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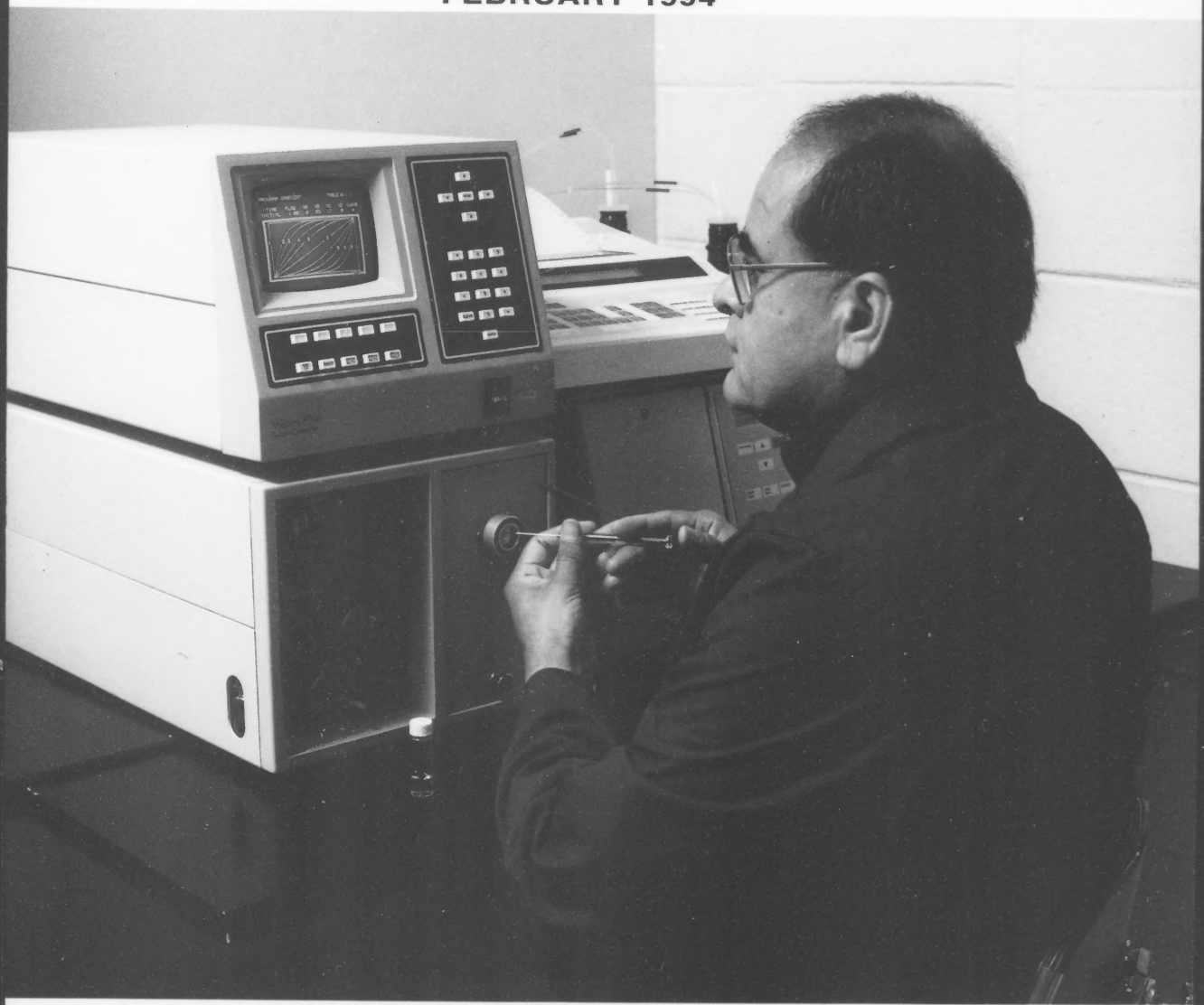
DAIRY, FOOD AND ENVIRONMENTAL

SANITATION

FEBRUARY 1994



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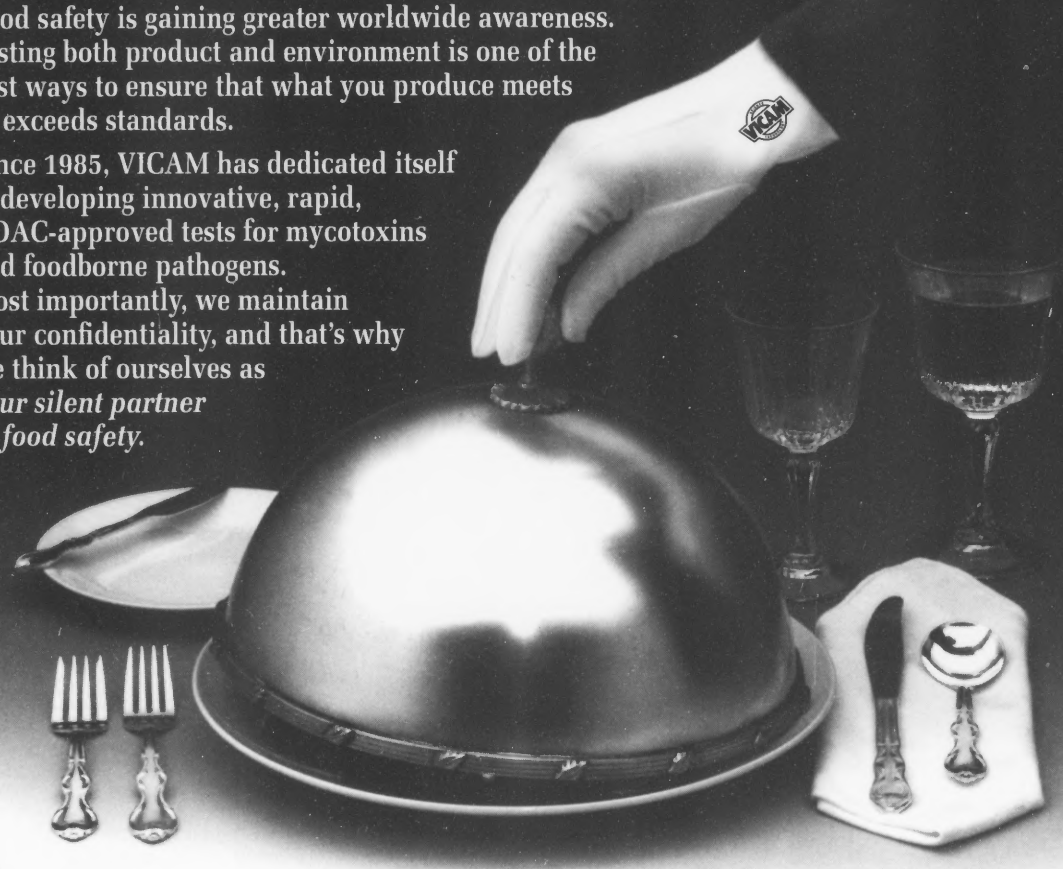

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ABOUT THE COVER . . . *Photo courtesy of Silliker Laboratories Group, Inc., Homewood, IL. Zubair Kirmani, chemistry supervisor at Silliker's Illinois facility, checks the Vitamin D content in a milk sample using the HPLC method.*

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Thoughts from the President . . .

By
Harold Bengsch
IAMFES Presidei

In the October issue of *Dairy, Food and Environmental Sanitation*, the President's column was devoted to **THE BLACK PEARL AWARD**. Believe it or not, we are rapidly approaching that point on the calendar when we make the call for nominations for all awards.

It is our desire that the first recognition for The Black Pearl Award will take place at this year's annual IAMFES meeting in San Antonio, Texas.

All of us involved on the regulatory side of food protection are keenly aware of corporate commitment toward food safety efforts exhibited by the industry we regulate. As such, there is from time to time a particular business that catches our attention which seems to go the "extra mile" in its efforts to assure the consumer of a safe and quality food product.

There are many links in the chain of food safety. Needless to say, food safety practices at each state of industry involvement can be numerous and interrelated. This, coupled with the fact that the public is becoming much more aware of food safety issues, has intensified the spotlight on industry.

Although the IAMFES has for many years recognized individuals and agencies who have excelled in their particular fields of education and public health protection, very little recognition has been directed toward industry itself. Now, thanks to Mr. Wilbur Feagan and the F & H Food Equipment Company, the IAMFES will be able to recognize a company for its outstanding achievement in corporate excellence in food safety and quality. However, this cannot happen without quality nominations from our membership.

Please join with me in giving serious consideration for the nomination of a worthy recipient for this first ever award.

THE BLACK PEARL AWARD

"THE ELUSIVE BLACK PEARL, SOUGHT AFTER FROM OCEANIA TO THE ORIENT BY
EUROPEAN LORDS AND ASIAN EMPERORS ALIKE.
ITS RARITY A SIGN OF DETERMINATION.
ITS LUSTER A SIGN OF QUALITY.
ITS ACQUISITION A SIGN OF EXCELLENCE."

Until next month!

On My Mind . . .

By
Steven K. Halstead, CAE
IAMFES
Executive Manager

is the Annual Meeting....

Each year, we have a little contest in the office regarding the number of abstracts we will receive for the Annual Meeting. As time has gone along, we have become more sophisticated in our contest and we have finally gotten to the point where we even made up rules!

The gist of the thing is who can guess the closest (without going over) to the number of abstracts we receive by 5:00 PM of the deadline. One entry per employee and ties will be broken with a coin toss. Entries must be submitted by noon, two days preceding the deadline. And, of course, the decision of the judge is final.

The winner gets a gift certificate to Red Lobster or Olive Garden, courtesy of President-elect Dee Clingman. While the contest might seem frivolous, we take it seriously enough to want to win.

It focuses our attention for a few days on a very important aspect of the Annual Meeting--the submitted papers.

In an effort to give everyone a level playing field, we post the winning number from previous years. Last year we received 65 so we were all confident that the winner would be in that range again this year. We were wrong. Real wrong!

When Margie counted the number of abstracts at 5:00 PM (CST) on December 15, 1993, we had received 87! The entries ranged from 32 to 82 with 82 being the winner, of course. All others were too low. Way too low!

The Program Advisory Committee will have its work cut out for it as it meets in San Antonio. We have now received over 100 abstracts that must be reviewed, accepted/rejected/revised, and organized into technical sessions and poster sessions. All of these will have to fit into the space and time constraints of a three day meeting. It will not be easy, but dealing with quality will make it that much more tolerable.

We may well ask the question as to why so many more submissions this year. One suggestion that quickly comes to mind is that our Annual Meeting is coming of age. Our *Journal of Food Protection* has been recognized for years as the premier food safety journal. Perhaps our Annual Meeting is beginning to receive the recognition it deserves.

It is my belief that the exposure we received last year because of the outstanding symposia sponsored by the International Life Sciences Institute of North America provided the catalyst. (ILSI will be back at the 1994 meeting with at least three symposia.) That, combined with the steady growth in the quantity and quality of the technical sessions, invited symposia and poster sessions, produced the sudden explosion of interest. On the one hand, people are beginning to see that the IAMFES meeting is the place to present the results of their work. On the other hand, it is also the place to learn about the latest developments in food safety.

According to our mission statement, that's what we are all about.

(By the way, Scott won the contest--for the second time.)

Dairy, Food and Environmental Sanitation, Vol. 14, No. 2, Pages 68-69 (February 1994)

Opening Remarks for the Symposium on Foodborne Microbial Pathogens

**Dr. Alex Malaspina, President, International Life Sciences Institute,
1126 Sixteenth Street, NW, Washington, DC 20036**

As presented at the 80th International Association of Milk, Food and Environmental Sanitarians Annual Meeting, Atlanta, Georgia, August 2, 1993

Foodborne microbial pathogens are a serious public health issue and the global community must increase its efforts to minimize their risks. In the United States alone, Centers for Disease Control estimates that these pathogens cause six and a half million acute illnesses a year . . . resulting in as many as 9,000 deaths. And the picture in many overseas countries is even worse, much worse.

This particular conference is a good example of how to focus on the problems of foodborne microbial pathogens. To resolve them successfully will require the cooperative international involvement of all sectors of society.

Promoting such a research-oriented partnership among scientists from government, industry and academia has been one of the International Life Science's Institute's objectives since it was established 15 years ago. In fact, the original goal that led to the creation of ILSI was the need to pool resources and sponsor research on food safety.

For instance, ILSI North America for many years has been supporting extensive research on key food pathogens and was ready to help when an outbreak of food poisoning from tainted hamburger meat afflicted hundreds of consumers eating at fast-food restaurants in Seattle. Immediately, three scientists who had received ILSI grants provided results of their research to state and federal investigators. This was very helpful in identifying the organism, *E. coli*, in the incriminated meat.

Because most of you may not be familiar with ILSI, I would like to spend a few minutes describing it. ILSI is a public, non-profit research foundation, supported by industry, private foundations, and government funding. We have branches around the world to address issues of local concern in the fields of food safety, nutrition, health and the environment. At present we have over 250 member companies and an international network of over 1,000 scientists who are involved in ILSI activities. And we continue to grow.

This year we are establishing branches in Chile and Costa Rica. Also, we are involved in China and have recently opened an office within the Chinese Academy of Preventive Medicine, which is an organization similar to the CDC.

In the U.S., ILSI collaborates with a number of regulatory bodies, such as CDC, the Environmental Protection Agency, the Food and Drug Administration, and the National Institutes of Health. ILSI is also recognized as a non-governmental organization by the World Health Organization and the Food and Agriculture Organization and cooperates with them on a number of projects.

For example, ILSI was actively involved in the International Conference on Nutrition held last year in Rome by WHO and FAO. ILSI provided working papers on food labeling, global dietary guidelines, food quality and safety standards and the role of food fortification in managing micronutrient deficiencies.

ILSI has a number of institutes that focus on specific concerns, and are housed under the ILSI Research Foundation.

The Human Nutrition Institute addresses issues involving food metabolism and the relationship between diet and health. This Institute acts as the Secretariat to the Agency for International Development in its programs which are intended to combat vitamin A and iron deficiencies in children of developing countries.

Also, the Institute holds, in Atlanta, a series of biennial conferences on nutrition and health promotion. Our cosponsors include the National Cancer Institute as well as three of Atlanta's major health institutions . . . CDC, Emory University and the American Cancer Society.

In April of 1990, we explored the relationship between nutrition and cancer. This past April we held a conference on nutrition and breast cancer. And in 1995, we will address nutrition and performance.

The Allergy and Immunology Institute advances the understanding, diagnosis, and management of food-related allergies. One of the recent initiatives is to study whether allergenic substances transfer to foods which have been derived from biotechnology.

The Health and Environmental Sciences Institute addresses issues on water quality, as well as other environmental concerns. Safe water supply was the focus of three of the 35 ILSI-sponsored conferences in 1992. ILSI Brazil, together with the Pan American Health Organization, sponsored a milestone conference on the cholera epidemic which is affecting Latin America.

During the summer of 1992 ILSI cosponsored, with a number of national and international agencies, a conference on the "Safety of Water Disinfection: Balancing the Chemical Versus the Microbial Risks."

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In addition, ILSI Mexico sponsored a workshop on guidelines for wastewater treatment in food plants.

ILSI has held several conferences in the area of harmonization of safety testing guidelines and food regulations. For instance, in November, 1992, in response to the lifting of the iron curtain, ILSI Europe held a workshop in Hungary with top regulatory officials from the European Community and Eastern European countries to discuss how to harmonize food regulations for all of Europe.

We will continue such discussions by holding similar meetings in Poland, Russia and the Czech Republic.

Looking toward the future, food safety and quality issues will be major activities for ILSI. For instance, this October ILSI will hold a conference in Beijing, China, on the safety of "Street Foods: Epidemiology, Management, and Practical Approaches." Co-sponsors are the Chinese Academy of Preventive Medicine, WHO and FAO.

In 1994, ILSI will hold an "Asian Conference on Food Safety" in Bangkok, Thailand. This is the second ILSI conference on food safety in Asia. The first was held in 1990 in Kuala Lumpur, Malaysia. Currently, ILSI and ILSI Mexico are planning to hold, in Mexico City in early 1995, a food safety conference for the American continent.

We also need to be vigilant about *new* emerging issues. The recent outbreak of *Cryptosporidium* in Milwaukee, which affected hundreds of thousands of people, should warn us to be prepared for future outbreaks.

Recent changes in food processing and distribution and changes in consumer behavior present new food safety opportunities and threats. To ensure the safety of the food supply, we all need to work together.

No one entity can meet these challenges alone. We must therefore increase our efforts to bring government, industry, and academia into a scientific partnership on a global level devoted to making decisions based on science.

This has been ILSI's mission for 15 years.

This Atlanta conference is a good example of the international involvement and collaborative effort necessary to minimize microbial pathogens from the food and water supply.

Dairy, Food and Environmental Sanitation, Vol. 14, No. 2, Pages 70-82 (February 1994)

Listeria monocytogenes: the State of the Science

Jocelyne Rocourt,
Centre National de Référence pour la Lysotypie et le Typage Moléculaire de *Listeria*, WHO Collaborating Center for Foodborne Listeriosis, Département de Bactériologie, Institut Pasteur, 28 rue du Dr Roux, 75724 Paris Cedex 15, France

As presented at the IAMFES 80th Annual Meeting, Atlanta, Georgia, August 2, 1993, in the symposium "*Listeria monocytogenes*: Current Issues and Concerns" sponsored by the International Life Sciences Institute

INTRODUCTION

L. monocytogenes has suddenly emerged as the etiologic agent of a foodborne disease and the disease has therefore been compared to legionellosis or AIDS. Listeriosis is not a new infection in spite of the recent interest. While the first confirmed diagnosis in man was that of a soldier suffering from meningitis during the first World War, a historian suggests that it was responsible for Queen Ann's 17 unsuccessful pregnancies (17th century) (176).

While rarely diagnosed prior to 1960, more than 10,000 cases were recorded in the medical literature before 1982 and hundreds are recorded annually worldwide (168, 173). This evolution reflects a change in social patterns that favors the expression of this bacterium:

- *L. monocytogenes* is a bacterium responsible for opportunistic infections, preferentially affecting individuals whose immune system is perturbed, including pregnant women, newborns, immunocompromised patients (cancer victims, transplant recipients, people on hemodialysis, AIDS patients...) and the elderly (>65). Medical progress, which increases the lifespan and allows immunodeficient individuals to survive, partially explains that evolution.
- Moreover, *L. monocytogenes* is ubiquitous and can grow at temperatures as low as + 3°C, explaining its ability to heavily contaminate certain food items. The expansion of an agro-alimentary industry, complemented by a system of cold storage (from warehouse to home refrigerator) has profoundly changed our eating habits ("TV-dinners" which are barely heated up). This change has led to the unprecedented accumulation of *Listeria* from which man can be contaminated. A serious illness, listeriosis is presently the alimentary infection associated with the highest lethality 20-30%). While it was the 12th most frequent in 1987 in the USA, listeriosis is the 4th most costly in terms of medical intervention and modifications of the food processing network (1).

Listeria monocytogenes

TAXONOMY AND IDENTIFICATION

Mainly because of morphological characteristics (Gram-positive rod), *Listeria* was first included within the broad group of coryneform bacteria in the 7th edition of the Bergey's Manual of Determinative Bacteriology in 1957. In 1986, the use of 16S ribosomal RNA partial sequencing unambiguously located *Listeria* within the *Clostridium* subbranch, together with *Staphylococcus*, *Streptococcus*, *Lactobacillus* and *Brochothrix* (128). This phylogenetic position of *Listeria* corroborates its low G + C % DNA content (36 to 42%).

L. monocytogenes remained the only recognized species of this genus during the two decades after its discovery, until the description of *L. denitrificans* in 1948 [now *Jonesia denitrificans* (175)], *L. grayi* in 1966 and *L. murrayi* in 1971. With the use of the first selective media, numerous strains looking "atypical" when compared to *L. monocytogenes* were isolated from the feces of healthy human and animal carriers as well as from environmental sources between 1970 and 1980. Phenotypic and genomic characterization of these isolates led to the description of a number of new species in the last decade. The genomic dissection of this genus, as indicated by DNA/DNA homology and 16S rRNA sequencing results, demonstrated that this genus comprises two lines of descent: one is composed of *L. monocytogenes* and genomically related species, *L. innocua*, *L. ivanovii* (subsp. *ivanovii* and subsp. *Iondoniensis*), *L. welshimeri*, and *L. seeligeri*, while the other contains *L. grayi* (18, 19, 36, 169, 172). These studies, which at first glance may seem more theoretical than practical, were especially useful in the field of food microbiology since all species can contaminate food, but only one species, *L. monocytogenes*, is of public health concern.

As for many other Gram-positive bacteria, the identification of *Listeria* species is based on a limited number of biochemical markers, among which hemolysis is essential to differentiate between *L. monocytogenes* and the most frequent non pathogenic *Listeria* species, *L. innocua*. Increase in regular control of foods since 1986 daily have led to daily study of numerous strains all over the world and discovery of time saving methods based on biochemical tests which have recently been commercialized (8,16). Molecular methods, based on ribotyping and DNA macrorestriction patterns, have also been proposed in order to identify atypical strains (42, 100, 105).

cont. on p. 72

TYPING

Discriminatory and reproducible typing systems are essential to a better understanding of listeriosis epidemiology as well as to recognize sources of contamination in food plants. In addition, they are of crucial importance as evidence of reliability for victims of listeriosis before the court.

Phenotypic methods

A valid scheme for antigenic analysis of *L. monocytogenes*, elaborated by Paterson as early as 1940 and further extended by Donker-Voet and Seeliger, has proven its scientific value over several decades. The present scheme distinguishes 4 serogroups (1/2, 3, 4, 5 and 6) divided in 19 serovars for *L. monocytogenes* and genomically related species on the basis of 14 somatic antigens and 4 flagellar antigens (184). *L. innocua*, *L. welshimeri* as well *L. ivanovii* can be easily differentiated from *L. monocytogenes* by their typical antigenic structure, while strains of *L. seeligeri* shares antigenic patterns common to *L. monocytogenes* (serogroup1/2) or to *L. innocua* and *L. welshimeri* (serogroup 6). Antigenic patterns can be grouped according to the sugar composition of the teichoic acids of the cell wall and surface proteins (70, 197). Besides its taxonomic use and its ability to confirm suspected strains in their identification, serotyping has mainly been dedicated to type *L. monocytogenes* for a better understanding of the epidemiology of listeriosis. Among the 12 serovars which can cause disease, only 3 serovars characterize 95% of the human isolates: 1/2a, 1/2b and 4b. Although strains of serogroup 1/2 were predominant in Europe and strains of serovar 4b were mainly found in the USA before 1960, no geographic differences in the global distribution of serovars exist today. Gray and Killinger (91) hypothetized that strains of serovar 4b were introduced in Europe through the importation of contaminated chinchillas from the USA. No direct link has been firmly established between the serovar and particular clinical forms of listeriosis in spite of suggestive evidence (5, 14, 139). Interestingly, while strains 4b are usually responsible for at least 50% of sporadic human cases worldwide as well as for the major outbreaks which have occurred since 1981 (168, 173), studies done in various countries have indicated that isolates recovered from food mostly belong to the serogroup 1/2 (179). In spite of its limitations, antigenic analysis is the only typing used in many different countries, and therefore the only typing available for comparisons, even when slight differences in methodology exist.

Because of the low discriminatory ability of serotyping, phage-typing was the only means to distinguish strains of the same serovar before the introduction of molecular methods. *Listeria* phages were isolated from lysogenic strains of all *Listeria* species as well as from environmental sources (sewage) (123, 167). A multicenter study between four laboratories was constituted in 1981 in order to select an international set of phages among those isolated in France and Germany and define a standardized method (171). A new promising phage-typing system was recently described (123). The practical value of phage typing has been the subject of clinical and epidemiological evaluations, including recurrent infections in humans, nosocomial infections and common source outbreaks (15, 71, 87, 120, 140, 141, 142, 178). Nevertheless, in spite of its usefulness, phage-typing is hampered by non-typable strains, the percentage of which may vary according to the origin of the strain. A recently published reverse phage-typing may represent an interesting alternative (121).

Molecular typings

The application of molecular typing to *L. monocytogenes* has overthrown the structural approach to this species employing phenotypic methods. Multilocus enzyme analysis, first applied in 1989, differentiates strains by the electrophoretic mobility of a large number of metabolic enzymes. Using this method, Piffaretti et al. (158) divided 175 strains in 45 electrotypes gathered in two major subdivisions delineated by flagellar antigens (one is constituted of strains serovar 1/2b and 4b, the other of strains serovar 1/2a and 1/2b). Interestingly, the strains responsible for outbreaks in Switzerland and California fit in the same electrotype while the Massachusetts strain belongs to a close, but distinct, electrotype of the same subdivision. Similar results were observed by Bibb et al. (14). In a further study, Boerlin and Piffaretti (17) demonstrated later that animals could represent a major source of diffusion of the clone responsible for outbreaks in environment and in food, while in contrast the contamination of meat products might originate from the environment in which they are processed rather than from animals. The analysis of restriction fragments of genes encoding rRNA (ribotyping) have been recently applied to *L. monocytogenes* (88, 104, 149). Using pBA2, it divides *L. monocytogenes* strains in at least 14 ribovars, two of which include almost 80 % of the strains. These two major ribovars are, respectively, constituted by most serovar 4b strains which are of human origin and by serogroup 1/2 strains, mainly from foods and their related environment (104). DNA restriction analysis using high-frequency cutting enzymes and conventional electrophoresis was used to study epidemic human and food isolates of Switzerland, Canada, California, and Massachusetts as well as sporadic foodborne disease and nosocomial infections (62,150,173,215). In each case, results confirmed the suspected epidemiological link. Macrorestriction DNA patterns generated by 3 different rare-cutting enzymes and shown by pulsed field gel electrophoresis distinguishes 48 groups of patterns among 77 strains (24, 28). To date, this typing appears to be the most discriminatory for *L. monocytogenes* as indicated by the characterization of the strains isolated during the French outbreak in 1992 (unpublished data). Recently, PCR (Polymerase Chain Reaction)-based methods have been devised for *L. monocytogenes* and look promising given their rapidity (42, 137). Analysis of plasmids has not yet been used in this field because of the low carrier status (20-28%) of *L. monocytogenes* strains, especially for human strains (118, 155). A recent study indicates a relation between cadmium resistance and plasmids (118). Pyrolysis mass spectrometry was also recently proposed to differentiate strains (74).

The introduction of molecular typing gave a new phylogenetic insight for the species, with the description of two main subdivisions, one including all epidemic strains, and providing useful discriminatory markers to trace the

bacterium. But these molecular methodologies are not suitable at the present time for application to routine typing, serotyping and phage-typing remaining the most appropriate methods for the screening of a large number of strains.

The large body of results accumulated during the past ten years allows a number of conclusions:

- the isolation of strains with the same characteristics from epidemic cases and from the food suspected by case-control study definitively explained the epidemiology of this infection (15, 27, 62, 87, 120, 142, 178);
- strains responsible for most major outbreaks since 1981 belong to a small number of well defined and very closely related clones (27);
- *L. monocytogenes* is constituted of two main groups of strains, whose significance for public health and food colonization is not completely elucidated (14, 104, 158);
- while typing has been used for many years to investigate listeriosis epidemiology, studies tracing the microorganism in plants have scarcely been published.

Because of the growing importance of typing and the application of new methodologies in numerous laboratories, in 1991 an international multicenter study involving 27 laboratories has been initiated under the auspices of the World Health Organization (WHO) in order to standardize the methods and to define a common nomenclature of varieties.

ECOLOGY

Healthy carriers

The existence of healthy human and animal carriers have been documented since 1965. Fecal carriage of *L. monocytogenes* have been investigated in humans, including pregnant women (86, 114), healthy individuals (108) and patients with renal transplantation, hemodialysis or symptoms of gastroenteritis (130). Recent studies indicated that 2 to 6% of investigated samples were positive. Since other *Listeria* species have been identified in these studies, the frequent positive results published before 1985 may be explained by the modification of *Listeria* taxonomy, at a time when most strains were ranked under the general heading "*L. monocytogenes*". In contrast, *L. monocytogenes* has not been isolated from oropharyngeal samples of healthy people (114) and the presence of the bacterium in cervicovaginal specimens is nearly always connected to listeriosis (86, 114). A more frequent fecal carrier state (10-50%) has been documented in animals, including cattle (99,101), poultry (187), pigs (188). In addition, *L. monocytogenes* has been isolated from 45% of pig tonsil samples (30). Comparing the percentage of *Listeria* spp. positive pig faecal samples (4.1%) and those of positive minced pork samples, Skovgaard and Norrung (188) concluded that fecal contamination during the slaughter could be considered a predominant cause of contamination of minced meat.

Environment

The presence of *Listeria* in various environments has also been known for a long time: the role of silage in the transmission of the animal disease was bacteriologically documented in 1960 (89) and Welshimer isolated strains from natural decaying vegetation in 1968 (212) which was later confirmed (211). The bacterium is able to survive and even to multiply in soil and water (20). *Listeria* species have been detected in various aqueous environments: surface water of canals and lakes, ditches of polders in the Netherlands (50), freshwater tributaries draining into a Californian Bay (35) as well as sewage (3). Experiments demonstrated that crops and alfalfa plants grown on soil treated with sewage sludge became contamined (4). Half samples of radishes sown in soil inoculated with *L. monocytogenes* were found positive three months later (202). Similarly, the presence of *L. monocytogenes* in various pasture grasses and grass silages have often been documented (69, 103, 154).

More recently the contamination of food-processing plants has been investigated, demonstrating that the entry of *L. monocytogenes* is primarily caused by animals which excrete the bacterium, raw food of animal origin and people in food establishments. Growth of *Listeria* is supported by high humidity and nutrient waste. *L. monocytogenes* has been detected in drains, condensed or stagnant water, floors, residues, process equipment (34, 39, 111, 205, 213) and may survive in aerosols suspensions (192). The presence of *Listeria* in the food-processing chain can be demonstrated by the widespread occurrence of the organism in processed products. Furthermore, contaminated effluents from food-processing plants (188), where the organism can grow (22), increase the spread of *Listeria* in the environment.

Food

Whereas little information on the presence of *Listeria* in food was available in the literature before 1986, considerable subsequent work demonstrate the presence of *L. monocytogenes* in various categories of food and its ability to grow in this environment.

Milk and dairy products were the first and certainly among the best studied foods. *L. monocytogenes* has been detected in around 2 to 5% of raw milk samples, without clearcut seasonal trends (65,68,126,190). Milk can be contaminated by environmental sources including cow faeces, soil, straw as well as by mastitis (102). The epidemiological evidence that pasteurized milk was the source of the Boston outbreak raises the question of the thermal resistance of *L. monocytogenes*. While conflicting results have been published in this regard (23, 61, 132) and experiments have evaluated the role of the intracellular location of the bacterium in protection (31, 40, 54), an informal working group of WHO concluded that "pasteurization is a safe process which reduces the number of *L. monocytogenes* occurring in raw milk to levels that do not pose an appreciable risk to human health" (72). A wide variety of cheese can be contaminated, but soft cheeses are more exposed to contamination, with a frequency of about 2 to 10% (55, 64, 135, 160), with concentrations of *Listeria* ranging from 10 to 10^7 ufc.g (64). The fate of *L. monocytogenes* in cheese has been the subject of many publications: briefly, the bacterium is able to survive a long period in brined, colby, brick, cottage, Trappist cheese; in contrast, Dutch type cheese and Parmesan do not favour growth of *L. monocytogenes* (58). A significant correlation of *Listeria* growth, pH values (> 5.5) and absence of starter cultures during cheese manufacturing has been observed (78). Shaack and Marth demonstrated than

growth of *L. monocytogenes* is inhibited by *Lactococcus lactis* susp. *Iactis* or *cremoris*, *L. bulgaricus*, *Streptoccocus thermophilus* (177). *L. innocua* have been detected in butter (135) and experiments indicated than *L. monocytogenes* can survive up to 30 days in yogurt (93).

A wide variety of meats and meat products including beef, pork, minced meat, ham, smoked and fermented sausages, salami, paté, etc... are contaminated with *L. monocytogenes*. Most is surface contamination (107) and usually at levels lower than found in many soft cheeses. Among them, poultry appears to be the most frequently contaminated, with up to 60% positive samples in some studies (64, 79, 160). *L. monocytogenes* is capable of growing on meat, depending upon pH, tissue type (lean or fat), type and amount of background microflora (lactobacilli, pseudomonads), temperature and curing ingredients (49, 80, 218, 219). *L. monocytogenes* contamination has been reported in samples of commercially broken raw liquid egg (117).

Similarly, *L. monocytogenes* has been detected on different types of vegetables (radishes, cucumbers, cabbage, potatoes), usually at low levels (10, 98). Unlike low-acid salad vegetables, tomatoes and carrots are not good substrates for *Listeria* (11,12). Sources of contamination include soil, water, animal manure, decaying vegetation and effluents from sewage treatment plants (10, 202).

Contaminated raw and ready-to-eat seafood (145,148, 210) as well as fish products (60) have been reported. Experiments on smoked salmon indicated *L. monocytogenes* to be able to grow during storage at 4°C (94).

VIRULENCE

Within the genus *Listeria*, only *L. monocytogenes* and *L. ivanovii* can be considered virulent both in terms of 50% lethal dose and ability to grow in spleen and liver, regardless of the resistance or susceptibility (either natural or induced) of mice (37, 133, 170, 194).

Virulence factors

The existence since 1962 of an excellent murine model (131) and the recent development of tissue culture and genetic tools have allowed molecular analysis of *L. monocytogenes* since 1985. Hemolysin (*hly* gene), a member of the family of sulfhydryl-activated pore-forming cytolysins, was the first studied and is without doubt the best characterized. Its role in pathogenicity has been thoroughly documented using nonhemolytic transposon mutants whose avirulence can be complemented with a plasmid containing a structural gene (38, 77, 109). In addition, hemolysin may represent the dominant target during the expression of the immune response to *L. monocytogenes* (21). Insertion mutants of the gene (*plc*A gene) encoding the phosphatidylinositol-specific phospholipaseare of reduced virulence, but the role of this molecule in the pathogenesis await further study (144, 195). The lecithinase operon is located downstream and comprises the genes *mpl*, *actA* and *plc*B as well as three open-reading frames of unknown function. Experiments with mutants coding for the lecithinase (*plc*B gene) suggest this molecule to be involved in lysis of the double-membrane vacuole which is formed during the cell-to-cell spread (203). A zinc metalloprotease (gene *mpl*) may play a role in the maturation of the phopholipase C (166). The *actA* gene product is a surface protein involved in actin assembly. Analysis of transposon mutants unable to invade cultured epithelial cells identified internalin (*inlAB* operon), a membrane protein (75). All *L. monocytogenes* strains secrete a protein named p60 (gene *iap*), whose reduced expression (rough mutants) correlates with a decrease in invasivness (113). In addition, a 20-kDa protein (*lmaAB* operon) induce specific delayed hypersensitivity (82).

A sequence of events leading to *L. monocytogenes* pathogenesis has been established: subsequent to internalization (*inlA* gene), bacteria escape from host vacuoles and enter the cytoplasm (*hly* gene), where rapid growth ensues. Shortly after, the bacteria appear to mediate the nucleation of host actin filaments which rearrange to form a tail consisting of short actin filaments and actin-binding proteins required for their movement (*actA* gene). Some of the bacteria move to the surface of the cell and are extruded in pseudopod-like structures. The pseudopods are apparently recognized by the neighboring cells and phagocytosed, whereupon the bacteria escape from the resulting double-membrane vacuole and enter the cytoplasm of the next cell (*plcB* gene) (162).

Besides adding to the fundamental understanding of the basis of *L. monocytogenes* virulence, these studies have allowed the development of rapid methods to detect the bacterium in heavily contaminated material (see Detection of *Listeria*).

They have been done with a very limited number of strains, however the analysis of a number of isolates from various origins indicates a certain diversity within the nucleotide sequence of *hly*, *prfA*, *mpl*, and *iap* genes (165, 204). Whether these differences produce salient variations in the pathogenic mechanism is not known.

Virulence of L. monocytogenes

The demonstration of the foodborne transmission of human listeriosis prompted the development of new studies on pathogenicity tests as well as methods to evaluate the virulence of individual *L. monocytogenes*.

Numerous methods have been devised since Anton's historic test [a laboratory accident in 1934 (6)]. These include the fertilized hen's test (116, 152, 199), tissue culture tests (37, 67, 159) and tests using laboratory animals, particularly mice, either immunocompetent (25, 37) or immunocompromised (37, 47, 198). In these studies, infection was induced in mice by the intraperitoneal (37, 47) or intravenous (25, 133, 170) route. Virulence was evaluated either by comparing the 50% lethal dose (37, 47, 159) or by enumerating bacteria in spleen or liver (25, 170).

Considerable heterogeneity in levels of virulence of various *L. monocytogenes* strains was observed; some show high virulence, while some show low or even rarely no virulence (25, 37, 47, 159, 198). No clear correlation with origin (human, animal, category of food, environment) or typing characteristics (serovars, phagovars, ribovars, DNA macrorestriction patterns) has been detected so far (25). Similarly, epidemic strains demonstrate a wide range of

virulence (25, 159). While hemolysis is the major virulence factor of *L. monocytogenes*, no quantitative correlation has been made between hemolysin production and virulence level (47, 67, 198). Some non-pathogenic, or very low pathogenic, *L. monocytogenes* isolates have been reported (25, 37, 47, 126, 198), but, from a public health point of view, all strains of this species should be considered as potentially virulent microorganisms.

DETECTION OF *Listeria*

Epidemiological investigations of ongoing outbreaks, regular surveillance of suspected food products and routine monitoring of food has encouraged the development of new methods to detect, resuscitate and enumerate *Listeria* from heavily contaminated material. Older methods exist, e.g. cold enrichment (92), oblique lighting to recognize typical colonies (90) and the use of nalidixic acid or acriflavine dyes in selective media (9, 164), but the last 10 years unambiguously provided significant progress in this field.

Selective isolation

Since efforts to isolate *Listeria* from food by direct plating are usually unsuccessful, enrichment followed by isolation on selective agar is necessary. Because cold enrichment requires several weeks, its use in quality control for the food industry is precluded. Growth inhibitors of competitors (nalidixic acid, polymyxin, acryflavin) have been introduced in enrichment broths allowing a more rapid enhancement of *Listeria* when incubated at 30° or 37°C (52, 56, 73,125). Primary enrichment is usually sufficient and secondary enrichment is only needed for particular foods (red smear or blue cheeses for example). Most selective agars contain more than one selective agent to inhibit the growth of the background microflora found in food (lithium chloride, naladixic acid, moxalactam, ceftazidime, cycloheximide, latamoxef, cefotetan, fosfomycin in addition to the previously mentioned agents) and some include an indicator that enhances recognition of suspect colonies (esculin, potassium tellurite) (7, 41, 119, 201). The most effective selective media include Oxford, PALCAM, McBride as well as LPM agars (41, 119, 125, 201). Numerous procedures and media have been proposed for the isolation of *Listeria* and substantial differences in performance were observed due to the type of food, the concentration of *Listeria* and the associated microflora (26, 51, 55, 96, 189, 209, 216).

Recovery of sublethally stressed Listeria

Due to food processing conditions, microorganisms present in food may encounter sublethal stress and are physiologically injured. Experiments demonstrate that a significant fraction of surviving cells are injured cells after heating below 54°C, freezing, or other treatments (2,84,191). Heat-stressed *L. monocytogenes* are considerably less pathogenic than non-stressed cells (138). On non-selective agar, injured cells can repair the damage induced by the stress and grow, but they are subject to additional stress in selective agar and variable recovery is observed (29, 83, 191). Various procedures have been devised and a kit which includes a resuscitation step is available (83, 134). The presence of sublethally damaged cells in food samples which are recovered with variable efficiency may lead to differences in enumeration results (83, 96, 160).

Enumeration

Quantitative enumeration of *Listeria* is essential since the risk for the consumer is directly related to the number present in food. It is especially warranted in countries where a certain level is tolerated in food. Different procedures have been compared, indicating variations with the media and the type of food analyzed (33,95,122,196, 220). The use of DNA probe in conjunction with selective media appeared appropriate for enumeration when the number of *Listeria* is above 10 cfu/g (43, 45).

Rapid methods

Although *Listeria* detection has improved over the last years, the methods based on culture remain slow and labor intensive. New assays which can be completed within 1-3 days are being devised, using recombinant DNA techniques to detect *L. monocytogenes* in food. 16S ribosomal RNA and hemolysin have been the two principal targets for DNA probes and PCR (32, 44, 48, 112, 146, 193, 200, 207) . The *iap* gene (32, 106, 146, 151), the *msp* gene (110), the *prfA* gene (214) as well as a DNA sequence encoding a surface protein (208) have recently been added. The first DNA probes were published in 1987 and 1988 (44, 112) and the serious drawback of radiolabels was later circumvented by non-radioactive labelling (43, 110, 153, 156). These methods are species specific. Since 1991, the use of PCR drastically improved the sensitivity of hybridization assays [1 cfu/30 ml of milk (193), 1 cfu/g of beef (200)]; in addition, since enrichment is unnecessary, the time required is 1-2 days. A recent study with the ligase chain reaction indicated that this test may become a powerful alternative for the rapid detection of *Listeria* from food (217). Enzyme-linked immunosorbant assays using monoclonal antibodies directed against protein antigen (13, 66, 136) have been devised for the detection of *Listeria* in food. However, the method is not specific for *L. monocytogenes* and is less sensitive than PCR. In addition to these methods, a cytofluorometry test (52), a direct immunofluorescent test (143), an electrical method (157) and an immunomagnetic separation (185) have been reported. The sensitivity of these methods to conventional tests has been documented (97, 134, 206).

LISTERIOSIS

HUMAN LISTERIOSIS

L. monocytogenes has a special predilection for individuals with depressed cell-mediated immunity. Populations at risks include pregnant women and neonates, adults with underlying disease (cancer patients, transplant recipients, AIDS, chronic hepatic disorder, diabetes...) and the elderly persons. Listeriosis is a rather rare infection experienced in patients with AIDS and this may be explained by their selective restriction diet which avoids high-risk foods, antibiotic treatment (cotrimoxazole) for other infections, T- cell subset compromised and the elevated levels of tumor necrosis factor (46). However, listeriosis occurs 300 times more frequently in people with AIDS than in the general population (182). Up to 30% of adults who suffer from listeriosis have no apparent risk factor (186) [nevertheless, nondiagnosed transient immunologic defect can exist in

previously "healthy" patients (81)]. Most adult patients present with meningitis and/or bacteremia, focal infections (endocarditis, septic arthritis, osteomyelitis, peritonitis...) being rare and usually preceded by bacteremia (147). Acute bacterial meningitis due to *L. monocytogenes* represents 8% of bacterial meningeal episodes (57). Rare cases of recurrent listeriosis in adults have been observed and typing of strains isolated during the sequential episodes strongly suggest reinfection by the same strain, although the anatomical site(s) which is (are) colonized by *L. monocytogenes* for long periods has not yet been identified (141).

Listeriosis in pregnancy occurs most frequently in the third trimester. While the infection of the mother may be asymptomatic or characterized by a flu-like illness with fever, myalgia, headache, it may have more serious consequences including spontaneous abortion, fetal death, stillbirth, severe neonatal septicemia and meningitis for the infant. Histories of recurrent fetal losses due to *L. monocytogenes* have been mentioned in the literature (115) but have never been firmly documented using strains typing.

Some antibiotic resistance has recently been observed in *L. monocytogenes*, but is rarely detected in wild strains isolated from human specimens, with the exception of the tetracyclin resistance which might originate from direct exchange of genetic information between enterococci and *Listeria* in the human gut (53, 163). The combination of ampicillin and gentamycin or cotrimoxazole is generally recommended. Promptly instituted antibiotic therapy is crucial for the prognosis (129). *L. monocytogenes* is readily isolated from clinical specimens obtained from normally sterile sites. To date, serodiagnosis using heat-killed bacteria as antigen has not proven appropriate mainly because *L. monocytogenes* induces a cell mediated immunity [the way the bacteria spread from one cell to another might explain why antibody plays little or no role in immunity to *L. monocytogenes* (cf. virulence]. Furthermore, it cross-reacts extensively with other Gram-positive bacteria (such as *Staphylococcus*, *Streptococcus*...). The recent use of a purified hemolysin as antigen may be promising (76, 127).

The pathogenesis of listeriosis is still poorly understood. Two to 6% of healthy individuals are reported to be asymptomatic fecal carriers of *L. monocytogenes*, but the risk of clinical disease in those harboring the bacterium in the gut is still unknown. Endogenous infection caused by *L. monocytogenes* in the gut is plausible, especially in patients receiving immunosuppressive therapy which not only impairs resistance to infection but can also result in alterations of intestinal defense mechanisms that predispose to Listeria invasion. Interestingly, an outbreak of listeriosis which occurred in 1987 in the Philadelphia metropolitan area was characterized by a multiplicity of strains isolated from patients (183). Due to the diversity of the strains, a single food vehicle could not be suspected. Clinical and epidemiological investigations suggested that infection may have occurred when individuals who were asymptomatic for *Listeria* infection but whose gastrointestinal tract had been colonized by *L. monocytogenes* became infected with another pathogen. A recent sporadic case with a brain stem abscess due to *L. monocytogenes* shortly after an episode of acute enteritis due to *Shigella sonnei* lends credence to this hypothesis (124).

EPIDEMIOLOGY OF HUMAN LISTERIOSIS

Since 1981, the epidemiologic studies have centered on the role of contaminated food in transmission of the disease. In order to evaluate the magnitude of the problem, surveillance schemes have been developed in many countries (Belgium, France, Denmark, Switzerland, United Kingdom, Canada, USA, Australia). The main goal of this surveillance is the evaluation of the annual incidence, the identification of populations at risk, the detection of outbreaks as soon as they emerge as well as the analysis of the foodborne transmission. In most countries, systems are based on voluntary reporting to national reference centers or to state health departments (173).

Listeriosis is mainly identified in industrialized countries, and reported prevalence in Africa, Asia and South America are non-existent or low. Whether this reflects different consumption patterns or dietary habits, different host susceptibility, or represents lack of testing facilities is not yet known (72, 168, 173). Despite obvious extensive exposure to *L. monocytogenes*, listeriosis is a rather rare disease whose incidence has been evaluated during the last years by passive surveillance in some European countries and Canada, indicating between 2 and 7 cases per million population (168,173). A more precise estimate of 7.4 cases per million population was recorded through an active study in the USA in 1989 and 1990 in a population of 19 million people (182). Interestingly, a clear decrease in the number of cases has been observed in the USA since 1990, suggesting that the measures taken in the food industry have been effective (180).

The basic epidemiological pattern of human listeriosis is a background of sporadic cases, on which outbreaks may be superimposed. No clear seasonal trend has been observed (168, 173). The role of contaminated food in the transmission of the disease has been documented by investigations of sporadic cases (161, 181) as well as outbreaks. The first foodborne outbreak was observed in 1981 in Nova Scotia, involved 41 patients* and was caused by a contaminated batch of coleslaw as indicated by epidemiological and microbiological investigations (178). The next outbreak occurred in Boston (Massachusetts) in 1983 and included 49 cases* in two months (71); on the basis of the case-control study, pasteurized milk was incriminated (postpasteurization contamination was one possible explanation). In 1985 in California, an epidemic of 142 cases* was traced to a Mexican-type cheese (120). North America experienced three major outbreaks from 1981 to 1985, and outbreaks were observed in Europe from 1983 to 1992. The contaminated Vacherin Mont d'or, a soft cheese, was responsible for a four year outbreak of 122 cases from 1983 to 1987 (15) and a paté caused a 300 patient epidemic in the UK in 1989-1990 (142). More recently in France, a contaminated pork tongue in aspic was the source of 279 cases in ten months in 1992 (87) and a potted pork was incriminated in 25 cases in 1993 (59). Similarly, a case-control study of dietary risk factors done in the USA demonstrated that foodborne

*:total number of cases (number of epidemic cases not known)

transmission may account for a substantial portion of sporadic cases (161, 181).

From all the data collected during the past ten years regarding the sources of outbreaks, it appears that some foods are more at risk than others. High risk foods are often ready to eat, stored at refrigeration temperature during a long period, enabling *Listeria* growth, contaminated with a high concentration of *L. monocytogenes*, and moreover by a strain serovar 4b.

Minimal infective dose of *L. monocytogenes* for humans is not known and this lack presents a real dilemma to both industry and regulatory agencies. The infectious dose of a foodborne pathogen depends on a number of variables including the condition of the host, the virulence of the strain, the type and amount of food consumed, and the concentration of the pathogen in the food. Animal studies, in monkeys (63) and in mice (85) suggest that reducing levels of exposure will reduce clinical disease. But these experiments do not help to evaluate the minimal infective dose for man. From the reported numbers of *Listeria* in the contaminated food responsible for epidemic and sporadic foodborne cases, there is little evidence that a very low number of *L. monocytogenes* in food could cause listeriosis. But because of the time elapsed between consumption and detection of the contaminated food, these results are mitigated, the organism could have either grown or died during the intervening period.

To reduce the morbidity and mortality, appropriate preventive measures, particularly in persons known to be at increased risk of infection, have been published in some countries regarding food hygiene at the consumer level as well as lists of foods at risk. Besides foodborne transmission, nosocomial infections are described from time to time, which occur mainly in nursery mates (174). A possible sexual transmission of the disease was suggested in the past, but has never been confirmed. Interestingly, Linnan et al. (120) found during the investigation of the Californian outbreak that sexual intercourse during the month preceding hospitalization constituted a risk factor significantly and independently associated to the development of the disease.

CONCLUDING REMARKS

The various challenges that the food microbiologist has had to face in the past few years has led to a tremendous interest in *Listeria*. It now appears that nearly all kinds of food can be contaminated with this bacterium and foods at highest risk have been defined. Methods for isolating *Listeria* were rapidly developed to deal with the crisis; however comparative studies agree that no single procedure gives consistent isolation from all *Listeria*-positive samples; similarly further refinement and optimization of rapid selective methods for the detection of the bacterium in food are needed. Useful enumeration procedures have been devised; nevertheless, in spite of numerous studies, these methods may not be sufficiently precise to allow regulations based on a certain level of tolerance.

Listeriosis has been described for many years making it a well identified and recognized infection in industrialized countries. Foodborne transmission has provided a new view of the pathogenesis of the disease and has led to new questions, including the ability of other pathogens to promote infection by *L. monocytogenes*.

The virulence of *L. monocytogenes* has been unambiguously unraveled at the genetic level, and the immediate application of these results has been to design rapid methods to detect *Listeria* in food. At the same time, screening of wild strains clearly demonstrates the heterogeneity of virulence within representatives of this species and the study of new epidemic strains exposes a low number of closely related clones. How these isolates differ from the few strains whose genomes have been thoroughly characterized regarding their virulence factors? Do the epidemic strains share one (or a few) specific properties which could explain their responsibility for large epidemics?

More sensitive surveillance systems should be developed since it is through the detection of time-space clusters by regional or state surveillance systems that common source outbreaks can be detected, investigated and prevented. In addition, they could help to understand the differences in reported incidences, which may be due to undereporting, differences in environmental factors, patients populations and host susceptibility or dietary exposures. The role of contaminated food, and more especially the percentage of infections caused by contaminated food, needs further evaluation. Refined epidemiological investigations should focus on that aspect to clearly elucidate the extend of the problem. This also includes the use of modern molecular typing systems for *L. monocytogenes*, characterized by their high discriminatory power and rapidity that can detect and identify outbreaks as soon as they emerge.

Finally, should we tolerate *L. monocytogenes* in foods? for what level? for what kind of food? and for what category of people?

REFERENCES

1. 1993. 1987 bacterial foodborne illness costs in USA. WHO surveillance programme for control of foodborne infections and intoxications in Europe Newsletter. 13;(3).
2. Ahamad, N. and Marth, E.H. 1990. Acid-injury of *Listeria monocytogenes*. J. Food Protect. 53:26-29.
3. Al-Ghazali, M.R. and Al-Azawi, S.K. 1986. Detection and enumeration of *Listeria monocytogenes* in a sewage treatment plant in Iraq. J. Appl. Bacteriol. 60:251-254.
4. Al-Ghazali, M.R. and Al-Azawi, S.K. 1990. *Listeria monocytogenes* contamination of crops grown on soil treated with sewage sludge cake. J. Appl. Bacteriol. 69:642-647.
5. Albritton, W.L., Wiggins, G.L. and Feeley, J.C. 1976. Neonatal listeriosis: distribution of serotypes in relation to age at onset of disease. J. Pediat. 88:481-483.
6. Anton, W. 1934. Kritisch-experimenteller Beitrag zur Biologie des *Bacterium monocytogenes*. Mit besonderer Berücksichtigung seiner Beziehung zur infektiösen Mononukleose des Menschen. Zbl. Bakt. Parasit. Infekt. Hyg. Abt. I. Orig. 131:89-103.
7. Bannerman, E.S. and Bille, J. 1988. A new selective medium for isolating *Listeria* spp. from heavily contaminated material. Appl. Environ. Microbiol. 54:165-167.
8. Bannerman, E., Yersin, M.N. and Bille, J. 1992. Evaluation of the Organon-Teknika MICRO-ID *Listeria* System. Appl. Environ. Microbiol. 58:2011-2015.
9. Beerens, H. and Tahon-Castel, M.M.1966. Milieu á l'acide nalidixique pour l'isolement des streptocoques, *D. pneumoniae*, *Listeria*, *Erysipelothrix*. Ann. Inst. Past. 111:90-93.
10. Beuchat, L.R., Berrang, M.E. and Brackett, R.E. 1990. Presence and public health implications of *Listeria monocytogenes* on vegetables. In: Foodborne Listeriosis (A.J. Miller, J.L. Smith, G.A. Somkuti, ed.), Elsevier Science Publishers, Amsterdam. pp. 175-181.

11. Beuchat, L.R. and Brackett, R.E. 1991. Behavior of *Listeria monocytogenes* inoculated into raw tomatoes and processed tomato products. Appl. Environ. Microbiol. 57:1367-1371.
12. Beuchat, L.R. and Brackett, R.E. 1990. Inhibitory effects of raw carrots on *Listeria monocytogenes*. Appl. Environ. Microbiol. 56:1734-1742.
13. Beumer, R.R. and Brinkman, E. 1989. Detection of *Listeria* spp. with a monoclonal antibody-based enzyme-linked immunosorbent assay (ELISA). Food Microbiol. 6:171-177.
14. Bibb, W.F., Gellin, B.G., Weaver, R., Schwartz, B., Plikaytis, B.D., Reeves, M.W., Pinner, R.W. and Broome, C.V. 1990. Analysis of clinical and foodborne isolates of *Listeria monocytogenes* in the United States by multilocus enzyme electrophoresis and application of the method to epidemiologic investigations. Appl. Environ. Microbiol. 56:2133-2141.
15. Bille, J. 1989. Anatomy of a foodborne listeriosis outbreak. In: Foodborne Listeriosis (Proceedings of a Symposium on September 7, 1988 in Wiesbaden, FRG) B. Behr's Gmbh & Co, Hamburg. pp 29-36.
16. Bille, J., Catimel, B., Bannerman, E., Jacquet, C., Yersin, M.N., Caniaux, I., Monget, D. and Rocourt, J. 1992. API *Listeria*, a new and promising one-day system to identify *Listeria* isolates. Appl. Environ. Microbiol. 58:1857-1860.
17. Boerlin, P. and Piffaretti, J.C. 1991. Typing of human, animal, food, and environmental isolates of *Listeria monocytogenes* by multilocus enzyme electrophoresis. Appl. Environ. Microbiol. 57:1624-1629.
18. Boerlin, P., Rocourt, J., Grimont, F., Grimont, P.A.D., Jacquet, Ch. and Piffaretti, J.-C. 1992. *Listeria ivanovii* subsp. *londoniensis* subsp. nov. Int. J . System. Bacteriol. 15:42-46.
19. Boerlin, P., Rocourt, J. and Piffaretti, J.C. 1991. Taxonomy of the genus *Listeria* by using multilocus enzyme electrophoresis. Int. J. System. Bacteriol. 41:59-64.
20. Botzler, R.G., Cowan, A.B. and Wetzler, T.F. 1974. Survival of *Listeria monocytogenes* in soil and water. J. Wild. Dis. 10:204-212.
21. Bouwer, H.G.A., Nelson, C.S., Gibbins, B.L., Portnoy, D.A. and Hinrichs, D.J. 1992. Listeriolysin-O is a target of the immune response to *Listeria monocytogenes*. J. Exp. Med. 175:1467-1471.
22. Boyle, D.L., Schmidt, G.R. and Sofos, J.N. 1990. Growth of *Listeria monocytogenes* inoculated in waste fluids from clean-up of a meat grinder. J. Food Sci. 55:277-278.
23. Bradshaw, J.G., Peeler, J.T., Corwin, J.J., Hunt, J.M., Tierney, J.T., Larkin, E.P. and Twedt, R.M. 1985. Thermal resistance of *Listeria monocytogenes* in milk. J. Food Protect. 48:743-745.
24. Brosch, R., Buchrieser, C. and Rocourt, J. 1991. Subtyping of *Listeria monocytogenes* serovar 4b by use of low frequency cleavage restriction endonucleases and pulsed-field gel electrophoresis. Res. Microbiol. 142:667-675.
25. Brosch, R., Catimel, B., Milon, G., Buchrieser, C., Vindel, E. and Rocourt, J. 1993. Virulence heterogeneity of *Listeria monocytogenes* strains from various sources (food, human, animal) in immunocompetent mice and its association with typing characteristics. J. Food Protect. 56:296-301.
26. Buchanan, R.L., Stahl, H.G., Bencivengo, M.M. and Del Corral, F. 1989. Comparison of lithium chloride-phenylethanol-moxalactam and modified Vogel Johnson agars for detection of *Listeria* spp. in retail-level meats, poultry, and seafood. Appl. Environ. Microbiol. 55:599-603.
27. Buchrieser, C., Brosch, R., Catimel, B. and Rocourt, J. 1993. Pulsed-field gel electrophoresis applied for comparing *Listeria monocytogenes* strains involved in outbreaks. Can. J. Microbiol. 39:395-401.
28. Buchrieser, C., Brosch, R. and Rocourt, J. 1991. Use of pulsed field gel electrophoresis to compare large DNA-restriction fragments of *Listeria monocytogenes* strains belonging to serogroups 1/2 and 3. Int. J. System. Microbiol. 14:297-304.
29. Buduamoako, E., Toora, S., Ablett, R.F. and Smith, J. 1992. Evaluation of the ability of primary selective enrichment to resuscitate heat-injured and freeze-injured *Listeria monocytogenes* cells. Appl. Environ. Microbiol. 58:3177-3179.
30. Buncié, S. 1991. The incidence of *Listeria monocytogenes* in slaughtered animals, in meat, and in meat products in Yugoslavia. Int. J . Food Microbiol.12:173-180.
31. Bunning, V.K., Donnelly, C.W., Peeler, J.T., Briggs, E.H., Bradshaw, J.G., Crawford, R.G., Beliveau, C.M. and Tierney, J.T. 1988. Thermal inactivation of *Listeria monocytogenes* within bovine milk phagocytes. Appl. Environ. Microbiol. 54:364-370.
32. Candrian, U., Hofelein, C. and Luthy, J. 1992. Polymerase chain reaction with additional primers allows identification of amplified DNA and recognition of specific alleles. Mol. Cell. Probes. 6:13-19.
33. Cassiday, P.K., Brackett, R.E. and Beuchat, L.R. 1989. Evaluation of ten selective direct plating media for enumeration of *Listeria monocytogenes* in hams and oysters. Food Microbiol. 6:113-125.
34. Charlton, B.R., Kinde, H. and Jensen, L.H. 1990. Environmental survey for *Listeria* species in California milk processing plants. J. Food Protect. 53:198-201.
35. Colburn, K.G., Kaysner, C.A., Abeyta, C. Jr. and Wekell, M.M. 1990. *Listeria* species in a California coast estuarine environment. Appl. Environ. Microbiol. 56:2007-2011.
36. Collins, M.D., Wallbanks, S., Lane, D.J., Shah, J., Nietupski, R., Smida, J., Dorsch, M. and Stackebrandt, E. 1991. Phylogenic analysis of the genus *Listeria* based on reverse transcriptase sequencing of 16S rRNA. Int. J. Syst. Bacteriol. 41:240-246.
37. Conner, D.E., Scott, V.N., Summer, S.S. and Bernard, D.T. 1989. Pathogenicity of foodborne, environmental and clinical isolates of *Listeria monocytogenes* in mice. J. Food Sci. 54:1553-1556.
38. Cossart, P., Vicente, M.F., Mengaud, J., Baquero, F., Perez-Diaz, J.C. and Berche, P. 1989. Listeriolysin O is essential for virulence of *Listeria monocytogenes*: direct evidence obtained by gene complementation. Infect. Immunity. 57:3629-3636.
39. Cox, L.J., Kleiss, T., Cordier, J.L., Cordellana, C. and Konkel, P., Pedrazzini, C., Beumer, R. and Siebenga, A. 1989. *Listeria* spp. in food processing, non-food and domestic environments. Food Microbiol. 6:49-61.
40. Crawford, R.G., Beliveau, C.M., Peeler, J.T., Donnelly, C.W. and Bunning, V.K. 1989. Comparative recovery of uninjured and heat-injured *Listeria monocytogenes* cells from bovine milk. Appl. Environ. Microbiol. 55:1490-1494.
41. Curtis, G.D.W., Mitchell, R.G., King, A.F. and Griffin, E.J. 1989. A selective differential medium for the isolation of *Listeria monocytogenes*. Lett. Appl. Microbiol. 8:95-98.
42. Czajka, J., Bsat, N., Piani, M., Russ, W., Sultana, K., Wiedmann, M., Whitaker, R. and Batt, C.A. 1993. Differentiation of *Listeria monocytogenes* and *Listeria innocua* by 16S rRNA genes and intraspecies discrimination of *Listeria monocytogenes* strains by random amplified polymorphic DNA polymophisms. Appl. Environ. Microbiol. 59:304-308.
43. Datta, A.R., Moore, M.A.A., Wentz, B.A. and Lane, J.1993. Identification and enumeration of *Listeria monocytogenes* by nonradioactive DNA probe colony hybridization. Appl. Environ. Microbiol. 59:144-149.
44. Datta, A.R., Wentz, B.A. and Hill, W.E. 1987. Detection of hemolytic *Listeria monocytogenes* by using DNA colony hybridization. Appl. Environ. Microbiol. 53:2256-2259.
45. Datta, A.R., Wentz, B.A. and Hill, W.E. 1988. Identification and enumeration of beta-hemolytic *Listeria monocytogenes* in naturally contaminated dairy products. J. Assoc. Off. Anal. Chem. 71:673-675.
46. Decker, C.F., Simon, G.L., DiGioia, R.A. and Tuazon, C.U.1991. *Listeria monocytogenes* infections in patients with AIDS: report of five cases and review. Rev. Infect. Dis. 13:413-417.
47. Del Corral, F., Buchanan, R.L., Bencivengo, M.M. and Cooke, P.H. 1990. Quantitative comparison of selected virulence associated characteristics in food and clinical isolates of *Listeria*. J. Food Protect. 53:1003-1009.
48. Deneer, H.G. and Boychuk, I. 1991. Species-specific detection of *Listeria monocytogenes* by DNA amplification. Appl. Environ. Microbiol. 57:606-609.
49. Dickson, J.S. 1990. Survival and growth of *Listeria monocytogenes* on beef tissue surfaces as affected by stimulated processing conditions. J. Food Safety. 10:165-174.
50. Dijkstra, R.G. 1982. The occurrence of *Listeria monocytogenes* in surface water of canals and lakes, in ditches of one big polder and in the effluents and canals of a sewage treatment plant. Zbl. Bakt. Hyg., I. Abt. Orig. B.176:202-205.
51. Dominguez, L., Fernandez, J.F., Briones, V., Blanco, J.L. and Suarez, G. 1988. Assessment of different selective agar media for enumeration and isolation of *Listeria* from dairy products. J. Dairy Res. 55:579-583.
52. Donnelly, C. and Baigent, G.J. 1986. Method for flow cytometric detection of *Listeria monocytogenes* in milk. Appl. Environ. Microbiol. 52:689-695.
53. Doucet-Populaire, F., Trieu-Cuot, P., Dosbaa, I., Andremont, A. and Courvalin, P. 1991. Inducible transfer of conjugative transposon Tn1545 from *Enterococcus faecalis* to *Listeria monocytogenes* in the digestive tracts of gnotobiotic mice. Antimicrob. Agents Chemother. 35:185-187.

54. Doyle, M.P., Glass, K.A., Beery, J.T., Garcia, G.A., Pollard, D.J. and Schultz, R.D. 1987. Survival of *Listeria monocytogenes* in milk during high-temperature, short-time pasteurization. Appl. Environ. Microbiol. 53:1433-1438.
55. Doyle, M.P. and Schoeni, J.L. 1987. Comparison of procedures for isolating *Listeria monocytogenes* in soft, surface-ripened cheese. J. Food Protect. 50:4-6.
56. Doyle, M. P. and Schoeni, J. L. 1986. Selective-enrichment procedure for isolation of *Listeria monocytogenes* from fecal and biologic specimens. Appl. Environ. Microbiol. 51:1127-1129.
57. Durand, M.L., Calderwood, S.B., Weber, D.J., Miller, S.I., Southwick, F.S., Caviness, V.S. and Swartz, M.N. 1993. Acute bacterial meningitis in adults - A review of 493 episodes. New Engl. J. Med. 328:21-28.
58. El-Gazzar, F.E. and Marth, E.H.1991. *Listeria monocytogenes* and listeriosis related to milk, milk products and dairy ingredients: a review - II. *Listeria monocytogenes* and dairy technology. Milchwissenschaft. 46:82-86.
59. 1993. Epidémie de listériose a Iysovar 2671-108-312 en France - Résultats préliminaires de l'enquête épidémiologique coordonnée par le Réseau National de Santé Publique. Bull. Epidémiol. Hebdom. 34; (157-158).
60. Farber, J.M. 1991. *Listeria monocytogenes* in fish products. J. Food Protect. 54:922-934.
61. Farber, J.M. 1989. Thermal resistance of *Listeria monocytogenes* in foods. Int. J. Food Microbiol. 8:285-291.
62. Farber, J.M., Carter, A.O., Varughese, P.V., Ashton, F.E. and Ewan, E.P. 1990. Listeriosis traced to the consumption of alfalfa tablets and soft cheese. New Engl. J. Med. 322:338.
63. Farber, J.M., Coates, E.D.F., Beausoleil, N. and Fournier, J. 1991. Feeding trials of *Listeria monocytogenes* with a nonhuman primate model. J. Clin. Microbiol. 29:2606-2608.
64. Farber, J.M. and Peterkin, P.I. 1991. *Listeria monocytogenes*, a foodborne pathogen. Microbiol. Rev. 55:476-511.
65. Farber, J.M., Sanders, G.W. and Malcolm, S.A. 1988. The presence of *Listeria* spp. in raw milk in Ontario. Can. J. Microbiol. 34:95-100.
66. Farber, J.M. and Speirs, J.I. 1987. Monoclonal antibodies directed against the flagellar antigens of *Listeria* species and their potential in ElA-based methods. J. Food Protect. 50:479-484.
67. Farber, J.M. and Speirs, J.I. 1987. Potential use of continuous cell lines to distinguish between pathogenic and nonpathogenic *Listeria* spp. J. Clin. Microbiol. 25:1463-1466.
68. Fenlon, D.R. and Wilson, J. 1989. The incidence of *Listeria monocytogenes* in raw milk from farm bulk tanks in North-East Scotland. J. Appl. Bacteriol. 66:191-196.
69. Fenlon, D.R., Wilson, J. and Weddell, J.R. 1989. The relationship between spoilage and *Listeria monocytogenes* contamination in bagged and wrapped big bale silage. Grass Forage Sci. 44:97-100.
70. Fiedler, F., Seger, J., Schrettenbrunner, A. and Seeliger, H.P.R. 1984. The biochemistry of murein and cell wall teichoic acids in the genus *Listeria*. System. Appl. Microbiol. 5:360-376.
71. Fleming, D.W., Cochi, S.L., MacDonald, K.L., Brondum, J., Hayes, P.S., Plikaytis, B.D., Holmes, M.B., Audurier, A., Broome, C.V. and Reingold, A.L. 1985. Pasteurized milk as a vehicle of infection in an outbreak of listeriosis. New Engl. J. Med. 312:404-407.
72. 1988. Foodborne listeriosis - Report of the WHO informal working group, Geneva, 15-19 February 1988 / Listérioses d'origine alimentaire-Rapport d'un groupe informel de travail de l'OMS, Genève, 15-19 février 1988. WHO/EHE/FOS/88.5.
73. Fraser, J.A. and Sperber, W.H. 1988. Rapid detection of *Listeria* spp. in food and environmental samples by esculin hydrolysis. J. Food Protect. 51:762-765.
74. Freeman, R., Sisson, P.R., Lightfoot, N.F. and McLauchlin, J.1991. Analysis of epidemic and sporadic strains of *Listeria monocytogenes* by pyrolysis mass spectrometry. Lett. Appl. Microbiol. 12:133-137
75. Gaillard, J.-L., Berche, P., Frehel, C., Gouin, E. and Cossart, P. 1991. Entry of *L. monocytogenes* into cells is mediated by internalin, a repeat protein reminiscent of surface antigens from Gram-positive cocci. Cell. 65:1127-1141.
76. Gaillard, J.L., Beretti, J.L., Boulottolle, M., Wilhelm, J.M., Bertrand, J.L., Herbelleau, T. and Berche, P. 1992. Serological evidence for culture negative listeriosis of central nervous system. Lancet. 340:560.
77. Gaillard, J.L., Berche, P. and Sansonetti, P. 1986. Transposon mutagenesis as a tool to study the role of hemolysin in the virulence of *Listeria monocytogenes*. Infect. Immunity. 52:50-55.
78. Genigeorgis, C., Carnicu, M., Dutulescu, D. and Farver, T.B. 1991. Growth and survival of *Listeria monocytogenes* in market cheeses stored at 4 to 30°C. J. Food Protect. 54:662-668.
79. Genigeorgis, C.A., Dutulescu, D. and Fernandez Garayzabal, J. 1989. Prevalence of *Listeria* spp. in poultry meat at the supermarket and slaughterhouse level. J. Food Protect. 52:618-624.
80. Glass, K.A. and Doyle, M.P. 1989. Fate of *Listeria monocytogenes* in processed meat products during refrigerated storage. Appl. Environ. Microbiol. 55:1565-1569.
81. Goday, A., Lozano, F., Santamaria, J., Gallard, T. and Tolosa, E. 1987. Transient immunologic defect, in a case of *Listeria* rhombencephalitis. Arch. Neurol. 44:666-667.
82. Göhmann, S., Leimeister-Wächter, M., Schiltz, E., Goebel, W. and Chakraborty, T. 1990. Characterization of a *Listeria monocytogenes*-specific protein capable of inducing delayed hypersensitivity in *Listeria*-immune mice. Mol. Microbiol. 4:1091-1099.
83. Golden, D.A., Beuchat, L.R. and Brackett, R.E.1988. Evaluation of selective direct plating media for their suitability to recover uninjured, heat-injured, and freeze-injured *Listeria monocytogenes* from foods. Appl. Environ. Microbiol. 54:1451-1456.
84. Golden, D.A., Beuchat, L.R. and Brackett, R.E. 1988. Inactivation and injury of *Listeria monocytogenes* as affected by heating and freezing. Food Microbiol. 5:17-23.
85. Golnazarian, C.A., Donnelly, C.W., Pintauro, S.J. and Howard, D.B.1989. Comparison of infectious dose of *Listeria monocytogenes* F5817 as determined for normal versus compromised C57B1/6J mice. J. Food Protect. 52:696-701.
86. Gomez-Mampaso, E., Michaux, L., De Rafael, L., Pena, P., Carvajal, A. and Baquero, F. 1975. *Listeria monocytogenes*: faecal carriers and perinatal mortality. Microbiol. Espan. 117:117-128.
87. Goulet, V., Lepoutre, A., Rocourt, J., Courtieu, A.L., Dehaumont, P. and Veit, P. 1993. Epidémie de listériose en France - Bilan final et résultats de l'enquete épidémiologique. Bull. Epidem. Hebdom. 4:13-14.
88. Graves, L.M., Swaminathan, B., Reeves, M.W. and Wenger, J. 1991. Ribosomal DNA fingerprinting of *Listeria monocytogenes* using a dioxigenin-labelled DNA probe. Eur. J. Epidemiol. 7:77-82.
89. Gray, M.L. 1960. Isolation of *Listeria monocytogenes* from oat silage. Science. 132:1767-1768.
90. Gray, M.L.1957. A rapid method for the detection of colonies of *Listeria monocytogenes*. Zbl. Bakt. Parasit. Infekt. Hyg. 1 Orig.169:373-377.
91. Gray, M.L. and Killinger, A.H. 1966. *Listeria monocytogenes* and listeric infections. Bacteriol. Rev. 30:309-382.
92. Gray, M.L., Stafseth, J., Thorp, F., Sholl, L.B. and Riley, W.F.1948. A new technique for isolating *Listerellae* from the bovine brain. J. Bacteriol. 55:471-476.
93. Griffith, M. and Deibel, K.E. 1990. Survival of *Listeria monocytogenes* in yogurt with varying levels of fat and solids. J. Food Safety. 10:219-230.
94. Guyer, S. and Jemmi, T.1991. Behavior of *Listeria monocytogenes* during fabrication and storage of experimentally contaminated smoked salmon. Appl. Environ. Microbiol. 57:1523-1527.
95. Hao, D. Y.-Y., Beuchat, L.R., Brackett, R.E. 1987. Comparison of media and methods for detecting and enumerating *Listeria monocytogenes* in refrigerated cabbage. Appl. Environ. Microbiol. 53:955-957.
96. Hayes, P.S., Graves, L.M., Ajello, G.W., Swaminathan, B., Weaver, R.E., Wenger, J.D., Schuchat, A., Broome, C.W. and the *Listeria* Study Group. 1991. Comparison of cold enrichment and U.S. Department Agriculture methods for isolating *Listeria monocytogenes* from naturally contaminated foods. Appl. Environ. Microbiol. 57:2109-2113.
97. Heisick, J.E., Harrell, F.M., Peterson, E.H., Mclaughlin, S., Wagner, D.E., Wesley, I.V. and Bryner, J. 1989. Comparison of four procedures to detect *Listeria* spp. in foods. J. Food Protect. 52:154-157.
98. Heisick, J.E., Wagner, D.E., Nierman, M.L. and Peeler, J.T. 1989. *Listeria* spp. found on fresh market produce. Appl. Environ. Microbiol. 55:1925-1927.
99. Hofer, E. 1983. Bacteriologic and epidemiologic studies on the occurrence of *Listeria monocytogenes* in healthy cattles. Zbl. Bakt. Hyg. A. 256:175-183.
100. Howard, P.J., Harsono, K.D. and Luchansky, J.B. 1992. Differentiation of *Listeria monocytogenes*, *Listeria innocua*, *Listeria ivanovii*, and *Listeria seeligeri* by pulsed field gel electrophoresis. Appl. Environ. Microbiol. 58:709-712.
101. Husu, J.R. 1990. Epidemiological studies on the occurrence of *Listeria monocytogenes* in the feces of dairy cattle. J. Vet. Med. B. 37:276:282.
102. Husu, J.R., Seppänen, J.T., Sivelä, S.K. and Rauramaa, A.L. 1990. Contamination of raw milk by *Listeria monocytogenes* on dairy farms.

J. Vet. Med. B. 37:268-275.
103. Husu, J.R., Sivelä, S.K. and Rauramaa, A.L. 1990. Prevalence of *Listeria* species as related to chemical quality of farm-ensiled grass. Grass Forage Sci. 45:309-314.
104. Jacquet, Ch., Bille, J. and Rocourt, J. 1992. Typing of *Listeria monocytogenes* by restriction polymorphism of the ribosomal ribonucleic acid gene region. Zbl. Bakt. 276:356-365.
105. Jacquet, Ch., Aubert, S., El Sohl, N. and Rocourt, J. 1992. Use of rRNA gene restriction patterns for the identification of *Listeria* species. System. Appl. Microbiol.15:42-46.
106. Jaton, K., Sahli, R. and Bille, J. 1992. Development of polymerase chain reaction assays for detection of *Listeria monocytogenes* in clinical cerebrospinal fluid samples. J. Clin. Microbiol. 30:1931-1936.
107. Johnson, J.L., Doyle, M.P. and Cassens, R.G.1990. Incidence of *Listeria* spp. in retail meat roasts. J. Food Sci. 55:572-574.
108. Kampelmacher, E.H. and Van Noorle Jansen, L.M. 1972. Further studies on the isolation of *L. monocytogenes* in clinically healthy individuals. Zbl. Bakt. Hyg., I. Abt. Orig. A. 221:70-77.
109. Kathariou, S., Metz, P., Hof, H. and Goebel, W. 1987. Tn *916*-induced mutations in the hemolysin determinant affecting virulence of *Listeria monocytogenes*. J. Bacteriol. 169:1291-1297.
110. Kim, C., Swaminathan, B., Cassaday, P.K., Mayer, L.W. and Holloway, B.P. 1991. Rapid confirmation of *Listeria monocytogenes* isolated from foods by a colony blot assay using a digoxigenin-labeled synthetic oligonucleotide probe. Appl. Environ. Microbiol. 57:1609-1614.
111. Klausner, R.B. and Donnelly, C.W. 1991. Environmental sources of *Listeria* and *Yersinia* in Vermont dairy plants. J. Food Protect. 54:607-611.
112. Klinger, J.D., Johnson, A., Croan, D., Flynn, P., Whippie, K., Kimball, M., Lawrie, J. and Curiale, M. 1988. Comparative studies of nucleic acid hybridization assay for *Listeria* in foods. J. Assoc. Off. Anal. Chem. 71:669-673.
113. Kuhn, M. and Goebel, W. 1989. Identification of an extracellular protein of *Listeria monocytogenes* possibly involved in intracellular uptake by mammalian cells. Infect. Immunity. 57:55-61.
114. Lamont, R.J. and Postlethwaite, R. 1986. Carriage of *Listeria monocytogenes* and related species in pregnant and non-pregnant women in Aberdeen, Scotland. J. Infect. 13:187-193.
115. Larsson, S., Cronberg, S. and Winblad, S. 1979. Listeriosis during pregnancy and neonatal period in Sweden 1958-1974. Acta Paediatr. Scand. 68:485-493.
116. Lattmann, C., Schwarzkopf, A. and Seeliger, H.P.R.1989. Pathogenicity testing of *Listeria* strains isolated from food in fertilized hen's eggs. Zbl. Bakt. Hyg. A. 270:400-405.
117. Leasor, S.B. and Foegeding, P.M.1989. *Listeria* species in commercially broken raw liquid whole egg. J. Food Protect. 52:777-780.
118. Lebrun, M., Loulergue, J., Chaslusdancla, E. and Audurier, A. 1992. Plasmids in *Listeria monocytogenes* in relation to cadmium resistance. Appl. Environ. Microbiol. 58:3183-3186.
119. Lee, W.H. and McClain, D. 1986. Improved *Listeria monocytogenes* selective agar. Appl. Environ. Microbiol. 52:1215-1217.
120. Linnan, M.J., Mascola, L., Lou, X.D., Goulet, V., May, S., Salminen, C., Hird, D.W., Yonekura, M.L., Hayes, P., Weaver, R., Audurier, A., Plikaytis, B.D., Fannin, S.L., Kleks, A. and Broome, C.V. 1988. Epidemic listeriosis associated with Mexican-style cheese. New Engl. J. Med. 319:823-828.
121. Loessner, M.J. 1991. Improved procedure for bacteriophage typing of *Listeria* strains and evaluation of new phages. Appl. Environ. Microbiol. 57:882-884.
122. Loessner, M.J., Bell, R.H., Jay, J.M. and Shelef, L.A. 1988. Comparison of seven plating media for enumeration of *Listeria* spp. Appl. Environ. Microbiol. 54:3003-3007.
123. Loessner, M.J. and Busse, M. 1990. Bacteriophage typing of *Listeria* species. Appl. Environ. Microbiol. 56:1912-1918.
124. Lorber, B. 1991. Listeriosis following shigellosis. Rev. Infect. Dis. 13:865-866.
125. Lovett, J. 1988. Isolation and identification of *Listeria monocytogenes* in dairy products. J. Assoc. Off. Anal. Chem. 71:658-660.
126. Lovett, J., Francis, D.W. and Hunt, J.M. 1987. *Listeria monocytogenes* in raw milk: detection, incidence, and pathogenicity. J. Food Protect. 50:188-192.
127. Low, J.C., Davies, R.C. and Donachie, W. 1992. Purification of listeriolysin-O and development of an immunoassay for diagnosis of listeric infections in sheep. J. Clin. Microbiol. 30:2705-2708.
128. Ludwig, W., Schleifer, K.-H. and Stackebrandt, E. 1984. 16S rRNA analysis of *Listeria monocytogenes* and *Brochothrix thermosphacta*. FEMS Microbiol. Lett. 25:199-204.
129. MacGowan, A.P. 1990. Listeriosis - The therapeutic options. J. Antimicrob. Chemother. 26:721-722.
130. MacGowan, A.P., Marshall, R.J. MacKay, I.M. and Reeves, D.S. 1991. *Listeria* faecal carriage by renal transplant recipients, haemodialysis patients and patients in general practice: its relation to season, drug therapy, foreign travel, animal exposure and diet. Epidemiol. Infect. 106:157-166.
131. Mackaness, G.B. 1962. Cellular resistance to infection. J. Exp. Med. 116:381-406.
132. Mackey, B. M. and Bratchell, N. 1989. The heat resistance of *Listeria monocytogenes*. Lett. Appl. Microbiol. 9:89-94.
133. Mainou-Fowler, T., MacGowan, A.P. and Postlethwaite, R. 1988. Virulence of *Listeria* spp: course of infection in resistant and susceptible mice. J. Med. Microbiol. 27:131-140.
134. Martin, A. and Katz, S.E. 1993. Rapid determination of *Listeria monocytogenes* in foods using a resuscitation/selection/kit system detection. J. Assoc. Off. Anal. Chem. 76:632-636.
135. Massa, S., Cesaroni, D., Poda, G. and Trovatelli, L.D. 1990. The incidence of *Listeria* spp. in soft cheeses, butter and raw milk in the Province of Bologna. J. Appl. Bacteriol. 68:153-156.
136. Mattingly, J.A., Butman, B.T., Plank, M.C., Durham, R.J. and Robison, B.J. 1988. Rapid monoclonal antibody-based-enzyme-linked immunosorbent assay for detection of *Listeria* in food products. J. Assoc. Off. Anal. Chem. 71:679-681.
137. Mazurier, S.I. and Wernars, K.1992. Typing of *Listeria* strains by random amplification of polymorphic DNA. Res. Microbiol. 143:499-505.
138. McCarthy, S.A. 1991. Pathogenicity of nonstressed, heat-stressed, and resuscitated *Listeria monocytogenes* 1A1-cells. Applied and Environmental Microbiology. 57:2389-2391.
139. McLauchlin, J. 1990. Distribution of serovars of *Listeria monocytogenes* isolated from different categories of patients with listeriosis. Eur. J. Clin. Microbiol. Infect. Dis. 9:210-213.
140. McLauchlin, J., Audurier, A. and Taylor, A.G. 1986. Aspects of the epidemiology of human *Listeria monocytogenes* infections in Britain 1967-1984; the use of serotyping and phage-typing. J. Med. Microbiol. 22:367-377.
141. McLauchlin, J., Audurier, A. and Taylor, A.G. 1991. Treatment failure and recurrent human listeriosis. J. Antimicrob. Chemother. 27:851-857.
142. McLauchlin, J., Hall, S.M., Velani, S.K. and Gilbert, R.J. 1991. Human listeriosis and pate - A possible association. Brit. Med. J. 303:773-775.
143. McLauchlin, J. and Pini, P.N. 1989. The rapid demonstration and presumptive identification of *Listeria monocytogenes* in food using monoclonal antibodies in a direct immunofluorescence test (DIFT). Lett. Appl. Microbiol. 8:25-27.
144. Mengaud, J., Braunbreton, C. and Cossart, P. 1991. Identification of phosphatidylinositol-specific phospholipase-C activity in *Listeria monocytogenes* - A novel type of virulence factor. Mol. Microbiol. 5:367-372.
145. Motes, M.L. 1991. Incidence of *Listeria* spp. in shrimp, oysters, and estuarine waters. J. Food Protect. 54:170-173.
146. Niederhauser, C., Candrian, U., Hofelein, C., Jermini, M., Buhler, H.P. and Luthy, J. 1992. Use of polymerase chain reaction for detection of *Listeria monocytogenes* in food. Appl. Environ. Microbiol. 58:1564-1568.
147. Nieman, R.E. and Lorber, B. 1980. Listeriosis in adult: a changing pattern - Report of eight cases and review of the literature, 1968-1978. Rev. Infect. Dis. 2:207-227.
148. Noah, C.W., Perez, J.C., Ramos, N.C., McKee, C.R. and Gipson, M.V. 1991. Detection of *Listeria* spp. in naturally contaminated seafoods using four enrichment procedures. J. Food Protect. 54:174-177.
149. Nocera, D., Altwegg, M., Martinetti Lucchini, G., Bannerman, E., Ischer, F., Rocourt, J. and Bille, J.1993. Characterization of *Listeria* strains from a foodborne listeriosis outbreak by rDNA gene restriction patterns compared to four other typing methods. Eur. J. Clin. Microbiol. Infect. Dis. 12:162-169.
150. Nocera, D., Bannerman, E., Rocourt, J., Jaton-Ogay, K. and Bille, J. 1990. Characterization by DNA restriction endonuclease analysis of *Listeria monocytogenes* strains related to the Swiss epidemic of listeriosis. J. Clin. Microbiol. 28:2259-2263.
151. Notermans, S., Chakraborty, T., Leimeister-Wächter, M., Dufrenne, J., Heuvelman, K.J., Maas, H., Jansen, W., Wernars, K. and Guinee, P. 1989. Specific gene probe for detection of biotyped and serotyped *Listeria* strains. Appl. Environ. Microbiol. 55:902-906.

152. Notermans, S., Dufrenne, J., Chakraborty, T., Steinmeyer, S. and Terplan, G. 1991. The chick embryo test agrees with the mouse bioassay for assessment of the pathogenicity of *Listeria* species. Lett. Appl. Microbiol.13:161-164.
153. Okwumabua, O., Swaminathan, B., Edmonds, P., Wenger, J., Hogan, J. and Alden, M. 1992. Evaluation of a chemiluminescent DNA probe assay for the rapid confirmation of *Listeria monocytogenes*. Res. Microbiol. 143:183-189.
154. Perry, C.M. and Donnelly, C.W. 1990. Incidence of *Listeria monocytogenes* in silage and its subsequent control by specific and nonspecific antagonism. J. Food Protect. 53:642-647.
155. Peterkin, P.I., Gardiner, M.A., Malik, N. and Idziak, E.S. 1992. Plasmids in *Listeria monocytogenes* and other *Listeria* species. Canad. J . Microbiol. 38:161-164.
156. Peterkin, P.I., Idziak, E.S. and Sharpe, A.N.1991. Detection of *Listeria monocytogenes* by direct colony hybridization on hydrophobic Grid-membrane filters by using a chromogen-labeled DNA probe. Appl. Environ. Microbiol. 57:586-591.
157. Phillips, J.D. and Griffiths, M.W. 1989. An electrical method for detecting *Listeria* spp. Lett. Appl. Microbiol. 9:129-132.
158. Piffaretti, J.C., Kressenbuch, H., Aeschbacher, M., Bille, J., Bannerman, E., Musser, J.M., Selander, R.K. and Rocourt, J. 1989. Genetic characterization of clones of the bacterium *Listeria monocytogenes* causing epidemic disease. Proc. Nat. Acad. Sci. U.S.A. 86:3818-3822.
159. Pine, L., Kathariou, S., Quinn, F., George, V., Wenger, J.D. and Weaver, R.E. 1991. Cytophatogenic effects in enterocytelike Caco-2 cells differentiate virulent from avirulent *Listeria* strains. J. Clin. Microbiol. 29:990-996.
160. Pini, P.N. and Gilbert, R.J. 1988. A comparison of two procedures for the isolation of *Listeria monocytogenes* from raw chickens and soft cheeses. Int. J. Food Microbiol. 7:331-337.
161. Pinner, R.W., Schuchat, A., Swaminathan, B., Hayes, P.S., Deaver, K.A., Weaver, R.E., Plikaytis, B.D., Reeves, M., Broome, C.V. and Wenger, J.D. 1992. Role of foods in sporadic listeriosis. 2. Microbiologic and epidemiologic investigation. J. Amer. Med. Assoc. 267:2046-2050.
162. Portnoy, D.A., Chakraborty, T., Goebel, W. and Cossart, P. 1992. Molecular determinants of *Listeria monocytogenes* pathogenesis. Infect. Immunity. 60:1263-1267.
163. Poyart-Salmeron, C., Trieucuot, P., Carlier, C., Macgowan, A., Mclauchlin, J. and Courvalin, P. 1992. Genetic basis of tetracycline resistance in clinical isolates of *Listeria monocytogenes*. Antimicrob. Agents Chemother. 36:463-466.
164. Ralovich, B., Forray, A., Mérö, E., Malovics, H. and Szazados, I. 1971. New selective medium for isolation of *L. monocytogenes*. Zbl. Bakt. I. Abt. Orig. 216:88-91.
165. Rasmussen, O.F., Beck, T., Olsen, J.E., Dons, L. and Rossen, L. 1991. *Listeria monocytogenes* isolates can be classified into two major types according to the sequence of the listeriolysin gene. Infection and Immunity. 59:3945-3951.
166. Raveneau, J., Geoffroy, C., Beretti, J.L., Gaillard, J.L., Alouf, J.E. and Berche, P. 1992. Reduced virulence of a *Listeria monocytogenes* phospholipase deficient mutant obtained by transposon insertion into the zinc metalloprotease gene. Infect. Immunity. 60:916-921.
167. Rocourt, J. 1986. Bactériophages et bactériocines du genre *Listeria*. Zbl. Bakt. Hyg. A. 261:12-28.
168. Rocourt, J. 1991. Human listeriosis - 1989. WHO/HPP/FOS/91.3, World Health Organization, Geneva.
169. Rocourt, J. 1988. Taxonomy of the genus *Listeria*. Infect. 16, Suppl. 2:89-91.
170. Rocourt, J., Alonso, J.M. and Seeliger, H.P.R. 1983. Virulence comparée des cinq groupes génomiques de *Listeria monocytogenes* (sensu lato). Ann. Microbiol. (Inst. Pasteur). 134A:359-364.
171. Rocourt, J., Audurier, A., Courtieu, A.L., Durst, J., Ortel, S., Schrettenbrunner, A. and Taylor, A.G. 1985. A multi-centre study on the phage-typing of *Listeria monocytogenes*. Zbl. Bakt. Hyg. A. 259:489-497.
172. Rocourt, J., Boerlin, P., Grimont, F., Jacquet, Ch. and Piffaretti, J.-C. 1992. Assignment of *Listeria grayi* and *Listeria murrayi* to a single species, *Listeria grayi*, with a revised description of *Listeria* grayi. Int. J. System. Bacteriol. 42:69-73.
173. Rocourt, J. and Brosch, R. 1991. Human listeriosis - 1990. WHO/HPP/FOS/91.3.
174. Rocourt, J. and Seeliger, H.P.R.1985. La listériose: une infection hospitaliere? Med. Mal. Infect. 12:721-725.
175. Rocourt, J., Wehmeyer, U. and Stackebrandt, E.1987. Transfer of *Listeria denitrificans* to a new genus, *Jonesia* gen. nov., as *Jonesia denitrificans* comb. nov. Int. J. System. Bacteriol. 37:266-270.
176. Saxbe, W.B. Jr. 1972. *Listeria monocytogenes* and the Queen Anne. Pediatrics. 49:97-101.
177. Schaack, M.M. and Marth, E.H. 1988. Behavior of *Listeria monocytogenes* in skim milk during fermentation with mesophilic lactic starter cultures. J. Food Protect. 51:600-606.
178. Schlech III, W.F., Lavigne, P.M., Bortolussi, R.A., Allen, A.C., Haldane, E.V., Wort, A.J., Hightower, A.W., Johnson, S.E., King, S.H., Nicholls, E.S., and Broome, C.V. 1983. Epidemic listeriosis - Evidence for transmission by food. New Engl. J. Med. 308:203-206.
179. Schönberg, A., Teufel, P. and Weise, E. 1989. Serovars of *Listeria monocytogenes* and *Listeria innocua* from food. Acta Microbiol. Hung. 36:249-253.
180. Schuchat, A. 1993. Epidemiology of listeriosis in the United States. ILSI Symposium on foodborne microbial pathogens. Atlanta (USA). (Abstract no. 8).
181. Schuchat, A., Deaver, K.A., Wenger, J.D., Plikaytis, B.D., Mascola, L., Pinner, R.W., Reingold, A.L. and Broome, C.V. 1992. Role of foods in sporadic listeriosis. 1. Case-control study of dietary risk factors. J. Amer. Med. Assoc. 267:2041-2045.
182. Schuchat, A., Pinner, R.W., Deaver, K., Swaminathan, B., Weaver, R., Hayes, P.S., Reeves, M., Pierce, P., Wenger, J.D., Broome, C.V. and *Listeria* Study Group. 1991. Epidemiology of listeriosis in the USA. In: *Listeria* et Sécurité Alimentaire/*Listeria* and Food Safety, (Proceedings of the International Conference on June 13-14 1991 in Laval, France), ASEPT ed., Laval, pp. 69-73.
183. Schwartz, B., Hexter, D., Broome, C.V., Hightower, A.W., Hirschhorn, R.B., Porter, J.D., Hayes, P.S., Bibb, W.F., Lorber, B. and Faris, D.G. 1989. Investigation of an outbreak of listeriosis: new hypotheses for the etiology of epidemic *Listeria monocytogenes* infections. J. Infect. Dis. 159:680-685.
184. Seeliger, H.P.R. and Höhne, K. 1979. Serotyping of *Listeria monocytogenes* and related species. in: Methods in Microbiology (Bergan, T. and Norris, J., ed.). Academic Press, New York: 33-48.
185. Skjerve, E., Rorvik, L.M. and Olsvik, O.1990. Detection of *Listeria monocytogenes* in foods by immunomagnetic separation. Appl. Environ. Microbiol. 56:3478-3481.
186. Skogberg, K., Syrjanen, J., Jahkola, M., Renkonen, O.V., Paavonen, J., Ahonen, J., Kontiainen, S., Ruutu, P. and Valtonen, V. 1992. Clinical presentation and outcome of listeriosis in patients with and without immunosuppressive therapy. Clin. Infect. Dis. 14:815-821.
187. Skovgaard, N. and Morgen, C.-A. 1988. Detection of *Listeria* spp. in faeces from animals, in feeds, and in raw foods of animal origin. Int. J. Food Microbiol. 6:229-242.
188. Skovgaard, N. and Norrung, B. 1989. The incidence of *Listeria* spp. in faeces of Danish pigs and in minced pork meat. Int. J. Food Microbiol. 8:59-63.
189. Slade, P.J. and Collins-Thomson, J. 1988. Comparison of two stays and direct selective enrichment-techniques for isolating *Listeria* spp. from raw milk. J. Food. Sci. 53:1694-1697.
190. Slade, P.J. and Collins-Thompson, D.L. 1988. Incidence of *Listeria* species in Ontario raw milk. Can. Inst. Food Sci. Technol. J. 21:425-429.
191. Smith, J.L. and Archer, D.L. 1988. Heat-induced injury in *Listeria monocytogenes*. J. Indust. Microbiol. 3:105-110.
192. Spurlock, A.T. and Zottola, E.A. 1991. The survival of *Listeria monocytogenes* in aerosols. J. Food Protect. 54:910-916.
193. Starbuck, M.A.B., Hill, P.J. and Stewart, G.S.A.B. 1992. Ultra sensitive detection of *Listeria monocytogenes* in milk by the polymerase chain reaction (PCR). Lett. Appl. Microbiol. 15:248-252.
194. Stelma, G.N., Reyes, A.L., Peeler, J.T., Francis, D.W., Hunt, J.M., Spaulding, P.L., Johnson, C.H. and Lovett, J. 1987. Pathogenicity test for *Listeria monocytogenes* using immunocompromised mice. J. Clin. Microbiol. 25:2085-2089.
195. Sun, A.N., Camilli, A. and Portnoy, D.A. 1990. Isolation of *Listeria monocytogenes* small-plaque mutants defective for intracellular growth and cell-to-cell spread. Infect. Immunity. 58:3770-3778.
196. Swaminathan, B., Hayes, P.S., Przybyszewski, V.A. and Plikaytis, B.D. 1988. Evaluation of enrichment and plating media for isolating *Listeria monocytogenes*. J. Assoc. Off. Anal. Chem. 71:664-667.
197. Tabouret, M., Derycke, J. and Dubray, G. 1992. Analysis of surface proteins of *Listeria* in relation to species, serovar and pathogenicity. J. Gen. Microbiol. 138:743-753.

198. Tabouret, M., Derycke, J., Audurier, A. and Poutrel, B. 1991. Pathogenicity of *Listeria monocytogenes* isolates in immunocompromised mice in relation to listeriolysin production. J. Med. Microbiol.34:13-18.
199. Terplan, G. and Steinmeyer, S. 1989. Investigations on the pathogenicity of *Listeria* spp. by experimental infection of the chick embryo. Int. J. Food Microbiol. 8:277-280.
200. Thomas, E.J.G., King, R.K., Burchak, J. and Gannon, V.P.J. 1991. Sensitive and specific detection of *Listeria monocytogenes* in milk and ground beef with the polymerase chain reaction. Appl. Environ. Microbiol. 57:2576-2580.
201. Van Netten, P., Perales, I., Van de Moosdijk, A., Curtis, G.D.W. and Mossel, D.A.A.1989. Liquid and solid selective differential media for the detection and enumeration of *L. monocytogenes* and other *Listeria* spp. Int. J. Food Microbiol. 8:299-316.
202. Van Renterghem, B., Huysman, F., Rygole, R. and Verstraete, W. 1991. Detection and prevalence of *Listeria monocytogenes* in the agricultural ecosystem. J. Appl. Bacteriol. 71:211-217.
203. Vazquez-Boland, J.A., Kocks, C., Dramsi, S., Ohayon, H., Geoffroy, C., Mengaud, J. and Cossart, P. 1992. Nucleotide sequence of the lecithinase operon of *Listeria monocytogenes* and possible role of lecithinase in cell-to-cell spread. Infect. Immunity. 60:219-230.
204. Vines, A., Reeves, M.W., Hunter, S. and Swaminathan, B. 1992. Restriction fragment length polymorphism in 4 virulence-associated genes of *Listeria monocytogenes*. Res. Microbiol. 143:281-294.
205. Walker, R.L., Jensen, L.H., Kinde, H.; Alexander, A.V. and Owens, L.S. 1991. Environment survey for *Listeria* species in frozen milk product plants in California. J. Food Protect. 54:178-182.
206. Walker, S.J., Archer, P. and Appleyard, J. 1990. Comparison of the *Listeria*-Tek ELISA kit with cultural procedures for the detection of *Listeria* species in food. Food Microbiol. 7:335-342.
207. Wang, R.F., Cao, W.W. and Johnson, M.G. 1992. 16S rRNA-based probes and polymerase chain reaction method to detect *Listeria monocytogenes* cells added to foods. Appl. Environ. Microbiol. 58: 2827-2831.
208. Wang, R.F., Cao, W.W. and Johnson, M.G. 1992. Development of cell surface protein associated gene probe specific for *Listeria monocytogenes* and detection of the bacteria in food by PCR. Mol. Cell. Probes. 6:119-129.
209. Warburton, D.W., Farber, J.M., Armstrong, A., Caldeira, R., Tiwari, N.P., Babiuk, T., Lacasse, P. and Read, S. 1991. A Canadian comparative study of modified versions of the "FDA" and "USDA" methods for the detection of *Listeria monocytogenes*. J. Food Protect. 54:669-676.
210. Weagent, S.D., Sado, P.N., Colburn, K.G., Torkelson, J.D., Stanley, F.A., Krane, M.H., Shields, S.C. and Thayer, C.F. 1988. The incidence of *Listeria* species in frozen seafood products. J. Food Protect. 51:655-657.
211. Weis, J. and Seeliger, H.P.R. 1975. Incidence of *Listeria monocytogenes* in nature. Appl. Microbiol. 30:29-32.
212. Welshimer, H.J. 1968. Isolation of *Listeria monocytogenes* from vegetation. J. Bacteriol. 95:300-303.
213. Wenger, J.D., Swaminathan, B., Hayes, P.S., Green, S.S., Pratt, M., Pinner, R.W., Schuchat, A. and Broome, C.V. 1990. *Listeria monocytogenes* contamination of turkey franks: evaluation of a production facility. J. Food Protect. 53:1015-1019.
214. Wernars, K., Heuvelman, K., Notermans, S., Domann, E., Leimeisterwachter, M. and Chakraborty, T. 1992. Suitability of the prfA gene, which encodes a regulator of virulence genes in *Listeria monocytogenes*, in the identification of pathogenic *Listeria* spp. Appl. Environ. Microbiol. 58:765-768.
215. Wesley, I.V. and Ashton, F. 1991. Restriction enzyme analysis of *Listeria monocytogenes* strains associated with foodborne epidemics. Appl. Environ. Microbiol. 57:969-975.
216. Westoo, A. and Peterz, M. 1992. Evaluation of methods for detection of *Listeria monocytogenes* in foods - NMKL collaborative study. J. Assoc. Off. Anal. Chem. 75:46-52.
217. Wiedmann, M., Czajka, J., Barany, F. and Batt, C.A. 1992. Discrimination of *Listeria monocytogenes* from other *Listeria* species by ligase chain reaction. Appl. Environ. Microbiol. 58:3443-3447.
218. Wimpfheimer, L., Altman, N.S. and Hotchkiss, J.H. 1990. Growth of *Listeria monocytogenes* Scott A, serotype 4 and competitive spoilage organisms in raw chicken packaged under modified atmospheres and in air. Int. J. Food Microbiol. 11:205-214.
219. Yen, L.C., Sofos, J.N. and Schmidt, G.R. 1991. Effect of meat curing ingredients on thermal destruction of *Listeria monocytogenes* in ground pork. J. Food Protect. 54:408-412.
220. Yu, L.S.L. and Fung, D.Y.C. 1991. Evaluation of FDA and USDA procedures for enumerating *Listeria monocytogenes* in ground beef. Food Microbiol. 8:69-74.

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Industry Perspectives on *Listeria monocytogenes* in Foods: Raw Meat and Poultry

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Abstract

Industry is committed to reducing the incidence of *Listeria monocytogenes* in both raw and cooked meat and poultry products. Pathogenic organisms are often present in small numbers and are part of the natural microbial flora of live animals. *Listeria monocytogenes* acts as an opportunistic pathogen which has the capacity to sustain itself in humans. Because of its nature, *Listeria monocytogenes* can occasionally cause disease in compromised individuals. Thus, infection and disease are as dependent on the host as on the microorganism. This is the reason that the infectious dose is dependent on the virulence of the organism and the obesity of the host immune system to resist infection.

Controlling the microbiological contamination of raw meat and poultry products is a primary area of focus in our industry. Research efforts are underway to identify control points in slaughter and processing operations which are designed to reduce the incidence of *Listeria monocytogenes* and other pathogens in raw product. New technology developed in part by AMI research on organic acid carcass sprays and decontamination procedures offers practical means to reduce microbial contaminants. Research is also being conducted to determine the effect of low dose gamma irradiation on *Listeria monocytogenes* and other pathogens in ground beef. Preliminary results indicate that this technology is effective. Through the application of thermal processes that assure the destruction of *Listeria monocytogenes* and through the wide use of HACCP and GMP's, improved sanitation, separation of raw materials from cooked product and other measures designed to reduce the probability of recontamination, the incidence of *Listeria monocytogenes* in cooked ready-to-eat produce is exceedingly low. However, unless these products are absolutely sterilized, the incidence is not likely to ever be zero: and even if the incidence is zero, recontamination and outgrowth may occur further down the food chain.

The absolute elimination of *Listeria monocytogenes* from the food supply is not a realistic objective. Additional measures can be taken to prevent listeriosis. An educational program should be developed which would be targeted at physicians and at risk individuals on food choice decisions and appropriate preparation methods to assure *Listeria monocytogenes* is not present in the food they eat. Research is needed to gain a better understanding of the pathogenicity of *Listeria monocytogenes* in humans and a better methodology is needed to differentiate virulent from non-virulent strains and to identify genetic markers associated with invasiveness.

Introduction

Over the past few weeks, two disparate events took place which underscore the problems that both industry and government regulators face in addressing the issue of *Listeria monocytogenes* in meat and poultry products.

The first of these events was a presentation by Dr. Mitchell Cohen, Director of Bacterial and Mycoten Diseases at the Center for Disease Control, in which he stated that unreheated hot dogs are no longer a risk factor for listeriosis in CDC data. Dr. Cohen also cited industry efforts to control *Listeria* as a major factor in the decline in *Listeria* cases in the U.S. from about 2,000 cases per year to about 900-1,000 cases per year. You may recall that a 1988 CDC case control study estimated that 20% of the sporadic cases of listeriosis in the U.S. were due to eating hot dogs not thoroughly reheated before serving or eating undercooked chicken. Dr. Cohen's comments reflect a massive effort on the part of the U.S. meat and poultry industry to control *Listeria monocytogenes*.

The other event occurred on July 15, when an article entitled "Undercooked Hot Dogs May Pose Health Risk, Tests Show" appeared in a front page story in the Los Angeles Times. Don Puzo, the staff writer of the LA Times responsible for the story conducted a test of 30 hot dog products and found 5 positives for *Listeria monocytogenes* and 1 positive for *L. innocua* -an overall positive rate of 20%.

While this level of *Listeria monocytogenes* in hot dogs is much higher than has been shown in other U.S. surveys, it serves as a reminder that there are still no fail safe production procedures for producing *Listeria* free meat and poultry products.

Considering the prevalence of *Listeria monocytogenes* reported in surveys, processed meat and poultry products

have been implicated in few instances of listeriosis in the U.S. Below are statistics and information related to meat and poultry products testing positive for *Listeria monocytogenes*. In addition, information below also includes guidelines for controlling *Listeria* in the meat and poultry industry and statistics and facts about listeriosis.

Relevant Facts About *Listeria monocytogenes* and the Illness—Listeriosis

The CDC has reported few cases of Listeriosis associated with meat and poultry products. One documented case (CDC Morbidity and Mortality Report-April 21, 1989) was reported as follows: "In December, 1988, a woman with cancer was hospitalized in Oklahoma with sepsis caused by *Listeria monocytogenes*." The woman subsequently died of cancer, not Listeriosis.

Processed Meats Implicated in Listeriosis

Product	Country	Number of Cases
Cooked chicken	England	1
Turkey frankfurters	USA	1
Pork & rice sausage	USA	1
Pork sausage	Italy	1
Pâté	UK	>300
Pâté	Australia	11

Source: Tompkin et al. 1992, Food Australia 44 (8)

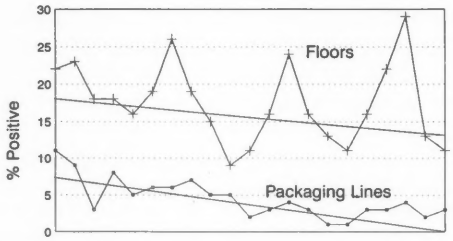


Figure 1. Incidence of *Listeria* on packaging lines and in the environment (floors) from 8/88-1/92

Source: Tompkin et al. 1992, Food Australia 44 (8)

Results of the USDA Program for *Listeria* in Processed Meats (7/89 to 2/9/93)

Product	Number of Samples	Plants w/ Positive Lm
Cooked roast beef	2,993	68
Sliced cooked ham	915	16
Cooked sausages	6,231	100
Cooked poultry	4,326	46
Salads/Spreads	3,828	50
Jerky	514	0
Imported cooked beef	1,489	14
TOTAL	20,296	294

Source: Green, 1993

Incidence of *Salmonella*, *Listeria monocytogenes*, and *E. coli* O157:H7 in Raw Preformed Patties

Pathogen	Total Number Samples Analyzed	Total Number Samples Positive	%Positive
Salmonella	974	46	4.7
L. monocytogenes	517	224	43.3
E. coli O157	50	0	0

Reported Incidence of *Listeria* in Ready-to-Eat Meat and Poultry Products

Country	Number of Samples	Lm	Lsp
Australia	175	45	10
Germany	560	8	12
Hungary	266	22	33
England, Wales	4,635	10	15
Canada	114	10	7
USA	15,165	2	NR

Source: Tompkins, et al., 1992 44 (8)

Incidence of *Listeria* in Post Processing Environments Prior to Implementation of *Listeria* Control Program

Location	Percent Positive
Floors	37
Drains	37
Cleaning Aids	24
Wash Areas	24
Sausage Peelers	22
Food Contact Surfaces	20
Condensate	7
Walls and Ceilings	5
Compressed Air	4

Listeria Control Principles

- Processes must rely on a traditional approach which requires:
  1. A rigid environmental sanitation program encompassing personal hygiene, separation of raw and ready-to-eat processing areas and sanitation and clean-up procedures which have been monitored to proven effectiveness.
  2. A Hazard Analysis and Critical Control Point (HACCP) program to insure microbiological safety of products which includes the quality and safety of ingredients, the control of the process on a continuing basis and conditions under which product is handled and stored.
  3. Trained, knowledgeable supervision for sanitation operations.
- Do not ascribe all problems to poor sanitation programs. A high level of performance by all elements of the manufacturing process is required.

Listeria Control Principles

Product Equipment	• Free of recesses, open seams, gaps, protruding ledges, inside shoulders, exposed bolts and rivets, and free of dead ends.
Cleaning and Sanitizing	• Dependable equipment, designed for equipment job
Pallets	• Good repair, clean and dry
Blowers and Ducts	• Cleaned routinely
Wet/Dry Vacuum Canisters	• Cleaned after use
Refrigeration Units	• Cleaned and sanitized routinely

Must have a total commitment to a long term undertaking by all levels of management and production employees.

- Fail-safe procedures for the production of *Listeria* -free meat products have not been developed.

Exposure to *Listeria monocytogenes* Does Not Constitute Disease

Several studies have documented the recovery of pathogenic strains of *L. monocytogenes* from the gastrointestinal tract of asymptomatic individual, including those at high risk, such as pregnant women and transplant recipients. These, coupled with the recognition that this soil organism can be isolated throughout the food chain, exposure clearly does not constitute disease.

Healthy Adults Exposed to *L. monocytogenes*: No symptoms or mild gastroenteritis

Susceptible Individuals:

Unborn, newborn
Persons with impaired immune systems:
Pregnant women (especially in 2nd and 3rd trimester)
Elderly, infirm
Persons on corticosteroid therapy, hemodialysis, or other treatments.
Persons with Leukemia, AIDS, or other illnesses affecting the immune system.

Serious Forms of Listeriosis Contracted by High Risk Individuals:

Meningitis, Septicemia, Endocarditis, Abscesses, Abortion/Stillbirth, Osteomyltis, Encephalitis, Local Lesions, or Mini-Granulomas (in spleen, gall bladder, skin, lymph nodes)

Factors Affecting Host Susceptibility/Listeriosis

1. Impairment of resistance to colonization in the gastrointestinal tract by antibiotics.
2. Diminished gastric acidity possibly due to disruption of microflora in the gut.
3. A concurrent illness in the Gastrointestinal Tract that disturbs the mucosal integrity.
4. Impairment of T-cell mediated immunity i.e., Immunosuppressive therapy and AIDS.
5. Suppression of IgM immune function i.e., neonates with low level of IgM.

Clinical Manifestations of Listeriosis

- Septic abortion
- Newborn and Adult Septicemia
- Meningitis
- Meningoencephalitis

Outbreaks of Listeriosis

Date	Location	Vehicle	Predominant Serotype	# Cases
1979	Boston	Raw Vegetables	4b	23
1980	New Zealand	Shellfish	Ib	22
1981	Maritime Provinces	Coleslaw	4b	41
1983	Massachusetts	Pasteurized Milk	4b	49
1985	California	Mexican Cheese	4b	230
1987	Switzerland	Soft Cheese	4b	122

Distribution of Listeriosis Cases in California Outbreak

Type	No. of Cases	No. of Deaths	Mortality Percents
Perinatal	93	29	31
Adult	49	18	37
Overall	142	47	33

Distribution of Listeriosis Cases in California Outbreak

"Multifaceted studies of this outbreak revealed that all perinatal cases were associated with consumption by pregnant, mainly hispanic, women of mexican-style cheese from one plant. The outbreak strain, serotype 4b, was recovered from unopened cheese packages and from the plant environment. The 49 non-pregnant adults had no recollection of cheese consumption and were regarded by the Los Angeles County Public Health Service (S. Fannin, Pers. Commun.) as background cases, not associated with the outbreak."

Source: Twedt, 1986

Opportunistic Infection

Infection caused by organisms that do not usually produce disease in healthy people, or widespread infection by organisms that normally produce only mild, local, infection. Many of the causative organisms are normally present on or in the human body cause disease only when the host's immune system is impaired.

Impairment of natural defenses may be due to treatment with anticancer and immunosuppressant drugs, to radiation therapy, or to disease such as leukemia. Opportunistic infections also affect premature or malnourished infants and people with immunodeficiency disorders.

Opportunistic infections are often unavoidable because the underlying defects in the host's defenses cannot easily be rectified. However, treatment with appropriate antimicrobial drugs may be lifesaving.

Foodborne Illness and Immune-Compromised Consumers

Probably any microorganism which has the capacity to sustain itself in humans will occasionally cause disease in compromised individuals and act as an opportunistic pathogen. Thus, infection and disease are as dependent on the host as on the microorganism.

Gram Negative Sepsis

Gram-negative bacteremia and sepsis, which were rare in the preantibiotic era, have increased in frequency in the second half of this century. This life-threatening infection usually occurs in patients with serious underlying disease and is often a complication of hospitalization.

Incidence in US: 100,000 to 300,000 cases per year
Mortality 20-50%

AMI Survey on Serotypes of *Listeria monocytogenes* Isolated from Each Ready-to-Eat Meat

Product Group	Serotype 1/2a	Serotype 1/2b	Serotype 3a	Serotype 3b	Serotype 4a	Serotype 4b	Serotype 4d
Hot Dogs	26	28	2	12	1	2	9
Bologna	9	4	0	1	1	0	0
Smoked Sausage	6	2	0	0	0	0	0
Ham Products	2	1	0	1	0	0	0
Poultry Breasts	2	0	0	1	0	0	0
Total	45	35	2	15	2	2	9

Comparison of Serovar Distribution of 68 Strains of *Listeria monocytogenes* Isolated in 1984 and 1985 Meat Products and Serovar Distribution of 355 Strains Isolated from Human Cases from 1984 and 1985 in France

Serovar	% of Strains Isolated from Meat Products (68 Strains)	% of Strains Isolated from Human Cases (355 Cases)
1/2a	34	12.7
1/2b	1.5	17.4
1/2c	3	1.7
3b	0	0.6
4b	1.5	66.5
NT	0	1.1

AMI Meat Safety Working Group Recommendations to NACMF *Listeria* Working Group

1. Develop methodology to differentiate virulent from nonvirulent strains of *Listeria monocytogenes* and to identify genetic markers associated with invasiveness.
2. Clarify the manifestations of disease associated with *Listeria monocytogenes* and distinguish between:
   a. Random individual cases of opportunistic infection among immune-compromised populations
   b. Acute foodborne illness
3. Determine the incidence of virulent types of *Listeria monocytogenes* in the food supply.

How Can Listeriosis be Prevented?

- If you are at risk, check with your physician.
- Follow the rules of safe food preparation:
  -Wash hands before handling food and especially after handling raw foods.
  -Keep hot foods hot (above 140°F).
  -Keep cold foods cold (below 40°F).
  -Thoroughly cook meat, poultry, and seafood, and adequately heat frozen or refrigerated foods.
  -Chill foods rapidly in shallow containers.

Dairy, Food and Environmental Sanitation, Vol. 14, No. 2, Page 87 (February 1994)

Foodborne Illness (Part 4)

Bacillus cereus Gastroenteritis

George H. Reed, Services Manager,
University of Massachusetts/Amherst,
Environmental Health & Safety (EH&S),
Environmental Health Services,
N 414 Morrill Science,
Amherst, MA 01003

Bacillus cereus is widespread in the environment (soil and dust) and is probably present in many raw foods. The bacterium is a rod-shaped, facultative spore-former. The organism grows in the temperature range of 41 F (5°C) to 122 F (50°C), with the optimum between 95°F (35°C) and 104 F (40°C). The pH range for of growth is 4.3 to 9.0; minimum water activity (a_w) for growth reported at 0.95.

This sporeformer generally survives food (heat) processing and is normally present in many foods from harvest through primary processing, usually at low levels where it is not a foodborne hazard. Problems develop when temperature abuse occurs and food products, usually in large batches, are held in the "danger zone" (45 to 140°F [7.2 to 60°C]) for a long period of time. A population of > 10 cells/g of food seem to be required to cause illness.

Two *B. cereus* illness syndromes are caused by distinct toxins:

- the *diarrheal* type (similar to *C. perfringens*) occurs within 8-16 hours (mean, 12) after food consumption, with symptoms of profuse, watery diarrhea, abdominal pain, and, less commonly, nausea; vomiting rare. Symptoms last about 12-24 hours. Foods involved have been varied, ranging from starchy vegetables and salads to proteinaceous foods (meat products and casseroles), sauces, cereal products, puddings, and spices. What happens? Spores survive the cooking process and unsatisfactory postcooking storage allows spores to germinate (with cooking reducing microbial competition) and grow to large numbers. In this syndrome the bacteria produces toxin in both the food product and the intestine. The toxin is heat-labile.
- the *emetic* (vomiting) type (mimics "staph" food poisoning) occurs within 0.5 to 5 hours after food ingested, with symptoms of vomiting and nausea, and only occasionally diarrhea. Symptoms last from 6-24 hours. Rice in some form seems to be the major food implicated in outbreaks; other starchy foods, such as macaroni and cheese, have been implicated. Cooked (boiled) rice, prepared in bulk, is allowed to cool at room temperature overnight; for serving the rice may be reheated/fried and held "warm" until needed or quickly fried for serving; this type of handling allows the agent to grow, producing the preformed toxin in the food; ingestion of this toxin results in rapid onset of illness. This toxin is heat-stable.

Control Measures

It is probable that the organism will be present in many foods, with time-temperature abuse a major factor in development of large numbers of bacteria; precise temperature monitoring is desirable. Therefore, prevention is two-fold: OVER destruction by a heat process and control of growth by proper holding methods. Consuming freshly prepared foods immediately is safe. The following measures will reduce or eliminate the threat of food poisoning by *B. cereus*:

- Try to avoid preparing food too far in advance of planned service.
- Holding cooked foods at room temperature should be avoided.
- Use quick chill methods to cool foods below 45°F (7.2°C) within 4 hours of preparation; store in shallow pans/small quantities with the food less than 4 inches deep; if food is especially thick (example, refried beans), store no more than 3 inches deep.
- Hold/store hot foods above 140°F (60°C) until served.
- Reheat foods rapidly to 165°F (74°C) or above.

Some specifics for handling cooked rice:

- Prepare in small batches several times throughout operating hours.
- While holding/serving keep prepared rice hot, above 140°F (60°C).
- For storage, cool quickly in shallow containers/small quantities in adequate refrigeration, below 45°F [7.2°C] (preferably at 40°F [4.4°C] or below). Do not store at room temperature.
- Cook fried rice thoroughly to a temperature exceeding 165°F (74°C).

Part five of the Foodborne Illness Series will be published in the March, 1994 issue of Dairy, Food and Environmental Sanitation.

Updates . . .

*TENTATIVE**
Symposia and Technical Sessions for the 1994 IAMFES Annual Meeting

July 31-August 3, 1994
San Antonio, Texas

The following is a list of symposia and technical sessions to be presented at the 81st IAMFES Annual Meeting. A more complete listing will be published in the April "Pre-Convention Issue" of *Dairy, Food and Environmental Sanitation*. Symposia scheduled for presentation are:

- Quality and Safety Concerns on Aquacultured Products
- Stainless Steels for Dairy and Food Equipment Users
- The New FDA Model Retail Food Code
- Microbiology Versus Epidemiology
- Quantitative Risk Assessment in Food Microbiology
- International Trade and International Disease
- Reduction of Foodborne Pathogens on Poultry
- European Hygienic Standards
- Partnership in Food Safety Assurance
- A Model for Risk Management
- Natural Antimicrobials and Inhibitors for Food Applications
- Applications for Predictive Microbiology
- Pesticides in the Food Industry
- Meat Quality
- Effect of Production and Processing on Quality
- Dairy Residues and Testing
- Dairy Production and Animal Health

Technical Sessions scheduled for presentation include:

- Analytical
- General Food Microbiology
- Dairy
- Risk Assessment
- Antimicrobials

The 1994 Annual Meeting will also include two sessions of poster presentations, at least one pre-meeting workshop, and educational exhibits from industry.

The Annual Meeting will be held at the Hyatt Regency San Antonio, with room rates from $95.00. Meeting Registration and Hotel Reservation forms will be published in the March 1994 issues of *Dairy, Food and Environmental Sanitation* and the *Journal of Food Protection*.

For further information on meeting registration, contact the IAMFES office.

**These symposia and technical sessions are current as of publication, but subject to change.*

Suggestions Sought for Revision of the IAMFES Manual "Procedures to Investigate Water-borne Illness"

The Communicable Diseases Affecting Man Professional Development Group is in the process of revising the manual, "Procedures to Investigate Water-borne Illness." If you or other members of IAMFES or its affiliate organizations have suggestions for revision, please contact:

Dr. Frank L. Bryan
Food Safety Consultation and Training
8233 Pleasant Hill Road
Lithonia, GA 30058

Consider material on (1) epidemiology of water-borne diseases and their surveillance; (2) diseases transmitted by ingestion of, contact by, or aerosoled by water; (3) investigational procedure; (4) investigative forms; (5) sample/specimen collection; or (6) anything else appropriate to the subject. Contributions can be in the following format:

1) Photocopied pages of the existing manual with line and/or marginal comments.
2) Reprints or manuals that may be used as references by the Committee.
3) Text that can be considered for inclusion into the manual. (If this is extensive, it would be helpful to have the material on computer disk.)

Thank you for your interest in the activities of the Association and for your cooperation.

FDA Seafood Hotline
1-800-FDA-4010

The U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition has announced the availability of a service from which industry and consumers may obtain information on the proper handling, safety, nutrition and storage of seafood products. The FDA Seafood Hotline provides general information on Seafood HACCP, HACCP and the FDA Food Code 1993. The Hotline can also be used to report problems with seafood.

The Seafood Hotline can be accessed 24 hours a day for automated information and document FAX service. FDA staff is available between 12 - 4 p.m. EST, Monday through Friday to take calls and answer questions.

News

Irradiated Foods Here to Stay

Despite some misgivings in the public and scientific arena, food irradiation is here to stay, and we most likely will see an increase in the number of irradiated foods available, says a Penn State food scientist.

"Many critics of food irradiation feel that government and industry have not presented strong enough evidence that it is safe," says Manfred Kroger, professor of food science in Penn State's College of Agricultural Sciences. "They also are concerned that irradiated foods can easily become recontaminated."

"Evidence gathered by the U.S. Department of Agriculture and the U.S. Food and Drug Administration shows that foods treated with ionizing radiation do not become radioactive. Also, irradiation does not alter the chemicals in food to make them unacceptable. There always is a chance of recontamination by foodborne pathogens, but this is minimized if food preparers are trained in safe food-handling procedures."

Irradiated foods have been exposed to an extremely low level of radioactive material. For example, irradiated poultry receives a 1.5 to 3.0 kilogray dose of ionizing gamma rays. This treatment destroys bacteria and other microorganisms, such as *Salmonella*, *E. coli*, *Listeria* and *Campylobacter*. These and other foodborne pathogens are responsible for an estimated 80 million illnesses and 9,000 deaths in the United States each year.

Because irradiation also deters spoilage, it could contribute to alleviating the world's food distribution problem, Kroger says. In November, The World Health Organization released a statement saying that food contamination probably is the most widespread world health problem. The organization called for greater use of irradiation to destroy the organisms that spread a variety of diseases through food, and noted that irradiation could prevent some of the massive food losses due to pests, bacteria and fungi.

Food irradiation is used in more than 30 countries. Japan, for example, irradiates thousands of tons of potatoes each year to prevent sprouting. In the United States, foods have been approved for sale after irradiation since the early 1980's.

"Only one U.S. company currently is irradiating foods — mainly fruits, as well as other foods upon request," says Kroger. "When retailed, these foods carry a special label showing a logo with a plant inside a circle and the statement "Treated by irradiation."

In 1992, the USDA's Food Safety and Inspection Service approved irradiation of uncooked poultry to control *Salmonella* and other bacteria. Currently, four independently owned food retailers in the U.S. are selling irradiated poultry. Irradiated beef is not yet available.

"Concerns about the process are reminiscent of those expressed during the early years of milk pasteurization," says Kroger. "People were afraid that this process would cause more health problems than it prevented. But pasteurization has posed no danger to human health. On the contrary, it put an end to tuberculosis bacteria in milk, which killed millions of people worldwide."

Irradiation is no guarantee against spoilage and foodborne illnesses," he says. "But it is an additional preventive measure, and it has the potential to save lives."

Davis Calvin Wagner Award

The American Academy of Sanitarians has announced the 12th Annual Davis Calvin Wagner Award. The Award, to be presented at the Academy Luncheon during the Annual Education Conference of the National Environmental Health Association, will consist of a plaque and a $500 honorarium. The Award is open to all Diplomates of the Academy. The recipients should be individuals who:

1. Exhibits resourcefulness and dedication in promoting the improvement of the public's health through application of environmental health and public health practices.
2. Demonstrates professional, administrative and technical skills and competence in applying such skills to raise the level of environmental health.
3. Continues to improve oneself through involvement in continuing education type programs to keep abreast of new developments in environmental health and public health.
4. Is of such excellence to merit Academy recognition.

The nominations for the Award may be made by a colleague or a supervisor and must include the following:

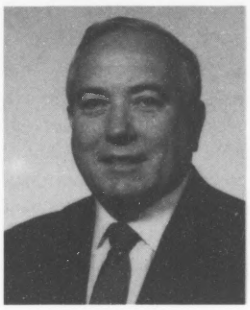
1. Name, title, grade and current place of employment of nominee.
2. A description of nominee's educational background and professional work experience.
3. A narrative statement of how the person meets the criteria for the Award including a description of specific accomplishments and contributions on which nomination is based.
4. These endorsements (an immediate supervisor and two other members of the professional staff or other persons as appropriate).

The Deadline for receipt of Nominations is April 15, 1994. Three copies of the nomination must be submitted and should be sent to:

Dr. John G. Todd, Chairman
Davis Calvin Wagner Award
17309 Fletchall Street
Poolesville, MD 20837

IAMFES Secretary Candidates

Paul Nierman



Gale Prince

Paul Nierman is Chief Executive Officer and Secretary of Dairy Quality Control Institute and President of DQCI Services, a wholly owned subsidiary of the Institute, both located in Moundsview, MN, a suburb of St. Paul, MN. Paul took over these responsibilities in 1991.

Prior to this time, Paul was Manager of Fluid Milk Operations for the Northern Division of Mid-America Dairymen. Paul worked in various positions within Mid-Am in his 12 year tenure. The positions include Member and Hauler Relations Manager, Quality Control Supervisor, and Process Engineer. Prior to this, Paul held positions with the Milk Market Administrators Office, Federal Order 68 (6 years), Resident Grader and Inspector with the U.S.D.A., Dairy Division (3 years), and also held supervisory positions in fluid, ice cream, and evaporated milk plants (5 years).

Paul is currently the secretary/treasurer of the Minnesota Sanitarians Association, and is the affiliate liaison with IAMFES. Paul is currently a board member of the National Mastitis Council and has also held the position of President of the Minnesota Dairy Technology Society.

Paul is a graduate of the University of Missouri (B.S. 1966), majoring in Dairy Manufacturing and Dairy Microbiology. Paul was raised on a dairy farm located near Concordia, Missouri. Paul and his wife, Mary, live in Eden Prairie, Minnesota, and have three grown children, ages 29, 28, and 20.

Gale is Manager of Regulatory Compliance for The Kroger Co. in Cincinnati, Ohio. He has been responsible for the Company's food safety and regulatory compliance programs since 1979.

But, Gale's sanitation experience began 25 years ago at the Eisner Food Store, a division of Jewel Companies, Inc., where he worked for 13 years. He began his career in meat merchandising and worked his way to Sanitation Specialist and then to Director of Quality Control and Sanitation. He was a pioneer in developing food safety programs for retail food operations.

In both the above capacities, Gale's work is focused on quality control, sanitation, food safety and regulatory compliance. His experience has included a wide variety of food products including fresh and processed meat, fresh fruits and vegetables, bakeries, milk and ice cream processing, cereal grains, canned and frozen foods, and health and beauty aids.

Gale received his bachelor of science from Iowa State University. Throughout his career he has also attended numerous short courses and seminars in the areas of sanitation, quality control, pest control, waste water management, air pollution, and others to enhance his professional expertise.

Currently, Gale is active in several committees and many professional organizations. For IAMFES, he was chairman of the Program Advisory Committee in 1990 and is a member of the Retail Food Protection Committee. He is also chairman of both the Council III on Science and Technology and of the Long Term Strategic Planning Committee of the Food Protection Conference.

Gale has spoken often on the subjects of food safety and *Listeria* at meetings and workshops throughout the United States and Canada.

For eight years he was on the Illinois Sanitarians Registration Board, while he spent three years as chairman of the Food section of the National Environmental Health Association.

Gale has been selected as a member of "Who's Who in U. S. Executives" and, in 1990 received an Associate Award from the Association of Food and Drug Officials.

Gale is married and has three sons.

Food and Environmental Hazards to Health

Update: Outbreak of Hantavirus Infection—Southwestern United States, 1993

An outbreak of illness associated with hantavirus infection continues to be investigated by state health departments in New Mexico, Arizona, Colorado, and Utah; the Indian Health Service; and CDC, with the assistance of the Navajo Nation Division of Health. This report updates information regarding the outbreak and presents information on two cases that occurred in the 10 months preceding this outbreak.

Laboratory evidence of acute hantavirus infection has been confirmed in 15 patients who had onsets of illness from January 1 through June 30. Each of these patients has had one or more of the following: positive enzyme-linked immunosorbent assay (ELISA) serology with elevated immunoglobulin M titers indicating recent infection, seroconversion by ELISA, positive immunohistochemistry on formalin-fixed lung tissue, or amplification of hantavirus nucleotide sequences from frozen tissue. Of the 15 cases, 10 occurred in New Mexico, three in Arizona, and one in Colorado; 12 (80%) occurred among persons aged 20-40 years. Eleven patients died. Similar illnesses in an additional 23 persons, 10 of whom died, are being investigated for possible hantavirus infection.

Since June 6, a total of 668 rodents have been trapped in and around houses in 14 different rural sites. *Peromyscus maniculatus* (deer mouse) comprised 63% (range: 36%-88%) of all rodents trapped and 85% of those trapped in homes. Of the first 283 rodents tested, hantavirus antibodies were detected in 23%.

In June 1993, two persons were identified who had evidence of hantavirus infection in 1992. In November 1992, fever and acute respiratory distress occurred in a resident of the outbreak area. Recent serologic evaluation of an acute serum specimen obtained at the time of illness showed evidence of hantavirus infection. In August 1992, fever and myalgias followed by adult respiratory distress syndrome occurred in a person who resided outside the outbreak area; onset of illness was approximately two weeks after this person had returned home from a trip to the four-state area. The traveler had engaged in outdoor activities and was exposed to rodents and rodent excreta during both indoor and outdoor activities during the trip. A serum sample tested in June 1993 showed elevated immunoglobulin G titers to hantavirus. Although a high immunoglobulin G titer in a single, recently obtained serum sample does not definitively establish the occurrence of a hantavirus infection at the time of illness, the serologic data and the clinical illness are strongly suggestive of hantavirus infection.

Editorial Note: The identification of two persons with evidence of hantavirus infection that occurred in 1992 suggests that hantavirus infection has been present previously but was not recognized. Investigations are now in progress to identify whether changes in the local environment or other factors have been associated with the increased occurrence and/or transmission of this infection. Preliminary data from field investigations indicate that *P. maniculatus* is the likely reservoir of this virus. Although the exact mechanism of hantavirus transmission to humans is unknown, potentially hazardous exposures include direct aerosolization of urine and other potentially infective rodent body fluids, secondary aerosolization of dried rodent excreta, contamination of food, and direct contact with virus-bearing rodents or their excreta or saliva.

Additional studies are under way to identify practical and effective means of preventing infection caused by hantaviruses. Residents and travelers in New Mexico, Arizona, Colorado, and Utah are advised to avoid any activities that may result in contact with wild rodents or rodent excreta or disruption of rodent burrows. The following specific recommendations for residents and travelers are based on current knowledge of transmission of other hantaviruses: 1) avoid activities that can result in contact with wild rodents, disruption of rodent burrows, or aerosolization of dried rodent excreta; 2) store food appropriately to avoid contamination with rodents and rodent excreta; and 3) dispose of food and trash properly to avoid attracting rodents.

Morbidity and Mortality Weekly Report 7/2/93

Lead Intoxication Associated with Chewing Plastic Wire Coating—Ohio

In December 1991, a venous blood lead level (BLL) of 50 µg/dL was detected in a 46-year-old Ohio man during a routine pre-employment examination. He was referred to a university-based pharmacology and toxicology clinic for further evaluation; clinic physicians investigated the case. Although a repeat BLL obtained 1 month later was 51 µg/dL, he reported no exposure to known sources of lead during the interim. However, he reported numbness of his fingers and palms, tinnitus, and a possible decrease in his ability to perform basic arithmetical calculations.

A comprehensive occupational and environmental history obtained at the time of the second BLL test revealed no apparent source of his lead exposure. Although he had been employed for approximately 20 years as a microwave technician during military service and while employed at a television station, he reported no history of exposure to lead from soldering or welding. He had no activities or hobbies associated with exposure to lead or lead products, no previous bullet or birdshot wounds, and he denied drinking illicitly distilled alcohol or using lead additives in his car. His residence was built in 1974 (after lead was banned from use in residential paint), and household water was obtained from a well. In January 1992, blood lead testing of family members revealed levels of 5 µg/dL for his wife and <5 µg/dL for his 17-year-old child. His only medication was ranitidine, which he had used for the previous 1-1/2 years for "indigestion." He reported occasional cigarette smoking.

Although results of a neurologic examination were normal, neuropsychiatric testing on March 13 demonstrated mild memory deficits, as evidenced by abnormalities on verbal and figural memory tests. Because of these abnormalities, beginning March 13, he was treated for 19 days with dimercaptosuccinic acid (DMSA), an oral chelating agent, and on April 4, his BLL had

decreased to 13 µg/dL. However, BLLs on May 15 and July 23 were 49 µg/dL and 56 µg/dL, respectively.

During a July 1992 follow-up clinic visit, he mentioned that for approximately 20 years he had habitually chewed on the plastic insulation that he stripped off the ends of electrical wires. Samples of the copper wire with white, blue, and yellow plastic insulation were obtained and analyzed for lead content. The clear plastic outer coating (present on all colors of wire) and the copper wire contained no lead; however, the colored coatings contained 10,000-39,000 µg of lead per gram of coating. On receipt of these results, he was instructed immediately to discontinue chewing the wire coating.

In January 1993, when his BLL was 24 µg/dL, he reported subjective improvement in his symptoms; follow-up neuropsychiatric testing is pending.

Editorial Note: This report likely represents the first documented case of lead poisoning following ingestion of lead as a consequence of chewing on plastic wire coatings. Plastic coatings previously have been associated with lead exposure in the burning of lead-containing plastics during repair of a storage tank, the production of plastics, and the manufacture and use of stabilizers and pigments in the plastics industry. Although lead exposure also can occur among workers who burn the plastic coating off copper wire to recycle the copper, lead intoxication by this route has not been reported.

Lead compounds may be employed in the production of colored plastics (in which lead chromates are used as pigment) and in the manufacture of polyvinyl chloride (PVC) plastics (in which 2%-5% lead salts [including lead oxides, phthalate, sulfate, or carbonate, depending on the desired quality of the final product] are used as stabilizers). Although environmental regulation has reduced considerably the amount of lead used in the United States in the manufacture of PVC plastics, manufacturers of electrical wire and cable continue to produce PVC stabilized and/or pigmented with lead compounds.

More than 573,400 U.S. workers are employed in occupations involving electrical work. Among these workers, potential for excessive exposure to lead may result from inhalation of fumes generated during lead soldering. Because the plastic coating from wires is usually removed by mechanical stripping, ingestion of lead from these plastic coatings is probably uncommon. Nonetheless, the findings in this report remind occupational and other health-care providers of the need to be aware of this potential source of lead exposure. In addition, workers should be warned of the potential hazard of chewing plastic coatings or other plastic products that may contain lead.

MMWR 6/25/93

Arboviral Diseases—United States, 1992

During 1992, health departments from 23 states reported to CDC 45 cases of arboviral encephalitis in humans and 97 in horses. An additional four states reported detection of arboviral activity in bird and mosquito populations. Unlike 1990 and 1991, when three St. Louis encephalitis (SLE) epidemics and an eastern equine encephalitis (EEE) epizootic occurred, during 1992, no focal outbreaks of arboviral disease were reported. This report summarizes information regarding arboviral encephalitis in the United States during 1992.

SLE. During 1992, 14 sporadic SLE cases occurred in Texas (12 cases) and California (two) —a substantial decrease from 1990 and 1991 (247 and 78, respectively), when SLE cases were at their highest level since 1976.

LaCrosse encephalitis (LAC). During 1992, 29 cases of LAC encephalitis were reported from Illinois (seven cases), Ohio (six), West Virginia (six), Wisconsin (four), Minnesota (three), and North Carolina (three). This is the lowest number of LAC cases reported since surveillance began in 1964.

EEE and Western equine encephalitis (WEE). During 1992, Florida and Massachusetts each reported one case of EEE. Because of isolation of EEE virus from *Aedes albopictus* during 1991 in Florida, human case surveillance was intensified at five regional medical centers. From May through September 1992, 357 cerebrospinal fluid samples were collected from persons with symptoms suggestive of meningitis or encephalitis. None had EEE-specific immunoglobin M antibody. In 1992, 88 cases of EEE in horses were reported from Florida (54 cases), Georgia (nine), Virginia (nine), Mississippi (four), South Carolina (four), North Carolina (three), Texas (two), Arkansas (one), Kentucky (one), and Michigan (one). Although no cases of WEE were reported in humans, nine cases of WEE in horses were reported during 1992: Idaho (two cases), Missouri (two), Oklahoma (two), Colorado (one), South Dakota (one), and Utah (one).

Enzootic arbovirus activity. In 1992, 28 states conducted arboviral surveillance using virus isolation or antigen detection in captured mosquitoes or viral-specific antibody assays in sentinel or wild birds. Enzootic arboviral activity was reported from 16 states: EEE (Delaware, Florida, Georgia, Massachusetts, Michigan, New Jersey, North Carolina, Ohio, and South Carolina), SLE (Arizona, California, Illinois, Michigan and Texas), WEE (Arizona, California, Colorado, Nevada, and Utah), and LAC (Illinois).

Editorial Note: An increased number of EEE cases had been anticipated in 1992 for two reasons: 1) in 1991, EEE virus had been isolated from *Aedes albopictus*, a more anthropophilic mosquito vector; and 2) in 1991, an EEE epizootic occurred in the Southeast. Although arboviral infections are often underreported, the results of intensified surveillance in Florida suggest that human EEE infection did not increase in 1992.

The last nationwide arboviral epidemic (1975 and 1976) resulted in 2,194 cases of SLE in 35 states and was preceded by a modest increase in human SLE cases in 1974. Because early recognition of arboviral activity allows for early institution of preventive measures, surveillance of virus activity in mosquito, avian, equine, and human populations has been emphasized.

During 1990 and 1991, moderate increases in arboviral encephalitis cases were noted with outbreaks in Arkansas, Florida, and Texas. Despite changes in the arboviral surveillance system to encourage a greater number of states to report regularly, only 45 cases of human arboviral encephalitis were reported—the lowest number of cases reported since the early 1960s. Most arboviral encephalitis cases were reported from midwestern states. Serosurveys indicate that arboviral infections have a wide geographic distribution in the United States, and that cases are often underreported.

Because early identification of cases is important in reducing the risk for arboviral disease through vector-control practices and changes in human activity patterns, health-care providers should consider arboviruses in the differential diagnosis of viral meningoencephalitis, obtain appropriate specimens for serologic testing, and promptly report cases to state health departments.

MMWR 6/25/93

HAZCON-Based Total Quality Management

Retail Food Operation Food Hazard Control Checklist

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St. Paul, MN 55114

The following is the fourth installment of the Retail Food Operation Food Hazard Control Checklist mentioned in the October 1993 column. This checklist will be continued over the next several months to cover its entirety.

RETAIL FOOD OPERATION FOOD HAZARD CONTROL CHECKLIST
[40°F - 150°F (4.4°C - 65.6°C)] [1]

FOOD SAFETY CONTROL REQUIREMENTS	PERFORMANCE EVALUATION	NEEDED TO ASSURE SAFETY
Cooling or refrigeration units (Haz) • Refrigeration or cooling units have non-toxic, corrosion-resistant racks with no restriction for bottom heat removal (e.g., food sitting on a solid shelf). • Reach-in refrigerators are used to cool more than 2 pounds of hot food per full-door section per hour, unless specifically designed for food cooling. • Walk-in refrigeration units used for cooling have an extra 0.25 hp of compressor capacity and 2,000 Btu of evaporator coil capacity for every 20 pounds (9.1 kg) of hot food to be cooled to 40°F (4.4°C). Air flow across the cooling zone is >1,000 feet per minute. • Refrigeration compressors are kept free of dirt. • For every 10°F rise above an outside ambient temperature of 90°F, 10% additional horsepower is provided in order to compensate for condenser over-heating. • All freezing and refrigeration units are self-defrosting.		
Surplus equipment and items for repair (Reg) • All articles that are not pertinent to the current operation of the food establishment are stored properly or are removed from the premises. • Items for repair are handled within _____ days.		
Dunnage racks, shelving, pallets, dollies, etc. (Reg) • Are made of approved materials and are designed to store food 6 inches off the floor.		
Backflow prevention valves for plumbing (Reg) • All equipment, sinks, or floor drains between potable water systems and sewage lines have adequate backflow prevention devices. • Are checked/changed once a year and are maintained.		
CO_2 backflow prevention valves (Haz) on carbonated beverage dispensers: • Have a 100-mesh filter and 10 micron paper filter in the water line immediately before the post mix water pump to trap the extraneous material in the water and prevent malfunction of the valve seats. • Are checked/changed once a year and are maintained.		
Ware washing equipment (Reg) • The manufacturers manual is available and is used to specify correct operating temperatures. • An approved chemical feeder on the automatic ware washer is maintained. • The audible or visible warning device for replenishing the chemical sanitizer is in functioning condition. • An accurate thermometer on the dishwashing machine is used to indicate all wash water and final rinse temperatures.		

Abbreviations: (Haz) = Hazard; (Reg) = Regulatory; (Qual) = Quality; (OSHA) = Occupational Safety and Health Agency

[1] Temperatures, unless otherwise stated, are food temperatures. They are measured both 1/16-inch below the surface as well as at the center of food in order to determine the degree of control and stability of hot and cold systems.

FOOD SAFETY CONTROL REQUIREMENTS	PERFOR-MANCE EVALU-ATION	NEEDED TO ASSURE SAFETY
• The pressure gauge and a valve to check pressure on the final rinse line is functional and maintained. • Test kits are used to accurately measure sanitizer concentration. • Proper wash and power rinse water temperatures for the hot water sanitizing dish or glass washing machine, the chemical sanitizing machine, the hot water sanitizing pot and pan washing machine, and the chemical sanitizing pot and pan washing machine are used. • The temperature of the sanitizing rinse water of the dishwashing machine is 180°F. • An adequate concentration of detergent in the wash tank, and clean water in the wash tank, the clear water rinse tank, and the sanitizing rinse tank are provided and maintained.		
Cutting boards and food contact surfaces (Haz) **The four-step cleaning and sanitizing process** is used as follows:. 1. Rinse and remove gross soil from the surface. 2. Wash and scrub surface(s) with _____ (oz. detergent) per gallon of water at 110°F or hotter. 3. Rinse surfaces with clean water at 110°F or hotter. 4. Sanitize surface. [Flood surface with sanitizer solution (75°F to 100°F) using a squirt bottle and wipe it across the (>75°F) surface with a clean, disposable paper towel. Sanitizers solutions will be made fresh daily and placed in a labeled bottle.] Let the surface air dry.		
Detergents (Haz) • Specified detergents, in correct proportions are used for each cleaning task, according to the cleaning and sanitizing schedule. • Highly alkaline detergent solutions are not used to wash aluminum utensils and containers as they will dissolve and pit the surface. • Correct proportions of detergent and sanitizing compounds are used in dish machines, in pot and pan washing machines, and in pot and pan sinks. • Detergents and cleaning supplies are inventoried and ordered regularly so that there is always an adequate supply.		
Sanitizing solutions: use and preparation (Haz) • Cleaning (detergent solutions) are never mixed with sanitizing solutions. • Fresh sanitizing solutions for sanitizing surfaces are made each day and are dispensed from a squirt bottle. • Sanitizing solutions will be used between a temperature of >75°F and < 120°F.		
Heat (hot water or steam) as a sanitizer (Reg) • Hot water or confined steam if used for sanitizing purposes is 170°F for 30 seconds.		
Changing detergent and sanitizing solutions (Haz) • _____ (detergent) solutions is changed when the solution is dirty. • Surface sanitizing solutions are made with _____ and are discarded when _____. • Immersion sanitizing solutions are made with _____ and are discarded when _____. • Test kits or test paper are used to check or verify sanitizer concentration.		
Cleaning and sanitizing food contact surfaces (Haz) • Employees clean work stations at the end of every major production step or operation ("clean-as-you-go"), using _____ (detergent) and warm water in order to maintain food contact surfaces with < 100 microorganisms/cm^2. • At least every four hours, the four-step cleaning and sanitizing process is used to clean and sanitize work stations and food preparation work surfaces in order to achieve food contact surfaces with < 10 microorganisms/cm^2. _____ (sanitizing solution) is used.		
Cleaning cloths (Reg) • Wiping cloths are stored clean and dry, or in _____ (detergent) and water solution. • Cloths used to clean non-food contact surfaces are not co-mingled with other cloths.		
Sponges (Haz) • Sponges are not used for cleaning and sanitizing, since they cannot be kept adequately sanitized.		

FOOD SAFETY CONTROL REQUIREMENTS	PERFOR-MANCE EVALU-ATION	NEEDED TO ASSURE SAFETY
Brooms and brushes (Qual) • Only brooms and brushes with non-absorbent bristles are used for cleaning. • Separate brushes are used to clean raw food contact surfaces and cooked, pasteurized food contact surfaces. • Brushes are cleaned and sanitized daily.		
Cooling equipment cleaning (Reg) • Refrigerators are cleaned weekly with _____ to minimize spoilage bacteria cross-contamination. • Freezers are cleaned at least every 3 months.		
Washing machinery, cleaning and use (Reg) • Washing machinery, sinks, and storage equipment are kept clean and maintained so that they will function properly and do not contaminate sanitized dishes, utensils, pots, and pans. • Dish machine and pot and pan machine strainers and the wash nozzles are cleaned every shift. • Rinse nozzles are cleaned everyday or as prescribed by the manufacturer. • Detergent and sanitizer supply systems on washing machinery are filled as needed. • Washing machinery is de-limed on a regular basis or as required for proper maintenance according to the cleaning schedule.		
Washing flatware (Reg) • Flatware (knives, forks and spoons) are soaked in _____ before being washed in the dishwasher to ensure cleaning. • Flatware are racked flat, run through the dishwasher and then put into dispensers (eating end down).		
QC (Quality Control) inspection (Qual) • All washed and sanitized dishes, utensils, and pots and pans are inspected for cleanliness. • Anything that does not look clean is re-washed and re-sanitized.		
SUPPLIES AND MATERIALS		
Purchasing (Haz) • Supplies are purchased from suppliers who have a registered HACCP program and provide HACCP-based Total Quality Assurance certification of all supplies and materials. If not, suppliers must at least provide information on probable levels of pathogen contamination. • Suppliers of chemical products furnish Material Safety Data Sheets. • Suppliers of food containers provide information on leaching of substance from the container. • Equipment suppliers provide simple cleaning and maintenance instructions for their equipment and how the equipment must be used to achieve FDA safety standards. • Fish, including shellstock (oysters, clams, or mussels) - Is purchased only from suppliers who get fish from health department inspected waters. - Shellstock is tagged and tags are kept in the original container until contents are used or discarded. - Tags are retained 90 days from the delivery date. - Mollusk or crustacean shells are not reused for serving food. • When food is obtained from suppliers who provide no data, it is assumed that the food contains the following microbial levels:		

Pathogenic Microorganism	Number / ml per gram of food
Salmonella spp., *Vibrio* spp., Hepatitis A, *Shigella* spp., *Escherichia coli, Listeria monocytogenes*	10
Campylobacter jejuni (on meat, poultry, and milk)	100
Clostridium botulinum	1
Clostridium perfringens (in meat and poultry) *Bacillus cereus* (in grains, cereals and legumes)	100
Mold toxins Food poisons	Below government tolerances

*This **Retail Food Operation Food Hazard Control Checklist** will continue in subsequent issues of* Dairy, Food and Environmental Sanitation. *The March installment will cover: **Supplies and Materials and Food Production and Service.***

Federal Register

Department of Health and Human Services

Food and Drug Administration

Irradiation in the Production, Processing, and Handling of Food

Agency: Food and Drug Administration, HHS.

Action: Tentative final rule.

Summary: The Food and Drug Administration (FDA) is announcing its tentative decision to amend the food additive regulations to provide for the safe use of sources of radiation to irradiate frozen, packaged beefsteak for use in the National Aeronautics and Space Administration (NASA) space flight programs. FDA is also announcing its tentative decision to amend the food additive regulations to permit the use of packaging materials that are not listed in the regulations regarding food irradiation in the irradiation of frozen, packaged beefsteak for use in the NASA space flight programs. This action is in response to a petition filed by NASA.

Dates: Written comments by February 7, 1994.

Addresses: Submit written comments to the Dockets Management Branch (HFA-305), Food and Drug Administration, rm. 1-23, 12420 Parklawn Dr., Rockville, MD 20857.

For Further Information Contact: Patricia A. Hansen, Center for Food Safety and Applied Nutrition (HFS-206), Food and Drug Administration, 200 C St. SW., Washington, DC 20204, 202-254-9523.

Supplementary Information:

I. Introduction

In a notice published in the Federal Register of February 6, 1989 (54 FR 5679), FDA announced that a food additive petition (FAP 9M4125) had been filed by NASA, Washington, DC 20546, proposing that the food additive regulations be amended to provide for the safe use of sources of radiation to process beefsteaks for use in space flight programs. The agency is publishing a tentative final rule before proceeding to final action because it is including provisions regarding the packaging materials to be used with the beefsteaks that it did not announce in the notice of filing for this petition.

II. Evaluation of Safety

In assessing the safety of food additives, including the use of irradiation in the processing of food, the agency usually considers the effects of lifetime daily exposure to the additive. The requested use, however, is limited to NASA's space flight programs. The amount of irradiated beefsteak that could be consumed by individuals in the programs would constitute an extremely small fraction of their diets when considered over a lifetime. Because of this factor, questions regarding acute hazards, including those resulting from pathogenic organisms that could be present in the food, are more significant than they would ordinarily be in deciding whether to list a food additive. The petition has requested that FDA authorize the use of irradiation processing only under conditions that ensure the microbial sterility of the product and the integrity of the product packaging. NASA has stated that it will ensure these qualities of sterility and of packaging integrity by requiring adherence to an irradiation processing protocol (scheduled process) that it submitted with the petition.

Having evaluated the data in the petition and other relevant material in its files, FDA tentatively finds that the total amount of radiolytic products that are produced in the beefsteaks during irradiation processing, and that will be consumed by individuals in the space flight programs, will be too small to be of any toxicological significance. Likewise, FDA tentatively finds that the total amount of radiolytic products that could be formed and migrate from the packaging materials to the food during irradiation processing, and then be consumed by individuals in the space flight programs, is too small to be of any toxicological significance.

Sections 179.25(c) (21 CFR 179.25(c)) restricts packaging materials used in the irradiation of packaged foods to those materials listed in §179.45 (21 CFR 179.45), namely, those that have been demonstrated to be safe for use during irradiation of prepackaged foods, assuming that those foods would be consumed daily over a lifetime span. The agency tentatively finds that this restriction is unnecessary for packaging to be used only in space flight programs. The tentative final regulation set forth below, therefore, waives the requirement in §179.25(c) that packaging materials be restricted to those listed in §179.45, provided that the packaging has been judged to be safe for holding food.

III. Tentative Conclusions

The agency tentatively finds that beefsteaks irradiated at a minimum dose of 44 kiloGrays and handled in accordance with the provisions of §179.25(d) will meet current standards for commercial sterility and nutritional adequacy. The protocol submitted by NASA in its petition is an example of a scheduled process that would satisfy the requirements of §179.25(d). The agency tentatively concludes, therefore, that the proposed use of a source of radiation is safe, and that §179.26 of the regulations should be amended as set forth below.

In accordance with §171.1(h) (21 CFR 171.1(h)), the petition and the documents that FDA considered and relied upon in reaching its tentative decision to approve the petition are available for inspection at the Center for Food Safety and Applied Nutrition by appointment with the information contact person listed above. As provided in 21 CFR 171.1(h), the agency will delete from the documents any materials that are not available for public disclosure before making the documents available for inspection.

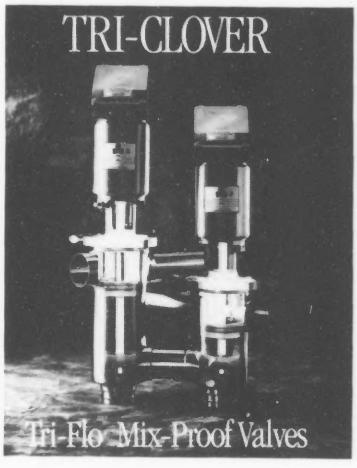
The agency has carefully considered the potential environmental effects of this action. FDA has concluded that the action will not have a significant impact on the human environment, and that an environmental impact statement is not required. The agency's finding of no significant impact and the evidence supporting that finding, contained in an environmental assessment, may be seen in the Dockets Management Branch (address above) between 9 a.m. and 4 p.m., Monday through Friday.

Federal Register/Vol. 58, No. 234/Wednesday, December 8, 1993/ Proposed Rules

Industry Products - Special Focus

Products and Equipment for Dairy and Food Processing

The Industry Products — Special Focus is a new feature for Dairy, Food and Environmental Sanitation. *This feature will group news releases into general categories, such as Products and Equipment for Dairy and Food Processing, to provide readers with a consolidated source of information on the products, services and equipment available to them.*



New Tri-Clover Brochure Highlights Unique Mix-Proof Valve

An eight-page brochure on its exclusive Tri-Flo® Mix-Proof valve systems has been published by Tri-Clover Inc.

The illustrated, four-color brochure provides detailed information on the performance features and application guidelines for the new valve which enables users to control the flow of similar and dissimilar products while preventing undesired product mixtures. Specification data are included, along with color-coded drawings showing the flow of different processing lines.

The Tri-Flo® Mix-Proof valve system is the first of its kind to meet the sanitary requirements of both 3-A and the Pasteurized Milk Ordinance (PMO). The systems offer distinct advantages in high volume applications in terms of increased productivity, sanitary operation and reduced operating costs in dairy, food, cosmetic, and beverage plants.

For a free copy of the Tri-Flo® Mix-Proof valve system brochure, contact a Tri-Clover distributor, or write Tri-Clover Inc., 9201 Wilmot Road, Kenosha, WI 53141-1413.

Tri-Clover Inc. is a leading manufacturer of sanitary stainless steel valves, pumps and fittings, as well as flow control, batch/weigh and Clean-In-Place (CIP) systems. Founded in 1919, Tri-Clover Inc. is an Alfa Laval Flow Company.

Tri-Clover, Inc. - Kenosha, WI

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Setra Systems, Inc., flush mounted diaphragm transmitter for food, dairy and pharmaceutical applications.

The C-290 complies with all 3-A sanitary design standards and is intended for pressure ranges as low as 0-1 psi and up to 1000 psi in applications that require rugged packaging and high performance at an affordable price.

Packaged in a laser welded stainless steel housing the C-290 provides exceptional insensitivity to vibration shock and other environmental extremes.

Thermal shock in particular is not a problem as the C-290 will withstand the low to high temperature extremes and subsequent vacuum pressures which result from clean-in-place (CIP) procedures.

A superior flush diaphragm design minimizes the clamping effect which normally results from installation with a tri-clover sanitary fitting.

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Setra Systems, Inc., is a leading designer, developer and manufacturer of high accuracy electronic instrumentation for the measurement of pressure, acceleration and weights. Setra's products are used by universities, government agencies and industry.

Setra Systems, Inc. - Acton, MA

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A pen computer uses stylus, or pen, input. You write on the screen as you would on paper; no keyboard or mouse required! It can recognize and convert your handprinting into computer text; it's intuitive. And it allows you to make free-form drawings. Pen computers are portable, and available in ruggedized, weatherized cases, so you can take them virtually anywhere, without fear of damage.

Do you need to fill out forms and collect data at a variety of locations? Pen computers can help you collect that data faster and more accurately, for less. Paper is eliminated, as is duplicate data entry, and the software can tell you when you've forgotten something, or entered information incorrectly.

WESTECH Information Systems, Inc. - Vancouver, British Columbia, Canada

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Level Commander™ Product Release

The new Level Commander™ Series I continuous ultrasonic process measurement system from Kay-Ray/Sensall, Inc. combines an accuracy of ±0.25% with multiple liquid measurement capabilities in one system that highlights greater technology and ease of use.

The Level Commander Series I uses advanced echo extraction algorithms, a feature that allows its microprocessor to discriminate against false signals in the ultrasonic measurement. This feature, combined with the system's high energy sensors, results in increased reliability and measurement validity.

The microprocessor-based Level Commander Series I system can be configured to monitor and control liquid level or distance, pumping routines, differential level, and open channel flow rates. It can calculate volumetric conversions to customize vessel shapes, and its integral keypad with parameter driven interface makes configuration simple for even the novice user.

The Level Commander's use of microprocessor technology, acoustical extraction techniques, automatic calibration and self-diagnostics combine versatility, power, and reliability in a system that brings greater ease to everyday use.

Kay-Ray/Sensall, Inc., headquartered in Mt. Prospect, Illinois, provides high precision ultrasonic, gamma, neutron and microwave process measurement instrumentation. As a member of the Fisher-Rosemount group, Kay-Ray/Sensall is a part of the largest process instrumentation provider in the world, servicing the process and aerospace industries with measurement, analytical and distributed control systems for better process management.

Kay-Ray/Sensall, Inc. - Mt. Prospect, IL

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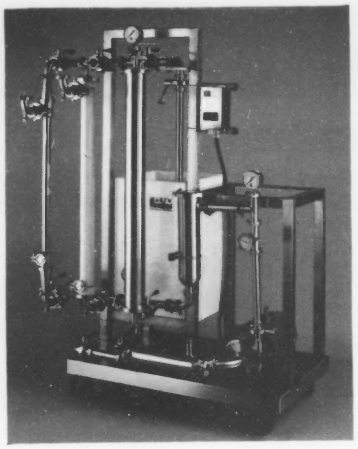

Multi-Purpose Pilot Ultrafiltration System

CUNO Separations Systems Division has developed a new multipurpose, modular ultrafiltration (UF) system, the Pilot 2000™. Used for a wide variety of concentration, purification and diafiltration applications, the versatile Pilot 2000 provides accurate scale-up design and small-scale production runs. This skid-mounted, portable UF system is capable of operating with spiral, hollow fiber and/or ceramic cartridges, giving the system unequaled flexibility.

Constructed of high-quality materials and components, the standard system includes a rugged stainless steel base and support frame with casters, sanitary centrifugal pump, manual starter, 30 gallon (114L) tank, prefilter, pressure and temperature gauges, sampling ports and all required valves, connectors and fittings. Additionally, the Pilot 2000 is normally configured to meet sanitary specifications.

The Pilot 2000 supports any combination of membrane cartridge configurations in parallel, including spiral-wound and hollow fiber polymeric membrane cartridges, and Membralox® ceramic filtration cartridges which are used for extreme environmental or process conditions. Cartridges may be placed either horizontally or vertically on the system for optimum drainage and cleaning. Options such as a heat exchanger and automatic diafiltration control are available.

CUNO's pilot system determines processing parameters, product yields and membrane cleaning protocols for the development of specific applications. Because variations occur from one process or plant to another, the Pilot 2000 can be used to provide accurate process design and scale-up data for the manufacture of custom products.

Cuno Separations Systems, Inc. - Norwood, MA

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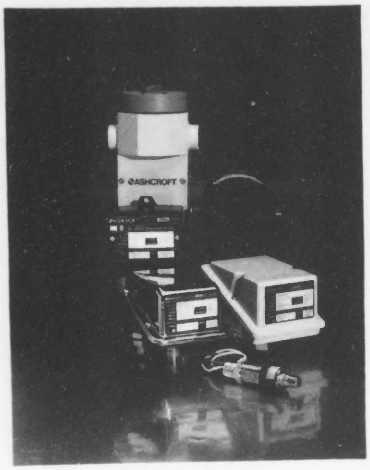

Ashcroft Switch Quick Guide

Ashcroft® announces the release of their new 4 color Switch Quick Guide (Bulletin QG-3). This new Quick Guide features seven different products as well as many different actuators. Among the seven different switch products are two new switches; the N-Series Electronic Switch and the 900 Series Stainless Steel Explosion Proof Switch.

The **Ashcroft N-Series Electronic Pressure Switch** combines the popular K-Series polysilicon thin film pressure transducer sensor and rugged, epoxy coated enclosures. The result is a highly reliable pressure switch that is ideal for high cycle, high pressure, or difficult deadband application.

The **Ashcroft 900 Series Stainless Steel Explosion Proof Switch** has been developed for the most corrosive applications found in many process plants and is especially suited for offshore use.

This new improved 4 color guide is easy to read and contains complete information for all your pressure and temperature needs. Gold Service℠ is offered on all switch products which guarantees delivery in 2-5 working days.

Dresser Industries - Stratford, CT

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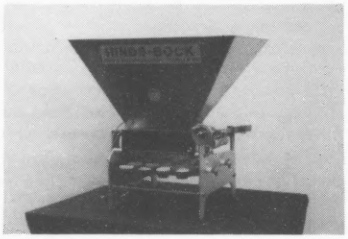

Productive Table Top Depositors

These NSF listed depositors are ideal for instore, and small to intermediate wholesale bakeries. They will accurately scale 1 1/2 - 12 oz./cylinder of batters ranging from thin cake particulate content such as carrot cake. Easily interchanged product valves provide for different centerlines and ganging of cylinders and fully adjustable side guides provide flexibility to handle a broad range of pan heights, widths, and layouts. The NT series depositors, with 3 or 4 pistons, handle pans to 18 1/2" wide and can deposit up to 1000 dozen muffins/hr. The WT series depositors, with 4, 5, 6 or 7 pistons, handle pans up to 26 1/2" wide for a 50-60% increase in depositing productivity.

Hinds-Bock Corporation - Redmond, WA

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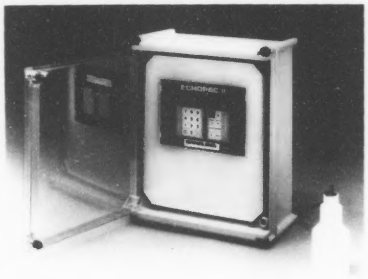

Sparling Announces New Ultrasonic Level/Flow Device

Sparling's new Model 41 Echopac II measures level and flow in a variety of flumes, weirs, tanks and partially full pipes. Popular formulas are in memory for primary devices you select. The Echopac II is equipped with a 20-key keypad for easy data-entry and a 48-character display which prompts the user through the software. Three programmable control relays provide contacts for samplers, alarms, lost echo and pump sequencing. Programs are password-protected.

This device, utilizing the non-contact, echo-ranging principle, has a wide range of options including built-in recorders, data-logging, heater, intrinsically-safe barrier, RS 232 output and others.

The electronics is housed in a NEMA-4X enclosure and features a wide variety of transducers. A 4-20 mA output, 0-10 Vdc output and scaled pulse are standard.

Sparling Instruments Co., Inc. - El Monte, CA

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WHERE TO FIND IT . . .

Affiliate News

WAMFS Fourteenth Annual Joint Conference

The Fourteenth Annual Joint Conference was held on October 7 & 8, 1993 at the Chula Vista Resort, Wisconsin Dells, Wisconsin. The conference is held jointly by the Wisconsin Association of Milk & Food Sanitarians, the Wisconsin Association of Dairy Plant Field Representative and the Wisconsin Environmental Health Association.

The conference was a resounding success with about 300 persons attending this exceptional program. The programs were very well attended as was the exhibition area. The Joint Conference planning committee did an excellent job with the program and we need to give our President-Elect, Erin Nutter and our 1st Vice-President, Fritz Buss a big salute for a job well done.

The 1993 Conference also marked the 50th anniversary of the founding of WAMFS. This milestone was celebrated with a luncheon; a review of WAMFS history by Joe Disch; reflections by Evert Wallenfeldt, a charter member; the reading of letters from former members who were unable to attend; and the introduction of charter members, Past-Presidents and past Sanitarian of the Year award recipients. Steve Halstead, IAMFES Executive Manager, presented a plaque recognizing WAMFS for its 50 years of outstanding contributions in the field of food safety and its contributions to IAMFES. Memorabilia, including our original charter, was displayed at a reception after the luncheon. Twenty-one Past-Presidents and Sanitarian of the Year Award recipients attended the program.

Two candidates were nominated for the 2nd Vice-President post. They are Phil Hermsen, Director of Quality Assurance with Associated Milk Producers, Inc. and Francis Nadosy, Technical Service Manager at Elm Grove Dairy.

Randy Daggs was honored as the 1993 Sanitarian of the Year. Randy was honored for outstanding performance in the field of milk and food sanitation. He currently serves as Program Manager, Milk Certification Section, Wisconsin Bureau of Environmental Health, Wisconsin Department of Health and Social Services. Congratulations Randy, and thank you for your contributions: past, present and future.

Julie Olson, attending George Washington University, was the recipient of the $500 WAMFS Memorial Scholarship and Amy Buechel, attending University of Wisconsin River Falls, was the recipient of the $1,000 Elmer Marth Food & Environmental Scholarship.

Submitted by: Joseph J. Disch, WAMFS Past President

Annual Conference was Informative

Another successful and information-packed North Dakota Environmental Health Association Annual Educational Conference was held in Bismarck on November 2 and 3. Presiding over this year's conference was outgoing President Dan Mattern. Special thanks and appreciation go out to the local arrangements and program committees for their efforts in making this conference a huge success.

This year's program included a wide variety of current topics of interest such as on-site sewage treatment, electromagnetic fields, stray voltage and its effect on the dairy industry, government regulations impact on industry, and nutritional food labeling. Leo Reinbold, Public Service Commissioner, kept conferees entertained with laughter at the luncheon on Tuesday.

At the business meeting on Wednesday, several awards were presented to a very deserving group of individuals. Roger Cilke, First District Health Unit, Minot, received a Dedicated Service Award for his 30 years of service to environmental health. Jim Michael, Central Valley Health Unit, Jamestown, received a Distinguished Service Award for his tireless efforts in the area of environmental and public health. Certificates of Merit were presented to Jeff Burgess, Keith Johnson and Deb Larson. Industry Awards were presented to St. Alexius Medical Center Dietary Department, Missouri Slope Lutheran Care Center Nutritional Services, and EcoLab, Inc.

Art Cox, Upper Missouri District Health Unit, Williston, has agreed to host the 1994 Conference in Williston. The meeting will be held November 2 and 3, 1994 at the International Inn. Make plans to be there!

Upcoming IAMFES Affiliate Meetings

1994

MARCH

•**16-18, Michigan Environmental Health Association Annual Meeting** will be held in Ann Arbor, MI. For more information, contact Durwood Zank at (517)543-2430.

APRIL

•**6-8, Missouri Milk, Food and Environmental Health Association's 1994 Annual Education Conference** will be held at the Ramada Inn, 1100 Vandiver Drive, Columbia, MO 65202 (314)449-0051. For more information, contact Janet Murray at (816)263-6643.

•**12-13, Carolina's Association of Milk, Food and Environmental Sanitarians** will meet in Greenville, SC. For more information, contact Beth Johnson at (803)935-6201.

•**18-22, Wyoming Environmental Health Association's Annual Educational Conference** will be held at the Holiday Inn, Sheridan, WY. For more information, contact Stephanie Whitman at (307)721-5283.

SEPTEMBER

•**19-21, Indiana Environmental Health Association, Inc. Annual Meeting** will be held in Muncie, IN. For more information, contact Tami Barrett at (317)633-8400.

OCTOBER

•**12-13, Iowa Association of Milk, Food and Environmental Sanitarians Annual Meeting** will be held at the Best Western Starlite Village (formerly the Ramada Hotel), Waterloo, IA. For more information call Dale Cooper at (319)927-3212.

MADFES Loses A Leader

Dick Henry Kleyn died December 2, 1993 in New Brunswick, New Jersey. He was 64.

Dr. Kleyn was a professor of food science at Rutgers University's Cook College for the past 30 years and was well known within the dairy science community. Among his numerous accomplishments he helped develop the Rutgers Phosphatase Test to measure pasteurization efficiency. For the past 15 years, almost to the time of his death, he was the Executive Secretary-Treasurer of the Metropolitan Dairy Technology Society, now an IAMFES affiliate known as the Metropolitan Association of Dairy, Food and Environmental Specialists.

Born in Den Helder, The Netherlands, he had lived in Youngstown, Ohio before moving to New Jersey 30 years ago. He received a bachelor's degree from Ohio State University and his master's and Ph.D. from Cornell University.

He was a navy veteran of the Korean War, and was an active member of the Princeton Chapter of Society for Preservation and Encouragement of Barber Shop Quartet Singing in America.

He was predeceased by his wife, Francina Brouwer, who died earlier this year. Surviving are a son, Franklin G. of Seattle; a daughter, Alison C. Kleyn of Naples, Florida; two brothers, John G. of Seattle and Carl of North Canton, Ohio, and a sister, Ella Frame of Cleveland, Ohio.

Memorial contributions may be made to the Leukemia Society of America, Lindenwold, NJ 08021.

A Few Notes from the WEHA (Wyoming Environmental Health Association) Newsletter

President's Message

Congratulations to Ken Hoff and his AEC committee for an excellent Annual Educational Conference. The excellent cross section of topics should have provided something for everyone. It appears almost everyone enjoyed the conference. The combination of WEHA and WPHA in the joint AEC was a success. If this is the direction the committee wants to take for the 1994 AEC, I certainly encourage it.

On September 23rd and 24th, I attended the Colorado Environmental Health Association (CEHA) Annual Educational Conference in Steamboat Springs. This was their first joint meeting with their public health association and it appeared to be a success also. I was asked to speak at their business meeting concerning our lending library. The CEHA voted to accept our offer of opening our library to CEHA members. They also decided to begin organizing their own resource material from the various health departments in Colorado and make that information available to their members. The CEHA executive board decided to look into organizing a lending library of their own, similar to ours. I offered Todd's and my assistance if they had questions on developing their library.

A few projects I would like to see completed within this next year in WEHA are:

1. Completion of the WEHA directory.
2. Completion of the revised By-Laws/Policy & Procedure Manual.
3. WEHA'S assistance in the development of the HACCP training video to be shown via satellite; and
4. Upgrading of our Food Safety Kits.

These are some of the things I would like to see accomplished, but I am sure there will be other projects that come up and can be added to the list. If any of you think of something you would like to see WEHA involved in, please contact me or any of the other executive board members with your ideas. Also, if you want to be on any of the committees, please contact me or the committee chairperson.

Submitted by Dean Finkenbinder, WEHA President

Howard Hutchings (r), IAMFES Past President, presents the Outstanding Sanitarian Award to Bud Anderson.

Outstanding Sanitarian

This years outstanding sanitarian is a long time member of WEHA and represents the best or our profession. Known as a fun-loving, warm, critical thinking and honest individual, our honoree is well known throughout Wyoming and the U.S. for his many contributions to food safety.

The recipient is a skilled team builder. He always seeks input from those who have most at stake as a result of a regulatory agencies actions.

Over the past year he has lead a committee of inspectors charged with creating the HACCP based system now used by the Department. Recently, great publicity has been brought to the Department, largely because of his efforts to promote the idea. The headline from an article published in the Billings Gazette stated: "Wyoming Pioneers Food Safety Program". If this is true, then our recipient should be addressed as "Wagon Master".

The Food and Drug Administration has tapped the abilities of our honoree as well. He has spent many weeks this past year in far off places helping FDA teach the HACCP concept to other individuals around the country. He is also helping FDA put together a HACCP training manual, which will be the basis for implementing the new food code.

This years recipient of the Outstanding Sanitarian Award is someone we can all be proud of —"WAGON MASTER" Bud Anderson.

WEHA Newsletter, December, 1993

International Association of Milk, Food and Environmental Sanitarians

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Dairy, Food and Environmental Sanitation, Vol. 14, No. 2, Pages 106-114 (February 1994)

3-A Sanitary Standards for Farm Milk Cooling and Holding Tanks, Number 13-09

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. Specifications for farm milk cooling and holding tanks heretofore or hereafter developed which so differ in design, material, and 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.

A

SCOPE

A.1

These standards cover the sanitary aspects of tanks in which bulk milk is cooled and stored on dairy farms.

A.2

Tanks made in conformance to these standards shall provide a means for cooling the milk.

A.3

In order to conform with these 3-A Sanitary Standards, farm milk cooling and holding tanks shall comply with the following design, material, fabrication, and cooling criteria.

B

DEFINITIONS

B.1

Product: Shall mean milk.

B.2

Farm Milk Cooling and Holding Tank: Shall mean a vertical or horizontal cylindrical, rectangular, oval or other equally satisfactorily shaped tank.

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

Nonproduct Contact Surfaces: Shall mean all other exposed surfaces.

B.4

Lining: Shall mean all surfaces used to contain the product, including the ends, sides, bottom, and top.

B.5

Shell: Shall mean the material covering the exterior of the insulation and/or heat exchange jacket.

B.6

Breast: Shall mean that portion of the metal used to join the lining to the shell.

B.7

Bridge: Shall mean a cover on an open top type tank which is open on both sides and is permanently attached to the lining on opposite sides of the tank. It may be used to support a removable or nonremovable main cover(s) and accessories.

B.8

Outlet: Shall mean the opening in the lining and the passage for milk to the exterior of the tank. The outlet passage starts at the opening in the lining and terminates at the connection for the outlet valve.

B.9

Inlet: Shall mean the opening that allows milk to enter the tank.

B.10

Vent: Shall mean an opening into the tank for maintaining atmospheric pressure within a farm cooling and holding tank during filling, emptying and cleaning.

B.11

Vent Cover: Shall mean a device for protecting the vent against entrance of contaminants into the tank.

B.12

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.

C

MATERIALS

C.1

Product contact surfaces including the breast, shall be of stainless steel of the AISI 300 Series[*1] or corresponding AC1[*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

[*1] *The data for this series are contained in the AISI Steel Products Manual, Stainless & Heat Resisting Steels, November 1990, Table 2-1, pp. 17-20. Available from the Iron and Steel Society, 410 Commonwealth Drive, Warrendale, PA 15086 (412-776-9460) (Use most current edition).*

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

types and is nontoxic and nonabsorbent, except that:

C.1.1

Rubber and rubber-like materials may be used for slingers, drip shields, agitator seals, agitator bearings, O-rings, seals, gaskets, and parts having the same functional purpose or for protective caps for sanitary tubing, fittings or vents.

C.1.2

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

C.1.3

Plastic materials may be used for slingers, drip shields, agitator seals, agitator bearings, O-rings, seals, gaskets, sight and/or light openings, spray devices, direct reading gauge tubes and parts having the same functional purpose or for protective caps for sanitary tubing, fittings or vents.

C.1.4

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

C.1.5

Except for the protective caps provided for in C.1.1 and C.1.3, sanitary fittings and valves shall be made of materials provided for in the current 3-A Sanitary Standards for Sanitary Fittings for Milk and Milk Products, Number 63- and current 3-A Sanitary Standards for Plug-Type Valves for Milk and Milk Products, Number 51- and current 3-A Sanitary Standards for Thermoplastic Plug-Type Valves, Number 52-.

C.1.6

Sanitary tubing, if provided, shall conform with the current 3-A Sanitary Standards for Polished Metal Tubing for Dairy Products, Number 33-.

C.1.7

Glass may be used in sight and/or light openings and as direct reading gauge tubes, and when used, shall be of a clear, heat-resistant type.

C.1.8

Where materials having certain inherent functional purposes are required for specific applications such as bearing surfaces and rotary seals, carbon[*3], and/or ceramic materials may be used. Carbon and/or ceramic materials shall be inert, nonporous, nontoxic, nonabsorbent, 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.2

The materials used for the lining shall not be less than 18 U.S. standard gauge thickness.

C.3

Nonproduct contact surfaces shall be of corrosion-resistant material or material that is rendered corrosion resistant. If coated, the coating used shall adhere. Nonproduct contact surfaces shall be relatively nonabsorbent, durable and cleanable. Parts removable for cleaning having both product contact and nonproduct 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 G.) The measuring rod of an immersion type measuring device may have a dull finish to facilitate reading.

D.2

All permanent joints in metallic product contact surfaces shall be continuously welded except that rolled on sanitary pipeline ferrules or flanges may be used on connections beyond the shell. Welded areas of 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

All product contact surfaces shall be easily accessible for cleaning either when in an assembled position or when removed. Removable parts shall be readily demountable. Tanks that are to be mechanically cleaned shall be designed so that all product contact surfaces of the tank, including product contact surfaces of the opening for a vertical mechanical agitator, and all nonremovable appurtenances thereto can be mechanically cleaned.

D.4

Product contact surfaces shall be self-draining except for normal clingage. The lining shall be so constructed that it will not sag, buckle, or become distorted in normal use. Horizontal tanks shall be so constructed that they will not prevent complete drainage of water when the tank has a pitch of not more than 1 in. in 100 in. (10 mm per m). If the tank is designed for use on a vacuum system the construction shall be such that the lining will not be distorted when the internal pressure is 20 in. of mercury (68 kPa) below atmospheric pressure.

D.4.1

When the tank is level or when it is in the position in which it was calibrated or when it is in position to be calibrated, the bottom shall pitch to the outlet to effect complete drainage.

D.4.2

If the tank is designed for mechanical cleaning, the bottom shall pitch (1) at least 1/4 in. per ft (21 mm per m) toward the outlet in a horizontal tank or (2) at

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[*3] *Carbon which is specifically in compliance wth the Food, Drug and Cosmetic Act, as amended, is that which is included in v fillers in the food additive regulations for rubber articles intended for repeated use, 177.2600 of Subpart F, Code of Federal Regulations, Title 21-Food and Drugs (Use most current edition).*

least 3/4 in. per ft (63 mm per m) toward the outlet in a vertical tank.

D.5

Gaskets shall be removable. Any gasket groove or gasket retaining groove 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.6

All internal angles of 135 degrees or less on product contact surfaces shall have minimum radii of 1/2 in. (13 mm) except that:

D.6.1

Minimum radii for fillets of welds in product contact surfaces may be 1/8 in. (3 mm) where the thickness of one or both parts joined is less than 3/16 in. (5 mm).

D.6.2

The minimum radii in agitator shaft bottom guide bearings and in gasket grooves or gasket retaining grooves other than those for standard 1/4 in. (6 mm) and smaller O-rings shall be not less than 1/8 in. (3 mm).

D.6.3

The minimum 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.6.4

The minimum radii of covers and agitator assemblies shall not be less than 1/4 in. (6 mm).

D.7

There shall be no threads on product contact surfaces.

D.8

Sanitary fittings and valves shall conform with the applicable fabrication provisions of current 3-A Sanitary Standards for Sanitary Fittings for Milk and Milk Products, Number 63- or current 3-A Sanitary Standards for Plug-Type Valves for Milk and Milk Products, Number 51-, or current 3-A Standards for Thermoplastic Plug-Type Valves for Milk and Milk Products, Number 52-, except that materials conforming to C.1.1 or C.1.3 may be used for caps of sanitary design for the protection of terminal ends of sanitary tubing, fittings, or vents.

D.9

Sanitary tubing, if provided, shall conform with the current 3-A Sanitary Standards for Polished Metal Tubing for Dairy Products, Number 33-.

D.10

The breast shall be integral with or continuously welded to the lining and shall be sloped so that drainage is away from the lining. The junction of the breast and the shell shall be continuously welded.

D.11

Covers

D.11.1

Main covers for open top-type tanks

Main covers (1) shall be sufficiently rigid to prevent buckling, (2) shall be self-draining, (3) shall be provided with an adequate, conveniently located and durable handle(s) of sanitary design welded in place or formed into the cover materials, (4) unless gasketed, shall have downward flanges not less than 3/8 in. (10 mm) along all edges and (5) shall be close fitting. If the cover is not gasketed, the clearance between the surface of the cover and the surface of the tank it is designed to contact shall not exceed 3/32 in. (2 mm). Covers not exceeding 24 x 30 in. 610 x 760 mm) or 30 in. (760 mm) in diameter may be removable and shall be designed to be self-draining in the closed position.

D.11.2

Nonremovable covers for open top-type tanks

Nonremovable covers (1) shall be of a type that can be opened and maintained in an open position, (2) shall be designed to be self-draining when in the closed position, (3) shall be designed so that when the covers are in any open position liquid from the exterior surface will not drain onto the lining and (4) shall be designed so that when in their fully opened position, condensation on the underside will not drain into the tank. Covers of openings that will be held in place by gravity or vacuum may be of the lift-off type and may be provided with a clamp(s) or other device(s) to maintain them in position.

D.11.3

Bridges and fixed covers for open top-type tanks

Bridges and fixed covers shall pitch to the outside edge(s) of the tank for complete drainage, and shall have a raised flange not less than 3/8 in. (10 mm) in height where the edge(s) meets the main cover(s). Bridges and fixed covers shall be integral or welded to the lining and shall be installed so the underside is accessible for cleaning and inspection without completely entering the tank. Bridges shall not exceed 24 in. (610 mm) in width. Generally horizontal fixed covers, located at ends or sides of an open top type tank (or segments of cylindrical open top type tanks) with generally vertical side walls, shall not exceed more than 12 in. (300 mm) over the surface of the product.

D.11.4

Manhole covers for closed-type tanks

Covers for manholes in side walls and/or ends shall be either of the inside or outside swing type. If the cover swings inside, it shall also swing outside away from the opening. Threads or ball joints employed to attach the manhole cover(s) and its appendages shall not be located within the lining. Covers for manholes in the top of tanks shall be of the outside swing type or be of a removable type.

D.11.5

All openings in the lining or in fixed covers or in bridges or main covers of open top type tanks, except those for agitators, all openings with permanently attached sanitary pipeline fittings, and thermometers or immersion-type measuring devices that remain in place while the product is in the tank, shall be provided with removable covers, which are designed to make close contact with the upper edges of the opening or cover surface. When the openings are in the main cover the removable cover(s) shall remain in position when the main cover is in an open position.

D.11.6

To protect against the entrance of dust, oil, insects and

other contaminants into the tank through the space around the agitator shaft, an umbrella or drip shield of sanitary design shall be provided that can be raised or readily demounted to permit cleaning of all its surfaces.

D.11.7

The water compartment of a tank designed for refrigerated water cooling shall have a cover. The clearance between the surface of the cover and the surface of the water compartment it is designed to contact shall not exceed 1/16 in. (2 mm).

D.12

Openings

The edges of all openings into the lining that are upward or horizontal shall extend upward or outward at least 3/8 in. (10 mm) above or beyond the shell or the exterior surface or be fitted with a permanently installed sanitary pipeline fitting.

D.12.1

The main openings of tanks shall be of sufficient number, adequate in size, and so located that all product contact surfaces are easily accessible and, except for the product contact surfaces of parts removable for cleaning, can be inspected visually without entering the tank.

D.12.2

An exception to the requirement of D.12.1 is made for closed-type tanks having product contact surfaces that cannot be manually cleaned and inspected without entering the tank.

D.12.2.1

The minimum inside height of this closed-type tank shall be 36 in. (910 mm); and if the inside height exceeds 96 in. (2440 mm), means shall be provided that will facilitate manual cleaning and inspection of all product contact surfaces (See Appendix, Section H.) or means shall be provided for mechanically cleaning the product contact surfaces of the tank and all nonremovable appurtenances thereto. This type of tank shall have a manhole opening(s) complying with the provisions of D.12.6

D.12.3

All openings shall terminate in the milk room, except those for agitators. (See Section D.15.)

D.12.4

A sanitary pipeline inlet shall be at least 1 1/2 in. (38 mm) or the inlet opening shall accommodate at least 1 1/2 in. (38 mm) 3-A sanitary tubing.

D.12.5

Agitator openings

Agitator shaft openings through the bridge or top enclosure shall have a minimum diameter of 1 in. (25 mm) on tanks which require removal of the agitator shaft for cleaning or be of a diameter that will provide a 1 in. (25 mm) minimum annular cleaning space between the agitator shaft and the inside surface of the flanged opening on tanks which do not require removal of the agitator for cleaning.

D.12.6

Manhole openings

A manhole opening, if provided, shall be located at the outlet end or side of the tank or the top of the tank. The inside dimensions of the manhole opening shall not be less than 15 x 20 in. (380 x 510 mm) oval, or 18 in. (460 mm) diameter.

D.12.7

Sight and light openings

Sight and light openings shall be provided when no other opening is available for viewing the surface of the milk and shall be of such design and construction that the inner surfaces drain inwardly; and if the tank is designed for mechanical cleaning, the inner surface of the plastic shall be relatively flush with the inner surface of the lining. The inside diameter of the opening, if only one is provided, shall be at least 5 3/4 in. (150 mm). If the two openings are provided, the inside diameter of each shall be at least 3 3/4 in. (95 mm). The external flare of the opening shall be pitched so that liquid cannot accumulate.

D.12.8

Thermometer connections

A connection(s) or opening(s) which will accommodate a temperature sensing element(s) of a thermometer(s) shall be provided. The connection(s) and/or opening(s) shall be located in the top enclosure, cover, bridge or through an end or sidewall. Thermometer wells may be used. The bulb of the temperature sensing element shall be located so as to permit registering the product temperature when the tank contains no more product than 20 percent of its capacity and shall be located so that the sensing element is not influenced by the cooling medium. Connections and/or openings shall conform to one of the following:

D.12.8.1

The applicable fittings found in the current 3-A Sanitary Standards for Instrument Fittings and Connections Used on Milk and Milk Products Equipment, Number 09-.

D.12.8.2

Fittings for temperature sensing devices which do not pierce the tank lining, but which have temperature sensing element receptacles securely attached to the exterior of the lining.

D.12.9

The vacuum connection for a tank designed to be operated under vacuum shall be standard stainless steel tubing not less than 1 1/2 in. (38 mm) in diameter and shall not rise vertically more than 4 in. (100 mm) to a stainless steel elbow. (See Appendix, Section 1.)

D.13

Outlet and Inlet Connections

D.13.1

Outlet

The outlet shall provide complete drainage of the tank. The outside diameter of the outlet passage shall conform to that of current 3-A sanitary tubing and shall be not less than that of 2 in. (50 mm) tubing. The terminal end of the outlet passage shall have a rolled-on or a welded sanitary pipeline ferrule or flange. The ferrule or flange shall not be below the bottom of the shell. The distance between the nearest point on the shell to the face of the ferrule or flange on the terminal end of a horizontal type outlet shall be not more than the smaller of (1) twice

the nominal diameter of the outlet passage or (2) 5 in. (130 mm). The outlet shall be one of the following types:

D.13.1.1

Horizontal type

The bottom of the outlet passage shall be at least as low as the low point of the lining at the outlet. The outlet passage shall be pitched downward toward the terminal end.

D.13.1.2

Vertical type

The vertical centerline of the outlet passage shall be as close as practical to a side wall of the tank. The outlet passage shall be a generally horizontal extension of an elbow which is a part of or is welded to the lining. The outlet passage shall not pass through the bottom of the shell if product will be held in the passage.

D.13.2

Inlet

The inlet connection, if provided, shall have an outside diameter of not less than 1 1/2 in. (40 mm). The inlet passage shall have a rolled-on or welded sanitary pipeline ferrule, sanitary threaded connection or flange. The distance between the nearest point on the shell to the face of the ferrule or flange on the terminal end shall be not more than the smaller of (1) twice the nominal diameter of the inlet passage or (2) 5 in. (130 mm). Outlets conforming to D.13.1 may also be used as inlets.

D.13.3

Inlet passage

The inlet passage on the upper section above the maximum fill line shall be not less than 1 1/2 in. (40 mm) and the passage shall have a raised flange of not less than of 3/8 in. (10 mm) above the surface of the outer liner or the manway, and a sanitary cap shall be provided to seal the passageway when the milk pipeline is removed.

D.14

Outlet Valves/Inlet Valves

Valves, when provided, shall conform to D.8. A cap conforming to D.8 shall be provided for the outlet end of the valves furnished with tanks.

D.15

Agitators

Means for mechanical and/or air agitation shall be provided that will result in a variation in milk fat content of the product in the tank of not more than plus or minus 0.1 percent as determined by an Official AOAC Milk Fat Test[4], when the tank is filled to (1) 100 percent of its capacity with product and the agitator has been in operation for 5 minutes if the capacity of the tank is less than 1500 gallons (5700 litres) or (2) 100 percent of its capacity with product and the agitator has been in operation for 10 minutes if the capacity of the tank is 1500 gallons (5700 litres) or larger. Agitators, if not designed for mechanical cleaning, shall be readily accessible for manual cleaning and inspection either in an assembled position or when removed. A seal for the agitator shaft, if provided, shall be of a packless type, sanitary in design and durable with all parts readily accessible for cleaning. A sanitary seal for the agitator shaft shall be provided for (1) a horizontal agitator, (2) a vertical agitator when it is specified that the tank is to be located so that the portion of the shaft outside the tank is not in the milk house or milk room and (3) a tank designed to be operated under vacuum. The means for agitation shall be one of the following:

D.15.1

Mechanical, top entering, nonremovable type

There shall be at least a 1 in. (25 mm) space between the nonremovable agitator and the bottom of the lining, unless the agitator is mounted on a hinged-type cover. A bottom shaft bearing shall not be provided for a nonremovable type agitator.

D.15.2

Mechanical, top entering, removable type

This type of agitator shall be provided with an easily accessible, readily demountable coupling of either a sanitary type located within the lining or a coupling located outside of the lining provided that it is above the shield provided to protect the annular space around the shaft. All product contact surfaces of the agitator shall be visible when the agitator is removed. A bottom support or guide, if used, shall be welded to the lining, shall not interfere with drainage of the tank and the inside angles shall have a minimum radii of 1/8 in. (3 mm). When the agitator shaft has a bearing cavity, the diameter of the cavity shall be greater than the depth. The agitator shall be readily demountable for cleaning of the bearing and any shaft cavity.

D.15.3

Mechanical side entering type

This type of agitator, shaft, and its complete seal shall be designed so it can be mechanically cleaned or shall be readily demountable for manual cleaning. Nonremovable parts having product contact surfaces shall be designed so that the product contact surfaces are readily cleanable from the inside of the tank.

D.15.4

Air agitation

The means for air agitation shall comply with the applicable provisions of D.16.

D.16

Air for Agitation or Movement of Product

Means for applying air under pressure shall conform to the applicable provisions of the current 3-A Accepted Practices for Supplying Air Under Pressure in Contact with milk, Milk Products and Product Contact Surfaces, Number 604-, and the following:

D.16.1

Tubing and related connections within the lining shall be of sanitary design and be readily demountable for cleaning outside the tank or be designed for mechanical cleaning. If designed for mechanical cleaning, the tubing and all related fittings shall be self-draining.

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[4] *The method of making these tests will be found in the following reference: Official Methods of Analysis: Available from the AOAC International, 2200 Wilson Blvd., Suite 400, Arlington, VA 22201-3301 (Use most current edition).*

D.16.2

Permanently mounted air tubing shall be constructed and installed so that it will not sag, buckle, vibrate or prevent complete drainage of the tank or tubing and shall be located so that the distance from the outside of the tubing to the lining shall be at least 2 in. (50 mm), except at the point of entrance.

D.17

Mechanical Agitator Driving Mechanism Mounting

The driving mechanism when above the lining shall be securely mounted in a position that will provide a minimum distance of 4 in. (100 mm) measured vertically downward from the bottom of the driving mechanism housing, excluding bearing bosses and mounting bosses, to the nearest surface of the tank; and it shall be mounted in such a manner that all surfaces of the tank under or adjacent to the driving mechanism shall be readily accessible for cleaning and inspection.

D.18

Thermometers

Each tank shall be provided with an indicating thermometer, and also may be supplied with a recording thermometer complying with the applicable specifications for indicating and recording thermometers in Appendix, Section J. The thermometer or the temperature sensing element of the thermometer shall fit one of the connections or openings provided for in D.12.7.1 and D.12.7.2. The indicating thermometer may be analog or digital. Each tank shall be provided with a means for adding a recording thermometer.

D.19

Vents

A vent(s), if provided, shall be so designed to prevent damage to the tank resulting from back pressure during filling and to prevent vacuum during emptying of the tank. (See Appendix, Sections M and N.) It shall be in the front head near the top of the tank, or in the top of the tank, or in a manhole cover for a manhole. The vent(s) shall terminate in the milk house or milk room. The air vent shall be provided with a cover or be fabricated to protect the vent from overhead drip or drainage. Perforations may be provided on the sides and/or the bottom of the vent. Perforations shall have openings not greater than 1/16 in. (2 mm) diameter, or slots not more than 1/32 in. (I mm) wide. Woven wire mesh shall not be used for this purpose. It shall be so designed that parts are readily demountable for cleaning and inspection.

D.20

Cleaning

Tanks having an inside height of more than 96 in. (2440 mm) shall be provided with that will facilitate manual cleaning and inspection of all product contact surfaces (See Appendix, Section H.) or means shall be provided for mechanically cleaning the product contact surfaces of the tank and all nonremovable appurtenances thereto.

D.20.1

Permanently mounted spray cleaning devices

The spray device shall be of sanitary design and be readily removable for inspection and shall be made of materials conforming to Section C. The tubing to which the spray device is connected shall be stainless steel conforming to Section C. The portion extending from the opening in the lining shall conform to Section D. When practical, all piping mounted between the shell and the lining shall be self-draining to the exterior. A means shall be provided to disconnect the cleaning solution and/or water supply when milk is in the tank. A protective cap or cover of sanitary design, constructed of materials specified in C.1 C.1.1 or C.1.3 shall be provided to cover all openings into the tank after the cleaning solution and/or water supply lines have been disconnected.

D.21

Sample Cock

A sample cock shall be provided when a sample cannot be readily obtained from a top opening or a sample port opening in the tank. It shall be of sanitary design and be of a type that has its sealing surface relatively flush with the product contact surface of the tank and have an inside diameter no less than that of 1 in. (25 mm) 3-A sanitary tubing.

D.22

Tank Supports

The means of supporting a tank designed to be installed wholly within the milk house or milk room or the means of supporting the portion of a tank that will be in the milk house or milk room shall be:

D.22.1

With legs

Adjustable legs shall be of sufficient number and strength, and so spaced that the filled tank will be adequately supported. Legs shall be smooth with rounded ends and have no exposed threads. Legs made of hollow stock shall be sealed. Legs shall be of a length that will provide (1) a distance between lowest interior surface of the outlet connection and the floor of not less than 4 in. (100 mm) and (2) a clearance of at least 6 in. (l50 mm) between the floor and the bottom tank 72 in. (1830 mm) or less in diameter or width, except in the case of a V-bottom or a rounded bottom tank of which the outer shell slopes continually upward from the outlet centerline, in which case the minimum clearance may be 4 in. (100 mm) if it increases to 6 in. (150 mm) within a horizontal distance of not more than 12 in. (300 mm) on each side of this centerline. On a tank more than 72 in. (1830 mm) in diameter or width, the clearance shall be at least 8 in. (200 mm). Where Weights and Measures Codes require that a seal be placed on the legs to detect height adjustment after the tank has been leveled or calibrated, the holes for seals shall be designed and located, or sealed, to prevent entrance of moisture into the legs.

D.22.2

A farm tank installed partially outside the milk house or milk room, shall be effectively sealed to the wall or ceiling.

D.23

Prevention of a Significant Product Temperature Increase

Insulation material shall be of a nature and installed in a manner that will prevent shifting or settling. It shall be capable of preventing, in 12 hours, a product temperature increase greater than 5 degrees F (2.8 degrees C) in a tank filled to 100 percent of its capacity with product when there is a difference of 50 degrees F (28 degrees C) between ambient temperature and the average temperature of the product in the tank. For test purposes, water may be substituted for product and refrigeration shall not be activated.

D.24

Measuring Devices

A measuring device of the immersion type or of the direct reading gauge type, if provided, shall comply with D.24.1 or D.24.2.

D.24.1

Immersion type

An immersion measuring device shall comply with the applicable provisions of the National Institute of Standards and Technology Handbook 44 - 1993 Edition, Sec. 4.42 Farm Milk Tanks, S. Specifications S.3.7, Graduations, pages 4-10 and 4-11.

The measuring rod shall have graduation marks not less than 0.005 in. (0.10 mm) in width and not exceeding 0.008 in. (0.20 mm) in depth. The measuring rod consists of a graduated, portion seat to engage the measuring rod supporting bracket or other supporting means and a handle. It does not include the supporting bracket or other supporting means. The measuring rod may be two or more parts welded together or may be one piece. The handle shall extend above the bridge or main cover on open type tanks or shall be above the milk overflow level in closed type tanks. The tank serial number stamped or etched on the rod shall be located as high on the rod as practical. The opening through which the measuring rod extends shall be protected against liquids or other contaminants entering the tank from that portion of the measuring rod outside the tank.

D.24.2

Direct reading gauge

Any farm cooling and holding tank with a capacity of greater than 2000 gallons (7600 litres) shall be equipped with an external gauge assembly. The direct reading gauge shall be of the glass or plastic tube type and shall be sanitary in design and construction and shall be readily accessible for cleaning or shall be designed for mechanical cleaning. The gauge shall comply with the applicable provisions of the code entitled National Institute of Standards and Technology Handbook 44 - 1993 Edition, Sec. 4.42 Farm Milk Tanks, S Specification, S.3.6, External Gauge Assemblies page 4-10. If designed for mechanical cleaning the inside diameter of the gauge parts shall be sufficiently uniform that all product contact surfaces will be cleaned. It shall be designed and constructed so that all product in the gauge will be discarded. Means to accomplish this shall be provided at the lowest point and in such a manner that product in the gauge will not enter the tank outlet nor re-enter the tank. The valve shall be close coupled. The distance, measured along the passage for the product in the tank to the gauge valve, from the nearest point on the shell to the ferrule or flange for the valve shall not be more than the smaller of (I) twice the nominal diameter of the passage or (2) 5 in. (130 mm).

D.25

Nonproduct Contact Surfaces

Nonproduct contact surfaces shall comply with the following:

D.25.1

They shall be smooth, free of pockets and crevices and be readily cleanable.

D.25.2

Surfaces to be coated shall be effectively prepared for coating.

D.25.3

The shell shall be effectively sealed against moisture and vermin at all joints and at junctions with the breast, manhole openings, outlets and other openings.

D.25.4

A vent or weep hole(s) may be provided in the shell. If provided, it shall be located in a position that will provide drainage from the shell and shall be vermin proof.

D.25.5

Outside welds need not be ground.

E

COOLING

E.1

Cooling Requirements for Milk Cooling System

The milk cooling tank shall be provided with sufficient cooling capacity to accomplish the following:

E.1.1

The milk shall be cooled to 50 degrees F (10 degrees C) within the first hour after milking, and to 40 degrees F (4.4 degrees C) within the second hour after milking provided the blend temperature after the first and subsequent milkings does not exceed 50 degrees F (10 degrees C).

E.1.1.1

For everyday pick-up, the tank shall be rated at 50 percent of tank capacity.

E.1.1.2

For every other day pick-up, the tank shall be rated at 25 percent of tank capacity.

E.2

Cooling Information

The tank shall have an information or data plate permanently attached to it giving the following information. (See Section E.2.2. and Appendix, Section K.)

E.2.1

The information on the data plate shall be rated as if the tank is the only source of cooling.

E.2.2

This tank is designed for [everyday or every other day] pick-up. Maximum rate at which milk can enter this tank and meet the cooling requirements of the current 3-A Sanitary Standards for Farm Milk Cooling and Holding Tanks Number 13- is _____ U.S. Gallons

per hour (____liters per hour). When milk enters the tank at the maximum rate, the minimum condensing unit capacity is * _____ BTU/hr. at * ____ degrees F (*_____ kJoules/hr at * _____ degrees C) suction temperature. *The BTU (kJoule) capacity specified is to be at the saturated suction temperature designated by the manufacturer.

E.2.3

In determining cooling capacity, the ambient temperature shall be 90 degrees F (32 degrees C) and when water cooled condensers are used, the refrigerant condensing temperature shall be not less than 103 degrees F (39 degrees C).

E.2.4

The tank shall be provided with an automatic refrigeration control capable of functioning on a change in product temperature of not more than plus or minus 2 degrees F at 37 degrees F (1.1 degree C at 2.8 degrees C).

E.2.5

The tank shall be provided with automatic, intermittent, timed agitation, which operates at a minimum of 5 minutes each hour milk is in the tank.

APPENDIX

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 steels of the 300 Series. Cast grades of stainless steel corresponding to types 303, 304, and 316, are designated CF-16F CF-8, and CF-8H respectively. These cast grades are covered by ASTM[*5] 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 Section D.1 herein.

H

MANUAL CLEANING

If the inside height of a tank exceeds 96 in. (2440 mm), one means for manual cleaning is to weld a sanitary stainless steel rung on each end of the tank to support a removable platform at a height which will facilitate cleaning and inspection.

I

VACUUM PIPING

When vacuum piping is provided, the piping downstream from the elbow connected to the vacuum connection on the tank (See Section D.12.9 should pitch downward from the tank to a moisture trap. The moisture trap, when provided by the tank manufacturer, should be equipped with automatic means to shut off the vacuum when the trap has become filled with moisture. The piping between the tank vacuum connection and the moisture trap should be stainless steel and have a pitch of not less than 1 in. (25 mm) in the first 12 in. (300 mm).

J

THERMOMETERS

J.1

Indicating Thermometers

The scale range should have a span not less than 50 degrees F (28 degrees C) including normal storage temperatures plus or minus 5.0 degrees F (3.0 degree C) with extension of scale on either side permitted graduated in not more than 2.0 degrees F (1 degree C) divisions. Digital thermometers should display to the nearest 1 degree F or 0.10 degrees C. Temperature scale divisions should be spaced not less than 1/16 in. (2 mm) apart between 35 degrees F (2 degrees C) and 55 degrees F (13 degrees C). Digital thermometers should have 0.30 in. (8 mm) digits as a minimum. Accuracy should be within 2 degrees F (1 degree C) plus or minus throughout the specified scale range. The stem fitting should conform to the current 3-A Sanitary Standards for Instrument fittings and Connections Used for Milk and Milk Products Equipment, Number 09-, or shall be a stem fitting that does not pierce the lining or means shall be provided to permit securely fastening the temperature sensing element to the outer surface of the lining.

J.2

Recording Thermometers

The scale should have a scale span of not less than 50 degrees F, (28 degrees C), including normal storage temperature plus or minus 5.0 degrees F (3.0 degrees C) graduated in not more than 2 degrees F (1 degree C). Divisions spaced not less than 0.040 of an in. (1 mm) apart are permitted when the ink line is thin enough to be easily distinguished from the printed line: graduated in time scale division of not more than 1 hour having a chord of straight-line length of not less than 0.125 of an in. (3 mm) at 40 degrees F (5 degrees C). Chart must be capable of recording temperatures up to 180 degrees F (83 degrees C). Span specifications do not apply to extensions beyond 100 degrees F (38 degrees C). Stem fitting should conform to the current 3-A Sanitary Standards for Instrument Fittings and Connections Used on Milk and Milk Products Equipment, Number 09-, or should be a stem fitting that does not pierce the lining or mean shall be provided to permit securely fastening the temperature sensing element to the outer surface of the lining. The circular chart should make one revolution in not more than seven days and should be graduated for a maximum record of seven days. Strip chart should move not less than 1 in. (25 mm) per hour and may be used continuously for one calendar month.

K

DETERMINATION OF COOLING CAPABILITY

In determining the capability of a farm cooling tank to

[*5] *Available from ASTM, 1916 Race St., Philadelphia, PA 19103-1187 (215-299-5400) (Use most current editions).*

meet the cooling requirements specified in E.1.1 at the maximum rate at which milk can enter the tank given on the information plate:

K.1

Water at 100 degrees F (38 degrees C) may be substituted for milk, and before the addition of the second and subsequent milkings, the water or milk in the tank be cooled to 37 degrees F (3 degrees C) and the condensing unit should be allowed to operate and automatically shut off.

L

SUPPLEMENTAL DATA PLATE INFORMATION

L.1

The data plate of the tank should also include the time the agitator was designed to be in operation (five or ten minutes) to obtain the homogeneity required in D.15.

L.2

Example of a data plate legend

The agitator of this tank is designed so that it must be in continuous operation * _____ minutes before removing a product sample. *i.e. specify whether 5 or 10.

L.3

The agitator of this farm tank is designed so that the portion of agitator shaft outside of the farm tank **_____ in the milk room.

**Insert one of the following:

(a) "does not have to be"

(b) "must be"

M

AIR VENTING

The free vent opening should be sized to protect the tank from internal pressure or vacuum damage during normal operation. The critical relationship between minimum vent-size and maximum filling or emptying rates should be observed. A perforated vent cover, if used, should have a free opening area equal to at least 1 1/2 times the area of the minimum vent opening in the tank. The venting system covered in the preceding paragraphs is intended to provide for venting during filling and emptying; however, if the venting system is not adequate during mechanical cleaning the tanks should be vented adequately by opening the manhole door to prevent vacuum or pressure build up due to sudden changes in temperature of very large volumes of air.*[6] Means should be provided to prevent excess loss of cleaning solution through the manhole opening. The use of tempered water of about 95 degrees F (35 degrees C) for both pre-rinsing and post-rinsing may be used to reduce the effect of flash heating and cooling. Provisions should be made to prevent overfilling with resultant vacuum or pressure damage to the tank.

N

CIP VENTING REQUIREMENTS

N.1

Inventive genius may provide a vent and tank design that is adequate to permit CIP cleaning without damage to the tank with the manhole cover in place. However, if the design is not adequate to permit C-l-P cleaning with a manhole cover in place, a label permanently affixed to the manhole cover(s) instructing user to open during mechanical cleaning should be provided as shown in the example below:

Door is
to be opened during
CIP Cleaning

Except that:

N.2

If venting is provided according to the following formula: 0.005 sq in. vent area x total tank capacity in gallons (0.085 sq mm vent area x total tank capacity in litres).

O

LOCATION, INSTALLATION AND PROTECTION OF REFRIGERATION UNITS

Refrigeration units should be located and installed in accordance with the manufacturers recommendations to provide protection against adverse weather and environmental conditions.

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[6] For example, when a 6,000 gallon tank (with 800 cu ft of 135 degrees F hot air after cleaning) is suddenly flash cooled by 50 degrees F water sprayed at 100 gpm the following takes place: Within one second, the 800 cu. ft. of hot air shrinks approximately 51 cu. ft. in volume. This is the equivalent in occupied space of approximately 382 gallons of product. The shrinkage creates a vacuum sufficient to collapse the tank unless the vent, manhole, or other openings allow the air to enter the tank at approximately the same rate as it shrinks. It is obvious, therefore, that a very large air vent such as the manhole opening is required to accommodate this air flow.

These standards shall become effective November 20, 1993, at which time the 3-A Sanitary Standard for Farm Milk Cooling and Holding Tanks, Number 13-08, are rescinded and become null and void.

Dairy, Food and Environmental Sanitation, Vol. 14, No. 2, Pages 115-128 (February, 1994)

Holders of 3-A Symbol Council Authorization on February 15, 1994

Questions or statements concerning any of the holders authorizations listed below, or the equipment fabricated, should be addressed to: Administrative Officer, 3-A Symbol Council, 4403 First Avenue, Suite 404, Cedar Rapids, IA 52402 (319) 395-9151.

01-07 Storage Tanks for Milk and Milk Products

2 APV Crepaco, Inc. (5/1/56)
100 South CP Ave.
Lake Mills, Wisconsin 53551

28 Cherry-Burrell Corporation (10/3/56)
(A Unit of AMCA Int'l., Inc.)
575 E. Mill St.
Little Falls, New York 13365

117 DCI, Inc. (10/28/59)
P.O. Box 1227, 600 No. 54th Ave.
St. Cloud, Minnesota 56301

76 Damrow Company (10/31/57)
(A Div. of DEC Int'l., Inc.)
196 Western Ave., P.O. Box 750
Fond du Lac, Wisconsin 54935-0750

127 Paul Mueller Co. (6/29/60)
P.O. Box 828
Springfield, Missouri 65801

440 Scherping Systems (3/1/85)
801 Kingsley St.
Winsted, Minnesota 55395

571 Viatec Process/Storage Systems (8/21/89)
500 Reed St.
Belding, Michigan, 48809

31 Walker Stainless Equipment Co., Inc. (10/4/56)
Elroy, Wisconsin 53929

02-08 Pumps for Milk and Milk Products

63R APV Crepaco, Inc. (4/29/57)
100 South CP Ave.
Lake Mills, Wisconsin 53551

636 Abel Pumps Corporation (7/10/91)
79 North Industrial Park
511 North Avenue
Sewickley, Pennsylvania 15143-2339
(Mfr: Abel Pumps, Buchen, Germany)

214R Ben H. Anderson Manufactures (5/20/70)
Box A
Morrisonville, Wisconsin 53571

212R Babson Brothers Company (2/20/70)
Dairy Systems Division
1400 West Gale
Galesville, Wisconsin 54630

739 CSF Inox S.P.A. (6/25/93)
Strada per Bibbiano
7 - Montecchio E. (RE)
Italy
(U. S. Rep: Sanchelima Intl.
1781-83 NW 93rd Avenue
Miami, Florida 33172)

709 Conexiones Inoxidables (01/18/93)
de Puebla S.A. de C.V.
Vicente Guerrero No. 211
Xicotepec de Juarez
Edo, Puebla MEXICO
(U. S. Rep: Ben Dolphin
Consulting, 4735 Lansing Drive
North Olmsted, Ohio 44070)

205R Dairy Equipment Co. (5/22/69)
1919 S. Stoughton Rd., P. O. Box 8050
Madison, Wisconsin 53716

462 Enprotech Corporation (12/5/85)
335 Madison Avenue
New York, New York 10017

671 Flowtech, Inc. (4/1/92)
1900 Lake Park Drive
Smyrna, Georgia 30080

466 Fluid Metering Inc. (1/10/86)
29 Orchard St.
Oyster Bay, New York 11771

306 Fristam Pumps, Inc. (5/2/78)
2410 Parview Road
Middleton, Wisconsin 53562

65R G & H Products Corp. (5/22/57)
7600-57th Avenue
P.O. Box 1199
Kenosha, Wisconsin 53141

145R ITT Jabsco Products (11/20/63)
1485 Dale Way
Costa Mesa, California 92626
(Mfg. by ITT Jabsco, England)

314 Len E. Ivarson, Inc. (12/22/78)
3100 W. Green Tree Rd.
Milwaukee, Wisconsin 53209

603 Johnson Pumps (UK) Ltd (8/16/90)
Highfield Industrial Estate
Edison Road, Eastbourne
East Sussex, England BN23 6PT
(Not Available in the U.S.A.)

325 Highfield Industrial Estate (8/16/90)
Edison Road, Eastbourne
East Sussex, England BN23 6PT
(U. S. Rep: Johnson Pump of America, Inc.
4825 Scott Street, Suit 306
Schiller Park, Illinois 60176)

502 Inoxpa, s.a. (9/16/92)
C/. Telers, 54
17820 Banyoles
Gerona, Spain

604 Johnson Pumps (UK) Ltd. (8/16/90)
Highfield Industrial Estate
Edison Road, Eastbourne
East Sussex, England BN23 6PT
(Not Available in the U.S.A.)

673 MGI Pumps, Inc. (4/16/92)
9201 Wilmot Road
Kenosha, Wisconsin 53141

654 Mono Pumps Ltd., Dresser Pump Division (10/22/91)
Martin Street
Audenshaw, Manchester
England M34 5DQ
(U.S. Rep: MonoFlo, Dresser Pump Division
Dresser Industries
821 Live Oak Drive
Chesapeake, Virginia 23320-2601)

400 Netzsch Incorporated (8/15/83)
119 Pickering Way
Exton, Pennsylvania 19341-139

684 PCM.POMPES (7/9/92)
17 Rue Ernest Laval
B. P. 35 - 92173 Vanves Cedex, France
(U.S. Rep: MGI Pumps
9201 Wilmot Road
Kenosha, WI 53141-1426)

701 Pierre Guerin SA (10/27/92)
BP. 12 - 79210
Mauze-Sur-Le-Mignon
France
(U. S. Rep: Alfa Technical Group, Inc.
601 Thompson Road N.
Syracuse, New York)

595 Seepex, Inc. (3/16/90)
(Formerly Pumpen - und Maschinenbau)
1834 Valley Street
Dayton, Ohio 45405

241 Puriti, S.A. de C.V. (9/12/72)
Alfredo Nobel 39
Industrial Puente de Vigas
Tlalnepantla, Mexico
U. S. Rep: Top Line Corporation

148R Robbins & Myers, Inc. (4/22/64)
1895 Jefferson St.
Springfield, Ohio 45506

364 Roper Pump Company (7/28/82)
P.O. Box 269
Commerce, Georgia 30529

568 Shanley Pump & Equipment, Inc. (5/15/89)
2255-1 Lois Dr.
Rolling Meadows, Illinois 60008
(Mfg. by Allweiler, West Germany)

678 Shanley Pump & Equipment (5/11/92)
2255-1 Lois Drive
Rolling Meadows, Illinois 60008

507 Sine Pump (7/21/87)
Division of The Kontro Co., Inc.
500 West River Street
Orange, Massachusetts 01364

567 Stainless Products, Inc. (4/4/89)
1649-72nd Ave.
P.O. Box 169
Somers, Wisconsin 53171

72R L.C. Thomsen Inc. (9/14/57)
1303-43rd St.
Kenosha, Wisconsin 53140

26R Tri-Clover, Inc. (9/29/56)
9201 Wilmot Road
Kenosha, Wisconsin 53141

609 Tuthill Corp. (12/12/90)
Tuthill Pump Division
12500 S. Pulaski Road
Alsip, Illinois 60658

175R Universal Dairy (10/25/56)
11100 N. Congress Ave.
Kansas City, Missouri 64153

52R Viking Pump, Inc. (12/31/56)
A Unit of IDEX Corporation
406 State St., P. O. Box 8
Cedar Falls, Iowa 50613
(Manufactured by: Johnson Pump
Highfield Ind. Estate, Edison Road
Eastbourne, E. Sussex
UK BN 23 6PT)

29R Waukesha Fluid Handling (10/3/76)
(Formerly Cherry-Burrell
Fluid Handling Division)
611 Sugar Creek Road
Delavan, Wisconsin 53115

04-03 Homogenizers and High Pressure Pumps of the Plunger Type

37 APV Crepaco, INC. (10/19/56)
100 South CP Ave.
Lake Mills, Wisconsin 53551

75 APV Gaulin, Inc. (6/26/57)
500 Research Dr.
Wilmington, Massachusetts 01887

309 APV Homogenizer, Div., Rannie Products (7/19/78)
(Formerly APV Rannie, Inc.)
445 Etna Street, Suite 57
St. Paul, Minnesota 55106

722 APV Rannie AS (03/23/93)
Roholmsvej 8, DK-2620
Albertslund, DENMARK
(Not Available in USA)

247 Alfa-Laval (4/14/73)
8400 Lake View Parkway
Suite 500
Pleasant Prairie, Wisconsin 53158

390 American Lewa, Inc. (6/9/83)
132 Hopping Brook Road
Holliston, Massachusetts 01760
(Mfg. by Lewa, Germany)

247 Bran & Luebbe, Inc. (4/14/73)
1025 Busch Parkway
Buffalo Grove, Illinois 60015

87 Waukesha Fluid Handling (12/29/57)
(Formerly Cherry-Burrell
Fluid Handling Division)
611 Sugar Creek Road
Delavan, Wisconsin 53115

486 Fowler Products Company (11/18/86)
150 Collins Industrial Blvd.
P.O. Box 80268
Athens, Georgia 30608-0268

657 Microfluidics Corp. (11/4/91)
P. O. Box 9101
90 Oak Street
Newton, Massachusetts 02164-9101

558 Niro Soavi S.p.A. (1/389)
43100 Parma (Italy)
VIA M. Da Erba Edoari, 29/A
Distributed in the U. S. by
Niro Hudson, Inc.
1600 Country Road F
Hudson, Wisconsin 54016

714 Union Homogenizer (02/25/93)
4600 W. Dickman Road
Battle Creek, MI 49015

05-14 Stainless Steel Automotive Milk Transportation Tanks for Bulk Delivery and/or Farm Pick-up Service

379 Bar-Bel Fabricating Co., Inc. (3/15/83)
N 3760 Hwy 12 & 16
Mauston, Wisconsin 53948

70R Brenner Tank, Inc. (8/5/57)
450 Arlington Ave., P.O. Box 670
Fond du Lac, Wisconsin 54936

40 Hills Stainless Steel & Equipment Co., Inc. (10/20/56)
505 W. Koehn Street
Luverne, Minnesota 56156

201 Paul Krohnert Mfg. Ltd. (4/1/68)
811 Steeles Ave., P.O. Box 126
Milton, Ontario, Canada L9T 2Y3
(Not available in USA)

513 Nova Fabricating Inc. (8/24/87)
404 City Rd.
P.O. Box 231
Avon, Minnesota 56310

85 Polar Tank Trailer, Inc. (12/20/57)
Holdingford, Minnesota 56340

653 Tremar (10/10/91)
(Not available in the U.S.A.)
1, Tougas Street
Iberville, Quebec, Canada J2X 2P7

25 Walker Stainless Equip. Co., Inc. (9/28/68)
625 State Street
New Lisbon, Wisconsin 53950

623 Walker Stainless Eq. Co., Inc. (3/28/91)
560 E. Burleigh Blvd.
P.O. Box 358
Tavares, Florida 32778

437 West-Mark (11/30/84)
2704 Railroad Ave., P.O. Box 418
Ceres, California 95307

08-17R Fittings and Plug-Type Valves is being separated into two distinct Standards and will be shown on *future* Lists of Holders as:
51-00 Plug-Type Valves (formerly 08-17R);
and 63-00 Sanitary Fittings (formerly 08-17R)

349 APN, Inc. (12/15/81)
400 W. Lincoln
Caledonia, Minnesota 55921

260 APV Crepaco, Inc. (5/21/75)
100 South CP Avenue
Lake Mills, Wisconsin 53551

470 Advance Stainless Mfg. Corp. (3/30/86)
218 West Centralia Street
Elkhorn, Wisconsin 53121

380 Allegheny Bradford Corp. (3/21/83)
P.O. Box 200 Route 219 South
Bradford, Pennsylvania 16701

79R Alloy Products Corp. (11/23/57)
1045 Perkins Ave., P.O. Box 529
Waukesha, Wisconsin 53187

682 Andron Stainless, Ltd. (6/30/92)
4610 Burgoyne Street
Mississauga, Ontario
Canada L4W 1G1
(U. S. Rep: Andron Stainless Corp.
8901 Farrow Road, #101
Columbia, South Carolina 29223)

621 Bradford Castmetals (2/25/91)
P. O. Box 33
Elm Grove, Wisconsin 53122

688 Cajon Company (8/4/92)
9760 Shepard Road
Macedonia, Ohio 44056

645 Cipriani, Inc. - Tassalini S.P.A. (8/27/91)
23195 LaCadena Drive
Suite #103
Laguna Hills, California 92653

696 Conexiones Inoxidables (10/1/92)
de Puebla S. A. de C. V.
Vicente Guerrero No. 112
Xicotepec de Juarez
Edo. Puebla, Mexico

528 Dayco Products Inc. (3/16/88)
333 West First Street
Dayton, Ohio 45402-3042

677 EXCEL-A-TEC, Inc. (5/8/92)
W141 N5984 Kaul Avenue
Menomonee Falls, Wisconsin 53051

455 Flowtech Inc. (9/17/85)
1900 Lake Park Dr. Suite 345
Smyrna, Georgia 30080

271 The Foxboro Company (3/8/76)
33 Commercial Street
Foxboro, Massachusetts 02035

676 HBS Products, Inc. (4/29/92)
181 Elliot Street
Beverly, MA 01915

67R G & H Products Corp. (6/10/57)
P.O. Box 1199
7600-57th Avenue
Kenosha, Wisconsin 53141

369 IMEX, Inc. (11/3/82)
4040 Del Ray Ave. Unit 9
Marina del Rey, California 90292
(Mfg. by Lube Corp., Japan)

454 Jensen Fittings Corp. (9/11/85)
107-111 Goundry St.
North Tonawanda, New York 14120-5998

389 Lee Industries, Inc. (5/31/83)
P.O. Box 688
Philipsburg, Pennsylvania 16866

239 Lumaco, Inc. (6/30/72)
P.O. Box 688
Teaneck, New Jersey 07666

703 Parker Hannifin Corp. (11/6/92)
Instrument. Connectors Div.
9400 South Memorial Pkwy
Huntsville, AL 35803

200R Paul Mueller Co. (3/5/68)
1600 W. Phelps St., Box 828
Springfield, Missouri 65801

726 Pure Fit, Inc. (04/14/93)
924 Marcon Blvd.
Allentown, Pennsylvania 18103

242 Puriti, S.A. de C.V. (9/12/72)
Alfredo Nobel 39
Industrial Puente de Vigas
Tlalnepantla, Mexico

424 Robert-James Sales, Inc. (8/31/84)
699 Hertel Ave., Suite 260
Buffalo, New York 14207

699 Rodger Industries, Inc. (10/23/92)
P. O. Box 186
Blenheim, Ontario
Canada N0P 1A0
(Not available in the USA)

719 Schott Process Systems (03/09/93)
1640 SW Blvd.
Vineland, New Jersey 08360

334 Stainless Products, Inc. (12/18/80)
1649-72nd Ave., Box 169
Somers, Wisconsin 53171

741 Steel & O'Brien Mfg., Inc. (8/26/93)
545 South Route 219
Springville, New York 14141

391 Stork Food Machinery, Inc. (6/9/83)
P.O. Box 1258/Airport Parkway
Gainesville, Georgia 30503
(Mfg. by Stork Amsterdam, Netherlands)

357 Tanaco Products (4/16/82)
3860 Loomis Trail Rd.
Blaine, Washington 98230

449 Tech Controls Enterprise Co., Ltd. (8/2/85)
2940 SE 200th Avenue
Issaquah, Washington 98027
(Mfg. in Taiwan)

73R L.C. Thomsen, Inc. (8/31/57)
1303-43rd. St.
Kenosha, Wisconsin 53140

34R Tri-Clover, Inc. (10/15/56)
9201 Wilmot Rd.
Kenosha, Wisconsin 53141

304 VNE Corporation (3/16/78)
1149 Barberry Drive
Janesville, Wisconsin 53547

707 Valvinox, Inc., SGRM Div. (01/05/93)
650 - 1st Street
Iberville, Quebec, Canada J2X 3B8
(Not available in USA)

82R Waukesha Fluid Handling (12/18/57)
(Formerly Cherry-Burrell
Fluid Handling Division)
611 Sugar Creek Road
Delavan, Wisconsin 53115

09-09 Instrument Fittings and Connections Used on Milk and Milk Products Equipment

32 ABB Kent-Taylor Inc. (10/4/56)
(Formerly Taylor Instruments)
P.O. Box 20550
Rochester, New York 14602-0550

428 ARI Industries, Inc. (9/12/84)
381 ARI Court
Addison, Illinois 60101

321 Anderson Instrument Co., Inc. (6/14/79)
156 Auriesville Road
Fultonville, New York 12072

586 Beta Technology, Inc. (12/14/89)
105 Harvey West Blvd.
Santa Cruz, California 95060

315 Burns Engineering, Inc. (2/5/79)
10201 Bren Rd., East
Minnetonka, Minnesota 55343

206 The Foxboro Company (8/11/69)
33 Commercial Street
Foxboro, Massachusetts 02035

592 Claud S. Gordon Co. (2/27/90)
5710 Kenosha St.
P.O. Box 500
Richmond, Illinois 60071

620 Larad Equipment (2/25/91)
26 Pearl Street
Bellingham, Massachusetts 02019

588 Minco Products, Inc. (12/20/89)
7300 Commerce Lane
Minneapolis, Minnesota 55432

418 Niro Hudson (4/2/84)
(Formerly Niro Atomizer Food & Dairy)
1600 County Road F
Hudson, Wisconsin 54016

487 Pyromation, Incorporated (12/16/86)
5211 Industrial Road
Fort Wayne, Indiana 46825

367 RDF Corporation (10/2/82)
23 Elm Ave.
Hudson, New Hampshire 03051

495 Rosemount Analytical Division (2/13/87)
2400 Barranca Pkwy.
Irvine, California 92714

732 SensorTec, Inc. (05/18/93)
16335-7 Lima Road
Huntertown, Indiana 46748

420 Stork Food Machinery, Inc. (4/17/84)
P.O. Box 1258/Airport Parkway
Gainesville, Georgia 30503

32 Taylor Instrument (10/4/56)
Combustion Engineering, Inc.
400 West Avenue, P.O. Box 110
Rochester, New York 14692

690 Texas Thermowell, Inc. (8/25/92)
PO Box 1535
Hwy. 96 North
Silsbee, Texas 77656

444 Tuchenhagen North America (6/17/85)
8949 Deerbrook Trail
Milwaukee, Wisconsin 53223

612 Viatran Corp & Haenni Druckmittler (12/13/90)
300 Industrial Drive
Grand Island, New York 14072

522 Weed Instrument Company, Inc. (12/28/87)
707 Jeffrey Way
Round Rock, Texas 78664

10-03 Milk and Milk Products Filters Using Disposable Filter Media, as Amended

371 Alloy Products Corp. (12/10/82)
1045 Perkins Ave., P.O. Box 529
Waukesha, Wisconsin 53187

593 Filtration Systems (3/2/90)
Div. of Mechanical Mfg. Corp.
10304 NW 50th St.
Sunrise, Florida 33351

704 Pall Trinity Micro Corp. (11/6/92)
3643 State Route 281
Cortland, NY 13045-0930

720 R-P Products (03/19/93)
Box 388, 407 Jefferson Street
Three Rivers, Michigan 49093

435 Sermia International (11/27/84)
740-212 Boul. Industriel
Blainville, Quebec
Canada J7C 3V4
(U. S. Rep: United Dairy
Machinery Corp.
301 Meyer Road
Buffalo, New York 14224)

296 L. C. Thomsen, Inc. (8/25/77)
1303 43rd St.
Kenosha, Wisconsin 53140

35 Tri-Clover, Inc. (10/15/56)
9201 Wilmot Road
Kenosha, Wisconsin 53141

11-05 Plate-type Heat Exchangers for Milk and Milk Products

365 APV Baker AS (9/8/82)
Platinvej, 8
P.O. Box 329
DK-6000 Kolding
Denmark
(Not available in USA)

20 APV Crepaco, INC. (9/4/56)
395 Fillmore Ave.
Tonawonda, New York 14150

17 Alfa-Laval Food & Dairy Co. (7/28/82)
(Div. of Alfa-Laval Inc.)
8400 Lake View Parkway
Pleasant Prairie, Wisconsin 53158

120 Alfa-Laval, Agri Inc. (12/3/59)
11100 No. Congress Ave.
Kansas City, Missouri 64153

718 Babson Bros. Co. (03/08/93)
Dairy Systems Div.
1400 West Gale Avenue
Galesville, Wisconsin 54630

30 Cherry-Burrell Corp. (10/2/56)
Process Equipment Division
P.O. Box 35600
Louisville, Kentucky 40232-5600

14 Chester-Jensen Co., Inc. (8/15/56)
5th & Tilghman Sts., P.O. Box 908
Chester, Pennsylvania 19016

468 GEA Food and Process Systems Inc. (2/2/86)
8940 Route 108
Columbia, Maryland 21045

622 ITT Standard (2/25/91)
175 Standard Parkway
Cheektowaga, New York 14227
P.O. Box 1102
Buffalo, New York 14240-1102

326 Karbate Vicarb Inc. (2/4/80)
21945 Drake Rd.
Strongsville, Ohio 44136
(Mfg. by Vicarb, France)

15 Kusel Equipment Co. (8/15/56)
820 West St., P.O. Box 87
Watertown, Wisconsin 53094

360 Laffranchi Wholesale Co. (7/12/82)
P.O. Box 1273
Ferndale, California 95536

657 Microfluidics Corp. (11/4/91)
P.O. Box 9101
90 Oak Street
Newton, Massachusetts 02164-9101

414 Paul Meuller Co. (12/13/83)
P.O. Box 828
Springfield, Missouri 65801

279 The Schlueter Company (8/30/76)
3410 Bell Street, P. O. Box 548
Janesville, Wisconsin 53547-0548
(Mfg. by Samuel Parker, New Zealand)

650 Schmidt-Bretten, Inc. (10/3/91)
20475 Woodingham Drive
Detroit, Michigan 48221

670 Skellerup Engineering, Ltd. (4/1/92)
P. O. Box 11-020, 2 Robert Street
Ellerslie, Auckland 5
New Zealand
(U. S. Rep: Masport, Inc.
6140 McCormick Drive
Lincoln, Nebraska 68507)

658 Thermaline (11/15/91)
180-37th Street
Auburn, Washington 98001

610 Universal Dairy Equipment (12/13/90)
11100 N. Congress Avenue
Kansas City, Missouri 64153
(Mgr. by Skellerup Engineering,
Ellerslie, Auckland 5,
New Zealand)

12-05 Tubular Heat Exchangers for Milk and Milk Products

614 Tetra Pak Processing Systems (12/27/90)
P. O. Box 179
8400 Lake View Parkway, Suite 500
Pleasant Prairie, Wisconsin 53158
(Manufactured by Spiraflo Indus., Australia)

628 Tetra Pak Processing Systems (5/2/91)
P.O. Box 179
8400 Lakeview Parkway, Suite 500
Pleasant Prairie, Wisconsin 53158

438 APV Crepaco, INC. (12/10/84)
395 Fillmore Avenue
Tonawanda, New York 14150

248 Allegheny Bradford Corp. (4/16/73)
P.O. Box 200, Route 219 South
Bradford, Pennsylvania 16701

243 Babson Brothers Company (10/31/72)
Dairy Systems Division
140 West Gale
Galesville, Wisconsin 54630

734 Berdell Industries (05/19/93)
62 Scott Avenue
Brooklyn, New York 11237

605 Cherry-Burrell (8/30/90)
Process Equipment Division
P.O. Box 35600
Louisville, Kentucky 40232-5600

103 Chester-Jensen Co., Inc. (6/6/58)
5th & Tilghman Sts., P.O. Box 908
Chester, Pennsylvania 19016

613 Efrex Corp. (12/27/90)
11 Kitty Hawk Drive
Pittsford, NY 14534-1620

712 Enerquip, Inc. (02/24/93)
611 North Road
P. O. Box 368
Medford, Wisconsin 54451

298 Feldmeier Equipment, Inc. (1/28/85)
6800 Town Line Road
P.O. Box 474
Syracuse, New York 13211

307 G & H Products Corp. (5/2/78)
7600-57th Avenue
P.O. Box 1199
Kenosha, Wisconsin 53141

217 Girton Manufacturing Co. (1/31/71)
Millville, Pennsylvania 17846

616 ITT Standard (1/4/91)
175 Standard Pkwy
P.O. Box 1102
Buffalo, New York 14240-1102

711 Kusel Equipment Co. (02/24/93)
820 West Street
Watertown, WI 53094

238 Paul Mueller Co. (6/28/72)
P.O. Box 828
Springfield, Missouri 65801

96 C. E. Rogers Co. (3/31/64)
So. Hwy #65, P.O. Box 118
Mora, Minnesota 55051

532 Scherping Systems (6/8/88)
801 Kingsley St.
Winsted, Minnesota 55395

392 Stork Food Machinery, Inc. (6/9/83)
P.O. Box 1258, Airport Parkway
Gainesville, Georgia 30503
(Mfg. by Stork, Netherlands)

591 Thermotech/Div. of Fristam Pumps, Inc. (2/8/90)
2410 Parview Rd.
Middleton, Wisconsin 53562

632 Yula Corporation (6/4/91)
330 Bryant Avenue
Bronx., New York 10474

13-09 Farm Milk Cooling and Holding Tanks

240 Babson Brothers Company (9/6/72)
Dairy Systems Division
1400 West Gale
Galesville, Wisconsin 54630

4R Dairy Equipment Co. (6/15/56)
1919 So. Stoughton Rd.
Madison, Wisconsin 53716

179R Heavy Duty Products (Preston) Ltd. (3/8/66)
1261 Industrial Rd.
Cambridge (Preston)
Ontario, Canada N3H 4W3
(Not available in USA)

12R Paul Mueller Co. (7/31/56)
1600 W. Phelps, P.O. Box 828
Springfield, Missouri 65801

611 Universal Dairy Equipment (12/13/90)
11100 N. Congress Avenue
Kansas City, Missouri 64153

16-05 Evaporators and Vacuum Pans for Milk and Milk Products

254 APV Crepaco, Inc. (1/7/74)
165 John L. Dietsch Square
Attleboro Fall, Massachusetts 02763

132 APV Crepaco, INC. (10/26/60)
395 Fillmore Ave.
Tonawanda, New York 14150

277 Contherm, Inc. (8/19/76)
P.O. Box 352, 111 Parker St.
Newburyport, Massachusetts 01950

639 Niro-Sterner, Inc. (7/10/91)
421-6th Street South
Winsted, Minnesota 55395

500 Dedert Corporation (4/9/87)
20000 Governors Drive
Olympia Fields, Illinois 60461

311 GEA Food and Process Systems Inc. (8/28/79)
8940 Route 108
Columbia, Maryland 21045

273 Niro Evaporators, Inc. (5/20/76)
(Formerly Niro Atomizer
Food and Dairy)
9165 Rumsey Road
Columbia, Maryland 21045

107R C.E. Rogers Co. (7/31/58)
So. Hwy #65, P.O. Box 118
Mora, Minnesota 55051

186R Marriott Walker Corp. (9/6/66)
925 E. Maple Rd.
Birmingham, Michigan 48011

17-07 Formers, Fillers and Sealers of Single Service Containers for Milk and Milk Products

366 Autoprod, Inc. (9/15/82)
(An Alcoa Subsidiary)
5355 115th Avenue N.
Clearwater, Florida 34620

192 Evergreen Packaging (1/3/67)
2400-6th St. SW, P.O. Box 3000
Cedar Rapids, Iowa 52406

382 Combibloc, Inc. (4/15/83)
4800 Roberts Road
Columbus, Ohio 43228
(Mfg. by Jagenberg, West Germany)

324 Erca USA, Inc. (11/29/79)
72A Grays Bridge Road
Brookfield, Connecticut 06804
(Mfg. by Erca, France)

488 Fords Holmatic Inc. (12/22/86)
1750 Corporate Dr.-Suite 700
Norcross, Georgia 30093

619 Hassia Verpackungsmaschinen GmbH (2/22/91)
6479 Ranstadt 1/Hessen Germany
(Hassia USA, Inc. 39 Plymouth St.
Fairfield, New York 07007)

473 International Paper Company (6/12/86)
Extended Shelf Life Division
4020 Stirrup Creek Drive, Bldg. B200
Durham, North Carolina 27703

735 Kvalitetsproduktion AB 6/11/93)
S-693 29 Degerfors, Sweden
(U. S. Rep: Flowtech, Inc.
1900 Lake Park Drive, Ste 345
Smyrna, Georgia 30080)

731 LIEDER-Maschinenbau Gmbh & Co. KG (05/18/93)
Postfach 1252/Im Laab 3
3033 Schwarmstedt, GERMANY

743 Liqui-Box Corporation (11/16/93)
6950 Worthington-Galena Rooad
Worthington, Ohio 43085

330 Milliken Packaging (8/26/80)
White Stone, South Carolina 29353
(Mfg. by Chubukkikai, Japan)

442 Milliken Packaging (2/21/85)
White Stone, South Carolina 29386

137 Pure-Pak, Inc. (10/17/62)
850 Ladd Road
Walled Lake, Michigan 48088

281 Purity Packaging Corp. (11/8/76)
30000 South Hill Road
New Hudson, Michigan 48165

723 James River Corporation (03/26/93)
One Better Way Road
Milford, Ohio 45150

482 Serac Inc. (8/25/86)
300 Westgate Drive
Carol Stream, Illinois 60188

681 Shikoku Kakoki Co., Ltd. (6/8/92)
No. 10-01 Nishinokawa
Tarohachisu, Kitajima-Cho
Itanogun, Tokushima, Japan
(U. S. Rep: Pure-Pak, Inc.
30000 South Hill Road
New Hudson, Michigan 48165)

351 Tetra Pak Inc. (1/7/82)
909 Asbury Drive
Buffalo Grove, IL 60089
(Mfg. by A. B. Tetra, Italy)

220 Tetra Rex Packaging Systems (4/24/71)
(formerly TetraPak/EquipUS)
909 Asbury Drive
Buffalo Grove, Illinois 60090

694 Verpaco AG (9/23/92)
Eggenwattt 12
8995 Weissensberg, B R D
Germany
(U. S. Rep: West Lynn Creamery
Lynn, Massachusetts)

19-04 Batch Continuous Freezers for Ice Cream, Ices, and Similarly Frozen Dairy Foods, as Amended

141 APV Crepaco, INC. (4/15/63)
100 South CP Ave.
Lake Mills, Wisconsin 53551

146 Cherry-Burrell Corp. (12/10/63)
P.O. Box 35600
Louisville, Kentucky 40232-5600

286 Hoyer, Inc. (12/8/76)
201 Broad Street
Lake Geneva, Wisconsin 53147
(Mfg. by O. G. Hoyer A/S, Denmark)

465 Leon's Frozen Custard (12/17/85)
3131 S. 27th Street
Milwaukee, Wisconsin 53151

573 Processing Machinery & Supply Company (9/28/89)
1108 Frankford Ave.
Philadelphia, Pennsylvania 19125
(Mfg. by PMS Italiana, Italy)

355 Emery Thompson Machine & Supply Co. (3/9/82)
1349 Inwood Ave.
Bronx, New York 10452

22-04 Silo-type Storage Tanks for Milk and Milk Products

154 APV Crepaco, Inc. (2/10/65)
100 South CP Ave.
Lake Mills, Wisconsin 53551

168 Cherry-Burrell Corp. (6/16/65)
(A Unit of AMCA Int'l, Inc.)
575 E. Mill Street
Little Falls, New York 13365

160 DCI, Inc. (4/5/65)
P.O. Box 1227, 600 No. 54th Ave
St. Cloud, Minnesota 56301

181 Damrow Co. (5/18/66)
(Div. of DEC Int'l., Inc.)
196 Western Ave., P.O. Box 750
Fond du Lac, Wisconsin 54935-0750

312 Feldmeier Equipment, Inc. (9/15/78)
6800 Town Line Road
P.O. Box 474
Syracuse, New York 13211

702 Paul Krohnert Manufacturing, Ltd. (11/6/92)
P. O. Box 126
811 Steeles Avenue
Milton, Ontario, Canada L9T 2Y3
(Not available in the USA)

439 JV Northwest Inc. (1/22/85)
28120 SW Boberg Rd.
Wisonville, Oregon 97070

155 Paul Mueller Co. (2/10/65)
1600 W. Phelps, P.O. Box 828
Springfield, Missouri 65801

503 Ripley Stainless Ltd. (5/1/87)
RR #3, Site 41
Summerland, British Columbia V0H 1Z0
(Not available in USA)

479 Scherping Systems (8/3/86)
801 Kingsley Street
Winsted, Minnesota 55395

675 Stainless Fabrication, Inc. (4/22/92)
620 North Prince Lane
Springfield, Missouri 65802

165 Walker Stainless Equipment Co., Inc. (4/26/65)
Elroy, Wisconsin 53929

23-02 Equipment for Packaging Frozen Desserts, Cottage Cheese, and Similar Milk Products

174 APV Rockford, Inc. (9/28/65)
Filling & Wrapping Systems Div.
1303 Samuelson Road
Rockford, Illinois 61109

209 Doboy Packaging Machinery Incorp. (7/23/69)
869 S. Knowles Ave.
New Richmond, Wisconsin 54017

674 Hayssen Manufacturing (4/20/92)
5300 Highway 42 North
P. O. Box 571
Sheboygan, Wisconsin 53082-0571

679 Ice Cream Novelties (6/1/92)
Division of Popsicle Inc., Ltd.
5305 Fairview Street
P. O. Box 610
Burlington, Ontario, Canada L7R 3Y5
(U. S. Rep: Sunshine Biscuits
100 Woodbridge Center Drive
Woodbridge, New Jersey 07095-1196)

635 Interbake Dairy Ingredients Div. (7/10/91)
2220 Edward Holland Drive
Suite 301
Richmond, Virginia 23230

343 O.G. Hoyer, Inc. (7/6/81)
201 Broad St.
Lake Geneva, Wisconsin 53147
(Mfg. by Alfa Hoyer, Denmark)

626 Klockner Bartelt, Inc. (4/2/91)
5501 N. Washington Blvd.
Sarasota, FL 34243-2283

447 Mateer-Burt Co., Inc. (7/22/85)
436 Devon Park Drive
Wayne, Pennsylvania 19087
(Mfg. by Trustpak, England)

537 Osgood Industries, Inc. (7/19/88)
601 Burbank Rd.
Oldsmar, Florida 34677

666 Rapidpak (3/5/92)
1725 West 8th Street
Appleton, Wisconsin 54911

740 Raque Food Systems, Inc. (6/25/93)
11002 Decimal Drive
Louisville, Kentucky 40299

222 Sweetheart Packaging (11/15/71)
(Formerly Fort Howard Pkg. Corp.)
10100 Reistertown Road
Owing Mills, Maryland 21117

24-02 Non-coil Type Batch Pasteurizers

158 APV Crepaco, INC. (3/24/65)
100 South CP Ave.
Lake Mills, Wisconsin 53551

161 Cherry-Burrell Corp. (4/5/65)
(A Unit of AMCA Int'l., Inc.)
575 E. Mill St.
Little Falls, New York 13365

187 DCI, Inc. (9/26/66)
P.O. Box 1227, 600 No. 54th Ave.
St. Cloud, Minnesota 56302

519 Feldmeier Equipment, Inc. (10/22/87)
6800 Town Line Road
P.O. Box 474
Syracuse, New York 13211

166 Paul Mueller Co. (4/26/65)
P.O. Box 828
Springfield, Missouri 65801

25-02 Non-coil Type Batch Processors for Milk and Milk Products

159 APV Crepaco, INC. (3/24/65)
100 South CP Ave.
Lake Mills, Wisconsin 53551

162 Cherry-Burrell Corp. (4/5/65)
(A Unit of AMCA Int'l., Inc.)
575 E. Mill St.
Little Falls, New York 13365

188 DCI, Inc. (9/26/66)
P.O. Box 1227, 600 No. 54th Ave.
St. Cloud, Minnesota 56301

725 Inox-Tech, Inc. (04/14/93)
6705 Route 132
Ville Ste-Catherine
Quebec, Canada J0L 1E0
(U. S. Rep: Michael Ripka, Pres., Bionex
12615 E. Meridian Avenue
Payallup, Washington 98373)

710 Lee Industries, Inc. (02/10/93)
P. O. Box 687
514 West Pine Street
Phillipsburg, Pennsylvania 16866

167 Paul Mueller Co. (4/26/65)
P.O. Box 828
Springfield, Missouri 65801

687 SANIFAB (8/3/92)
528 North Street
Stratford, Wisconsin 54484

448 Scherping Systems (8/1/85)
801 Kingsley Street
Winsted, Minnesota 55395

520 Stainless Fabrication, Inc. (12/8/87)
4455 W. Kearney
Springfield, Missouri 65801

202 Walker Stainless Equip. Co., Inc. (9/24/68)
625 State St., P. O. Box 202
New Lisbon, Wisconsin 53950-0202

26-03 Sifters for Dry Milk and Dry Milk Products

634 Great Western Mfg. Co. (7/10/91)
2017 South Fourth Street
P.O. Box 149
Leavenworth, Kansas 66048

363 Kason Corp. (7/28/82)
1301 East Linden Ave.
Linden, New Jersey 07036

430 Midwestern Industries, Inc. (10/11/84)
915 Oberlin Rd., P.O. Box 810
Massillon, Ohio 44648-0810

185 Rotex, Inc. (8/10/66)
1230 Knowlton St.
Cincinnati, Ohio 45223

656 Separator Engineering Ltd. (11/4/91)
810 Ellingham Street
Pointe Clair, Quebec, Canada H9R 3S4
(U. S. Rep: Kason Corp.
1301 E. Linden Avenue
Linden, NJ 07036)

172 Sweco, Inc. (9/1/65)
7120 Buffington Rd.
Florence, KY 41042

27-02 Equipment for Packaging Dry Milk and Dry Milk Products

353 All-Fill, Inc. (3/2/82)
418 Creamery Way
Exton, Pennsylvania 19341

618 Hayssen Manufacturing Company (2/18/91)
5300 Highway 42 North
P.O. Box 571
Sheboygan, Wisconsin 53082-0571
(Manufactured by Yamato Scale Co.
Akasi, 673, Japan)

625 Ishida Scales Mfg. Co., Inc. (4/2/91)
44, Sanno-Cho, Shogoin
Sakyo-Ku, Kyoto, Japan
(U. S. Rep: Heat & Control
225 Shaw Rd.
S. San Francisco, California 94080)

409 Mateer-Burt Co. (10/31/83)
436 Devon Park Dr.
Wayne, Pennsylvania 19087

476 Stone Container Corporation (7/17/86)
1881 West North Temple
Salt Lake City, Utah 84116-2097

497 Triangle Package Machinery Co. (2/26/87)
6655 West Diversey Ave.
Chicago, Illinois 60635

28-02 Flow Meters for Milk and Milk Products

270 ABB Kent-Taylor, Inc. (2/9/76)
(Formerly Taylor Instruments)
P.O. Box 20550
Rochester, New York 14602-0550

272 Accurate Metering Systems, Inc. (4/2/76)
1651 Wilkening Court
Schaumburg, Illinois 60173

253 Badger Meter, Inc. (1/2/74)
4545 W. Brown Deer Road
P.O. Box 23099
Milwaukee, Wisconsin 53223

359 Brooks Instruments (6/11/82)
407 West Vine St.
Hatfield, PA 19440

660 Danfoss A/S (11/20/91)
DK-6430
Nordborg, Denmark
(U.S. Rep: Danfoss Electronics
2995 Eastrock Drive
Rockford, Illinois 61109)

469 Endress & Hauser, Inc. (3/3/86)
2350 Endress Place
Greenwood, Indiana 46142

692 Endress & Hauser Flowtec AG (9/14/92)
Kagenstrasse 7
Ch - 4153 Reinach, Switzerland
(U. S. Rep: Endress & Hauser, Inc.
Greenwood, Indiana 46142)

599 Euromatic Machine & Oil Co., Ltd (4/26/90)
P.O. Box 297, St. Helier
Jersey C.I. UK

226 Fischer & Porter Co. (12/9/71)
County Line Rd.
Warminster, Pennsylvania 18974

477 Flowdata Inc. (7/31/86)
1784 Firman Drive
Richardson, TX 75081

506 Flow Technology, Inc. (6/17/87)
4250 East Broadway Road
Phoenix, Arizona 85040

224 The Foxboro Company (11/16/71)
33 Commercial Street
Foxboro, Massachusetts 02035

717 Gemu Valves, Inc. (03/04/93)
3800 Camp Creek Parkway
Ste. 102, Bldg. 2400
Atlanta, Georgia 30331

649 Geo Technology (10/2/91)
12312 E. 60th Street
Tulsa, Oklahoma 74146

661 G/H Products Corp. (11/21/91)
7600-57th Avenue
P.O. Box 1199
Kenosha, Wisconsin 53142

562 Great Lakes Instruments, Inc. (2/6/89)
8855 North 55th Street
Milwaukee, Wisconsin 53223

630 Halliburton Services (5/28/91)
Drawer 1431
Duncan, Oklahoma 73536-0602

574 Hersey Measurement Co., Inc. (10/12/89)
P.O. Box 4585, 150 Venture Blvd.
Spartanburg, South Carolina 29305

512 Hoffer Flow Controls, Inc. (8/17/87)
107 Kitty Hawk Lane
Elizabeth City, NC 27909

744 Honeywell (11/16/93)
Industrial Controls Div.
1100 Virgina Drive
Fort Washington, Pennsylvania 19034

733 Honeywell, Inc. (05/18/93)
14841 Black Canyon Highway
Phoenix, Arizonaa 85023

474 Hydril Production (6/30/86)
Technology Division
330 North Belt East
Houston, Texas 77032-3411

265 GH Flow Automation (3/10/75)
(formerly Tekheim Automation)
9303 Sam Houston Parkway
Houston, Texas 77099-5298

535 Invalco, Inc.
P.O. Box 556
Tulsa, Oklahoma 74101

529 Krohne America, Inc. (5/18/88)
7 Dearborn Road
Peabody, Massachusetts 01960
(Mfg. by Altometer, Holland)

378 Micro Motion, Inc. (2/16/83)
7070 Winchester Circle
Boulder, Colorado 80301

729 Peek Measurement, Ltd. (04/14/93)
Kings Worthy, Winchester
Hampshire, England S023 7QA
(U. S. Rep: Peek Measurement
10335 Landsbury, Ste. 300
Houston, Texas 77099-3407)

490 Rosemount Inc. (1/8/87)
12001 Technology Dr.
Eden Prairie, Minnesota

585 Schlumberger Industries Ltd. (12/7/89)
11321 Richmond Ave.
Houston, Texas 77082-2615
(Mfg. by Schlumberger, England)

587 Schlumberger Ind., Measurement Div. (12/18/89)
1310 Emerald Rd.
Greenwood, South Carolina 29646
(Mfg. by Schlumberger, France)

550 Sparling Instruments Co., Inc. (10/26/88)
4097 N. Temple City Blvd.
P.O. Box 5988
El Monte, California 91731

715 Thermal Instrument Co. (02/25/93)
217 Sterner Mill Road
Trevose, Pennsylvania 19053

386 Turbo Instruments, Inc. (5/11/83)
4 Vashell Way
Orinda, California 94563
(Mfg. by Turowerk, West Germany)

664 XO Technologies, Inc. (12/16/91)
28020 Avenue Stanford
Valencia, California 91355

29-01 Air Eliminators for Milk and Fluid Milk Products

340 Accurate Metering Systems, Inc. (6/2/81)
1651 Wilkening Court
Schaumburg, Illinois 60173

662 G/H Products Corp. (11/21/91)
7600-57th Avenue
P.O. Box 1199
Kenosha, Wisconsin 53142

436 Scherping Systems (11/27/84)
801 Kingsley Street
Winsted, Minnesota 55395

30-01 Farm Milk Storage Tanks

421 Paul Mueller Co. (4/17/84)
P.O. Box 828
Springfield, Missouri 65801

31-02 Scraped Surface Heat Exchangers

290 APV Crepaco, INC. (6/15/77)
100 South CP Ave.
Lake Mills, Wisconsin 53551

274 Contherm, Inc. (6/25/76)
P.O. Box 352, 111 Parker St.
Newburyport, Massachusetts 01950

323 Cherry-Burrell Corp. (7/26/79)
Process Equipment Division
P.O. Box 35600
Louisville, KY 40232-5600

496 FR Mfg. Corp. (2/23/87)
2807 South Highway 99
Stockton, California 95202

361 N.V. Terlet (7/12/82)
P.O. Box 62
7200 AB Zutphen
Netherlands
(US Agent Manning & Lewis-NJ)

32-01 Uninsulated Tanks for Milk and Milk Products

397 APV Crepaco, INC. (6/21/83)
100 South CP Ave.
Lake Mills, Wisconsin 53551

264 Cherry-Burrell Corp. (1/27/75)
(A Unit of AMCA Int'l., Inc.)
575 E. Mill St.
Little Falls, New York 13365

268 DCI, Inc. (11/21/75)
600 No. 54th Ave., P.O. Box 1227
St. Cloud, Minnesota 56301

354 C.E. Rogers Co. (3/3/82)
S. Hwy #65, P.O. Box 118
Mora, Minnesota 55051

708 Lee Industries, Inc. (01/12/93)
P. O. Box 688
Phillipsburg, PA 16866

683 SANIFAB (7/9/92)
A Division of A&B Process Systems Corp.
528 North Street
Stratford, WI 54484

441 Scherping Systems (3/1/85)
801 Kingsley St.
Winsted, Minnesota 55395

339 Walker Stainless Equip. Co., Inc. (6/2/81)
618 State St.
New Lisbon, Wisconsin 53950

33-00 Polished Metal Tubing for Dairy Products

310 Allegheny Bradford Corp. (7/19/78)
P.O. Box 200 Route 219 South
Bradford, Pennsylvania 16701

413 Azco, Inc. (12/8/83)
P.O. Box 567
Appleton, Wisconsin 54912

736 Kvalitetsproduktion AB (6/11/93)
S-693 29 Degerfors, Sweden
(U. S. Rep: Flowtech, Inc.
1900 Lake Park Drive, Ste 345
Smyrna, Georgia 30080)

308 Rath Manufacturing Co., Inc. (6/20/78)
2505 Foster Ave.
Janesville, Wisconsin 53545

368 Rodger Industries Inc. (10/7/82)
P.O. Box 186, RR1
Blenheim, Ontario
Canada N0P 1A0
(Not available in USA)

335 Stainless Products, Inc. (12/18/80)
1649-72nd Ave., Box 169
Somers, Wisconsin 53171

289 Tri-Clover, Inc. (1/21/77)
9201 Wilmot Road
Kenosha, Wisconsin 53141

331 United Industries, Inc. (10/23/80)
1546 Henry Ave.
Beloit, Wisconsin 53511

34-02 Portable Bins

647 Thomas Conveyor Company (9/18/91)
Tote System Division
555 I-35 South
Burleson, Texas 76028

35-00 Continuous Blenders

527 Arde Barinco, Inc. (3/15/88)
500 Walnut Street
Norwood, New Jersey 07648

526 Bepex Corp./Schugi (3/15/88)
333 Taft St. NE
Minneapolis, Minnesota 55413
(Mfg. by Lelystad, Netherlands)

590 Chemineer Inc. (1/23/90)
125 Flagship Dr.
North Andover, Massachusetts 01845

417 Cherry-Burrell (2/7/84)
Process Equipment Division
P.O. Box 35600
Louisville, Kentucky 40232-5600

464 Dairy Service Mfg., Inc. (12/12/85)
4630 W. Florissant Ave.
St. Louis, Missouri 63115

642 Mondomix Holland b.v. (8/7/91)
Reeweg 13
P.O. Box 98
1394 ZH Nederhorst den Berg
The Netherlands
(U.S. Rep: Carrier Assoc.
50 Dunnell Lane
Pawtucket, Rhode Island 02860-5828)

680 Quadro Engineering, Inc. (6/3/92)
613 Colby Drive
Waterloo, Ontario
Canada N2V 1A1

724 Silverson Machines, Inc. (04/14/93)
P. O. Box 589
355 Chestnut Street
East Longmeadow, Massachusetts 01028
(Manufactured by Silverson Machines, Chesham, England)

To receive information on membership with IAMFES Circle 360 on this card

IAMFES

International Association of Milk, Food and Environmental Sanitarians Inc

DFES
2/94

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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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102	115	128	141	154	167	180	193	206	219	232	245	258	271	284	297	310	323	336	349
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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R.D. #1
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405 Drexelbrook Engineering Co. (9/27/83)
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2350 Endress Place
Greenwood, Indiana 46142

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4250 E. Broadway Road
Phoenix, Arizona 85040

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33 Commercial Street
Foxboro, Massachusetts 02035

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Grand Island, New York 14072

651 Granzow, Inc. (10/3/91)
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396 King Engineering Corp. (6/13/83)
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Ann Arbor, Michigan 48106

501 Lumenite Electronic Company (4/27/87)
2331 N. 17th Avenue
Franklin Park, Illinois 60131

596 Magnetrol International (3/20/90)
5300 Belmont Rd.
Downers Grove, Illinois 60515

627 Milltronics, Inc. (4/12/91)
730 The Kingsway
Peterborough, Ontario
Canada K9J 7B1
(U. S. Rep: Milltronics, Inc.
709 E. Stadium Drive
Arlington, Texas 76011)

419 Niro Hudson (4/2/84)
(Formerly Niro Atomizer Food & Dairy)
1600 County Road F
Hudson, Wisconsin 54016

597 NUOVA FIMA S.p.A. (3/20/90)
Via C. Battisti 59
28045 - INVORIO (N0) Italy
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554 Par Sonics, Inc. (11/30/88)
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Centre Hall, Pennsylvania 16828

563 PI Components Corp. (2/13/89)
10825 Barely Lane, Suite H
Houston, Texas 77070

644 Princo Instruments, Inc. (8/22/91)
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Southampton, Pennsylvania 18966-4095

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85 Bell St.
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(Mfg. by Nuova-Fima, Italy)

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800 Mill Rd
Freeport, New York 11520-0808

646 WIKA Instrument Corp. (9/10/91)
1000 Wiegand Blvd.
Lawrenceville, Georgia 30243

685 Winter's Thermogauges, Ltd. (8/3/92)
2220-3 Midland Avenue
Scarborough, Ontario
Canada M1P 3E6
(U.S. Rep: Winter's Thermogauges, Inc.
100 Sonwil Drive
Buffalo, New York 14225)

38-00 Cottage Cheese Vats

541 Kusel Equipment Company (9/16/88)
820 West St.
Watertown, Wisconsin 53094

385 Stoelting, Inc. (5/5/83)
P.O. Box 127
Kiel, Wisconsin 53042-0127

40-01 Bag Collectors for Dry Milk and Dry Milk Products

504 General Resource Corporation (5/15/87)
201 3rd Street South
Hopkins, Minnesota 55343

381 Marriott Walker Corp. (4/12/83)
925 E. Maple Rd.
Birmingham, Michigan 48011

453 Hosokawa MikroPul E. Systems (9/4/85)
102 American Road
Morris Plains, New Jersey 07950

456 C. E. Rogers Company (9/25/85)
P.O. Box 118
Mora, Minnesota 55051

41-00 Mechanical Conveyors

631 Flexicon Corporation (5/28/91)
1375 Stryker's Road
Phillipsburg, NJ 08865

42-00 In-Line Strainers

606 Cherry-Burrell/Superior Stainless (9/18/90)
Fluid Handling Division
611 Sugar Creek Road
Delavan, Wisconsin 53115

655 Tri-Clover, Inc. (10/23/91)
9201 Wilmot Drive
Kenosha, Wisconsin 53141

44-01 Air Driven Diaphragm Pumps

624 Granzow, Inc. (4/1/91)
2300 Crown Point
Executive Drive
Charlotte, North Carolina 28227
Manufactured by KWW-DEPA in Germany

713 Warren Rupp, Inc. (02/05/93)
800 North Main Street
P. O. Box 1568
Mansfield, Ohio 44905

669 Skellerup Engineering, Ltd. (3/30/92)
2 Robert Street
P. O. Box 11-020
Ellerslie, Auckland 5
New Zealand
(U. S. Rep: Masport, Inc.
6140 McCormick Drive
Lincoln, Nebraska 68507)

46-00 Refractometers and Optical Sensors

737 Katrina, Inc. (6/17/93)
91 Western Maryland Pkwy
Hagerstown, Maryland 21740

697 Liquid Solids Control, Inc. (10/21/92)
P. O. Box 259
Farm Street
Upton, MA 01568

742 Reflectronics, Inc. (9/15/93)
3009 Montavesta Road
Lexington, Kentucky 40502

50-00 Level Sensing Devices

705 CTI Celtek Electronics (12/29/92)
136 Merizzi Street
St. Laurent, Quebec, Canada H4T 1S4
(U. S. Rep: CTI Celtek Electronics, Inc.
1000 Leonidas Street
New Orleans, Louisiana 70118)

52-00 (formerly 08-17H) Thermoplastic Plug Type Valves

577 Ralet-Defay (11/2/89)
66, Blvd. Poincare
1070 Brussels, Belgium
(U.S. Agent GENICANAM, Chazy, NY)

53-00 (formerly 08-17A) Compression Type Valves

533 APV Crepaco, Inc. (5/21/75)
100 S. CP Ave.
Lake Mills, Wisconsin 53551

484 APV Crepaco, Inc. (10/22/86)
100 South CP Avenue
Lake Mills, Wisconsin 53551

730 APV Rockford, Inc. (04/21/93)
1303 Samuelson Roadf
Rockford, Illinois 61109

552 Alloy Products Corp. (11/23/57)
1045 Perkins Ave.
P.O. Box 529
Waukesha, Wisconsin 53187

245 Babson Brothers Company (2/12/73)
Dairy System Division
1400 West Gale Ave.
Galesville, Wisconsin 54630

443 Badger Meter, Inc. (4/30/85)
6116 East 15th Street
P. O. Box 581390
Tulsa, Oklahoma 74158-1390

686 Bardiani Valvole S.R.L. (8/3/92)
Via G. Vittorio, 53
43045 Fornovo (PR) Italy
(U. S. Rep: Sanchelima Int.
1763 Northwest 93rd Ave.
Miami, Florida 33172)

555 Waukesha Fluid Handling (12/11/57)
(Formerly Cherry-Burrell
Fluid Handling Division)
611 Sugar Creek Road
Delavan, Wisconsin 53115

538 Cipriani, Inc. (7/31/86)
23195 La Cadena Drive, Suite 103
Laguna Hills, California 92653
(Mfg. by Fratelli Tassalini, Italy)

716 Conexiones Inoxidables (03/04/93)
de Puebla S.A. de C.V.
Vicente Guerrero No. 211
Xicotepec de Juarez
Edo, Puebla MEXICO
(U. S. Rep: Ben Dolphin
Consulting, 4735 Lansing Drive
North Olmsted, Ohio 44070)

376 Definox Division (1/25/83)
Defontaine, Inc.
17044 W. Victor Road
New Berlin, Wisconsin 53151

530 G & H Products Corp. (6/10/57)
7600-57th Ave.
P.O. Box 1199
Kenosha, Wisconsin 53141

480 GEA Food and Process Systems Inc. (8/8/86)
8940 Route 108
Columbia, Maryland 21045

607 Kammer Valve, Inc. (9/25/90)
510 Parkway View Drive
Pittsburgh, Pennsylvania 15205
(Manufactured by: Kammer Ventile GmbH
Manderscheidtstr. 19
4300 Essen 1
Germany)

570 LUMACO (8/9/89)
9-11 East Broadway
Hackensack, New Jersey 07601

594 Oden Corp. (3/6/90)
255 Great Arrow Ave.
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BP.12 - 79210
Mauze-Sur-Le-Mignon
France
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601 Thompson Road N.
Syracuse, New York 13211)

551 Puriti, S.A. de C.V. (9/12/72)
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Fracc. Ind. Puente de Vigas
Tlalnepantla, Mexico

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Kenosha, Wisconsin 53141

467 Tuchenhagen North America Inc. (1/13/86)
(Mfg. by Otto Tuchenhagen, West Germany)
8949 Deerbrook Trail
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561 VACU-PURG, Inc. (1/26/89)
214 West Main St.
P.O. Box 272
Fredericksburg, Iowa 50630

584 Valvinox Inc. (11/27/89)
654 1ere Rue.
Iberville-QUE-Canada J2X 3B8

86R Waukesha Specialty Co., Inc. (12/20/57)
P.O. Box 160, Hwy 14
Darien, Wisconsin 53144

54-00 (formerly 08-17B) Diaphragm-Type Valves

565 APV Rosista, Inc. (10/22/86)
1325 Samuelson Rd.
Rockford, Illinois 61109
(Mfg. by APV Rosista, Inc. W. Germany & Denmark)

615 AsepCo (1/4/91)
1101 San Antonio
Mountain View, California 94043

745 Cashco, Inc. (12/9/93)
P. O. Box 6, Hwy 140 West
Ellsworth, Kansas 67439-0006

617 Definox Division (2/1/91)
Defontaine, Inc.
17044 W. Victor Road
New Berlin, Wisconsin 53151

637 Gemu Valves, Inc. (7/10/91)
3800 Camp Creek Parkway
Bldg. 2400, Suite 102
Atlanta, Georgia 30331

514 H. D. Bauman Assoc., Ltd. (8/24/87)
35 Mirona Road
Portsmouth, New Hampshire 03801

203R ITT Grinnell Valve Co., Inc. (11/27/68)
Dia-Flo Division
33 Centerville Rd.
Lancaster, Pennsylvania 17603

494 Saunders Valve, Inc. (2/10/87)
15760 W. Hardy, #440
Houston, Texas 77060

56-00 (formerly 08-17E) Inlet and Outlet Leak-Protector Plug Valve

556 Waukesha Fluid Handling (12/12/57)
(Formerly Cherry-Burrell
Fluid Handling Division)
611 Sugar Creek Road
Delavan, Wisconsin 53115

34E Tri-Clover, Inc. (10/15/56)
9201 Wilmot Rd.
Kenosha, Wisconsin 53141

57-00 (formerly 08-17F) Tank Outlet Valve

531 G & H Products Corp. (6/10/57)
P.O. Box 1199, 7600-57th Ave.
Kenosha, Wisconsin 53141

534 Lumaco (6/30/72)
9-11 East Broadway
Hackensack, New Jersey 07601

643 Paul Mueller Company (8/22/91)
1600 West Phelps
Springfield, Missouri 65801

58-00 (formerly 08-17M) Vacuum Breakers and Check Valves

376 Definox Division (1/25/83)
Defontaine, Inc.
17044 W. Victor Road
New Berlin, Wisconsin 53151

689 VNE Corporation (8/17/92)
1149 Barberry Drive
Janesville, Wisconsin 53547

59-00 (formerly 08-17D) Automatic Positive Displacement Sampler

291 Accurate Metering Systems Inc. (6/22/77)
1650 Wilkening Ct.
Schaumburg, Illinois 60173
(Mfg. by Diessel, Germany)

284 Bristol Engineering Co. (11/18/76)
P.O. Box 696, 210 Beaver St.
Yorkville, Illinois 60560

693 Micropure Filtration, Inc. (9/17/92)
2323 6th Street, PO Box 7007
Rockford, Illinois 61125
(Manufactured by: Olper Maschinen & Armaturen
Olpe, Germany)

60-00 (formerly 08-17G) Rupture Discs

422 BS & B Safety Systems, Inc. (6/12/84)
7455 E. 46th St.
Tulsa, Oklahoma 74133

407 Continental Disc Corp. (10/14/83)
4103 Riverside NW
Kansas City, Missouri 64150

61-00 (formerly 08-17I) Steam Injected Heaters

728 APV Crepaco, Inc. (04/14/93)
395 Fillmore Avenue
Tonawanda, New York 14150

560 Pick Heaters, Inc. (1/19/89)
P.O. Box 516
West Bend, Wisconsin 53095

62-00 (formerly 08-17L) Hose Assemblies

721 Dixon Valve & Coupling Co. (03/23/93)
800 High Street
Chestertown, Maryland 21620

695 Couple-Up, Inc. (9/28/92)
420 Dixon Street
Compton, California 90222

727 Pure Fit, Inc. (04/14/93)
924 Marcon Blvd.
Allentown, Pennsylvania 18103

698 Sanitary Couplers, Inc. (10/23/92)
9151 Normandy Lane, S.
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Coming Events

1994

March

•**7-10, Better Process Control School**. For more information, please contact Robert Price (916/752-2194) or Pamela Tom (916/752-3837), Food Science and Technology Department, University of California, Davis, CA 95616-8598, FAX: (926)752-4759.

•**14-15, HACCP for Seafood Processors,** a two day interactive workshop designed for those responsible for implementing a HACCP plan in a seafood plant, will be held in Boston, MA. Sponsored by Silliker Laboratories Group, Inc., more information is available by calling Silliker's Education Services Dept. at (800) 829-7879.

•**16, Annual Food Industry Conference** will be sponsored by the Food Science Department at Purdue University. For more information, contact James V. Chambers, Food Science Department, Smith Hall, Purdue University, West Lafayette, IN 47907, Phone: (317)494-8279.

•**16-18, Michigan Environmental Health Association Annual Meeting** will be held in Ann Arbor, MI. For more information, contact Durwood Zank at (517)543-2430.

•**17-19, Introduction to Statistical Methods for Sensory Evaluation of Foods,** sponsored by the University Extension, University of California-Davis, will be held on the UC-Davis campus. For more information or to enroll, call toll free in California (800)752-0881, from Davis, Dixon, Woodland or outside California, call (916)757-8777.

•**21-23, Sensory Evaluation: Overview and Update,** sponsored by the University Extension, University of California-Davis, will be held on the UC-Davis campus. For more information or to enroll, call toll free in California (800)752-0881, from Davis, Dixon, Woodland or outside California, call (916)757-8777.

April

•**6-8, Annual Educational Conference of the Missouri Milk, Food and Environmental Health Assn.** will be held at the Ramada Inn, Columbia, MO. For more information, contact Janet Murray at (816) 263-6643.

•**11-13, Microbiology and Engineering of Sterilization Processes** will be given at the St. Paul Campus of the University of Minnesota. For further information, contact Dr. William Schafter, course coordinator, Department of Food Science and Nutrition, 1334 Eckles Avenue, St. Paul, MN 55108, (612)624-4793.

•**11-14, Statistical Process Control for the Food Processing Industries**, sponsored by the University Extension, University of California-Davis, will be held on the UC-Davis campus. For more information or to enroll, call toll free in California (800)752-0881, from Davis, Dixon, Woodland or outside California, call (916)757-8777.

•**12-13, Carolina's Association of Milk, Food and Environmental Sanitarians** will meet in Greenville, SC. For more information, contact Beth Johnson at (803)935-6201.

•**18-21, Purdue Better Process Control School** will be sponsored by the Food Science Department at Purdue University. For more information, contact James V. Chambers, Food Science Department, Smith Hall, Purdue University, West Lafayette, IN 47907, Phone: (317)494-8279.

•**18-22, Wyoming Environmental Health Assn. and Wyoming Public Health Assn. Annual Educational Conference** will be held at the Holiday Inn, Sheridan, WY. The theme for this conference will be "Public Health / Planning the Future." For more information, contact Stephanie Whitman at (307) 721-5283.

May

•**7-12, Food Structure Annual Meeting** will be held at the Holiday Inn Downtown City Hall, Toronto, Ontario, Canada. For more information, please contact Dr. Om Johari, SMI, Chicago (AMF O'Hare), IL 60666-0507, USA (or call 708-529-6677, FAX: 708-980-6698).

•**9-11, Introduction to Food Industry Quality Management,** sponsored by the University Extension, University of California-Davis, will be held on the UC-Davis campus. For more information or to enroll, call toll free in California (800)752-0881, from Davis, Dixon, Woodland or outside California, call (916)757-8777.

•**18-21, Purdue Better Process Control School** will be sponsored by the Food Science Department at Purdue University. For more information, contact James V. Chambers, Food Science Department, Smith Hall, Purdue University, West Lafayette, IN 47907, Phone: (317)494-8279.

•**25-27, International Conference on Food Physics**, sponsored by the International Society of Food Physicists and the Editorial Board of Journal of Food Physics, will be held at the University of Horticulture and Food Industry, Budapest, Hungary. For further information, contact A. S. Szabo, President of the Organizing Committee, H-1118 Budapest, Somloi Street 14-16, Phone: 361-1850-666/470, Fax: 361-166-6220.

July

•**8-15, Rapid Methods and Automation in Microbiology International Workshop XIV**, to be held at Kansas State University, Manhattan, KS. For more information contact Dr. Daniel Y. C. Fung at (913)532-5654, FAX (913)532-5681. A mini-symposium will occur on July 8th and 9th.

•**31-August 3, 81st Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians** will be held at the Hyatt Regency Hotel, San Antonio, TX. For more information, contact: Julie Heim — Registration; Scott Wells — Exhibits; at (800)369-6337 (US), (800)284-6336 (Canada), or (515)276-3344.

August

•23-24, Microbiological Concerns in Food Plant Sanitation & Hygiene, a two day interactive lecture course, sponsored by Silliker Laboratories Group, Inc., will be held in Chicago, IL. For further information, contact Silliker Laboratories, Education Services Department at (800)829-7879.

September

•19-21, Indiana Environmental Health Association Fall Annual Educational Conference will be held in Muncie, IN. For additional information, contact Tami Barrett at (317)633-8400.

October

•5-8, 1994 International Dairy Show, sponsored by the International Dairy Foods Association, Milk Industry Foundation, National Cheese Institute and International Ice Cream Association, co-sponsored by the American Butter Institute, will be held at the Minneapolis Convention Center, Minneapolis, MN. For more information, contact International Dairy Show Convention Management at (703)876-0900.

•12-13, Iowa Association of Milk, Food and Environmental Sanitarians Annual Meeting will be held at the Best Western Starlite Village (formerly the Ramada Hotel), Waterloo, IA. For more information, call Dale Cooper at (319)927-3212.

•25-26, HACCP for Meat and Poultry Processors, a two day interactive workshop designed for those responsible for implementing a HACCP plan in a processing plant, will be held in Dallas, TX. Sponsored by Silliker Laboratories Group, Inc., more information is available by calling Silliker's Education Services Dept. at (800)829-7879.

November

•2-3 North Dakota Environmental Health Assn. Annual Educational Conference will be held at the International Inn, Williston, ND. For more information, contact Deb Larson at (701)221-6147.

To insure that your meeting time is published, send announcements at least 90 days in advance to: IAMFES, 200W Merle Hay Centre, 6200 Aurora Avenue, Des Moines, IA 50322.

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