productive training session.

❑ **Supermarket Sanitation Program - "Cleaning and Sanitizing"** - (12.5 minute videotape). Contains a full range of cleaning and sanitizing information with minimal emphasis on product. Designed as a basic training program for supermarket managers and employees.

❑ **Supermarket Sanitation Program - "Food Safety"** - (10.5 minute videotape). Contains a full range of basic sanitation information with minimal emphasis on product. Filmed in a supermarket, the video is designed as a basic program for manager training and a program to be used by managers to train employees.

❑ **Wide World of Food Service Brushes** - An 18 minute video tape that discusses the importance of cleaning and sanitizing as a means to prevent and control foodborne illness. Special emphasis is given to proper cleaning and sanitizing procedures and the importance of having properly designed and constructed equipment (brushes) for food preparation and equipment cleaning operations.

❑ **Your Health in Our Hands - Our Health in Yours** - (8 minute videotape). For professional food handlers, the tape covers the do's and don'ts of food handling as they relate to personal hygiene, temperature control, safe storage and proper sanitation. (Jupiter Video Production)

ENVIRONMENTAL

❑ **The ABC's of Clean - A Handwashing & Cleanliness Program for Early Childhood Programs** - For early childhood program employees. This tape illustrates how proper handwashing and clean hands can contribute to the infection control program in daycare centers and other early childhood programs. (The Soap & Detergent Ass'n.)

❑ **Acceptable Risks?** - (16 minute VHS). Accidents, deliberate misinformation, and the rapid proliferation of nuclear power plants have created increased fears of improper nuclear waste disposal, accidents during the transportation of waste, and the release of radioactive effluents from plants. The program shows the occurrence of statistically anomalous leukemia clusters; governmental testing of marine organisms and how they absorb radiation; charts the kinds and amounts of natural and man-made radiation to which man is subject; and suggests there is no easy solution to balancing our fears to nuclear power and our need for it. (Films for the Humanitites & Sciences, Inc.)

❑ **Air Pollution: Indoor** - (26 minute VHS). Indoor air pollution is in many ways a self-induced problem ... which makes it no easier to solve. Painting and other home improvements have introduced pollutants, thermal insulation and other energy-saving and water-proofing devices have trapped the pollutants inside. The result is that air pollution inside a modern home can be worse than inside a chemical plant. (Films for the Humanities & Sciences, Inc.)

❑ **Asbestos Awareness** - (20 minute videotape). This videotape discusses the major types of asbestos and their current and past uses. Emphasis is given to the health risks associated with asbestos exposure and approved asbestos removal abatement techniques (Industrial Training, Inc.)

❑ **Down in the Dumps** - (26 minute VHS). Garbage is no laughing matter. The fact is that we are running out of space to dump the vast amounts of waste we create each day. Since many of the former methods of disposal are environmentally unacceptable, what are we to do? The program examines the technological approaches to the garbage dilemma, including composting, resource recovery, and high-tech incinerators, and public reaction to the creation of new waste treatment facilities. (Films for the Humanities & Sciences, Inc.)

❑ **EPA Test Methods for Freshwater Effluent Toxicity Tests (using Ceriodaphnia)** - (22 minute tape). Demonstrates the Ceriodaphnia 7-Day Survival and Reproduction Toxicity Test and how it is used to monitor and evaluate effluents for their toxicity to biota and their impact on receiving waters and the establishment of NPDES permit limitations for toxicity. The tape covers the general procedures for the test including how it is set up, started, monitored, renewed and terminated.

❑ **EPA Test Methods for Freshwater Effluent Toxicity Tests (using Fathead Minnow Larva)** - (15 minute tape). A training tape that teaches environmental professionals about the Fathead Minnow Larval Survival and Growth Toxicity Test. The method described is found in an EPA document entitled, "Short Term Methods for Estimating the Chronic Toxicity of Effluents & Receiving Waters to Freshwater Organisms." The tape demonstrates how fathead minnow toxicity tests can be used to monitor and evaluate effluents for their toxicity to biota and their impact on receiving waters and the establishment of NPDES permit limitations for toxicity.

❑ **Fit to Drink** - (20 minute VHS). This program traces the water cycle, beginning with the collection of rain water in rivers and lakes, in great detail through a water treatment plant, to some of the places where water is used, and finally back into the atmosphere. Treatment of the water begins with the use of chlorine to destroy organisms; the water is then filtered through various sedimentation tanks to remove solid matter. Other treatments employ ozone, which oxidizes contaminants and makes them easier to remove; hydrated lime, which reduces the acidity of the water; sulfur dioxide, which removes any excess chlorine; and flocculation, a process in which aluminum sulfate causes small particles to clump together and precipitate out. Throughout various stages of purification, the water is continuously tested for smell, taste, titration, and by fish. The treatment plant also monitors less common contaminants with the use of up-to-date techniques like flame spectrometers and gas liquefaction. (Films for the Humanities & Sciences, Inc.)

❑ **Foodservice Disposables: Should I Feel Guilty?** - (11 1/2 minute videotape). The video, produced by the Foodservice & Packaging Institute, Inc., national trade association of manufacturers and suppliers of single service articles for foodservice and packaging, examines such issues as litter, solid waste, recycling, composting and protection of the earth's ozone layer, makes for an excellent discussion opener on the theme of conservation of natural resources (trees, fresh water and energy) and the environmental trade-offs (convenience, sanitation and family health) that source reduction necessarily entails. (Foodservice & Packaging Institute, Inc.)

❑ **Garbage: The Movie** - (24 1/2 minute videotape). A fascinating look at the solid waste problem and its impact on the environment. Viewers are introduced to landfills, incinerators, recycling plants and composting operations as solid waste management solutions. Problems associated with modern landfills are identified and low-impact alternatives such as recycling, reuse, and source reduction are examined. (Churchill Films)

❑ **Global Warming: Hot Times Ahead?** - (23 minute videotape). An informative video tape program that explores the global warming phenomenon and some of the devastating changes it may cause. This program identifies greenhouse gases and how they are produced by human activities. Considered are: energy use in transportation, industry and home; effects of deforestation, planting of trees and recycling as means of slowing the build-up of greenhouse gases. (Churchill Films)

❑ **Kentucky Public Swimming Pool and Bathing Facilities** - (38 minute videotape). It was developed by the Lincoln Trail District Health Department in Kentucky and includes all of their state regulations which may be different from other states, provinces and countries. It was very well done and could be used to train those responsible for operating pools and waterfront bath facilities. All aspects are included of which we are aware, including checking water conditions and filtration methods. (1987)

❑ **Putting Aside Pesticides** - (26 minute VHS). This program probes the long-term effects of pesticides and explores alternative pest-control efforts; biological pesticides, genetically-engineered microbes that kill objectionable insects, the use of natural insect predators, and the cross-breeding and genetic engineering of new plant strains that produce their own anti-pest toxins. (Films for the Humanities & Sciences, Inc.)

❑ **Radon** - (26 minute VHS). This program looks at the possible health implications of radon pollution, methods homeowners can use to detect radon gas in their homes, and what can be done to minimize hazards once they are found.

❑ **RCRA - Hazardous Waste** - (19 minute video). This videotape explains the dangers associated with hazardous chemical handling and discusses the major hazardous waste handling requirements presented in the Resource Conservation and Recovery Act. (Industrial Training, Inc.)

The New Superfund: What It Is & How It Works - A six-hour national video conference sponsored by the EPA. Target audiences include the general public, private industry, emergency responders and public interest groups. The series features six videotapes that review and highlight the following issues:

❑ **Tape 1 - Changes in the Remedial Process: Clean-up Standards and State Involvement Requirements** - (62 minute videotape). A general overview of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and the challenge of its implementation. The remedy process -- long-term and permanent clean-up -- is illustrated step-by-step, with emphasis on the new mandatory clean-up schedules, preliminary site assessment, petition procedures and the hazard ranking system/National Priority List revisions. The major role of state and local government involvement and responsibility is stressed.

❑ **Tape 2 - Changes in the Removal Process: Removal and Additional Program Requirements** - (48 minute videotape). The removal process is a short term action and usually an immediate response to accidents, fires and illegally dumped hazardous substances. This program explains the changes that expand removal authority and require procedures consistent with the goals of remedial action.

❑ **Tape 3 - Enforcement and Federal Facilities** (52 minute videotape). Who is responsible for SARA clean-up costs? Principles of responsible party liability; the difference between strict, joint and several liability; and the issue of the innocent landowner are discussed. Superfund enforcement tools- mixed funding, De Minimis settlements and the new nonbinding preliminary allocations of responsibility (NBARs) are explained.

❑ **Tape 4 - Emergency Preparedness and Community Right-To-Know** - (48 minutes). A major part of SARA is a free-standing act known as Title III: The Emergency Planning and Community Right-To-Know Act of 1986, requiring federal, state, and local governments and industry to work together in developing local emergency preparedness/response plans. This program discusses local emergency planning committee requirements, emergency notification procedures, and specifications on community right-to-know reporting requirements, such as using OSHA Material Safety Data Sheets, the emergency & hazardous chemical inventory and the toxic chemical release inventory.

❑ **Tape 5 - Underground Storage Tank Trust Fund and Response Program** - (21 minutes). Another addition to SARA is the Leaking Underground Storage Tank (LUST)Trust Fund. One half of the U.S. population depends on ground water for drinking -- and EPA estimates that as many as 200,000 underground storage tanks are corroding and leaking into our ground water. This program discusses how the LUST Trust Fund will be used by EPA and the states in responding quickly to contain and clean-up LUST releases. Also covered is state enforcement and action requirements, and owner/operator responsibility.

❑ **Tape 6 - Research and Development/Closing Remarks** - (33 minutes). An important new mandate of the new Superfund is the technical provisions for research and development to create more permanent methods in handling and disposing of hazardous wastes and managing hazardous substances. This segment discusses the SITE (Superfund Innovative Technology Evaluation) program, the University Hazardous Substance Research Centers, hazardous substance health research and the DOD research, development and demonstration management of DOD wastes.

❑ **Sink A Germ** - (10 minute videotape). A presentation on the rationale and techniques for effective handwashing in health care institutions. Uses strong imagery to educate hospital personnel that handwashing is the single most important means of preventing the spread of infection. (The Brevis Corp.)

❑ **Waste Not: Reducing Hazardous Waste** - (35 minute VHS). This tape looks at the progress and promise of efforts to reduce the generation of hazardous waste at the source. In a series of company profiles, it shows activities and programs within industry to minimize hazardous waste in the production process. Waste Not also looks at the obstacles to waste reduction, both within and outside of industry, and considers how society might further encourage the adoption of pollution prevention, rather than pollution control, as the primary approach to the problems posed by hazardous waste. (Umbrella films)

OTHER

❑ **Diet, Nutrition and Cancer** - (20 minute video). Investigates the relationship between a person's diet and the risk of developing cancer. The film describes the cancer development process and identifies various types of food believed to promote and/or inhibit cancer. The film also provides recommended dietary guidelines to prevent or greatly reduce the risk of certain types of cancer.

❑ **Eating Defensively: Food Safety Advice for Persons with Aids** - (14 1/2 minute videotape). While HIV infection and AIDS are not acquired by eating foods or drinking liquids, persons infected with the AIDS virus need to be concerned about what they eat. Foods can transmit bacteria and viruses capable of causing life-threatening illness to persons infected with AIDS. This video provides information for persons with AIDS on what foods to avoid and how to better handle and prepare foods. (FDA/CDC)

❑ **Legal Aspects of the Tampering Case** - (about a 25-minute, 1/2" videocassette). This was presented by Mr. James T. O'Reilly, University of Cincinnati School of Law at the fall 1986 Central States Association of Food and Drug Officials Conference. He emphasizes three factors from his police and legal experience - know your case, nail your case on the perpetrator, and spread the word. He outlines specifics under each factor. This should be of the greatest interest to regulatory sanitarians, in federal, state and local agencies. (1987)

❑ **Personal Hygiene & Sanitation for Food Processing Employees** - (15 minute videotape). Illustrates and describes the importance of good personal hygiene and sanitary practices for people working in a food processing plant.

❑ **Psychiatric Aspects of Product Tampering** - (about a 25 minute, 1/2" videocassette). This was presented by Emanuel Tanay, M.D. from Detroit, at the fall 1986 conference of CSAFDA. He reviewed a few cases and then indicated that abnormal behavior is like a contagious disease. Media stories lead to up to 1,000 similar alleged cases, nearly all of which are false. Tamper proof packaging and recalls are essential. Tampering and poisoning are characterized by variable motivation, fraud and greed. Law enforcement agencies have the final responsibilities. Tamper proof containers are not the ultimate answer. (1987)

❑ **Tampering: The Issue Examined** - (37 minute videotape). Developed by Culbro Machine Systems, this videotape is well done. It is directed to food processors and not regulatory sanitarians or consumers. A number of industry and regulatory agency management explain why food and drug containers should be made tamper evident. (Culbro-1987)

❑ **75th IAMFES Annual Meeting Presentations.** 30 cassette tapes covering the complete conference. 5 videotapes covering various symposia and sessions (For more specific information, contact Sue Kary)

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Synopsis of Papers for the 79th Annual Meeting

The following are abstracts of papers to be presented at the 79th Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians, Inc., to be held in Toronto, Ontario, July 26-29, 1992.

ELIMINATION OF SURFACE-ATTACHED BACTERIA BY DETERGENT WASHING AND CHEMICAL SANITATION IN A DYNAMIC FLOW SYSTEM, Melvin H. Czechowski*, Ph.D., Senior Research Microbiologist, and Mark J. Banner, Diversey Corporation, IBL, 1532 Biddle Avenue, Wyandotte, MI 48192

Recent reports have suggested that sanitizers are ineffective in killing surface-attached bacteria. However, sanitizers should be applied only as part of a total cleaning process, i.e., detergent washing followed by chemical sanitation. A study, therefore, was conducted showing the results of the total cleaning process. Stainless steel surfaces, contaminated with *Pseudomonas fluorescens*, were water rinsed, washed (Cl-alkaline, alkaline, and acid detergents) at 24 and 63°C and/or sanitized (NaOCl, acid anionic, iodophor, and peracetic acid) in a tubular flow system utilizing CIP protocols. Detergent washing resulted in at least 99% reduction of viable surface-attached bacteria. When followed by chemical sanitizers, the total cleaning process resulted in a 4 log or greater reduction, in most cases. Sanitizers applied to the non-washed surfaces reduced viable bacteria only 1 to 2.5 log. These results indicate that the total cleaning process is effective in giving surfaces that are bacteriologically clean, thus reducing food-contaminating problems caused by surface-attached bacteria.

A NOVEL SYSTEM OF SANIITATION DISINFECTION AND STERILIZATION EFFECTIVE AGAINST BIOFILMS, David N. Kramer, Vice President of Research and Development, Sterilex Corp., 18 Gwynns Mill Ct., Owings Mills, MD 21117

Biofilms are recognized as a severe challenge to sterilization, disinfection and sanitation proceduress. They result from attachment of microorganisms to surfaces forming water insoluble lipid films containing lipopolysaccarides and glycopeptides. Water based chemical sterilizers, disinfectants and sanitizers, such as, bleach, caustics, phenolics, peroxides, and quaternary ammonium salts, while demonstrating high efficacy in laboratory tests, do not reliably function in the field under practical conditions. It has been demonstrated that a phase transfer system which renders water-soluble disinfectant salts fat soluble is extremely effective against microorganisms including bacteria, spores, fungi and thermophilic organisms.

The phase transfer system effects rapid hydrolysis and oxidation of the films and by the same mechanism penetrates the organisms and destroys the membranes and inhibits their enzyme systems.

EFFECT OF COLD TEMPERATURE ON GERMICIDAL EFFICACY OF QUATERNARY AMMONIUM COMPOUND, IODOPHOR AND CHLORINE ON *LISTERIA*, Erdal U. Tuncan, Ph.D., Senior Microbiologist, ConAgra Frozen Foods, 409 Vandiver Drive, Bldg. 7, Suite 102, Columbia, MO 65202

The effect of cold temperature (between 2°C and 25°C) on the germicidal efficacy of quaternary ammonium compound (25 to 200 ppm), iodophor (12.5 to 50 ppm), and chlorine (25 to 200 ppm) on *Listeria* (a pool of two *L. monocytogenes* strains, *L. ivanovii* and *L. innocua*) was studied by using the suspension test method. At 30 sec exposure time, the efficacy of the quaternary ammonium compound (QAC) and iodophor decreased as the temperature decreased. The magnitude of the effect of the temperature was dependent on the concentrations of the sanitizers. In fact, the temperature showed an effect only at 50 ppm and lower QAC concentrations. The lower the concentrations of the sanitizers were, the greater the effect of the temperature. However, the effect of the temperature was reversible by increasing the exposure time. On the other hand, temperature did not show an effect on the efficacy of chlorine.

ASSESSMENT OF HANDLING CONDITIONS AND QUALITY OF MILK IN OREGON PUBLIC SCHOOLS, Floyd W. Bodyfelt*, Professor of Food Science, and A. J. Gatherum, Oregon State University, Department of Food Science and Technology, Corvallis, OR 973331-6602

A survey and audit of 11 Oregon milk plants was conducted to evaluate the processing and delivery systems for fluid milk to public schools. The shelf life potential of 1/2 pint size milk, lowfat milk and chocolate milks, were determined by the Mosley Test; 14% of the samples were found unsatisfactory. The food service administrators of 17 school districts were interviewed about "school milk" service and products performance. Observations of milk handling practices and product temperatures were undertaken in 71 schools. Not one school monitored milk temperature at time of delivery, in storage or at the point of serving. Nearly 40% of all milk products were stored in excess of 4.2°C and 29% of the products were observed to be held non-refrigerated for periods exceeding 30 min. It was concluded that dairy processors need to focus attention on problems such as soiled milk cases and cartons, leaker cartons, product rotation, frozen milk, and warm milk (greater than 7.2°C).

A COMPARISON OF COMMERCIALLY PROCESSED FLUID MILKS HELD AT 7.2°C (45°F) FOR 10, 12, AND 14 DAYS, S. E. Barnard*, Professor of Food Science, and R. A. Smeltz, Penn State University, University Park, PA 16802

Fluid milk samples were obtained from the 38 fluid milk dealer processors in Pennsylvania on more than 100 occasions during the past 18 months. These samples represented all fillers except dispensers and all products proccessed by each plant. They were selected from conveyors or cold rooms and held for 10, 12 or 14 days at 7.2° C (45°F) prior to testing and tasting. Initial studies showed that about 90% of samples remained of acceptable flavor for 10 days, but that only 62% of samples were acceptable after 14 days. Following education programs and individual assistance, holding times were set for 12 days at 7.2°C (45°F). Following two rounds of samples from the 38 plants which demonstrated that 96% of samples remained acceptable, the Pennsylvania open dating regulation was extended to 12 days. Monitoring shows about 90% compliance. Bacterial results showed that about 40% of samples had bacterial counts of less than one coliform, and less than 20,000 SPC per ml. at the end of the 12-day holding. Dairy processors have requested that educational, testing, and tasting programs continue. The goal will be to demonstrate that fluid milk can be processed and packaged which will be of acceptable flavor after 14 days. If product temperatures do not exceed 7.2°C (45°F), the 14-day open date would still represent the actual keeping quality which consumers can expect.

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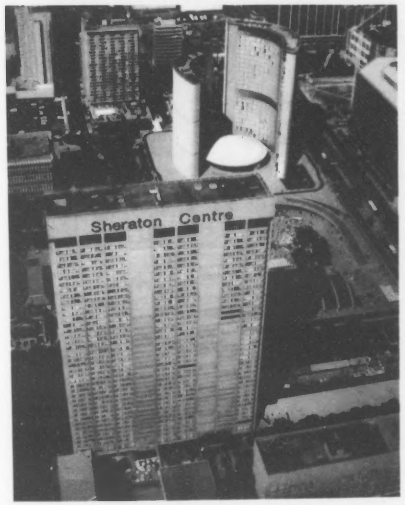

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Send payment with registration to IAMFES, 502 E. Lincoln Way, Ames, IA 50010-6666. Make checks payable to IAMFES. Pre-registration must be post-marked by July 1, 1992. The pre-registration deadline will be strictly observed. For additional information contact Julie Heim at 1-800-369-6337, 1-800-284-6336 (Canada).

Refund/Cancellation Policy

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Exhibitor Information

An exhibition of products and consultant services will be at the Sheraton Centre Hotel. For more information on exhibiting at the conference, please contact Scott Wells at 1-800-369-6337 (US), 1-800-284-6336 (Canada).

79th IAMFES Annual Meeting Registration Form - U.S. Funds

Sheraton Centre Hotel — Toronto, Ontario — July 26-29, 1992
(Use photocopies for extra registrations)

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	IAMFES Student Member	$ 25 ($ 25 on-site)		
	IAMFES Member One Day (Circle: Mon/Tues/Wed)	$ 50 ($ 70 on-site)		
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Other Fees: (Per Person)	Cheese & Wine Reception (Sun., 7/26)	FREE	_____	
	CASA Loma Dinner (Mon., 7/27)	$ 40 ($ 45 on-site)	_____	
	IAMFES Awards Banquet (Wed., 7/29)	$ 25 ($ 30 on-site)	_____	
Spouse/Companion Events:	A Get-Acquainted Tour of Toronto and CN Tower (Mon., 7/27)	$ 17 ($ 22 on-site)	_____	
	Historic Tour of Downtown and Restored Theatres (Mon., 7/27)	$ 12 ($ 17 on-site)	_____	
	Niagara Falls and Niagara-on-the-Lake (Tues., 7/28)	$ 42 ($ 47 on-site)	_____	
	Children (16 & under)	$ 30 ($ 35 on-site)	_____	
	Blue Jay Baseball and dinner at Windows (Tues. P.M., 7/28)	$ 40 ($ 45 on-site)	_____	

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IAMFES

79th Annual Meeting
Spouse/Companion Tours

A Get-Acquainted Tour of Toronto and CN Tower

Monday, July 27, 1992
9:00 a.m. - 12:00 noon

Explore the unique personality of the world's "newest great city" on this get-acquainted tour of Toronto!

With emphasis on the blending of residential, commercial and recreational facilities and the eye-catching combination of old and new, your guide will share interesting and unusual anecdotes about Toronto and its residents as you tour through distinct areas of the city, including: the downtown financial district with its stunning skyline of skyscrapers, many of which are constructed from a different material (for example, the Royal Bank building with windows containing real gold dust); the midtown section, where fashionable boutiques and galleries of Yorkville are just a stones' throw from the Victorian Gothic of the Ontario Parliament Buildings; and uptown Toronto, where the playing fields of two of Canada's most prestigious private schools back on to the residences of a few of its more famous personalities!

Some of the other attractions included in today's look at Toronto will be the Royal Ontario Museum and McLaughlin Planetarium; Roy Thomson Hall; Old Towne of York, where Toronto had its beginnings; O'Keefe and St. Lawrence Centre for the Arts; Old and New City Halls; Ontario Parliament Buildings; the Eaton Centre, with its stunning glass domed galleria; Chinatown; the Art Gallery of Ontario and innovative Village by the Grange residential and shopping developments; parks; theatres, and numerous other places of interest in and around the city.

Then to complete your morning, "Zoom" to the clouds via a thrilling 58-second ride in a glass sided elevator up the CN Tower, the world's tallest free standing structure and marvel at modern technology. Whilst revelling in the magnificent bird's eye panoramic view of Toronto from 1,150 feet above the ground, your knowledgeable guide will also conduct a unique aerial tour of the city and its surrounding area.

Historic Tour of Downtown and Restored Theatres

Monday July 27, 1992
2:00 p.m. to 5:00 p.m.

Take an exciting tour "behind the scenes" and discover the hidden world that transforms fantasies to realities! Third in the world behind New York and London, Toronto is proud of its first class theatres and concert halls, however, the ultimate treasures are found in two magnificently restored vaudeville houses of the 1920's. Look back to a time of extravagance with visits to the historic Elgin and Winter Garden Theatres the only active stacked theatres in the world. The restorations for this complex began in March 1987 and lasted for 33 months with artists, historians, carpenters, plasterers, painters and many others painstakingly repairing or re-creating every detail of the original theatres' design. Vaudeville was presented here until 1930 when the Elgin became exclusively a movie house. Situated directly above is the Winter Garden Theatre, which opened in February 1914. As this theatre was strictly a vaudeville house, it too became passé and had its last performance in 1928, after which its doors were simply closed and the theatre left to slumber for sixty years. Walking through the Winter Garden Theatre with its hand painted walls and leaves suspended from the ceiling is reminiscent of a stroll through an English fantasy garden. Both the Elgin and the Winter Garden Theatres are designated national historic sites.

Following your theatre tour, this Historic walking tour of Downtown will continue by highlighting two of Toronto's most imposing buildings which are reflections of the city's past and present - The Old and New City Halls. Located across the street from each other, these two buildings share an important part of the city's architectural and historic identity. Begin your walking tour at New City Hall with a view of the Peace Garden, Henry Moore's famous sculpture "The Archer", and finally the beautiful rotunda inside.

Across the street from new City Hall, but light-years removed in architectural style, stands Old City Hall. It was completed just in time to ring in the 20th century at 1/10 the cost of the New City Hall. Marvel at the magnificent wood paneling, high ceilings and marble columns, and elaborate 300 foot high clock tower.

Finally, your guide will escort you to the Church of the Holy Trinity which, set against the Eaton Centre's high-tech glitter, looks more impressive today than it did even a century ago. Right next door is the home of the first rector of Holy Trinity, Rev. Henry Scadding. This Georgian/Gothic style house was built in 1857 and its intriguing balcony once commanded a view down to the harbour and around the entire town.

Niagara Falls and Niagara-on-the-Lake

Tuesday, July 28, 1992
8:00 a.m. to 5:00 p.m.

This spectacular showcase of Niagara has been specially designed to offer delegates attending the IAMFES 1992 Convention an excellent opportunity to experience first hand, the beauty and excitement of the Niagara Peninsula.

Begin your day with a pleasant journey to the Niagara Peninsula and feel the thrill of excitement and anticipation as your approach the majestic and thunderous Falls! Upon arriving at this magnificent splendor, your first impressions will be that of the powerful surging waters of the Canadian and American Falls. First your guide will take you on a short orientation tour of the area, pointing out such attractions as the Oaks' amphitheatre, the scenic tunnels, the Maid of the Mist and superb gardens. Then time will be available for those who wish to climb aboard the *Maid of the Mist* tour boat for a thrilling and exciting close-up look at the base of the thundering falls. (Tour boat ride at your own expense).

On leaving the Falls for Niagara-on-the-Lake, journey along the Niagara Parkway, where participants will have a chance to see the impressive Niagara Gorge, with its swirling whirlpool rapids; the massive power stations which provide hydro-electricity to southern Ontario and the north-eastern part of New York; the floral clock, one of the largest of its kind in North America.

A picnic lunch today will take place in the area of one of the famous battlefields of the war of 1812 between British and American armies at Queenston Heights Park. The picnic area is located on the brow of the Niagara escarpment and has a spectacular view of the broad Niagara River and fruitlands.

After lunch you will continue your trip on to Niagara-on-the-Lake, a charming 19th Century town which, as the first capital of Upper Canada, has a rich history and culture. The home of the world renowned Shaw Festival which draws both international performers and audiences, this tranquil town offers participants an opportunity to meander through quaint boutiques and tree-lined streets. Visit an old fashioned apothecary, explore some of the fine examples of 19th Century homes, and perhaps indulge in freshly made fudge and preserves.

Blue Jay Baseball and dinner at Windows

Tuesday, July 28, 1992
7:30 p.m. to 11:00 p.m.

Let's go Blue Jays!

Enjoy an evening watching the Toronto Blue Jays play in the fabulous SkyDome Stadium. The SkyDome-billed as "like no other in the world" is being talked about by virtually every sports fan in North America. This incredible multi-use facility provides 55,000 to 70,000 fans with spectacular views in all directions and outstanding sight lines for a variety of activities, including all major sporting events and star-studded concerts. It is more than merely a sports stadium. This magnificent complex also includes a 450 room hotel with 77 rooms overlooking the playing field, a health club, a movie theatre, bars and restaurants.

Windows on SkyDome is an elegant, three tiered restaurant overlooking the stadium and features a delicious buffet dinner. A section of this unique restaurant, has been specially reserved for delegates attending the IAMFES 1992 Convention. Some tables offer full viewing of the playing field and others offer monitor viewing only, therefore seating will be assigned on a "first come-first serve" basis.

Dairy, Food and Environmental Sanitation, Vol. 12, No. 6, Pages 383-386 (June 1992)

3-A Sanitary Standards For Refractometers And Energy Absorbing Optical Sensors For Milk and Milk Products, Number 46-00

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

It is the purpose of the IAMFES, USPHS, and DIC in connection with the development of the 3-A Sanitary Standards program to allow and encourage full freedom for inventive genius or new developments. Refractometers and energy absorbing optical sensor specifications heretofore or hereafter developed which so differ in design, material, fabrication, or otherwise, as not to conform to the following standards but which, in the fabricator's opinion, are equivalent or better, may be submitted for the joint consideration of the IAMFES, USPHS, and DIC at any time.

A

SCOPE

A.1

These standards cover the sanitary aspects of refractometers and energy absorbing optical sensors used on milk and milk products equipment for sensing concentration, turbidity and/or color.

A.2

In order to conform with these 3-A Sanitary Standards, refractometers and energy absorbing optical sensors shall comply with the following design, material, and fabrication criteria.

B

DEFINITIONS

B.1

Product: Shall mean milk and milk products.

B.2

Refractometer: A device to measure the refractive index of a product.

B.3

Energy Absorbing Optical Sensor: A device to measure the energy absorption, such as infrared energy, of a product.

B.4

Optical Element: An optical device utilized to transmit, reflect, refract, alter the angle of or in some way interface energy with a milk or milk product.

B.5

Flushing Nozzle: A device utilized to direct flushing media to the optical surface.

B.6

Surfaces

B.6.1

Product Contact Surfaces: Shall mean all surfaces that are exposed to the product, or surfaces from which liquids may drain, drop, or be drawn into the product.

B.6.2

Non-Product Contact Surfaces: Shall mean all other exposed surfaces.

B.6.3

Optical Surface: Shall mean the optically sensitive product contact surface of the optical element.

B.7

Mechanical Cleaning or Mechanically Cleaned: Shall denote cleaning, solely by circulation and/or flowing chemical detergent solutions and water rinses onto and over the surfaces to be cleaned, by mechanical means.

B.8

Optical Surface Flushing: Shall mean the flushing of the optical surfaces with a flushing media so as to provide an obstruction-free interface.

B.9

Flushing Media: Shall mean a safe and product-compatible media such as safe water, culinary steam, or milk or milk product.

B.9.1

Safe Water: Shall mean water from a supply properly located, protected and operated and shall be of a safe, sanitary quality. The water shall meet the standards prescribed in the National Drinking Water Regulation of the Environmental Protection Agency as referenced in 40 CFR Parts 141, 142 and 143.*[1] (Information also available from the EPA Drinking Water Hot Line - 800-426-4791).

B.9.2

Culinary Steam: Shall mean steam produced using a system meeting criteria in the 3-A Accepted Practices for a Method of Producing Steam of a Culinary Quality, Number 609-00.

C

MATERIALS

C.1

Product contact surfaces shall be of stainless steel of the AISI 300 Series*[2] or corresponding ACI*[3] types (See Appendix, Section E.), or metal which under condi-

[1] Document for sale by the Superintendent of Documents, U.S. Government Office, Washington, DC 20402 (202-783-3238).
[2] The data for this series are contained in the AISI Steel Products Manual, Stainless & Heat Resisting Steels, December 1974, Table 2-1, pp. 18-20. Available from the Iron and Steel Society, 410 Commonwealth Drive, Warrendale, PA 15086 (412-776-9460).
[3] Steel Founders Society of America, Cast Metal Federation Bldg., 455 State St., Des Plaines, IL 60016 (708-299-9160).

tions of intended use is at least as corrosion resistant as stainless steel of the foregoing types, and is non-toxic and non-absorbent, except that:

C.1.1

Rubber and rubber-like materials may be used for O-Rings, gaskets, and parts having the same functional purposes.

C.1.2

Rubber and rubber-like materials when used for the above specified applications shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials, Used as Product Contact Surfaces in Dairy Equipment, Number 18-00.

C.1.3

Plastic materials may be used for optical surfaces, optical elements, optical element insulators, optical element holders, gaskets and parts having the same functional purposes.

C.1.4

Plastic materials when used for the above specified applications shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Plastics Materials Used as Product Contact Surfaces for Dairy Equipment, Number 20-14 as amended.

C.1.5

Rubber and rubber-like materials and plastics materials having product contact surfaces shall be of such composition as to retain their surfaces and conformation characteristics when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment or sterilization.

C.1.6

The final bond and residual adhesive, if used, of bonded rubber and rubber-like materials and bonded plastic materials shall be non-toxic.[*4]

C.1.7

Where materials having certain inherent functional properties are required for optical surfaces, materials such as glass, sapphire, quartz, fluorspar and spinel may be used.

C.1.7.1

Materials used for optical surfaces shall be inert, non-porous, non-toxic, non-absorbent, insoluble, resistant to scratching, scoring and distortion when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment or sterilization.

C.1.7.2 2

Glass, when used, shall be of a clear, heat resistant type.

C.2 4

Materials used as product contact surface(s) in the construction of refractometers and energy absorbing optical sensors used in a processing system to be sterilized by heat and operated at a temperature of 250 degrees F (121 degrees C) or higher shall be such that they can be (1) sterilized by saturated steam or water under pressure (at least 15.3 psig or 106 kPa) at a temperature of at least 250 degrees F (121 degrees C) and (2) operated at the temperature required for processing.

C.3

Non-product contact surfaces shall be of corrosion resistant material or material that is rendered corrosion resistant. If coated, the coating used shall adhere. Non-product contact surfaces shall be relatively non-absorbent, durable and cleanable. Parts removable for cleaning having both product contact and non-product contact surfaces shall not be painted.

D

FABRICATION

D.1

All product contact surfaces shall have a finish at least as smooth as a No. 4 ground finish on stainless steel sheets and be free of imperfections such as pits, folds and crevices in the final fabricated form. (See Appendix, Section F.)

D.2

All permanent joints in metallic product contact surfaces shall be continuously welded. Welded areas on product contact surfaces shall be at least as smooth as a No. 4 ground finish on stainless steel sheets and be free of imperfections such as pits, folds and crevices.

D.3

Product contact surfaces not designed to be mechanically cleaned shall be easily accessible for cleaning and inspection either when in an assembled position or when removed. Removable parts shall be easily demountable.

D.4

Optical elements and flushing nozzles that are to be mechanically cleaned shall be designed so that the product contact surfaces of these devices can be mechanically cleaned, and all non-removable appurtenances thereto can be mechanically cleaned and are accessible for inspection.

D.5

When used, systems designed to flush the optical surface during processing shall be designed to meet the following criteria:

D.5.1

The flushing system nozzle shall be designed to minimize the quantity of flushing media required to adequately flush the optical surface, and shall not adulterate the product with added water when such addition is not permitted.

D.5.2

When flushing media is introduced into the product during optical surface flushing, an isolation valve shall be installed as close as practical to the point of flushing media application, and a spring loaded check valve of sanitary design shall be installed between the valve and the point of flushing media application.

D.5.3

Steam or water, when used as a flushing media, shall

[*4] *Adhesives shall comply with 21 CFR Part 175 - Indirect food additives. Adhesives and components of coatings. Document for sale by the Superintendent of Documents, U.S. Government Office, Washington, DC 20402 (202-783-3238).*

comply with section B.9.1 or B.9.2 herein.

D.6

Product contact surfaces shall be self-draining except for normal clingage.

D.7

All sanitary fittings and connections shall conform with the applicable provisions of 3-A Sanitary Standards for Fittings Used on Milk and Milk Products Equipment and Used on Sanitary Lines Conducting Milk and Milk Products, Number 08-17, 08-17A, 08-17B, 08-17C, as amended, and 08-17H.

D.8

All tubing including that for the flushing media lines from a check valve forward to the process shall comply with the applicable provisions for welded sanitary product pipelines found in the 3-A Accepted Practices for Permanently Installed Sanitary Product Pipelines and Cleaning Systems, Number 605-03, and/or with 3-A Sanitary Standards for Polished Metal Tubing for Dairy Products, Number 33-00.

D.9

All instrument connections having product contact surfaces shall conform to the 3-A Sanitary Standards for Instrument Fittings and Connections Used on Milk and Milk Products Equipment, Number 09-08.

D.10

Gaskets

D.10.1

Gaskets having a product contact surface shall be removable or bonded.

D.10.2

Bonded rubber and rubber-like materials and bonded plastic materials having product contact surfaces shall be bonded in a manner that the bond is continuous and mechanically sound so that when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment or sterilization the rubber and rubber-like material or the plastic material does not separate from the base material to which it is bonded.

D.10.3

Grooves in gaskets shall be no deeper than their width, unless the gasket is readily removable and reversible for cleaning.

D.10.4

Gasket grooves or gasket retaining grooves in product contact surfaces for removable gaskets shall not exceed 1/4 in. (6 mm) in depth or be less than 1/4 in. (6 mm) wide except those for standard O-Rings smaller than 1/4 in. (6 mm).

D.11

Radii

D.11.1

All internal angles of 135 degrees or less on product contact surfaces shall have radii of not less than 1/4 in. (6 mm) except that:

D.11.1.1

Smaller radii may be used when they are required for essential functional reasons, such as those in the nozzle of the optical surface flushing fitting, the junction of the optical surface flushing fitting with the refractometer or other optical sensor body, and the junction of the refractometer or other optical sensor body with the mounting fitting. In no case shall such radii be less than 1/32 in. (1 mm).

D.11.1.2

The radii in gasket grooves, gasket retaining grooves, or grooves in gaskets, except for those for standard 1/4 in. (6 mm) and smaller O-Rings, shall be not less than 1/8 in. (3 mm).

D.11.1.3

The radii in grooves for standard 1/4 in. (6 mm) O-Rings shall not be less than 3/32 in. (2 mm) and for standard 1/8 in. (3 mm) O-Rings shall be not less than 1/32 in. (1 mm).

D.11.1.4

The minimum radii for fillets of welds in product contact surfaces shall be not less than 1/4 in. (6 mm) except that the minimum radii for such welds may be 1/8 in. (3 mm) when the thickness of one or both parts joined is less than 3/16 in. (5 mm).

D.12

There shall be no threads on product contact surfaces.

D.13

Refractometers and energy absorbing optical sensors used in a processing system to be sterilized by heat and operated at a temperature of 250 degrees F (121 degrees C) or higher shall comply with the following additional criteria:

D.13.1

The construction shall be such that all product contact surfaces can be (1) sterilized by saturated steam or water under pressure (at least 15.3 psig or 106 kPa) at a temperature of at least 250 degrees F (121 degrees C) and (2) operate at the temperature required for processing.

D.13.2

Devices that have one or more product contact surfaces to be used in such a processing system, not designed so that the system is automatically shut down if the product pressure in the system becomes less than that of the atmosphere and cannot be restarted until the system is re-sterilized, shall have a steam or other sterilizing medium chamber surrounding the joint at the product contact surface between the fitting and the device.

D.13.3

The connection(s) on the steam or other sterilizing medium chamber(s) for the steam or other sterilizing medium lines shall be such that the lines can be securely fastened to the connection(s). The lines shall be connected in a manner that they may be disconnected to allow the sterilizing medium chamber to be inspected and cleaned if necessary.

D.14

Non-product contact surfaces shall have a smooth finish, be free of pockets and crevices and be readily cleanable and those surfaces to be coated shall be effectively prepared for coating.

APPENDIX

E

STAINLESS STEEL MATERIALS

Stainless steel conforming to the applicable composition ranges established by AISI*2 for wrought products, or by ACI*3 for cast products, should be considered in compliance with the requirements of Section C.1 herein. Where welding is involved the carbon content of the stainless steel should not exceed 0.08 percent. The first reference cited in C.1 sets forth the chemical ranges and limits of acceptable stainless steel of the 300 series. Cast grades of stainless steel corresponding to types 303, 304, and 316 are designated CF-16F, CF-8, and CF-8M, respectively. These cast grades are covered by ASTM*5 specifications A351/A351M, A743/A743M and A744/A744M.

F

PRODUCT CONTACT SURFACE FINISH

Surface finish equivalent to 150 grit or better as obtained with silicon carbide properly applied, on stainless steel sheets is considered in compliance with the requirements of Section D.1 herein.

G

The flushing media shall not contaminate the product with toxic substances or foreign material through the use of sub-standard steam or steam distribution systems (See Section B.9.2) or sub-standard water (See Section B.9.1.).

---

5 Available from ASTM, 1916 Race St., Philadelphia, PA 19103-1187 (215-299-5400).

These standards shall become effective September 28, 1992.

Dairy, Food and Environmental Sanitation, Vol. 12, No. 6, Pages 387-391 (June 1992)

3-A Sanitary Standards for Scraped Surface Heat Exchangers, Number 31-02

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

It is the purpose of the IAMFES, USPHS and DIC in connection with the development of the 3-A Sanitary Standards program to allow and encourage full freedom for inventive genius or new development. Scraped surface heat exchanger specifications heretofore or hereafter developed which so differ in design, material, fabrication, or otherwise as not to conform with the following standards, but which, in the fabricator's opinion, are equivalent or better may be submitted for the joint consideration of IAMFES, USPHS, and DIC at anytime.

A

SCOPE

A.1

These standards cover the sanitary aspects of scraped surface heat exchangers for adding heat to, or removing heat from, milk and milk products. These standards do not pertain to freezers for ice cream, ices and similarly frozen dairy foods[*1] nor to batch processors for milk and milk products.[*2]

A.2

In order to conform with these 3-A Sanitary Standards, scraped surface heat exchangers shall comply with the following design, material and fabrication criteria.

B

DEFINITIONS

B.1

Scraped Surface Heat Exchanger: (Referred to as SSHE throughout these 3-A Sanitary Standards) shall mean cylinder(s) with closed ends, means for heating or cooling, having a precise wiping or scraping blade(s) for removing the heated or cooled product from the cylinder wall(s), and through which the product flows continuously.

B.2

Product: Shall mean milk and milk products.

B.3

Surfaces

B.3.1

Product Contact Surfaces: Shall mean all surfaces which are exposed to the product and surfaces from which liquids may drain, drop or be drawn into the product.

B.3.2

Non-Product Contact Surfaces: Shall mean all other exposed surfaces .

B.4

Mechanical Cleaning or Mechanically Cleaned: Shall denote cleaning, solely by circulation and/or flowing chemical detergent solutions and water rinses onto and over the surfaces to be cleaned, by mechanical means.

B.5

Surface Modification[*3]

B.5.1

Surface Treatments: Shall mean a process whereby chemical compositions or mechanical properties of the existing surface are altered. There is no appreciable (typically less than 1 micron) build-up of new material.

B.5.1.1

Surface treatments include:

1. Mechanical (shot peening, glass beading, polishing)
2. Thermal (surface hardening laser, electron beam)
3. Diffusion (carbonizing, nitriding)
4. Chemical (etching, oxidation)
5. Ion Implantation

B.5.2

Coatings: Shall mean the results of a process where a different material is deposited to create a new surface. There is appreciable (typically more than 1 micron) build-up of new material.

B.5.2.1

Coating processes include:

1. Chemical (conversion coatings)
2. Electrodeposition[*4]
3. Spraying (pneumatic, flame, plasma, arc spray)
4. Physical Vapor Deposition
5. Chemical Vapor Deposition
6. Centrifugal Casting

[*1] *Sanitary criteria for freezers will be found in the 3-A Sanitary Standards for Batch and Continuous Freezers for Ice Cream, Ices and Similarly Frozen Dairy Foods, Number 19-04.*

[*2] *Sanitary criteria for batch processors will be found in the 3-A Sanitary Standards for Non-Coil Type Batch Processors, Number 25-02.*

[*3] *Additional information on surface modification is contained in Advance Materials and Processes, 137(1): 59 and 61, January 1990.*

C

MATERIALS

C.1

All product contact surfaces shall be of stainless steel of the AISI 300 Series[*5] or corresponding ACI[*6] types (See Appendix, Section E.), or metal that is non-toxic and non-absorbent, and which under conditions of intended use is at least as corrosion resistant as stainless steel of the foregoing types, except that:

C.1.1

Cylinder liners (tubes) made of the materials provided for in C.1 may have their product contact surfaces modified by surface treatment or coating(s).

C.1.2

Cylinder liners (tubes) may also be made of other non-toxic structurally suitable heat-exchange metal(s) that have their product contact surfaces modified by surface treatment or coating(s).

C.1.3

Bearings, drive and mounting pins, seals, and scraping parts may also be made of stainless steel of the AISI 400 Series or made of non-toxic, non-absorbent metal that is as corrosion-resistant, under the conditions of intended use, as stainless steel of the AISI 400 Series, or is made as corrosion-resistant by surface treatment or coatings.

C.1.4

Solder, when used, shall be silver bearing solder, and shall be corrosion-resistant, free of cadmium, lead and antimony, non-absorbent and shall not impart any toxic substance to the product when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment or sterilization.

C.1.5

Rubber and rubber-like materials may be used for O-Rings, gaskets, seals, and parts having the same functional purposes.

C.1.6

Rubber and rubber-like materials when used for the above specified applications shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Number 18-00.

C.1.7

Plastic materials may be used for bearings, scraping parts, O-Rings, gaskets, seals, spraying for surface coatings, and parts having the same functional purposes.

C.1.8

Plastic materials when used for the above specified applications shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surface for Dairy Equipment, Number 20-14 amended.

C.1.9

Where materials having certain inherent functional properties are required for specific applications, such as seal parts, carbon, ceramic, or tungsten carbide, may be used. These materials shall be inert, non-porous, non-toxic, non-absorbent, insoluble, and resistant to scratching, scoring, and distortion when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment or sterilization.

C.2

All materials having a product contact surface(s) used in the construction of an SSHE designed to be used in a processing system to be sterilized by heat and operated at a temperature of 250 degree F (121 degrees C) or higher shall be such that they can be (l) sterilized by saturated steam or water under pressure (at least 15.3 psig or 106 kPa) at a temperature of at least 250 degrees F (121 degrees C) and (2) operated at the temperature required for processing.

C.3

All non-product contact surfaces shall be of corrosion-resistant materials or material that is rendered corrosion resistant. If coated, the coating used shall adhere. All non-product contact surfaces shall be relatively non-absorbent, durable and cleanable. Parts removable for cleaning having both product and non-product contact surfaces shall not be painted.

D

FABRICATION

D.1

All product contact surfaces shall have a finish at least as smooth as a No. 4 ground finish on stainless steel sheets and be free of imperfections such as pits, folds, and crevices in the final fabricated form. (See Appendix, Section F.)

D.2

All permanent joints in metallic product contact surfaces shall be continuously welded, except that;

D.2.1

In such cases where welding is impractical, soldering, press-fitting or shrink-fitting may be employed where necessary for essential functional reasons such as mechanical seals, bushings or internal bearings.

D.2.2

Welding, press-fitting, shrink-fitting or soldering shall produce product contact surfaces which are at least as smooth as a No. 4 ground finish on stainless steel sheets and which are free of imperfections such as pits, folds and crevices. (See Appendix, Section H.)

[*4] *QQ-C-320b-Federal Specification for Chromium Plating (Electrodeposited) June 17, 1985 Amendment 4, 1987. QQ-N-290a-Federal Specification for Nickel Plating (Electrodeposited) November 12, 1971. Both documents available from the General Services Administration, 18th & F Sts., NW, WFCIA, Washington, DC 20405 (202-472-2205).*

[*5] *The data for this series are contained in the AISI Steel Products Manual, Stainless & Heat Resisting Steels, December 1974, Table 2-1, pp. 18-20. Available from the Iron and Steel Society, 410 Commonwealth Drive, Warrendale, PA 15086 (412-776-9460).*

[*6] *Alloy Casting Institute Division, Steel Founders Society of America, Cast Metal Federation Bldg., 455 State St., Des Plaines, IL 60016 (708-299-9160).*

D.3

Silver bearing solder may be used around blade mounting pins, bushings and bearings for flushing joints and producing fillets for minimum radii.

D.4

Coatings

D.4.1

Coatings, if used, shall be free from surface delamination, pitting, flaking, spalling, blistering and distortion when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment or sterilization.

D.4.2

The minimum thickness of electrodeposited coatings shall not be less than 0.0002 in. (0.005 mm) for all product contact surfaces when used on stainless steel. When these surfaces are other than stainless steel, the minimum thickness of electrodeposited coatings shall not be less than 0.002 in. (0.05 mm).

D.4.3

Cast metallic coatings used on the inside of a cylinder liner (tube) shall be at least 0.040 in. (1.0 mm) thick.

D.4.4

Ceramic materials used as coatings shall be at least 0.003 in. (0.08 mm) thick.

D.4.5

Plastic or plastic-like materials, when used as a coating, shall be at least 0.005 in. (0.125 mm) thick.

D.5

A SSHE that is to be mechanically cleaned shall be designed so that all product contact surfaces of the SSHE and all non-removable appurtenances thereto can be mechanically cleaned and are easily accessible for inspection.

D.6

All product contact surfaces of the SSHE not designed to be mechanically cleaned shall be easily accessible for cleaning and inspection either when in an assembled position or when removed. Removable parts shall be readily demountable.

D.7

Gaskets

D.7.1

Gaskets having a product contact surface shall be removable.

D.7.2

Grooves in gaskets shall be no deeper than their width, unless the gasket is readily removable and reversible for cleaning.

D.7.3

Gasket grooves or gasket retaining grooves in product contact surfaces for removable gaskets shall not exceed 1/4 in. (6 mm) in depth or be less than 1/4 in. (6 mm) wide except those for standard O-Rings smaller than 1/4 in. (6 mm).

D.8

Radii

D.8.1

All internal angles of 135 degrees or less on product contact surfaces shall have radii of not less than 1/4 in. (6 mm) except that:

D.8.1.1

Smaller radii may be used when they are required for essential functional reasons, such as those in sealing ring grooves, scraper blade mounting pins and parts used in similar applications. In no case shall such radii be less than 1/32 in. (1 mm).

D.8.1.2

The radii in gasket grooves, gasket retaining grooves, or grooves in gaskets, except for those for standard 1/4 in. (6 mm) and smaller O-Rings, shall be not less than 1/8 in. (3 mm).

D.8.1.3

The radii in grooves for standard 1/4 in. (6 mm) O-Rings shall not be less than 3/32 in. (2 mm) and for standard 1/8 in. (3 mm) O-Rings shall be not less than 1/32 in. (1 mm).

D.8.1.4

The minimum radii for fillets of welds in product contact surfaces shall be not less than 1/4 in. (6 mm) except that the minimum radii for such welds may be 1/8 in. (3 mm) when the thickness of one or both parts joined is less than 3/16 in. (5 mm).

D.9

All sanitary tubing shall confirm with the applicable provisions of the 3-A Sanitary Standards for Polished Metal Tubing for Dairy Products, Number 33-00.

D.10

All sanitary fittings and connections shall conform with the applicable provisions of the 3-A Sanitary Standards for Fittings Used on Milk and Milk Products Equipment And Used on Sanitary Lines Conducting Milk and Milk Products, Parts I and II, Number 08-17 as amended.

D.10.1

All product connections to the SSHE shall be in a processing area.

D.11

All instrument connections having product contact surfaces shall conform to the 3-A Sanitary Standards for Instrument Fittings and Connections used on Milk and Milk Products Equipment, Parts I and II, Number 09-08.

D.12

There shall be no threads on product contact surfaces.

D.13

All coil springs having product contact surfaces shall have at least 3/32 in. (2 mm) openings between coils including the ends when the spring is in a free position.

D.14

A SSHE used in a processing system to be sterilized by heat and operated at a temperature of 250 degree F (121 degree C) or higher shall comply with the following additional criteria:

D.14.1

The construction shall be such that the all product contact surfaces can be (l) sterilized by saturated steam or water under pressure (at least 15.3 psig or 106 kPa) at a temperature of at least 250 degrees F (121 degrees

C) and (2) operated at the temperature required for processing.

D.14.2

SSHE that have a product contact surface(s) to be used in such a processing system, not designed so that the system is automatically shut down if the product pressure in the system becomes less than that of the atmosphere and cannot be restarted until the system is resterilized, shall have a steam or other sterilizing medium chamber surrounding the shaft(s) adjacent to the seal required by D.15.1. The SSHE shall be constructed so that the steam chamber or other sterilizing medium chamber may be exposed for inspection.

D.14.3

Where steam or other sterilizing medium is used, the connection(s) on the SSHE shall be such that the steam lines or other sterilizing medium lines can be securely fastened to the SSHE.

D.15

Shafts of SSHE's shall have a seal of a packless-type, sanitary in design. Bearings having a product contact surface shall be of a non-lubricated type. Lubricated bearings, including the permanent sealed type, shall be located outside the product contact surface with at least 1 in. (25 mm) clearance open for inspection between the bearing and any product contact surface. Where a shaft passes through a product contact surface, the portion of the opening surrounding the shaft shall be protected to prevent the entrance of contaminants.

D.15.1

The seal(s) in a SSHE designed to be used in a processing system to be sterilized by heat and operated at a temperature of 250 degrees F (121 degrees C) or higher shall be between the product contact surface and the steam or other sterilizing chamber.

D.16

SSHE SUPPORTS

The means of supporting an SSHE shall be one of the following:

D.16.1

If legs are used they shall be smooth with rounded ends and have no exposed threads. Legs made of hollow stock shall be sealed. Legs shall provide a minimum clearance between the lowest part of the base and the floor of not less than 6 in. (150 mm).

D.16.2

If mounted on a slab or island, the base shall be designed for sealing to the slab or island surfaces. (See Appendix, Section G.)

D.16.3

If mounted on a wall or column, the point of attachment of a SSHE to its mounting shall be designed for sealing. The mounting, if supplied by the SSHE manufacturer, shall be designed for sealing to the wall or column. The design of a SSHE with a cylinder(s) to be mounted on a wall or column shall be such that there will be at least a 4 in. (100 mm) clearance between the outside of the cylinder(s) and the wall or column.

D.16.4

An SSHE designed to be installed partially outside a processing area, shall be provided with a plate or other suitable member to close the opening in the processing room wall or ceiling and shall be such that it can be sealed to the wall or ceiling.

D.17

The SSHE shall be designed so that there is at least a 4 in. (100 mm) space between the driving mechanism and the cylinder(s) when parts normally removed during cleaning have been removed.

D.18

Any guard(s) required by a safety standard that will not permit accessibility for cleaning and inspection shall be designed so that it can be removed without the use of tools.

D.19

Non-product contact surfaces shall be smooth, free of pockets and crevices and be readily cleanable and those to be coated shall be effectively prepared for coating.

D.20

An SSHE shall have an information plate in juxtaposition to the name plate giving the following information or the information shall appear on the name plate:

(1) The maximum temperature and pressure at which the SSHE can be operated.

(2) A statement that, to prevent corrosion, the recommendations of the SSHE manufacturer should be followed with respect to time, temperature and the concentration of specific cleaning solutions and chemical bactericides.

D.20.1

The information plate shall also provide the following information: "This SSHE [Insert one of the following] designed for steam sterilization."

(a) is

(b) is not

D.21

All identification or information plates affixed to a SSHE shall be attached to the exterior of the SSHE in such a way as to be effectively sealed.

APPENDIX

E

STAINLESS STEEL MATERIALS

Stainless steel conforming to the applicable composition ranges established by AISI for wrought products, or by ACI for cast products, should be considered in compliance with the requirements of Section C.1 herein. Where welding is involved the carbon content of the stainless steel should not exceed 0.08%. The first reference cited in C.1 sets forth the chemical ranges and limits of acceptable stainless steels of the 300 series. Cast grades of stainless steel equivalent to types 303, 304, and 316 are designated CF-16F, CF-8, and CF-8M, respectively. These cast grades are covered by ASTM [*7] Specifications A351/A351M, A743/A743M and A744/A744M.

[*7] *Available from ASTM, 1916 Race St., Philadelphia, PA 19103-1187 (215-299-5400).*

F

PRODUCT CONTACT SURFACE FINISH

Surface finish equivalent to 150 grit or better as obtained with silicon carbide, properly applied on stainless steel sheets is considered in compliance with the requirements of Section D.1 herein.

G

SLABS OR ISLANDS

When an SSHE is designed to be installed on a slab or island, the dimensions of the slab or island should be such that the base of the SSHE will extend beyond the slab or island at least 1 in. (25 mm) in all horizontal directions. The slab or island should be of sufficient height so that the bottom of all product connections are not less than 4 in. (100 mm) above the floor. The surface of the slab or island should be coated with a thick layer of waterproof mastic material, which will harden without cracking. The junction of the SSHE base and the slab or island should be sealed.

H

PRESS FITS AND SHRINK FITS

Press fits or shrink fits fabricated by the following procedures should yield satisfactory joints to conform to the requirements of Section D.2.2 and for use in the specified areas. Press fits may be used to assemble round pins or round bushings into round holes where the outside diameter of the part being inserted is greater than the inside diameter of the hole. In the case of press fit the parts are forced together by applying pressure. The pressure required is dependent upon the diameter of the parts, the amount of interference and the distance the inner member is forced into the outer member. In shrink fits, the diameter of the inner member is educed by chilling it to a low temperature. Dry ice is commonly used to shrink the inner member. Alternatively, shrink fits are made by heating the outer member. Less assembly force is required for this type of fit. The design of these fits depend on a variety of factors.

Note: The designer should follow recommended practices to assure that a crevice-free joint is produced. A recognized authoritative reference is "Machinery's Handbook" published by Industrial Press Inc., 200 Madison Ave., New York, NY 10157.

These revised standards are effective September 28, 1992, at which time the 3-A Sanitary Standards for Scraped Surface Heat Exchangers, Number 31-01 are rescinded and become null and void.

Dairy, Food and Environmental Sanitation, Vol. 12, No. 6, Page 392 (June 1992)

Amendments to the 3-A Sanitary Standards For Flow Meters For Milk and Milk Products, Number 28-01

28-02

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

It is the purpose of the IAMFES, USPHS, and DIC in connection with the development of the 3-A Sanitary Standards Program to allow and encourage full freedom for inventive genius or new developments. Flow meter specifications heretofore and hereafter developed which so differ in design, material, fabrication, or otherwise as not to conform with the following standards, but which, in the fabricator's opinion are equivalent or better, may be submitted for the joint consideration of the IAMFES, USPHS, and DIC at any time.

C.1.2

[Deleted as part of this amendment-sections renumber accordingly.]

C.1.8

Where materials having certain inherent functional purposes are required for specific applications, such as pistons, shafts, meter body liners, bearings, rotary seals, and electrodes, carbon, and/or ceramic materials may be used. Carbon and/or ceramic materials shall be inert, non-porous, non-toxic, non-absorbent, insoluble, resistant to scratching, scoring, and distortion when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment.

C.1.9

The final bond and residual adhesive, if used, of bonded carbon, ceramic materials, plastic materials and/or rubber or rubber-like materials shall be non-toxic.*4

D.2

Permanent joints in metallic product contact surfaces shall be continuously welded, except that:

D.2.1

In such cases where welding is impractical, press-fitting or shrink-fitting may be employed where necessary for functional reasons such as shafts to rotor assemblies and bushings to shafts. Any method utilized shall produce product contact surfaces which are at least as smooth as a No. 4 ground finish on stainless steel sheets and which are free of imperfections such as pits, folds and crevices. (See Appendix, Section H.)

APPENDIX

E

STAINLESS STEEL MATERIALS

Stainless steel conforming to the applicable composition ranges established by AISI*2 for wrought products, or by ACI*3 for cast products, should be considered in compliance with the requirements of Section C.1 herein. Where welding is involved, the carbon content of the stainless steel should not exceed 0.08 percent. The first reference cited in C.1 sets forth the chemical ranges and limits of acceptable stainless steel of the 300 series. Cast grades or stainless steel corresponding to types 303, 304, and 316 are designated CF-16F, CF-8, and CF-8M, respectively. These cast grades are covered by ASTM*5 specifications A351/A351M, A743/A743M and A744/A744M.

H

PRESS-FITS AND SHRINK-FITS

Press fits or shrink fits fabricated by the following procedures should yield satisfactory joints to conform to the requirements of Section D.2.1 and for use in the specified areas.

Press fit may be used to assemble round pins or round bushings into round holes where the outside diameter of the part being inserted is greater than the inside diameter of the hole. In the case of press fits the parts are forced together by applying pressure. The pressure required is dependent upon the diameter of the parts, the amount of interference and the distance the inner member is forced into the outer member.

In shrink fits, the diameter of the inner member is reduced by chilling it to a low temperature. Dry ice is commonly used to shrink the inner member. Alternatively, shrink fits are made by heating the outer member. Less assembly force is required for this type of fit. The design of these fits depend on a variety of factors.

Note: The designer should follow recommended practices to assure that a crevice-free joint is produced. A recognized authoritative reference is "Machinery's Handbook" published by Industrial Press Inc., 200 Madison Ave., New York, NY 10157.

These revised standards are effective September 28, 1992 at which time the 3-A Sanitary Standards for Flow Meters for Milk and Milk Products, Number 28-01 are rescinded and become null and void.

*2 *The data for this series are contained in the AISI Steel Products Manual, Stainless & Heat Resisting Steels, December 1974, Table 2-1, pp. 18-20. Available from the Iron and Steel Society, 410 Commonwealth Drive, Warrendale, PA 15086 (412-776-9460).*

*3 *Steel Founders Society of America, Cast Metal Federation Bldg., 455 State St., Des Plaines, IL 60016 (708-299-9160)*

*4 *Adhesives shall comply with 21 CFR Part 175 - Indirect food additives. Adhesives and components of coatings. Document for sale by the Superintendent of Documents, U.S. Government Office, Washington, DC 20402 (202-783-3238).*

*5 *Available from ASTM, 1916 Race St., Philadelphia, PA 19103-1187 (215-299-5400).*

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107	120	133	146	159	172	185	198	211	224	237	250	263	276	289	302	315	328	341	354
108	121	134	147	160	173	186	199	212	225	238	251	264	277	290	303	316	329	342	355
109	122	135	148	161	174	187	200	213	226	239	252	265	278	291	304	317	330	343	356
110	123	136	149	162	175	188	201	214	227	240	253	266	279	292	305	318	331	344	357
111	124	137	150	163	176	189	202	215	228	241	254	267	280	293	306	319	332	345	358
112	125	138	151	164	177	190	203	216	229	242	255	268	281	294	307	320	333	346	359
113	126	139	152	165	178	191	204	217	230	243	256	269	282	295	308	321	334	347	360

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103	116	129	142	155	168	181	194	207	220	233	246	259	272	285	298	311	324	337	350
104	117	130	143	156	169	182	195	208	221	234	247	260	273	286	299	312	325	338	351
105	118	131	144	157	170	183	196	209	222	235	248	261	274	287	300	313	326	339	352
106	119	132	145	158	171	184	197	210	223	236	249	262	275	288	301	314	327	340	353
107	120	133	146	159	172	185	198	211	224	237	250	263	276	289	302	315	328	341	354
108	121	134	147	160	173	186	199	212	225	238	251	264	277	290	303	316	329	342	355
109	122	135	148	161	174	187	200	213	226	239	252	265	278	291	304	317	330	343	356
110	123	136	149	162	175	188	201	214	227	240	253	266	279	292	305	318	331	344	357
111	124	137	150	163	176	189	202	215	228	241	254	267	280	293	306	319	332	345	358
112	125	138	151	164	177	190	203	216	229	242	255	268	281	294	307	320	333	346	359
113	126	139	152	165	178	191	204	217	230	243	256	269	282	295	308	321	334	347	360

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Dairy, Food and Environmental Sanitation, Vol. 12, No. 6, Pages 393-395 (June 1992)

3-A Sanitary Standards For Hose Assemblies For Milk And Milk Products

Number 08-17L

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

It is the purpose of the IAMFES, USPHS, and DIC in connection with the development of the 3-A Sanitary Standards Program to allow and encourage full freedom for inventive genius or new developments. Hose assemblies specifications heretofore or hereafter developed which so differ in design, material, construction, or otherwise, as not to conform with the following standards, but which in the manufacturer's or fabricator's opinion are equivalent or better may be submitted for the joint consideration of IAMFES, USPHS, and DIC at any time.

A

SCOPE

A.1

These standards cover the sanitary aspects of hose assemblies fabricated of sanitary couplings permanently attached to multiple use hoses of flexible thermoplastic, rubber or rubber-like materials, used as product contact surfaces on or in equipment for the production, processing and handling of milk or milk products. These standards do not cover hose assemblies which utilize band, strap or worm gear-type clamps customarily used to secure removable fittings.

A.2

In order to conform to these 3-A Sanitary Standards, hose assemblies shall comply with the following design, material and fabrication criteria.

B

DEFINITIONS

B.1

Product: Shall mean milk and milk products.

B.2

Surfaces:

B.2.1

Product Contact Surfaces: Shall mean all surfaces which are exposed to the product or from which liquid may drain, drop or be drawn into the product.

B.2.2

Non-Product Contact Surfaces: Shall mean all other exposed surfaces.

B.3

Mechanical Cleaning or Mechanically Cleaned: Shall denote cleaning, solely by circulation and/or flowing chemical detergent solutions and water rinses onto and over the surfaces to be cleaned, by mechanical means.

B.4

Sanitary Coupling: A device attached to the end of a hose to facilitate connection to a suitable fitting and insure a full flow passageway.

B.6

Sanitary Reusable: Shall mean field-fabricated, compression methods to provide a 360 degree seal area at the junction point of the fitting to the hose inside diameter.

B.7

Coupling Retention: Shall mean the ability of the assembly to maintain its sanitary integrity under operating conditions.

C

MATERIALS

C.1

Product contact surfaces shall be of stainless steel of the AISI 300 Series*[3] or corresponding ACI*[2] types (See Appendix, Section F.) or metal which under conditions of intended use is at least as corrosion-resistant as stainless steel of the foregoing types, and is non-toxic and non-absorbent, except that:

C.1.1

Rubber and rubber-like materials may be used for gaskets, seals, hoses, and parts having the same functional purposes.

C.1.2

Rubber and rubber-like materials when used for the above specified applications shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use
Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Number 18-00, except that:

C.1.2.1

Hose material shall be restricted to class II, class III and class IV found in the above referenced 3-A Sanitary Standards.

**[1] The data for this series are contained in the AISI Steel Products Manual, Stainless & Heat Resisting Steels, December 1974, Table 2-1, pp. 18-20. Available from the Iron and Steel Society, 410 Commonwealth Drive, Warrendale, PA 15086 (412-776-9460).*

**[2] Alloy Casting Institute Division, Steel Founders Society of America, Cast Metal Fabrication Bldg., 455 State St., Des Plaines, IL 60016 (708-299-9160).*

**[3] Adhesives shall comply with 21 CFR Part 175 - Indirect food additives. Adhesives and components of coatings. Document for sale by the Superintendent of Documents, U.S. Government Office, Washington, DC 20402 (202-783-3238).*

C.1.3

Plastic materials may be used for fittings, gaskets, hoses, hose couplings, seals and parts having the same functional purposes.

C.1.4

Plastic materials when used for the above specified applications shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Number 20-14, as amended.

C.1.5

Rubber and rubber-like materials and plastic materials having product contact surfaces shall be of such composition as to retain their surface and conformation characteristics when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment.

C.1.6

The final bond and residual adhesive, if used, of bonded rubber and rubber-like materials and bonded plastic materials shall be non-toxic.*[3]

C.2

Non-product contact surfaces shall be of corrosion-resistant materials complying with sections C.1 through C.1.6 and shall not be coated or painted.

D

FABRICATION

D.1

All product contact surfaces shall have a finish at least as smooth as a No. 4 ground finish on stainless steel sheets, and be free of imperfections such as pits, folds, and crevices in the final fabricated form. (See Appendix, Section G.)

D.2

All permanent joints in metallic product contact surfaces shall be continuously welded. Welded areas on product contact surfaces shall be at least as smooth as No. 4 ground finish on stainless steel sheets and be free of imperfections such as pits, folds and crevices, except that:

D.2.1

Sanitary reusable and permanently attached hose couplings shall have complete coupling retention at the interior periphery junction point of the hose to the coupling that is free of gaps or crevices 360 degrees along the circumference of the junction. The interior junction of the hose and coupling must be visible for inspection and have no more than 1/32 in. (1.0 mm) rise, cleft, ridge or bump. In no case shall the location of the interior junction of the hose and coupling exceed the lesser of 1) five times the inside diameter of the coupling, or 2) 8 in. (200 mm) from the end of the hose assembly.

D.2.2

Hose assemblies shall have an inside diameter (25 mm) or larger.

D.3

Hose assemblies that are to be mechanically cleaned shall be designed so that the product contact surfaces of the hose assembly, and all non-removable appurtenances thereto can be mechanically cleaned, and are accessible for inspection.

D.4

Product contact surfaces of hose assemblies not designed to be mechanically cleaned shall be easily accessible for cleaning and inspection.

D.5

All product contact surfaces to be mechanically cleaned shall be self-draining except for normal clingage except that:

D.5.1

Product contact surfaces which are not self-draining shall be constructed so that they can be readily and easily opened and drained without complete disassembly.

D.6

All sanitary fittings and connections shall conform to the applicable provisions of the 3-A Sanitary Standards for Fittings, Used on Milk and Milk Products Equipment and Used on Sanitary Lines Conducting Milk and Milk Products, as amended, Parts I and II, rev., Number 08-17, as amended.

D.7

Metal tubing to be used in hose assemblies shall conform to the applicable provision of the 3-A Sanitary Standards for Polished Metal Tubing for Dairy Products, Number 33-00.

D.8

Gaskets

D.8.1

Gaskets having a product contact surface shall be removable or bonded.

D.8.2

Bonded rubber and rubber-like materials and bonded plastic materials having product contact surfaces shall be bonded in a manner that the bond is continuous and mechanically sound so that when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment the rubber and rubber-like material or the plastic material does not separate from the base material to which it is bonded.

D.8.3

Grooves in gaskets shall be no deeper than their width, unless the gasket is readily removable and reversible for cleaning.

D.8.4

Gasket grooves or gasket retaining grooves in product contact surfaces for removable gaskets shall not exceed 1/4 in. (6 mm) in depth or be less than 1/4 in. (6 mm) wide.

D.9

Radii

D.9.1

All internal angles of 135 degrees or less on product contact surface shall have radii of not less than 1/4 in. (6 mm), except that:

D.9.1.1

For the internal portion of the hose-to-coupling junction point, see Section D.2.1.

D.1.2

The radii in gasket grooves, gasket retaining grooves or,

grooves in gaskets, shall be not less than 1/16 in. (2 mm).

D.10

There shall be no threads on product contact surfaces.

D.11

Non-product contact surfaces shall have a smooth finish, free of pockets and crevices, and be readily cleanable.

APPENDIX

E

SPECIAL CONSIDERATIONS The subsequent welding of adaptors, ferrules or like devices should be done in such a way so that it does not affect the integrity of the assembly, its ability to be readily inspected or in any other way alter the assembly so that it no longer conforms to the criteria listed herein.

F

STAINLESS STEEL MATERIALS Stainless steel conforming to the applicable composition ranges established by AISI for wrought products, or by ACI for cast products, should be considered in compliance with the requirements of Section C.1 herein. Where welding is involved, the carbon content of the stainless steel should not exceed 0.08 percent. The first reference cited in C.1 sets forth the chemical ranges and limits of acceptable stainless steel of the 300 series. Cast grades or stainless steel corresponding to types 303, 304, and 316 are designated CF-16F, CF-8, and CF-8M, respectively. These cast grades are covered by ASTM*[4] specifications A351/A351M, A743/A743M and A744/A744M.

G

PRODUCT CONTACT SURFACE FINISH Surface finish equivalent to 150 grit or better as obtained with silicon carbide properly applied on stainless steel sheets is considered in compliance with the requirements of D.1 herein.

These standards shall become effective:

**4 Available from ASTM, 1916 Race St., Philadelphia, PA 19103-1187 (215-299-5400).*

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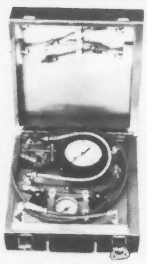

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Coming Events

1992

July

•**10-17, International Workshop on Rapid Methods and Automation in Microbiology XII** and Mini-Symposium (July 10-11) at Kansas State University. Contact Daniel Y.C. Fung, Director, (913)532-5654 or FAX (913)532-5681, 207 Call Hall, KSU, Manhattan, KS 66506.

•**14-16, Basic Pasteurization Course**, sponsored by the Texas Association of Milk, Food and Environmental Sanitarians, will be held at the Holiday Inn, Emerald Beach, 1102 S. Shoreline Blvd., Corpus Christi, TX. For registration information contact Ms. Janie F. Park, TAMFES, P.O. Box 2363, Cedar Park, TX 78613-2363, (512)458-7281.

•**26-29, 79th Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians** will be held at the Sheraton Centre, Toronto, Ontario. For more information, please contact Julie at IAMFES, (800)369-6337 (US), (800)284-6336 (Canada) or FAX (515)232-4736.

August

•**4-7, Fermentation Microbiology**, sponsored by the American Type Culture Collection, will be held in Rockville, MD. For more information contact ATCC/Workshops, 12301 Parklawn Drive, Rockville, MD 20852; (301)231-5566; FAX (301)770-1805.

-•**9-14, The 49th Annual Meeting of the Society for Industrial Microbiology**, Workshop I - "Controlling Biotechnology Risks: A Holistic Approach to Safety and Environmental Protection" (August 9); and Workshop II - "Clean Room Management" (August 9), to be held at the Town & Country Hotel, San Diego, CA. For more information contact the Society for Industrial Microbiology at (703)941-5373 or FAX (703)941-8790.

•**10-14, Biotechnology: Principles and Processes** to be held at the Massachusetts Institute of Technology. For more information contact the Director of Summer Session, MIT, Room E19-356, Cambridge, MA 02139, Phone: (617)253-6721.

•**11-14, Fermentation Microbiology**, sponsored by the American Type Culture Collection, will be held in Rockville, MD. For more information contact ATCC/Workshops, 12301 Parklawn Drive, Rockville, MD 20852; (301)231-5566; FAX (301)770-1805.

•**24-28, Advanced Recombinant DNA Methodology**, sponsored by the American Type Culture Collection, will be held in Rockville, MD. For more information contact ATCC/Workshops, 12301 Parklawn Drive, Rockville, MD 20852; (301)231-5566; FAX (301)770-1805.

•**25-28, International Dairy Federation** Seminar on "Milkfat & Protein Processing" will be held in Munich. For more information contact Verband der Deutschen Milchwirtschaft, c/o Mr. T. Kützemeier, Meckenheimer Allee 137, D-5300 Bonn 1 (Germany), Tel: 228/638270; FAX: 228/638425.

September

•**1-4, Diagnostic Virology**, sponsored by the American Type Culture Collection, will be held in Rockville, MD. For more information contact ATCC/Workshops, 12301 Parklawn Drive, Rockville, MD 20852; (301)231-5566; FAX (301)770-1805.

•**14, Radiation Safety Seminar**, sponsored by the American Type Culture Collection, will be held in Rockville, MD. For more information contact ATCC/Workshops, 12301 Parklawn Drive, Rockville, MD 20852; (301)231-5566; FAX (301)770-1805.

•**14-15, Food Safety for Zero Defects**, sponsored by ASI Food Safety Consultants', will be held in St. Louis, MO. For more information call Christine VerPlank or Nancy Sullivan toll-free at (800)477-0778 or, in MO, (314)725-2555, or write, ASI, P.O. Box 24198, St. Louis, MO 63130.

•**16, Reclamation and Environmental Concerns in the Food Industry**, sponsored by ASI Food Safety Consultants', will be held in St. Louis, MO. For more information call Christine VerPlank or Nancy Sullivan toll-free at (800)477-0778 or, in MO, (314)725-2555, or write, ASI, P.O. Box 24198, St. Louis, MO 63130.

•**17, Employee Health, Hygiene and Practices in the Food Industry**, sponsored by ASI Food Safety Consultants', will be held in St. Louis, MO. For more information call Christine VerPlank or Nancy Sullivan toll-free at (800)477-0778 or, in MO, (314)725-2555, or write, ASI, P.O. Box 24198, St. Louis, MO 63130.

•**17-18, Minnesota Sanitarians Association, Inc. Annual Meeting** will be held at the Earl Brown Center, St. Paul, MN. For more information, please contact Paul Nierman (612)785-0484.

•**21-25, Wisconsin Cheese Technology Short Course** will be held at the University of Wisconsin, Madison, WI. For more information, contact Bill Wendorff, Dept. of Food Science, (608)263-2015.

•**23-24, Wisconsin Association of Milk & Food Sanitarians, Wisconsin Environmental Health Association and Wisconsin Dairy Plant Fieldmen's Association Joint Educational Conference** will be held at the Holiday Inn-Downtown, Eau Claire, WI. For more information contact Neil M. Vassau, P. O. Box 7883, Madison, WI 53707; (608)267-3504.

•**23-25, Freezing & Freeze-Drying of Microorganisms**, sponsored by the American Type Culture Collection, will be held in Rockville, MD. For more information contact ATCC/

Workshops, 12301 Parklawn Drive, Rockville, MD 20852; (301)231-5566; FAX (301)770-1805.

•**24, Consumer Food Trends**, sponsored by the American Association of Cereal Chemists, will be held at AACC, 3340 Pilot Knob Road, St. Paul, MN. For more information, contact Marie McHenry, AACC Short Course Coordinator, (612)454-7250; FAX (612)454-0766.

•**30, October 1-2, Statistics and Measurement in Sensory Evaluation** will be held at Tragon Corporation, 365 Convention Way, Redwood City, CA 94063, (415)365-1833; FAX (415)365-3737.

October

•**5-6, The Eleventh Annual Midwest Food Processing Conference "Consumers: Driving Force For Our Future"** sponsored by the Chicago, Iowa, Minnesota and Wisconsin IFT sections, will be held at the Radisson Hotel in LaCrosse, Wisconsin. For more information, contact Ellen Bragg, MFPC Publicity Chairperson, Cargill, Inc., Salt Division, P.O. Box 5621, Minneapolis, MN 55440; phone: (612)475-6929.

•**7-9, Kansas Association of Sanitarians Annual Meeting** will be held at the Holidome, Great Bend, KS. For more information contact John Davis, Wichita-Sedgewick Co., 1900 E. 9th Wichita, KS 67214; (316)268-8351.

•**14-15, Annual Conference of the North Central Cheese Industries Association** will be held at the Holiday Inn, Brookings, SD. For further information, contact E. A. Zottola, Executive Secretary, NCCIA, P. O. Box 8113, St. Paul, MN 55108.

•**20-22, Basic Pasteurization Course**, sponsored by the Texas Association of Milk, Food and Environmental Sanitarians, will be held at the Le Baron Hotel, 1055 Regal Row, Dallas, TX. For registration information contact Ms. Janie F. Park, TAMFES, P.O. Box 2363, Cedar Park, TX 78613-2363, (512)458-7281.

•**26, GMPs for the Food Industry**, sponsored by ASI Food Safety Consultants', will be held in Chicago, IL. For more information call Christine VerPlank or Nancy Sullivan toll-free at (800)477-0778 or, in MO, (314)725-2555, or write, ASI, P.O. Box 24198, St. Louis, MO 63130.

November

•**5, Food Industry Sanitation and Food Safety Workshop**, presented by the University of California Cooperative Extension, will be held at the Anaheim Plaza Resort Hotel, 1700 S. Harbor Blvd., Anaheim, CA. For more information contact Heidi Fisher, Food Science and Technology, University of California, Davis, CA 95616; (916)752-1478.

•**8-12, PACK EXPO 92, The World of Packaging Technology**, sponsored by Packaging Machinery Manufacturers Institute (PMMI), will be held at the McCormick Place, Chicago, IL. For more information contact Bonnie E. Kilduff, Exposition Manager, PMMI at (202)347-3838 or FAX (202)628-2471.

•**9-11, Quality Control and Stability Testing** will be held at Tragon Corporation, 365 Convention Way, Redwood City, CA 94063, (415)365-1833; FAX (415)365-3737.

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May

•**6-12, INTERPACK 93, 13th International Trade Fair for Packaging Machinery, Packaging Materials and Confectionery Machinery**, will be held at the fairgrounds in Dusseldorf, Germany. For further information on exhibiting at or attending INTERPACK 93, contact Dusseldorf Trade Shows, Inc., 150 North Michigan Avenue, Suite 2920, Chicago, IL 60601,(312)781-5180; FAX (312)781-5188.

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