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DAIRY, FOOD AND ENVIRONMENTAL

SANITATION

FEBRUARY 1991

78th ANNUAL MEETING
JULY 21-24, 1991, LOUISVILLE, KY
(Program outline inside this issue)

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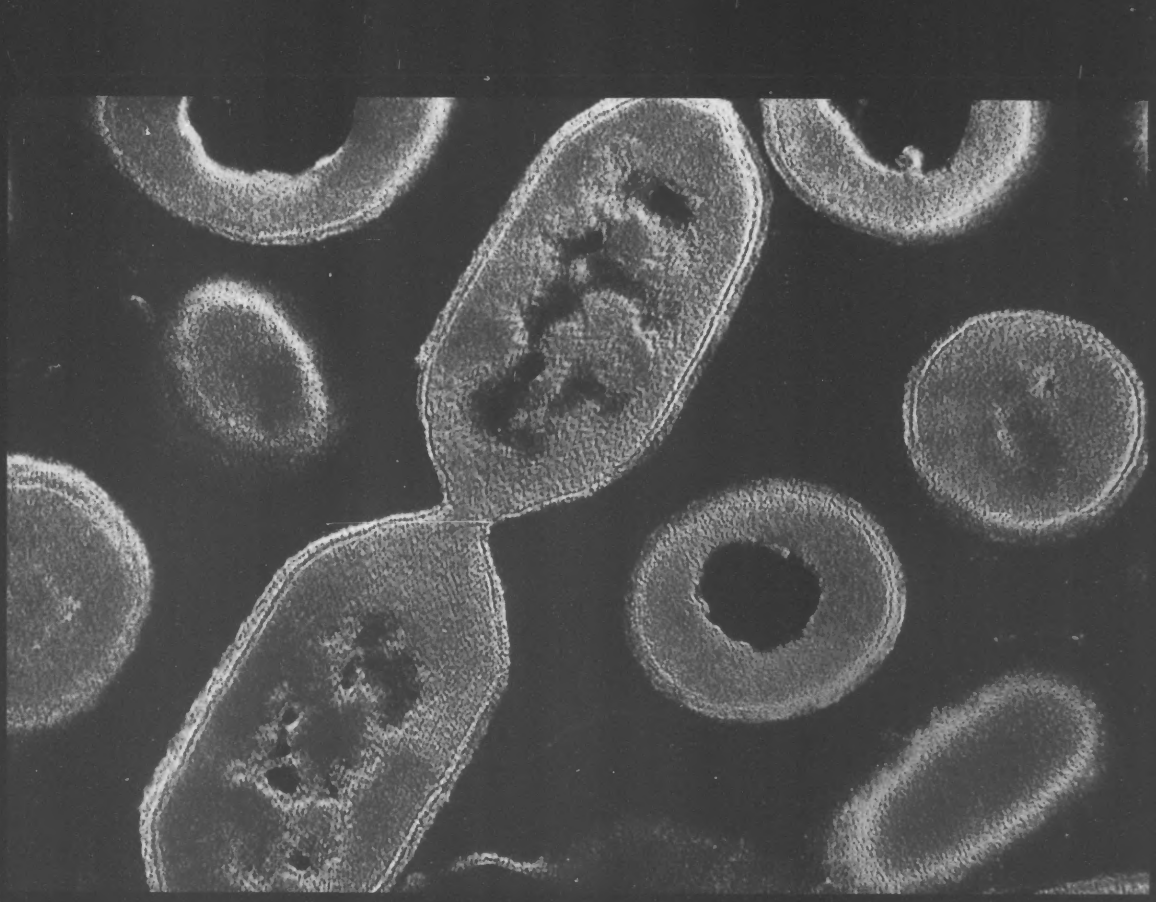

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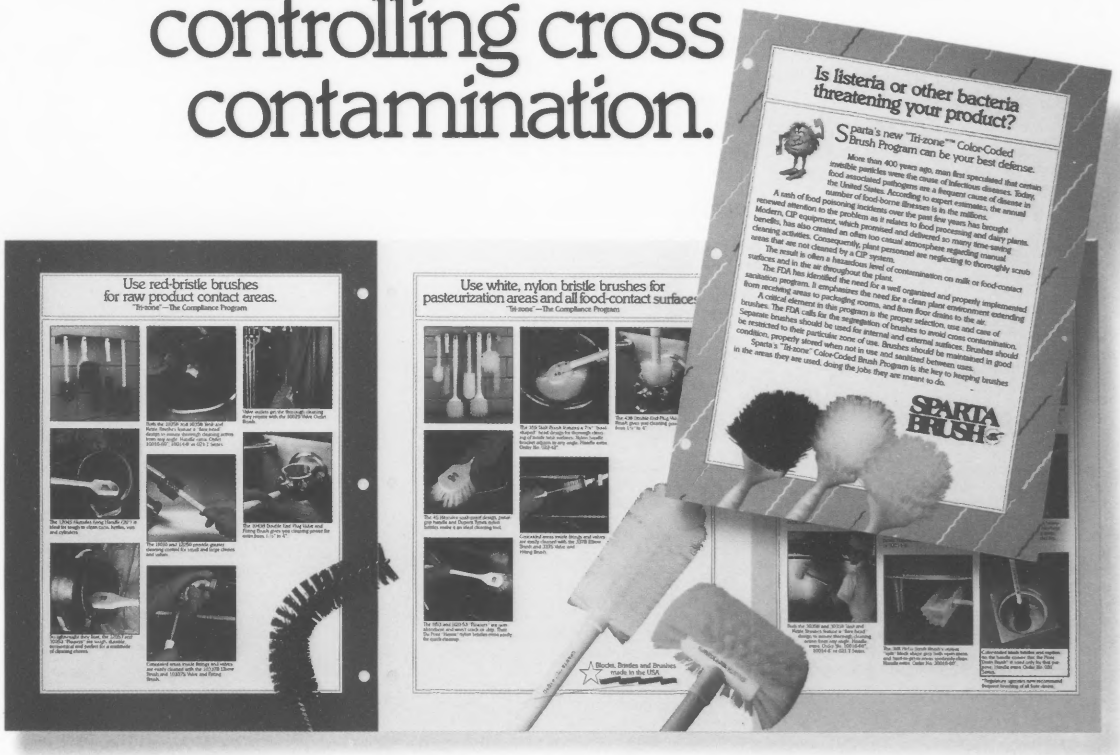

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On My Mind . . .

By
Steven K. Halstead
IAMFES
Executive Manager

. . . are upcoming elections

Sometime in the 1960's, Joseph Heller wrote an absolutely wonderful book - *Catch 22*. The movie bombed and to date, Heller's subsequent efforts have not been commercial successes, but *Catch 22* is a classic.

The novel takes place in World War II. The hero, Yarsinian, had a fear that he was going to be killed on a bombing mission. The only way to prevent his death, he felt, was to not fly any more missions.

The Air Corps had decided that after 20 missions, a crew would be discharged. Our hero saw this as a way to prevent his death so he volunteered for extra flights in order to get to the 20. As soon as he got there, the required number was raised to 25.

You can imagine what happened when Yarsinian reached that level. Yes, it was raised to 30. And so it went.

Each mission became "the one" in which the plane would be shot down and our hero killed. You can well imagine the terror. For Yarsinian, the threat to his life was just as real as if he had a loaded revolver pointed at his head. Each successful mission was a click on an empty chamber. Would the next one click?

In desperation, Yarsinian turned to a new approach - insanity. He knew that if he was declared insane, he would be sent home, thereby ending the death threat.

That's where Yarsinian learned about Catch 22. If you realized that the only way out of flying more missions was to be declared insane, then you were sane. And of course, if you were sane, you couldn't get out of flying more missions. Catch 22.

Life is surrounded by Catch 22 in a wide variety of forms. One continually hears the lament of the young saying "I can't get a job because I have no experience, and I can't get experience without a job!" Catch 22.

Or the college football coach who can't win games because he can't recruit better players, and he can't get better players because he's not winning games. Catch 22.

Dr. P.C. Vasavada, president of our Wisconsin affiliate, wrote about the Association version of Catch 22 in the December, 1990 issue of the WAMFS newsletter.

"One doesn't have experience in the organization without being involved in the committee work, etc. and one doesn't feel comfortable about accepting nominations to the Board without feeling close association with the Group."- Catch 22

He wrote "As for involving 'new blood' your Executive Board recognizes the need for getting new people involved in committee work and other association affairs. At the Joint Educational Conference, several members were asked to consider nominations for the Executive Board positions, but many were reluctant about accepting the challenge. Primary reasons were work commitments or the lack of experience in the Association. Here is a typical Catch 22 situation. One doesn't have experience in the organization without being involved in the committee work, etc. and one doesn't feel comfortable about accepting nominations to the Board without feeling close association with the Group." The only way out of this dilemma is to get involved. NOW.

To that I simply say "AMEN."

Thoughts From the President . . .

By
Bob Sanders
IAMFES President

Greetings from snowy Washington. As the years go on I envy those of you who live in the sunny south and do not have to put up with the cold weather, freezing rain, and snow that seems to suddenly appear this time of year. However, I probably shouldn't complain about Washington weather considering the cold and snow that has occurred the past few months in the upper Midwest and Northwest. It seems like all we can do with the weather is talk about it; we sure can't change it.

Back to sensible things. By the time you read this, the IAMFES Program Advisory Committee will have met with Damien Gabis, IAMFES President-Elect, who is program chairman for this year's IAMFES Annual Meeting. Plans are well along the way for the meeting. Appearing on pages 106 and 107 of this month's *Dairy, Food and Environmental Sanitation* is a preview of the Annual Meeting and the subjects covered by the technical sessions.

To refresh your memory, this year's Annual Meeting will be held at the Galt House Hotel in Louisville, Kentucky. The meeting will open on Sunday evening, July 21st, and will continue through the 24th with the IAMFES Awards banquet Wednesday evening. The Kentucky Association of Milk, Food and Environmental Sanitarians will be our host. They have some interesting things planned to make our stay in Louisville more pleasant and to entertain our spouses while we are participating in the technical sessions.

As I mentioned in last month's column, IAMFES is sponsoring a workshop prior to the opening of the Annual Meeting. The topic for the workshop will be "Investigation of Foodborne Disease Outbreaks." Dr. Frank Bryan, a long time member of IAMFES and formerly with CDC in Atlanta, will be in charge of this workshop. There will be further details on the workshop in upcoming issues of *Dairy, Food and Environmental Sanitation*. I hope all Regulatory and Industry personnel take advantage of the over the weekend low fares offered by the airlines and attend this workshop. Also being planned, for Wednesday, is the poster session of technical presentations. If you are interested in displaying a poster, please contact Damien Gabis, John Bruhn or Steve Halstead for further details.

Louisville is a central location and an easy one day drive from many parts of the country. We hope that many members plan to attend and take advantage of this wonderful opportunity to participate in the Annual Meeting. Meeting and hotel registration forms are included in this issue. Fill them out and send them in early. The hotel forms should be sent directly to the Galt House. Reserving early will assure you of a room and eliminate the possibility of having to commute from an overflow housing site.

Also appearing in this month's issue is the announcement of the Nominating Committee's choices for Secretary candidates. The elected candidate will be installed as Secretary at this year's Annual Meeting and will progress through the offices to become your president for the 1995 Annual Meeting. I believe the committee has selected two very fine candidates. Review their biographical sketches that appear in this issue. You will be receiving a ballot for Secretary soon. When your ballot comes, mark it and vote for the individual you feel will make the best officer for IAMFES.

In addition to the ballot for Secretary, a card will be included for each member to express his or her opinion on the topic of a name change for IAMFES. Please give this matter some serious thought and express your opinion. We hope to have a record number of ballots returned and to settle this name change issue.

The IAMFES Executive Board will be holding it's Spring meeting March 22nd and 23rd. If any member or committee chair has any business they wish to have brought before the board, please send it to me or Steve Halstead in time to be included on the agenda.

This is about all the IAMFES news I can think of for this month. See you next month.

Dairy, Food and Environmental Sanitation, Vol. 11, No. 2, Page 64 (February 1991)

How Can Drug Residues Affect You?

What is the problem with drug residues in milk and how does the problem of drug residues affect consumers, dairy farmers and the dairy industry? John Adams, director of milk safety and animal health for National Milk Producers Federation, says, "In a nutshell, we are facing new technology that has the capability to screen milk at levels far below what we were able to do five or even two years ago."

He notes that there is increased concern on the part of the consuming public about residues in their food. In the decade of the 1990s, Adams thinks we will hear even more concern from consumers about the purity and wholesomeness of their food.

This poses fundamental challenges for the dairy farmer in the United States and for the dairy industry. Adams notes that consumers must be convinced that the dairy sector will do an even better job in assuring the safety of the milk supply.

If consumers hear adverse stories on TV or read articles regarding drug residues in the milk supply, they have problems being able to determine whether the stories are accurate. "We must be concerned with what the public understands. Otherwise, there may be a problem," Adams says.

The basic concern for the dairy industry is to make sure there is no perception that milk is unsafe. To do otherwise can bring lower sales and profit for dairy farmers and the dairy industry.

"We have to improve our overall system of monitoring and testing, and we must work more closely with the regulatory agencies, producers and veterinarians, to get this job done," Adams continues.

Adams notes that one factor is that very few drugs are approved for use by laymen with lactating cows. Most drugs are approved only for prescription use after a veterinarian has made a prescription or diagnosis for that animal.

Adams also notes that there are new regulations for drug labelling and drug storage at the farm level. Their purpose is to generate more awareness as to which drugs are approved and which are not.

"But it's not the total answer to the problem," he says. "We have to do a better job of educating veterinarians and producers as to which drugs are approved and which are not."

Adams adds, "If a drug is used in an extra-label situation (beyond what it has been prescribed and approved for), there must be an appropriate test and proper procedure for using the drug, including a specified withdrawal time. If we cannot be absolutely certain of the withdrawal time, we need to have a test to assure that the drug does not get into the milk or meat supply."

Congress is seeking ways to ensure better control of drug use on dairy farms. This creates pressure on the Food and Drug Administration (FDA), Adams thinks.

This puts pressure on the states and the dairy industry. "We are all working to do the best job we can," Adams says. Knowledge and technology are needed to get the job done, he says, and these must be brought together at the farm, rather than waiting until the milk is processed.

"The individual dairy farmer has an immense responsibility because once a mistake is made at the farm level, it can affect the entire market," he says. "Research shows that the milk from one cow can contaminate the milk from 70,000 other cows."

"After working with the American Veterinary Medical Association the past two years, it's apparent that these problems will not be resolved unless both the veterinarians and the producers understand what they need to do and indeed work cooperatively to get the job done," Adams says.

The need for cooperative efforts to solve the drug residue problem is reflected in new guidelines to manage the problem at the farm level. The new program was developed by a Joint Task Force representing the American Veterinary Medical Association and National Milk Producers Federation. It is designed to bring the producer and the veterinarian together under a special quality assurance protocol. The program will emphasize preventive herd health management, proper record keeping and proper use of drugs with appropriate records and tests.

Failure to do these things inevitably will result in more regulation and control, he thinks. "It will not make sense to continue to pour money into advertising and promotion, unless you are able to demonstrate that you have a safe and wholesome product." he says.

Information kits now are being developed and tested for use with field representatives, extension staffs and veterinarians, who will deliver the information to the grassroots level. "It's imperative to get this program funded," Adams says.

He adds, "We are hopeful that the National Dairy Board will find a way to fund it, so that we can get this program implemented by the end of 1990. It's vital in protecting our markets."

Reprinted from the Mid Am Reporter, A Publication of Mid-America Dairymen Inc., August 1990

Dairy, Food and Environmental Sanitation, Vol. 11, No. 2, Pages 66-68 (February 1991)

The International Commission on Microbiological Specifications for Foods (ICMSF)

F.L. Bryan[1] and R.B. Tompkin[2]

[1]Food Safety Consultation and Training, 8233 Pleasant Hill Road, Lithonia, GA 30058
[2]Swift-Eckrich, Research Center, 3131 Woodcreek Drive, Downers Grove, IL 60515

The ICMSF was formed in 1962 by the International Association of Microbiological Societies which is now called the International Union of Microbiological Societies (IUMS). Through the IUMS, the ICMSF is linked to the International Union of Microbiological Societies (IUBS) and to the World Health Organization (WHO) of the United Nations.

The ICMSF was founded to: (a) assemble, correlate, and evaluate evidence about the microbiological quality of foods; (b) consider whether microbiological criteria are necessary for any particular food; (c) propose, where necessary, such criteria; and (d) recommend appropriate methods of sampling and examination. Its primary purpose is to appraise the microbiological safety of foods. Meeting these objectives would be of great value to the expansion of international trade, national control agencies, the food industry, international agencies concerned with the humanitarian aspects of food distribution, and the consuming public.

The ICMSF is a scientific advisory body that provides basic information through extensive study and makes recommendations without prejudice based on information. Results of the studies are published as books or papers.

When meeting, the ICMSF functions as a working party, not as a forum for the reading of papers. Meetings consist largely of discussions within subcommittees, debating to achieve consensus, editing of draft materials, and planning. Much of the work, however, is done by members and subcommittees between meetings, often with the help of non-member consultants. Twenty-four meetings have been held in 13 countries (Canada, Denmark, Dominican Republic, Egypt, England, Germany, Italy, Mexico, Switzerland, U.S.A., U.S.S.R., Venezuela, and Yugoslavia).

Currently membership consists of 17 food microbiologists from eight countries whose combined professional interests include research, public health, official food control, education, product and process development, and quality control. Members are from government laboratories in public health, agriculture, and food technology, from universities, and from the food industry. The ICMSF also engages consultants to help with

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specific aspects of its studies. Members and consultants are selected because of their expertise in areas of food microbiology, not as national delegates or as representatives of a certain group or agency.

Three subcommissions (Balkan and Danubian, Latin American, and Middle-East North African) have been formed to promote activities similar to those of the ICMSF among food microbiologists on a regional scale and to facilitate world-wide communication.

The ICMSF is supported by funds from government agencies, WHO, IUMS and IUBS, and the food industry. Grants for specific projects have been provided by government agencies. Over 80 food companies and agencies have contributed to the ICMSF.

The ICMSF has been known best for its recommendations of sampling plans and criteria for foods in international commerce. The commission will continue to propose, where appropriate, sampling plans and microbiological criteria; however, the commission has concluded that the safety and quality of foods can be better assured by anticipating and preventing microbiological problems. To satisfy this strategy, the commission has developed a book which describes and recommends the hazard analysis critical control point (HACCP) system. Currently, the commission's major activity is to complete a new book on the characteristics of foodborne pathogens which will be useful in hazard analysis and the development of HACCP plans. The book is to be a thorough, but concise, critical review of the literature on foodborne pathogens which can be used as a quick reference manual to assist the reader in making decisions.

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Dairy, Food and Environmental Sanitation, Vol. 11, No. 2, Pages 70-72 (February 1991)

Effective Control of *Listeria monocytogenes* In a Dairy Processing and Packaging Plant By Isothiazolone Microbicide

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Abstract

The incidence of contamination with *Listeria monocytogenes* in food, especially dairy products, has caused public health concerns. An EPA-approved microbicide, 2-Methyl/5-Chloro-2-methyl Isothiazolones (MCI), was evaluated for the control of *L. monocytogenes* on the conveyors in a dairy processing and packaging plant. This conveyor lubrication system used about 3,200 gallons of a 1:125 dilution of the lubricant per day. The pH of the use-dilution lubricant was 11. Microbial slimes and *L. monocytogenes* were present on the conveyor tracks at the start of the trial. The MCI microbicide provided effective control of *L. monocytogenes* when it was incorporated in the use dilution of a conveyor lubricant at a continuous dosing rate of 10 ppm active ingredient. At this use rate, the overall microbial population on the conveyors was also greatly reduced. The same treatment regimen is recommended for most conveyor lubricants to control Listeria on the conveyors.

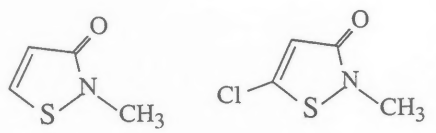
Introduction

Listeria monocytogenes was responsible for several foodborne outbreaks in North America (1,3,4,7) and in Europe (2) in the last few years. The outbreaks along with recalls of many dairy products in the U.S. due to contamination with *L. monocytogenes* have raised great concern in the food industry. This concern stems from the fact that this ubiquitous organism can grow in refrigerated foods and is associated with a high fatality rate when infected.

Listeria contamination of finished dairy products exists as a result of post-pasteurization process (5). *Listeria monocytogenes* is frequently detected in floor drains and on conveyors in dairy processing plants (6). Incorporation of a biocide in conveyor lubricants is a simple way to deliver the biocide to the sources where *Listeria monocytogenes* directly contacts with dairy products.

A MCI microbicide was tested in the use dilution of a conveyor lubricants for the control of listeria and other microorganisms. This MCI biocide is EPA registered for use in conveyor lubricants. The active ingredients are 2-methyl-4-isothiazolin-3-one and 5-chloro-2-methyl-4-isothiazolin-3-one in about 1:3 ratio, respectively (Table 1). This biocide is effective at very low concentrations in many industrial applications. Preliminary laboratory studies indicated that a use level of a few parts per million active ingredients controlled *L. monocytogenes* and other microorganisms in the laboratory (Table 2). However, laboratory test organisms and test conditions differ significantly from those of real-world where *in situ* organisms have different physiology and non-planktonic organisms are more resistant to surfactant sanitizers and heat (4). Thus, field tests are essential to demonstrate efficacy of a biocide to control *L. monocytogenes* in a dairy plant.

Table 1
Composition of MCI Microbicide



2-Methyl-4-isothiazolin-3-one
CAS Registry No. 2682-20-4

5-Chloro-2-methyl-4-isothiazolin-3-one
CAS Registry No. 26172-55-4

(Sold under Kathon CL® trade name)

This report discusses the efficacy of the MCI microbicide in a field evaluation.

General Description Of The Field Trial

The field trial was conducted at a dairy processing and packaging plant and the conveyor lubricant was supplied by a conveyor lubricant manufacturer. Microbial slime on the conveyor tracks and confirmed *L. monocytogenes* were present at the start of the trial. The conveyor lubrication system used about 3200 gallons of a 1:125 dilution of the lubricant per day. The pH of the use-dilution lubricant was 11.

In this plant there are 20 conveyor tracks, and a total of about 75-100 nozzles feeding these tracks. The lubricant concentrate was held in a bulk tank and was metered into a 55 gallon mixing tank at 1:125 dilution in tap water. The use dilution lubricant then went to a pressurized feed tank where it was distributed into all nozzles. The lubricant was further diluted or mixed with washing water and spills from the filling location and finally drained from the tracks to a pit. The lubricant was not recirculated or reused in the system.

Two trials were set up to use a continuous dosing rate of 4 ppm a.i. or 10 ppm a.i. of the MCI biocide by pumping

Table 2. Antimicrobial Activity of MCI Microbicide

Gram-Negative Bacteria	Strain	MIC (ppm AI)
Achromobacter parvulus	ATCC 4335	2
Alcaligenes faecalis	ATCC 8750	2
Azotobacter vinelandii	ATCC 12837	5
Enterobacter aeroaenes	ATCC 3906	5
Escherichia coli	ATCC 11229	8
Flavobacterium suaveolens	ATCC 958	9
Nitrobacter agilis	ATCC 14123	0.1
Proteus vulgaris	ATCC 8427	5
Pseudomonas aeruginosa	ATCC 15442	5
Pseudomonas cepacia	Gibraltar 165	0.8
Pseudomonas fluorescens	ATCC 13525	2
Pseudomonas oleoverans	ATCC 8062	5
Salmonella typhosa	ATCC 6539	5
Shigella sonnei	ATCC 9292	2
Gram-Positive Bacteria	**Strain**	**MIC (ppm AI)**
Bacillus cereus var. mycoides	(R&H L5)	2
Bacillus subtilis	(R&H L5)	2
Brevibacterium ammoniagenes	ATCC 6871	2
Cellulomonas sp.	ATCC 21399	6
Sarcina lutea	ATCC 9341	5
Listeria monocytogenes	ATCC 13932	2
Staphylococcus aureus	ATCC 6538	2
Streptococcus epidermidis	ATCC 155	2
Streptococcus pyogenes	ATCC 624	9
Streptomyces albus	ATCC 3004	1
Fungi	**Strain**	**MIC (ppm AI)**
Aspergillus foetidus	ATCC 16878	8
Aspergillus niger	ATCC 9642	9
Aspergillus oryzae	ATCC 10196	5
Aureobasidium pullulans	ATCC 9348	5
Candida albicans	ATCC 11651	5
Chaetomium globosum	ATCC 6205	9
Cladosporium resinae	ATCC 11274	5
Gliocladium fimbriatum	QM 7638	9
Lentinus lepideus	ATCC 12653	4
Lenzites trabea	ATCC 11539	6
Mucor rouxii	R&H L5-83	5
Penicillium funiculosum	ATCC 9644	5
Penicillium variabile	USDA	2
Phoma herbarum	ATCC 12569	2
Rhizopus stolonifer	ATCC 10404	5
Rhodotorula rubra	ATCC 9449	2
Saccharomyces cerevisiae	ATCC 2601	2
Trichophyton mentagrophytes	ATCC 9533	5

into the 55 gallon mixing tank directly from a 30 gallon drum of the biocide. Three sampling sites were chosen to collect samples for determination of presence of listeria, total microbial population, pH, and active ingredients of the biocide.

Test Methods

Swab samples on selected sites were checked for presence of Listeria. Listeria detection was done by Silliker Labs, a USDA-certified microbiological service company.

Fluid samples from the same sites were checked for pH, a.i., and total microbial count. Total bacterial count was done by 10-fold serial dilutions and plating on Tryptic Soy Broth Agar, and total fungal count was determined by plating on Rose Bengal Agar. The active ingredient analysis was done by reverse phase HPLC using a UV detector.

Results

Results from the first trial are shown in Table 3. In this trial, the continuous dosing rate of 4 ppm a.i. of the MCI biocide provided some but insufficient control of listeria. The total microbial count showed a significant reduction (more than 90%) of microbial population in 2 out of 3 sampling sites. However, the 4 ppm a.i. continuous dosing rate of the MCI biocide did not meet the objective to eliminate listeria contamination on the conveyors.

Table 3. Field Trial Results with 4 ppm a.i. of the MCI Biocide

Presence of Listeria

Sample Site	Pre-test	Day 1	Day 7	Day 14
Drain	+	-	-	-*
Case Conveyor	+	-*	-*	+
Main Conveyor	+	+	+	+

\+ = present
\- = absent
* = No L. monocytogenes, but other species found

Total Microbial Population (CFU/ML)

Sample Site	Pre-test	Day 1	Day 7	Day 14
Drain	Bacteria $>10^6$	$>1 \times 10^6$	1.8×10^5	8.0×10^6
	Fungi $>10^4$	1.7×10^3	1.2×10^2	4.7×10^3
Case Conveyor	Bacteria $>10^6$	$>1 \times 10^6$	1.2×10^4	1.3×10^5
	Fungi $>10^4$	3.2×10^3	$<1 \times 10^2$	< 10
Main Conveyor	Bacteria $>10^6$	$>1 \times 10^6$	1.0×10^3	6.9×10^4
	Fungi $>10^4$	7.6×10^2	3.0×10^2	< 10

CFU/ML = colony forming unit per ml.

The second trial started with a dosing rate of 10 ppm a.i. of the MCI biocide. Test results of the second trial are shown in Table 4. The 10 ppm a.i. dosing rate completely eliminated all listeria species, and very significantly reduced bacterial and fungal populations in conveyor lubricant fluid. The pH of the samples indicated substantial dilution and mixing of other fluid in the collected lubricant samples since

Table 4. Field Trial Result with 10 ppm a.i. of the MCI Biocide

Presence of Listeria

Sample Site	Pre-test	Day 1	Day 9
Drain	+	-	-
Case Conveyor	+	-	-
Main Conveyor	+	-	-

Total Microbial Population (CFU/ML)

Sample Site	Pre-test	Day 1	Day 9
Drain	Bacteria $> 10^6$	2.6×10^6	2.5×10^4
	Fungi $> 10^4$	3.8×10^3	4.2×10^2
Case Conveyor	Bacteria $> 10^6$	1.8×10^4	3.5×10^4
	Fungi $> 10^4$	1.9×10^2	< 10
Main Conveyor	Bacteria $> 10^6$	1.1×10^5	3.2×10^5
	Fungi $> 10^4$	40	< 10

PPM A.I. Remaining

Sample Site	Day 1	Day 9
Drain	<0.5	1.6
Case Conveyor	5.1	4.1
Main Conveyor	4.6	4.0

pH

Sample Site	Day 1	Day 9
Drain	6.5	7.2
Case Conveyor	9.2	8.6
Main Conveyor	9.5	8.8

the original use concentration of the lubricant was pH 11. The a.i. analysis indicated that about 40% of the initial concentration of the biocide still remained in the lubricant. The MCI biocide at 10 ppm a.i. continuous dosing rate provided satisfactory control of all listeria species.

Discussion and Conclusion

Conveyor lubricants are not recirculated or reused. Since fresh use dilution of lubricant is feeding continuously to the conveyors, the resident time of lubricant on the conveyors is less than 30 minutes in the system. Therefore, stability of the MCI biocide in the use dilution of conveyor lubricants should not be a major concern. The speed of kill of the MCI biocide, rather, is a key factor for its effectiveness.

Previous laboratory studies showed that the MCI biocide kills microorganisms quickly at pH higher than 9.0. Since most use dilution of conveyor lubricants have alkaline pH above pH 9, these are actually desirable conditions for the MCI biocide application in conveyor lubricants. When the pH of this conveyor lubricant was adjusted in the laboratory from pH 11 to pH 8 the effectiveness of the MCI biocide was significantly reduced.

In conclusion, the MCI biocide is efficacious at a continuous dosing rate of 10 ppm a.i. in the use dilution of a conveyor lubricant used in this study for the control of *Listeria monocytogenes*. The same treatment regimen should be used for most other conveyor lubricants since most conveyor lubricants have high pH, in which the MCI biocide has fast speed of kill and is most effective for this application.

Acknowledgment

The author thanks Dianne Carmody and Ted Cooke for arrangement of this field study, and Kathryn Fearnside and Richard Grabowski for development of technical data.

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HACCP in the Retail Food Industry

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What is the Hazard Analysis and Critical Control Point (HACCP) Process?

HACCP has often been specified as a government-imposed safety process that industry must implement in order to satisfy government inspection criteria. Government inspection is not prevention. The government, however, can and should provide knowledge of the factors that must be considered and controlled in order to produce food that is safe for human consumption. It is the responsibility of the food operation owner to control the safety of the items that are produced for consumption. All employees, from upper management to lowest level workers, must have a knowledge and understanding of these factors for safety control. The use of HACCP in food production facilities to solely satisfy government inspection is a misuse of this system.

HACCP is a systematic analysis of all process steps in a food production system to acquire a detailed knowledge of each step. The analysis is then applied to the production steps in order to eliminate hazardous conditions and procedures and to ensure that each food product is safe when consumed. Microbiological, chemical, and hard foreign object contamination in food products can be kept at a safe level or eliminated when HACCP is applied. If HACCP is used by the industry in this manner, it is then the government's task to review the operator's control process and to verify that it provides adequate safety control procedures and standards for food production. The food industry's vital purpose for implementing HACCP-based pre-control programs is not to comply with government regulations, but to prevent customer litigation and the disaster of public notoriety in case of a foodborne illness incident or outbreak.

Any process is never absolutely safe but there must always be a continual effort to reach the zero defect (absolute safety) goal. HACCP must include evolutionary improvement that continually addresses weaknesses in the process and reduces the chance of failure of the safety control system at each process step (critical control point).

Seven Operational Steps involved in implementing a HACCP-based evolutionary improvement process are [FSIS, 1990]:

1. Assessment of the microbiological, chemical, and hard foreign object hazards associated with each step in the product flow, from growing, harvesting raw materials and ingredients through consumption of the item. Determination is made of the levels at which these contaminants are safe and levels at which they become hazardous.
2. Determination of the step(s) or point(s) within the process at which the hazards can be most reliably controlled.
3. Completion of a failure mode analysis at each critical control point in order to determine all variables in the process, and how they might change, thus causing a hazard to develop. Prevention measures must be established in the form of control policies, procedures, and standards whereby:
   a. Hazards can be kept out of the food.
   b. Hazards can be kept below a non-risk level.
   c. Hazards can be reduced to a non-risk level by some form of processing.
4. Establishment of procedures for employees to follow and use to monitor each process variable at each critical control point, thus ensuring that the process will continually meet safety control standards.
5. Establishment of corrective action(s) to be used by employees if there is a critical deviation beyond the set standards for a variable at each critical control point. Employees must be trained and performance-certified to recognize and control these critical variables.
6. Establishment of an effective record-keeping system (statistical process control) that documents the performance of the process and the HACCP program. This record-keeping system is the basis for the systematic improvement of the process by management, over a period of time.
7. Establishment of procedures to verify that the HACCP process is working according to plan. This verification can be made by auditors or other designated personnel with the use of microbiological, physical, chemical, and sensory tests. When these procedures are used, government inspectors can review the records for compliance with operating policies, procedures, and standards to ensure that the process is stable and controlled. Note, that under HACCP, the output has so few defects that it becomes impossible to determine safety by sampling the output for hazardous contamination. The only way to have reasonable confidence that the output is safe is to verify that the personnel producing the food have process control at each step.

The History of HACCP

Hazard analysis actually began many years ago in the chemical processing industry. It is called HAZOPS (Hazard and Operability Study) by this industry. It includes the concept of failure mode analysis to determine how a hazard

can cause a problem. There are many points in a chemical process, just as in a food process, that rely on precise temperatures, times, equipment, and personnel performance. If equipment is not maintained and functional, and if performance is not precise, a poor quality product is produced, or worse, a hazard is created. For example, in Bhopal, India in December, 1984, 2,500 people were killed and perhaps 10 times that number were injured when a leak in a storage tank allowed the escape of deadly methyl isocyanate vapor. The most important cause of the Bhopal disaster was the failure of personnel to monitor and maintain the safety equipment and instrumentation that would have detected the leak and prevented the tragic incident [Kletz, 1985].

The principle of hazard control was applied by NASA (National Aeronautics and Space Administration) to ensure the construction of rockets designed to take astronauts to the moon. An important aspect of space exploration was a supply of safe food. Producers of this food were asked to use HACCP logic to formulate and produce space food that would not cause astronaut illness [Bourland et al., 1981]. The production and preservation of food is actually a chemical engineering process.

In the early 1970s, the FDA mandated that the commercial canning industry use HACCP in order to assure an adequate retort process and commercial sterilization of canned food products. The government, working with the canning industry, completed a hazard analysis of commercial canning operations and then developed critical control points and procedures to ensure that all cans of food are given an adequate thermal process [CFR 21, 1987]. The canning industry requires a training and certification program for retort operators that is verified by government regulatory agencies.

Contamination of Raw Food

Most raw food today is produced and sold by growers and processors who do not use HACCP. As a consequence, the retail food industry and people preparing food at home are responsible for ensuring the safety of the products before they are consumed. There are low levels, and occasionally hazardous levels, of contamination on and in all food. This includes: toxins; chemicals; hard foreign objects; infective pathogenic microorganisms, which must be destroyed or decreased in number in order make food safe; and pathogenic spores, which must not be permitted to outgrow.

It is hoped that government action within the next few years will encourage and mandate the use of HACCP in all areas of food production and processing. However, the contamination of food by microorganisms from the soil will be a constant hazard. There will always be a need for time and temperature control of processing steps in the retail food production industry.

Commercially Sterilized vs. Pasteurized Food

Commercially sterilized food is subjected to a process of sufficient energy (usually thermal) to reduce the population of *Clostridium botulinum* types A and B spores by a factor of 10^{-12}. This "sterility" after processing is highly dependent on package integrity. Weaknesses in container seams can allow recontamination of food after processing. (The probability of a *Clostridium botulinum* spore leaking into a can is 2×10^{-6} to 2×10^{-7} [Odlaug and Pflug, 1978].) While a few aseptic systems have been developed for sterilization and then container filling, the sterility of products produced by this method is difficult to maintain. A hermetically sealed, commercially sterilized, spore-controlled canned food product is characterized by its microbiological stability at room temperature storage, 70°F (21.1°C).

Pasteurized food is food that has been subjected to a process of sufficient energy or effect to reduce only the vegetative pathogenic microorganisms to a safe level. Spore-forming pathogens (except *Clostridium botulinum* type E, which can be destroyed at 180°F [Lynt and Kautter, 1982]) are not assumed to be controlled by a pasteurization process. Therefore, the food must be refrigerated after thermal processing. If process procedures have not included sufficient thermal processing or other barriers (i.e., pH below 5 or addition of a chemical) for controlling *Clostridium botulinum* types E, F, and non-proteolytic B strains, then the food must be stored at refrigeration temperatures of less than 38°F (3.3°C).

Destruction of *Salmonella* has often been used by the USDA over the years as the basis for vegetative pathogenic cell pasteurization safety standards. Table 1 lists three well-defined USDA-sanctioned pasteurization standards for processing beef, eggs, and milk. Note that there are no reports documenting the logical development of the reduction factors of 10^{7}, $10^{8.75}$, and 10^{12}, such as basing them on the actual contamination of the raw food and reduction of pathogens to a safe level. They seemed to be based on someone's judgment.

Table 1. Regulated Reduction Numbers for Selected Pathogens Used to Determine Pasteurization Times and Temperatures for Beef, Eggs and Milk.

Food	Organism	Reduction
Beef	*Salmonella* spp.	10^{7} to 1
Eggs	*Salmonella* spp.	$10^{8.75}$ to 1
Milk	*Coxiella burnetii*	10^{12} to 1

At the present time, a product is considered pasteurized if there are no recoverable *Salmonella*, even though there is no formal statement regarding this. In standard testing methods, this means that there is less than one *Salmonella* per 25 grams of product. Pasteurized foods require storage at 45°F (7.2°C) or less [FDA, 1976]. Note again that this is not a "safe" temperature since some pathogens, including *Listeria monocytogenes* and some *Salmonella* strains as well as other pathogens listed in Table 2 are capable of growth at temperatures less than 45°F (7.2°C). *Listeria monocytogenes* has generation times of 29 to 45 hours in milk and 21 hours in soft hispanic cheese at 39.2°F (4°C) [Rosenow and Marth, 1987].

Therefore, it is essential that these microorganisms be destroyed and not allowed to recontaminate pasteurized food if food is to be safe at 45°F (7.2°C) for more than a short period of time. **For true safety, chilled pasteurized food must be stored below 30°F (-1.1°C).**

Table 2. Microorganisms with Low Multiplication Initiation Temperatures.

Microorganism	Temperature °F(°C)	Reference
Yersinia enterocolitica	30-32 (-1.1-0.0)	Walker & Stringer (1988)
Listeria monocytogenes	32-35 (-1.1-1.7)	Seeliger & Jones (1986)
Salmonella spp.	35-41 (1.7-5.0)	Catsaras & Grebot (1984); Matches & Liston (1968)
Escherichia coli spp.	36.5-39.2 (2.5-4.0)	Mitscherlich and Marth (1984); Olsvik and Kapperud (1982)
Clostridium botulinum, types E, F, and non-proteolytic B strains	38 (3.3)	Genigeorgis and Rieman (1979)
Aeromonas hydrophila	39.2-41 (4-5)	Palumbo et al. (1985)

The safety of pasteurized foods is highly dependent on package integrity. In commercially sterilized food, because of can seam weaknesses, a residual amount of chlorine is used in water to cool cans of food after processing. The chlorine at 0.5 to 1 ppm destroys many pathogenic bacteria in the cooling water, and their rapid growth is prevented. Therefore, if can or package leaks do occur, the incidence of pathogen entry through seams during cooling is reduced to a "safe level" as a result of the chlorine. This same procedure is even more necessary for pasteurized foods that are packaged in plastic films and cooled in water after pasteurization.

While there is no research summary on plastic packages, the data from the U.S. Army, which has been attempting to do thermally sterilized pouch food for more than 30 years, indicate that it is not uncommon to find the seal failure rate of plastic pouches of 0.1 to 1 percent. These facts seem to indicate that the true high risk critical control point will be plastic package integrity after pasteurization.

HACCP Applied to the Chilled Pasteurized Food System

An overview of HACCP applications in chilled pasteurized food systems is shown in Figure 1. The input (hazards coming from the food producers and the environment) to the retail system includes: microorganisms, chemicals, and hard foreign objects on food from people, air, water, and food contact surfaces.

Figure 1. Application of HACCP to The Chilled (Pasteurized) Food System.

Input--Hazards	Process--Controls	Output
Microorganisms	Supplier certification of hazard levels	People who can accept moderate levels of pathogens: 1-70 years old with normal stomach acidity, balanced intestinal microflora, and adequate T and B lymphocytes
Chemicals		
Hard foreign objects in: Food and beverages, People, Air, Water, Food contact surfaces	Control hazards through processing below a threshold that will make consumers ill: Raw process plant, Finished food process plant, Commissary, Supermarket, Vending, Foodservice, Home	People who can accept only very low levels of pathogens: Babies 0-1 year, Pregnant women, Immune-comprised, Elderly on antibiotics
Coming from the producers and environment		

The pasteurization process must reduce the hazards to a safe level or be controlled through supplier certification so that they do not exceed the control limitations of the process that prevents them from becoming hazardous to consumers of the food. The hazard threshold is determined by consumers of the food. Healthy people can usually accept moderate levels of pathogens. They have normal stomach acidity, balanced intestinal microflora, and adequate immune cells. There are also individuals who can accept only low levels of pathogens. This group includes infants, pregnant women, immune-compromised people, and elderly people, especially those who are on antibiotics.

The environment will never be free of pathogens. Healthy people can exist in this environment because they have been and continue to be exposed to low levels of pathogens, which enable their bodies to develop a passive immunity to some bacteria and viruses. If foods were to become pathogen-free, this immunity would not develop in people.

The Hazards of Refrigerated Foods

The objective of pasteurizing foods is to ensure that when the food is consumed, the hazards will be below an illness-causing level. This also means that, aside from pathogen control, chemicals, mold toxins, and other natural toxins in food must be maintained below hazardous thresholds through supplier controls. Hard foreign objects must be sufficiently small so that there will be no injury to the mouth, teeth, or digestive tract. They must not lodge in the throat or cause digestive problems.

In order to design a safe process, it must be assumed that the food contains a maximum load of pathogens based on recognized microbiological measurements. Processing standards must be designed to decrease or maintain the pathogenic population in the food at levels that will cause no risk to consumers. What pathogen levels in raw food should be considered high? Genigeorgis (1987) observed 1,400 *Salmonella*/100 g of chicken skins. When muscle foods were tested for *Listeria monocytogenes*, raw fish had a maximum of 25-50 CFU/g [Anon., 1989]. Johnson et al. (1990) aeseptically removed interior muscle cored from 50 beef, 50 pork and 10 lamb roasts, purchased at retail outlets for *Listeria monocytogenes*. The lamb was negative, but 5 of the 100 beef and pork roasts were positive for *Listeria monocytogenes*. On two occasions it was present at an estimated level of 10 CFU/g. All other cases of isolation were achieved by enrichment suggesting that there was a level of less than 10 CFU/g. This existence of *Listeria monocytogenes* in muscle cores is probably due to antemortem exposure of the animal to *Listeria*. Wehr (1982) compiled a list of microbiological guidelines and standards for food established by some individual states. This is an indication of levels that have apparently been tolerated with no problems.

Table 3 provides the best estimate for expected number of pathogens in food coming into the retail food system today, and an estimate of what people with normal immune systems can tolerate.

Table 3. Expected Number Pathogenic Cells per Gram of Food Before Processing and Safe Tolerance Levels.

Spore-formers and/or Toxin Producers	Expected	Tolerance
C. botulinum	1/10 grams	1,000/gram
C. perfringens	10/gram	1,000/gram
B. cereus	100/gram	1,000/gram
S. aureus	10/gram	1,000/gram
Infective Vegetative Microorganisms		
Salmonella spp.	10/gram	<1/25 grams
Listeria monocytogenes	100/gram	<10/gram
Viruses	10-100/gram	<1/gram

Classifying Pathogens for Process Control

Pathogenic organisms can be categorized into two groups:

1. **Spore-formers** and/or **toxin-producers** such as *Clostridium botulinum, Clostridium perfringens, Bacillus cereus,* and *Staphylococcus aureus*: Heat will inactivate the spores or toxin. Therefore, growth must be controlled by time and temperature.
2. **Infective microorganisms** such as *Salmonella* spp., *Listeria monocytogenes*, and viruses: They can be inactivated by heat.

Note that people can tolerate fairly high levels of spores and toxin-producing organisms. The key control is to limit their multiplication to less than 4 generations. On the other hand, people can usually tolerate only low levels of infective vegetative microorganisms per gram. Since cross-contamination cannot be completely prevented without extensive effort, the multiplication of infective microorganisms must also be process controlled to 4 generations or less.

People are often the sources of microbial hazards and can contaminate food products during production. If food is produced, stored at 40°F (4.4°C), and sold within 5 days, there is very little time for pathogenic microorganisms to multiply on or within the food. Data indicated that *Yersinia* and *Listeria* will be limited to less than 4 generations (1:16) [Snyder, 1989]. The critical controls, if food is cooked and served within a short time period of 5 days are **employee hand washing** and **pasteurization**. Only high levels of pathogens that are a result of gross cross-contamination and improper temperature control will cause problems.

When chilled food products are produced for storage periods longer than 5 days at 40°F to 50°F (4.4°C to 10°C), it is essential that there are very high standards of environmental sanitation and employee hygiene both during and after pasteurization. The reason is that there will be time for extensive pathogen multiplication if they are present after pasteurization or if there is post-processing contamination.

Process Environmental Controls

In some chilled food systems (i.e., cold sandwich and salad production) food is assembled after it is pasteurized. In these processing environments, employee personal hygiene is critical if the food is to be held at temperatures above 40°F (4.4°C) that allow active growth of psychrophilic pathogenic organisms such as *Yersinia enterocolitica* and *Listeria monocytogenes* to levels that will cause illness. Personnel must wear masks when assembling food that will not further be pasteurized after packaging. It must be mandatory for employees to have short fingernails, wash fingertips and hands using a fingernail brush, and wear latex gloves. Employees must dip gloved hands in sanitizing solutions in order to maintain low levels of both spoilage and pathogenic organisms in food products.

City water systems are reasonably safe. However, failures occur each year [Levine and Craun, 1990]. The amount of chlorine in water when the water arrives at the food processing plant is variable. Since some parasites, such as *Giardia*, can survive in chlorinated water systems for a long time, it is important to have a water filtration system as well as a chlorinator for the incoming water supply.

The atmosphere in any room where pasteurized food is handled must be controlled. There are documented incidents of microbiological contamination of food caused by air cooling systems and dehumidifiers [Morey and Feeley, 1988]. It is of utmost importance to put high quality air filters on air systems to maintain low levels of microbiological contamination [Kang and Frank, 1989]. Pathogens should not be detectable in the air or through surface sampling.

The processing area should operate at a temperature of less than 50°F (10.0°C) and a relative humidity of 45% (to prevent moisture condensation and microbiological growth on walls, ceilings, and surfaces) when food is being processed for a storage life of more than 5 days. There should be no areas for standing water to collect.

The production area (entire plant or room) must be designed so that it can be easily cleaned and sanitized. There should be tile from floor to ceiling. Ceilings must be free of any over hanging obstructions and piping. Floors should be constructed of durable materials (e.g., ceramic tile or brick) which are easy to foam, wash down, and sanitize each night or more often if necessary.

Lighting must be greater than 100 foot candles so that it is possible to see filth and dirt accumulating in corners and nooks, which should be removed during wash-downs throughout the process day. All finished food contact surfaces in operations should be stainless steel and should be sanitized regularly. (After sanitizing there should be less than 10 spoilage organisms per 8 square inches on these surfaces.) All equipment must be constructed of materials and design to facilitate its ease of cleaning and sanitizing. Only stainless steel surfaces should contact food.

Chemicals must be carefully controlled. Concentrated chemicals in food processing plants and food production areas can cause serious safety and foodborne illness problems when not used properly. Chemical supplies must be kept in separate locked storage units or areas (i.e., separated from food). Only chemicals that have been diluted to nontoxic levels should be allowed in food production areas. Employees must be informed about each hazardous chemical used in the facility and must be trained to correctly measure and use all chemicals in the process area.

The Critical Control Points in Refrigerated Food Processes

The first input control strategy for ensuring a minimum hazard in foodservice operations is to obtain commodities

from suppliers who certify both the pathogen and spoilage microorganism level of their products. (At this time, there are very few suppliers who certify microbial levels in their products.) Government inspection of raw product provides little or no control over the pathogenic load in raw food. Therefore, until suppliers have HACCP programs that provide microbiological, chemical, and hard foreign object statistical process control data with their products, the retail food operations are forced to assume full accountability for safety control of the products they sell. However, the objective must be to prevent food from becoming contaminated during production, harvesting, and distribution, rather than having attempts made to control pathogen content at the user level.

Pasteurization

Current USDA pasteurization standards for *Salmonella* and *Listeria monocytogenes* are shown in Table 4. The USDA has specified that food processors should apply a 7D *Salmonella* destruction, which is actually equivalent to a 4D destruction of *Listeria monocytogenes*, according to recommendations of the National Advisory Committee on Microbiological Criteria for Foods (1990).

Table 4. USDA Recommended Pasteurization Standards for *Salmonella* spp. and *Listeria monocytogenes* in Refrigerated Foods.

Temperature °F (°C)	*Salmonella* 7D (Time: min.)	*Listeria* 4D (Time: min.)
130 (54.4)	121	87.8
140 (60.0)	12	11.4
150 (65.6)	1.2	1.48
160 (71.1)	0.12	0.19

Note that it will be common to have to "over-pasteurize" for shelf life extension because spoilage microorganism contamination will normally exceed that of pathogens. Also, spoilage microorganisms tend to have a higher thermal resistance than pathogens.

Pasteurization with ionizing radiation is an effective way to control vegetative microorganisms. However, food ionizing radiation should never be used as a substitute for clean, low-pathogen raw food, which can be achieved when HACCP is applied to growing, processing, and distribution procedures.

Process Control Strategies

In order to develop an overall strategy for control of pathogenic organisms in chilled food production units, pathogens are again categorized into two groups:

1. **Spores** that will survive the heating process.
2. **Vegetative pathogenic organisms** that are assumed to be on the food coming into the process, unless otherwise certified by the supplier. They must be reduced to a sufficiently low level so that they will not multiply to hazardous levels during storage and distribution.

The growth of spore-forming microorganisms must be controlled. Table 5 provides data on cold holding control standards for the spores. It is evident from this table that the only spore-forming pathogens that are hazards in chilled food stored below a temperature of 40°F (4.4°C) are *Clostridium botulinum* types E and F and non-proteolytic B strains, which can multiply at a temperature of approximately 38°F (3.3°C). These strains or types of *Clostridium botulinum* are also controlled when the pH of these foods is decreased to less than 5.0. Except in fish, they do not represent a major hazard because there are usually so few in food. The fact that there have been so few deaths from *Clostridium botulinum* types E and F and non-proteolytic B strains (i.e., approximately 10 over the last 15 years due to process failures), indicates that these spore-formers are a low-risk problem.

Table 5. Temperatures and pH Inhibition of Spore-forming Microorganisms.

Process	Spores	Temperature °F (°C)	pH
Cold holding	*C. botulinum* A, B*, D, F	<50 (10.0)	4.6
	C. botulinum E, B**, F	<38 (3.3)	5.0
	C. perfringens	<59 (15.0)	5.0
	B. cereus	<41 (5.0)	4.3
Heating	*C. perfringens*	40 to 130 (4.4 to 54.4) in <6 hours	
Hot holding	*C. perfringens*	>130 (54.4)	
Cooling	*C. perfringens*	130 to 40 (54.4 to 4.4) in <4 hours	

* = proteolytic strains
** = non-proteolytic strains

The spore-forming pathogen whose vegetative cell growth sets the minimum temperature for heating food is *Clostridium perfringens*. Under very carefully controlled laboratory conditions, *Clostridium perfringens* can be made to multiply up to a temperature of 127.5°F (approximately 53°C) [Shoemaker and Pierson, 1976]. During some dynamic conditions which occur when food is heated or cooked slowly, there is an opportunity for the organism to store metabolic products, making carry-over multiplication possible at a temperature as high as 130°F (54.4°C). However, this is a dynamic, rather than a static, heating phenomenon. Thus, the upper temperature limit for pathogenic growth is 130°F (54.4°C) [Willardsen et al., 1979]. Hot holding temperature standards [maintaining hot foods above 140°F (60° C)] [FDA 1976 code] are based on inhibiting the growth of *Clostridium perfringens*.

Above 130°F (54.4°C), food quality deteriorates due to dehydration, chemical changes in food (i.e., excess protein denaturation, lipid oxidation), and the growth of some spoilage bacteria. There are several thermophilic spoilage bacteria that are capable of multiplying in food at temperatures from 130°F to 160°F (54.4°C to 71.1°C) or higher, causing off-flavors and odors to develop in food (i.e, *Bacillus stearothermophilus, Bacillus coagulans, Clostridium thermosaccharolyticum*, and *Desulfotomaculum nigricans*) [Banwart, 1983]. Food, such as casseroles and roasts should not be held hot for longer than 4 hours, if these products are to meet customer acceptability standards. Food such as chops, steaks, and single-portioned entrees are of poor quality after 20 to 30 minutes.

Longree and White (1955) studied the growth of *Escherichia coli* in beef broth and white sauce cooled at

different rates. A growth of 7 log cycles occurred in as little as 8 hours as the products were cooled from 115°F (46.1° C) to 60° F (15.6° C). Stern and Custer (1985) studied the growth of *Salmonella* in cooked beef at selected cooling rates of 2 to 6 hous and found essentially no growth at the end of 2 hours, but as much as 10^1 increase at the end of 6 hours. Since both of these microbes are vegetative organisms, they should be destroyed during cooking or reheating and should not be a cooling hazard. *Clostridium perfringens* is the pathogenic microorganism on which cooling standards are based. Because spores of *Clostridium perfringens* can become activated during cooking and hot holding of foods, cooling must be accomplished quickly. Food must be cooled from 130°F to 40°F (54.4°C to 4.4°C) in less than 4 hours in order to prevent *Clostridium perfringens* multiplication. The food should not be kept longer than 5 days, if it is held at 40°F (4.4°C), unless there is absolute control over vegetative pathogen post-processing contamination.

Infective Vegetative Microorganism Control

Infective vegetative microorganisms that must be controlled in chilled foods include: *Salmonella* spp., *Vibrio* spp., *Campylobacter jejuni*, *Shigella* spp., *Staphylococcus aureus*, *Listeria monocytogenes*, *Yersinia enterocolitica*, *Escherichi coli* 0157:H7, Hepatitis A virus, Norwalk virus, and parasites.

The pathogen that grows at the lowest temperature in raw and cooked food products, is *Yersinia enterocolitica*. This pathogen has been shown to begin multiplication in hamburger at temperatures between 30°F and 32°F (-1.1°C to 0.0°C) [Hanna et al., 1977].

Growth data from food indicate that if food is held for less than 5 days at 40°F (4.4°C), the multiplication of psychrotrophic microorganisms will be controlled to less than 4 generations. If food products have been produced using good methods of sanitation, they will have reasonably low levels of pathogens when they arrive at the processing plant, and 4 generations (i.e., a multiplication factor of 16:1), should be within the control parameters of the process system. These products should meet food safety standards as well as customer satisfaction expectations.

During pre-preparation, the food should be kept below 50°F (10.0°C) and should not stay at temperatures between 40°F and 50°F (4.4°C and 10.0°C) for longer than 60 minutes before it is returned to a 40°F (4.4°C) environment. If raw products are in large containers, the estimated 8 hours for the food to re-cool to 40°F (4.4°C) will not allow multiplication of more than a fraction of a generation, which is acceptable.

Since none of the infective organisms grow as rapidly as *Clostridium perfringens*, the heating standard for prohibiting growth of infective microorganisms is the same as for spore-forming microorganism control: allow 6 hours to heat food from 40°F to 130°F (4.4°C to 54.4°C).

Once 130°F (54.4°C) is reached, it is critical to heat the food to specified temperatures for specified times in order to provide adequate pasteurization. A review of the D Values for all the infective organisms reveals that *Salmonella* spp. and *Listeria* are the best high-hazard, infective organisms on which to design pasteuriztion processes. For healthy people with a normal immune system, a 10^3:1 pasteurization of products should be sufficient to reduce *Salmonella* spp. counts to less than 1 per 100 grams of food. As a safety factor, a pasteurization standard of 10^7:1 *Salmonella* standard should be applied when food is to be consumed by immune-compromised individuals (hospitals and other health care facilities) or for food that will be stored for more than 5 days.

The D Values for *Salmonella*, taken from USDA beef pasteurization standards [CFR 9: 318, 1987] are:

D 130°F (54.4°C) = 1,037 seconds
D 140°F (60.0°C) = 104 seconds
D 150°F (65.6°C) = 10.4 seconds
D 160°F (71.1°C) = 1.04 seconds

If there are high salt and sugar concentrations greater than 10 percent, then pasteurization temperatures should be increased by 10°F (5.6°C) in order to compensate for the lower water activity of the system and greater thermal resistance of the organisms. If the product is more acid than pH 4.6, the pasteurization temperature can be decreased by 10°F (5.6°C).

After pasteurization, if food is held above 130°F (54.4°C), it will be safe. Most infective bacterial pathogens in food cease multiplication at temperatures at or below 115°F (46.1°C) [Doyle, 1989]. An exception is *Staphylococcus aureus*, which multiplies up to a temperature of 122°F (50.0°C) [Halpen-Dohnalek, 1989]. However, because it does not produce a toxin above 114.8°F (46°C) [Tatini, S.R., 1973], it is not hazardous above this temperature.

Product cooling is again based on *Clostridium perfringens* because of its multiplication potential at temperatures between 130°F (54.4°C) and 59°F (15°C). The object is to cool the food from above 130°F (54.4°C) to 40°F (4.4°C) in less than 4 hours. When food is cut, chopped, or mixed, it should be kept at less than 50°F (10.0°C) and returned to the cold holding unit (refrigerator or cooler) with a temperature maintained at 40°F (4.4°C) or less, in less than 60 minutes. For example, when salads are prepared, if all cooked food ingredients are cooled to below 40°F (4.4°C) in less than 4 hours prior to mixing, and the temperature of ingredients is kept below 50°F (10.0°C) during mixing, the threat of *Staphylococcus aureus* foodborne intoxication will be controlled, because *Staphylococcus aureus* does not produce toxin below 50°F (10.0°C).

When pasteurized foods are stored in cold holding units, it is critical to have perfect package integrity. If distribution and retail sales temperatures are controlled between 28°-30°F (-2.2 to -1.1), pathogenic microorganisms will be controlled and spoilage organism growth will be very slow. If there is any uncertainty about the package integrity or the distribution system, then chilled foods should be held for less than 5 days at less than 40°F (4.4°C) to limit the pathogen multiplication below a hazardous level.

Some products do not tolerate hot pasteurization. A typical example is mayonnaise, which is made with raw eggs. While pasteurized eggs can be used in the preparation of this product, process standards for mayonnaise and other salad dressings are based on the assumption that there is a high level of *Salmonella* spp. in the ingredients, and that these pathogens must be inactivated. The preferred method

used to inactivate the pathogens and prevent their growth is the use of sufficient amounts of organic acids (i.e., citric or acetic) in the preparation of these products [Smittle, 1977]. If the products are acidified to below a pH of 4.1 and the finished salad dressings and mayonnaise are held for 2 days at 70°F (21.1°C), high levels of infective organisms, particularly *Salmonella*, are destroyed and the products are safe to consume.

Other critical control parameters must also be implemented in this environment. Food contact surfaces must be washed and scrubbed with hot [120°F (48.9°C)] detergent water at least every 4 hours in order to minimize the growth of spoilage organisms. All surfaces, including all hard-to-reach corners and crevices must be reached and then sanitized with 50 ppm chlorine or equivalent sanitizing solution.

It must also be assumed that food handlers are infected and are passing approximately 10 viruses in their stools. The double hand washing method using a fingernail brush, must be used by food handlers to ensure that viruses and other pathogenic bacteria which may be deposited on the hands and under fingernails do not contaminate food products. Fingernails of employees must be kept short so that they can be kept clean and do not break gloves if gloves are worn.

When the double hand washing method is used, water at 110°F to 120°F (43.3°C to 48.9°C) is used with a fingernail brush with at least 2 mL of soap on the fingers and 2 mL of soap on the brush. The brush is used to clean fingertips of the hand and to clean under the fingernails. The important critical point in hand washing is the removal of fecal organisms from the fingertips and under the fingernails.

After the first wash, the hands and brush should be rinsed in water that is flowing at a rate of at least 2 gallons (approximately 8 liters) per minute. Hand washing is repeated using at least 2 mL of well-lathering soap. The fingernail brush is not used during the second wash. Hands should be rinsed and dried with a paper towel. Soaps and detergents containing bactericidal chemicals should not be used. These types of soaps or detergents harm beneficial resident bacteria in the epidermal layer of the hands and cause many problems.

Using Pathogen Control Information to Design Refrigerated Foods Processes

There are four major categories of chilled food processes [National Advisory Committee on Microbiological Criteria for Foods, 1990], as shown in Figure 2. Within these major processes, there are a total of 9 sub-categories, which describe all of the food process systems in both wholesale pasteurized processing operations, commissaries, and retail operations.

The first category is **Assemble, Package, Cook-pasteurize, Chill**. Products that characteristically undergo these processes are sous vide, individual, vacuum-bagged portions, and meat or poultry rolls and roasts sold often as deli meats. The critical controls are:

1. Starting with as clean a product as possible (i.e, low microbial count as well low chemical or particulate contamination).
2. Providing adequate pasteurization.

Figure 2. Types of Chilled Food Processes.

1. **ASSEMBLE——PACKAGE——COOK——CHILL**
   - •Sous vide — Pre-prep-->Vac. pkg.-->Pasteurize-->Chill
   - •Rolls and roasts — Pre-prep->Vac. pkg.-->Pasteurize-->Chill

2. **ASSEMBLE——COOK——PACKAGE——CHILL**
   - •Stews, sauces soups — Pre-prep—>Pasteurize & Pkg. hot—>Chill

3. **COOK—CHILL——ASSEMBLE——PACKAGE**
   - •Roast or fried chicken, other roasts, & uncured sausages — Pre-prep—>Pasteurize-->Chill-->Pkg.
   - •Uncured luncheon meat & diced meat — Pre-prep—>Past.—>Chill—>Slice/-->dice—>Pkg.
   - •Meat & pasta, meat & sauces, dinners, sandwiches, & pizza — Pre-prep—>Past.—>Chill—>Assemble—>Pkg.
   - •Meat pies, quiches, patties, pates — Pre-prep—>Past.—>Fill—>Chill—>Pkg. into dough

4. **ASSEMBLE WITH COOKED AND RAW INGREDIENTS—— PACKAGE**
   - •Chef salad, chicken salad, sandwiches, & pizza with raw ingredients — Pre-prep—>Chill—>Assemble—>Opt.—>Pkg. cook chill
   - •Uncured jellied meats — Pre-prep—>Past.—>Add raw ingredients—>Chill—>Pkg. to gel

3. Ensuring that there is no hazardous post-processing contamination prior to consumption.
4. Maintaining food temperatures below 38°F (3.3°C) until consumed.

The second category is **Assemble, Cook-pasteurize, Package, Chill**. This is characteristic of stews, soups, and sauces of the Cryovac system. Since these foods are cooked to above 180°F (82.2°C) and filled at above 180°F (82.2°C), there should be control of *Clostridium botulinum* types E, F and non-proteolytic B strains. The critical controls are:

1. Providing adequate pasteurization during cooking.
2. Preventing post-processing contamination.
3. Maintaining food post-processing temperatures below 38°F (3.3°C) until consumed.

The third category, **Cook-pasteurize, Chill, Assemble, Package**, includes roast or fried chicken, uncured luncheon meats, meats, pastas, meat sauce dinners, meat pies, quiches, patties, and pates. These products are all characterized by much post-pasteurization manipulation of the food. Because of the many environmental contaminants that can contaminate the products during post-processing handling, the critical controls are:

1. Running a scrupulously clean and aseptic post-process handling.
2. Ensuring that there is no hazardous contamination of the product during or after packaging.
3. Maintaining post-processing temperatures below 30°F (-1.1°C) as long as possible.

The final category involves **Cook-pasteurize, Chill, Raw Ingredient Addition, Final Chill, Package**. This is characterized by products such as salads, sandwiches, and

uncured jellied meats. This is by far the most dangerous process because there is no control over the pathogens on the raw ingredients (except washing these ingredients in water), which are combined with cooked ingredients. Perhaps in the future, ionizing radiation will be used to decrease microbial pathogens in raw ingredients. At this time, precontrol of the pathogens on the raw ingredients through use of certified products is critical to the safety of the food. Prevention of post-processing contamination of the product is crucial, as is food storage for as long as possible at 30°F (-1.1°C).

Preparing Food and the Control of Microbiological Hazards

Figure 3 incorporates the information about each of the four major processes and applies specific time-temperature controls for each process.

Figure 3. Process Time—Temperature Controls [With Final Distribution <30°F (-1.1°C)].

1.	Assemble --------> <50°F (10.0°C)	Package -- <50°F (10.0°C)	Cook --------> Pasteurize**	Chill*
2.	Assemble <50°F (10.0°C)	Cook Pasteurize**	Package <50°F (10.0°C)	Chill*
3.	Cook Pasteurize**	Chill*	Assemble <50°F (10.0°C)	Package <50°F (10.0°C)
4.	Cook Pasteurize**	Chill*	Raw Ingred. Chill* <50°F (10.0°C)	Package <50°F (10.0°C)

* 40°F (4.4°C) <4 hours, <5 days holding, or
35°F (1.7°C) <30 minutes, >5 days holding
** See Table 3

Packaging of foods processed by Category 1 (**Assemble, Package, Cook-pasteurize, Chill**) must be done at less than 50°F (10°C). Products must be cooked-pasteurized according to USDA pasteurization standards, and chilled to 40°F (4.4°C) in less than 4 hours. For extended shelf life, this quick chilling should be done to 30°F (-1.1°C) in less than 30 minutes in order to extend the lag phase for the outgrowth of spoilage microorganisms and to maximize flavor quality. To have a maximum shelf life, the products must be stored at 30°F (-1.1°C).

For the second major category (**Assemble, Cook-pasteurize, Package, Chill**), products are assembled at less than 50°F (10°C), cooked-pasteurized according to USDA pasteurization standards, packaged under a scrupulously clean, pathogen-free environment at less than 50°F (10°C), and chilled to 40°F (4.4°C) in less than 4 hours. For a long shelf life and pathogen control, the product should be stored at 30°F (-1.1°C).

In the third category (**Cook-pasteurize, Chill, Assemble, Package**), cook-pasteurization is done according to USDA standards. Food must be chilled as rapidly as possible to 40°F (4.4°C), assembled in a scrupulously clean, pathogen-free environment at less than 50°F (10°C), and packaged at less than 50°F (10°C). Finally, the product should be held at less than 30°F (-1.1°C) for extended shelf life and for safety.

The fourth category (**Cook-pasteurize, Chill, Addition of Raw Ingredients, Final Chill, Package**) requires that the product be assembled at less than 50°F (10°C), packaged in a clean environment at less than 50°F (10°C), and distributed as cold as possible. Keeping the product at less than 30°F (-1.1°C) is crucial because all pathogen such as *Listeria monocytogenes* on products such as lettuce, radishes, and celery cannot be removed.

Distribution

The approximate shelf life of these products is shown in Table 6. Note that this shelf life is highly dependent on the initial spoilage microorganism load of the product. Enzymes within food may not be inactivated during pasteurization processes. Many enzymes require temperatures higher than 160°F (71.1°C) for inactivation. Enzymes catalyze chemical reactions in food (e.g., oxidation reactions leading to loss of color and nutritive value, and change in flavor, and hydrolytic reactions resulting in change in flavor and texture). Enzymes are capable of causing deterioration in products at temperatures lower than those necessary to prevent the growth of spoilage organisms.

The overall shelf life is extremely dependent on packaging, gas vapor transmission ratios, and package integrity and durability.

Finally, the shelf-life is dependent on distribution temperatures. The distribution system has many potential irregularities in time-temperature controls. Distribution temperatures should be maintained at or below 30°F (-1.1°C).

Table 6. Approximate Shelf Life [Storage at or below 30°F (-1.1°C)].

Food Item	Days
Sous vide	21
Roasts	60-90
Stews and sauces	
low acid (>4.6 pH)	21
acid (<4.6 pH)	180
Roast cut packaged meat	42
Meat and sauce dinners	>21
Meat pies	>21
Sandwiches	<7
Salads (<4.6 pH)	30-180
Pizza	30-60
Uncured jellied meat	<7

Very hazardous conditions for refrigerated foods on display in supermarkets can easily develop. If products are put close to lights in a display cabinet, product temperature can easily rise to a temperature of 55°F (12.8°C) or above. Defrost cycles on supermarket and convenience store refrigeration equipment are erratic. It is not uncommon to find refrigerated product temperatures in retail refrigeration cases to be from 50°F to 55°F (10.0°C to 12.8°C). These temperatures must be maintained near the freezing point 28°F to 30°F (-2.2°C to -1.1°C) in retail distribution of refrigerated foods in order to prevent foodborne illness and resulting litigation. The foodservice industry must also maintain temperatures of 28°F to 30°F (-2.2°C to -1.1°C) for refrigerated products for these same reasons. (This can be achieved by purchasing and using freezer units with thermostats that can be set to maintain temperatures at 28°F to 30°F (-2.2°C to -1.1°C).

Summary

Refrigerated food systems have been with us for years and have aided in shelf life extension of many foods. As consumers demand "new" and "fresher" convenience foods, refrigeration storage will be the foundation on which future food processes will be developed.

The optimum procedures to use for processing and storing refrigerated foods at the present time are to:

1. Obtain fresh,raw food with as few spoilage and pathogenic microorganisms as possible.
2. Process it at correct times and temperatures for adequate pasteurization.
3. Keep it as close as possible to the freezing point of the food system (28°F to 30°F (-2.2°C to -1.1°C) during distribution to extend the shelf life of the product to its maximum limit and maintaining its safety.

If regional production centers for refrigerated foods are developed, as milk processing plants are today, there would be a tremendous opportunity for chilled foods to have a major impact on the retail food environment. These production centers could pattern their processing and distribution methods after traditional milk processing plants and distribution centers, which allows for a maximum of 14 days of product storage. The quality of refrigerated foods (produced and stored under controlled conditions for correct periods of time) is unquestionably better than foods preserved by canning, freezing, or other preservation processes. The safety of these refrigerated products can be controlled with the application of HACCP and use of good refrigeration systems throughout the retail food industry.

Chilled food systems await technically competent entrepreneurs who are willing to operate with the discipline and control that will enable them to produce high-quality products and maintain optimal food handling and storage procedures during retail distribution of the products.

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Keeping Quality of Fluid Milk from Various Regions of the United States

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Abstract

Winter and summer fluid milk samples (whole, lowfat and skim) were obtained from nineteen plants representing five geographic areas. Samples were evaluated by a sensory panel for up to fourteen days of storage at 6.5°C to determine if the quality was still acceptable. Using this approach, a greater percentage of summer milk samples (94 of 158) spoiled within 14 days than did winter milk samples (64 of 156). If, however, samples were evaluated as to whether they were acceptable based on the code date utilized by the processor, then no difference was observed between the spoilage rate of summer (52 of 158) versus winter milks (53 of 156). Minnesota milks maintained their quality the longest while samples from Kansas and the northeast had the shortest shelf lives. Characterization of the flavors in the milks revealed that summer milks tended to go rancid during storage while winter milks became bitter.

Introduction

Good quality milk flavor has been described as being bland and slightly sweet with a clean and pleasant aftertaste and mouthfeel (2). Many factors, however, contribute off-flavors to this product from the time it is produced on the farm until it is drunk by the consumer (2,6,9,12,14). One of the main items associated with this concern for the quality of the milk is its shelf life, that is how long the product will remain of acceptable quality once it has been processed. Thus, rightly, much effort has been expended in trying to predict the shelf life of milk products as well as devising means by which one can lengthen the shelf life of the product.

To assess how well processors are doing with respect to shelf life of fluid milk, numerous surveys have been conducted. Periodically, surveys have been conducted in California (4) to determine the quality and shelf life of milk at the retail level. Overall, these surveys indicate that fluid milk products in California are of acceptable quality to and beyond their code date. Barnard (3) surveyed milks in Pennsylvania and, as a result of his work, developed a program to help increase milk shelf life. In Minnesota, organizations such as the Dairy Quality Control Institute have ongoing programs to evaluate milk quality. Thus, on a local or regional basis, a data base on the quality and shelf life of milk exists.

In addition to surveys of milk quality, many approaches to predict or assess shelf life have been used by the fluid milk industry. The most common of these is the Moseley keeping quality test (1). There are numerous other approaches that have been and are currently used; among these are SPC and psychrotrophic bacterial tests (1), modified psychrotrophic test of Oliveria and Parmalee (13) and others as reviewed by Bishop and White (5).

One approach to shelf life determination that is under study at the University of Minnesota is the use of gas chromatography profiles as prediction tools. Studies involving a limited number of milk samples have shown this approach has promise (7,10,11,16). Current work was undertaken with the objective of studying milks from various geographic locations and from two seasons to determine the general usefulness of this approach. This paper reports the shelf life data from this study as well as the sensory defects attributable to microbial spoilage.

Materials and Methods

Milk Samples

Half-gallon paperboard containers, three each of whole, low fat and skim, were obtained during the winter of 1987-88 and summer of 1988. Samples, packed on ice, came from 5 plants in Wisconsin, 3 in Minnesota (Twin Cities area), 5 in the Northeast (Connecticut and New Jersey), 3 in Georgia, 2 in Florida and 1 in Kansas. Samples were received within 48 hours of processing and stored in the dark at 6.5 ± 0.5° C in their original containers.

Shelf Life Determination

Shelf life was determined by a five-member trained sensory panel chosen from the University of Minnesota Food Science and Nutrition Department personnel. Training was accomplished by first familiarizing the panelists with the response form. Then, examples of cooked, feed and light-oxidized samples were presented and panelists were instructed that these were considered acceptable. They were further instructed that for any other off-flavored sample, they were to mark that sample spoiled on their response forms.

Two sets of training samples of known composition were prepared by the methods of Harper and Hall (8) for the

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panelists to evaluate. The composition of each training sample was then revealed and results were discussed.

Milk quality was determined by sensory evaluation of the samples on arrival (0 day), after 1 week and every other day thereafter, up to and including 2 weeks. Each sensory sample was taken from the same carton on the dates of the sensory tests.

For each sensory session, the samples were coded with a three-digit random number. Approximately 10-15 ml of each sensory sample was poured from the cartons to labelled sample cups. Pouring was done in the storage cooler. The small cups were then capped and refrigerated until evaluated. Control samples, either fresh or with known defects, were included in each session to monitor each panelist's performance. Samples were presented in random order.

When three of the five panelists, judged a sample as spoiled, it was taken out of the study. Samples judged spoiled before the end of the 14-day storage were labelled "short-lived" (SL). Samples acceptable on the 14th day were labelled "long-lived" (LL). The spoiled samples were then characterized by a three-member panel of experienced dairy judges. They were instructed to indicate the presence of specific off-flavor characteristics.

Statistical Analysis

Statistical analysis was performed using the chi-square statistic (15) comparing the proportions of SL and LL milks in each season or in each region to proportions of the same in all the milk samples. The proportions of SL and LL milks were compared because no definite number of days for LL milks to spoil was determined because the study ended on the 14th day of storage. Therefore, milks thus could only be classified as SL (spoiled before the 14th day of storage) or LL (acceptable on the 14th day of storage).

The numbers of SL and LL milks were arranged in 2-way frequency tables or contingency tables (Table 1). For each cell in the tables (season-shelf life or region-shelf life combination), the column totals, row totals and grand totals were obtained to calculate expected values, i.e., numbers of SL or LL milks when the proportions of these in each season (or region) are statistically not different from the proportions of SL and LL milks in all the samples.

Table 1. Contingency Table of Shelf Life Length of Summer and Winter Milks from Six Regions -- Plant Code Date Criterion

	Shelf Life[a] Short	Long	Row Totals	
Summer	52[b] (52.08)[c]	106 (105.2)	158	
Winter	53 (52.2)	103 (103.8)	156	
Column Totals	105	209	314	Grand Total, all samples

[a]Short = spoiled before 14th day
Long = not spoiled on 14th day

[b]observed value

[c]expected value - number of samples expected when there is no difference in proportions of SL and LL milk from each season as compared to proportions of SL and LL milks in all samples.

The observed and expected values in each cell were compared by calculating the chi-square statistic, a measure of the difference between the values. Small chi-square values reflect no difference in proportions of SL and LL milk. For large chi-square values, Snedecor and Cochran (15) suggest partitioning the contributions of each cell to the chi-square statistic. This step is useful in that the cell that contributes most to the statistical difference calculated can be isolated.

Results and Discussion

The primary criterion used to determine shelf life in this study was whether the milk samples were acceptable to the sensory panel (i.e., considered not spoiled) on the 14th day of the storage study. A second criterion was also used to determine shelf life. This criterion was based on the plants' code dates. During the course of the 14 day storage study, it was also determined whether the sample lasted to its code date or not, regardless of the sample acceptability on the 14th day of storage. Although the latter criterion would be more consistent with actual plant experience, it does not provide for uniformity of sample treatment (storage time) to determine cut-off date for shelf life determination.

Comparing the two criteria in the way each classified the seasonal milk samples seemed useful (Tables 1 and 2). For uniformity of sample treatment, however, and for all subsequent discussions, only the laboratory study criterion was used.

Table 2. Contingency Table of Shelf Life Length of Summer and Winter Milks from Six Regions -- Laboratory Study Criterion

	Shelf Life[a] Short	Long	Row Totals	
Summer	94[b] (79.5)[c]	64 (78.5)	158	
Winter	64 (78.5)	92 (77.5)	156	
Column Totals	158	156	314	Grand Total, all samples

[a]Short = spoiled before 14th day
Long = not spoiled on 14th day

[b]observed value

[c]expected value - number of samples expected when there is no difference in proportions of SL and LL milk from each season as compared to proportions of SL and LL milks in all samples.

The distributions of summer and winter milks with long and short shelf lives using the plant code date criterion and the laboratory study criterion, respectively, are summarized in Tables 1 and 2. Contingency tables or two-way frequency tables were used to summarize the data for the reasons discussed under the Materials and Methods section. Of the 314 milk samples studied, 158 were from summer and 156 were from winter. Of the total samples, 34.4% were SL and 66.6% were LL based on the plant code date criterion. Of the 158 summer milks, 32.9% were SL and 67.1 were LL. For the winter milks, 34.0% were SL and 66.0% were LL.

A comparison of the percentages of SL and LL milks for each season reflected no differences in the proportions of SL and LL milks between summer and winter using the plant code date criterion. This difference is supported by the calculated X^2 (chi-square) statistic that is low (0.037) compared to the critical value of 3.84 for X^2 0.05 1 df.

Using the laboratory study criterion, of the 314 milks studied, 50.3% were SL and 49.7% were LL (Table 2). These proportions are not, however, reflected in the individual seasons—summer SL, 59.5%; summer LL, 40.5%; winter SL, 41.0% and winter LL, 59.0%—indicating a seasonal difference in the proportions of SL and LL milks. The X^2 value reflects this seasonal difference (X^2 = 10.7 compared to the critical value of 3.84). The laboratory study criterion, while an arbitrary one, is stricter than the plant code date criterion and thus should be able to reflect differences. This difference would indicate a different mechanism of spoilage, especially when the spoilage characteristics of summer and winter milks are compared as discussed later.

The classification of milks by region and shelf life using the laboratory study criterion is presented in Table 3. A regional difference in SL and LL milk distribution was observed (total X^2 was large: 48.98). Minnesota milk was observed to contribute most to this regional difference due to a greater number of LL milks (83.3%) as compared to 49.7% LL milks for all the samples.

Table 3. Contingency Table of Shelf Life Length of Milk Samples by Region

	Shelf Life[a] Short	Long	Row Totals	
Wisconsin	49[b] (45.3)[c]	41 (44.7)	98	
Minnesota	9 (27.2)	45 (26.8)	54	
Northeast	50 (37.7)	25 (37.3)	75	
Kansas	17 (9.1)	1 (8.9)	18	
Georgia	19 (21.1)	23 (20.9)	42	
Florida	14 (17.6)	21 (17.4)	35	
Column Totals	158	156	314	Grand Total, all samples

[a]Short = spoiled before 14th day
Long = not spoiled on 14th day

[b]observed value

[c]expected value - number of samples expected when there is no difference in proportions of SL and LL milk from each region as compared to proportions of SL and LL milks in all samples.

Statistically, the contributions of each region to the X^2 statistic are compared (Table 4). Minnesota milks were observed to contribute to greater than half the total X^2 statistic. This distribution toward longer shelf life may be the result of the concerted effort by the processors to strictly monitor the quality of Twin Cities milk through the Dairy Quality Control Institute.

Table 4. Contribution of Each Region to the Chi-square Statistic

	Shelf Life[a] Short	Long
Wisconsin	0.302	0.306
Minnesota	12.178	12.360
Northeast	4.013	4.056
Kansas	6.852	7.012
Georgia	0.209	0.211
Florida	0.736	0.745

[a]Short = spoiled before 14th day
Long = not spoiled on 14th day

The shelf life data of summer and winter milks by region is summarized in Tables 5 and 6. Kansas was excluded from the investigation because the small sample size made statistical evaluation impossible.

Table 5. Contingency Table of Shelf Life Length of Summer Milks by Region

	Shelf Life[a] Short	Long	Row Totals	
Wisconsin	35[b] (25.7)[c]	10 (19.3)	45	
Minnesota	6 (15.4)	21 (11.6)	27	
Northeast	26 (20.5)	10 (15.5)	36	
Georgia	13 (13.1)	10 (9.9)	23	
Florida	5 (10.3)	13 (7.7)	18	
Column Totals	85	64	149	Grand Total, summer samples

[a]Short = spoiled before 14th day
Long = not spoiled on 14th day

[b]observed value

[c]expected value - number of samples expected when there is no difference in proportions of SL and LL milk from each region as compared to proportions of SL and LL milks in all samples.

In Table 5, it may be seen that a difference can be observed in summer milks from each of the regions (X^2 = 31.02). Examination of the observed and expected values showed Minnesota had the greatest difference in SL and LL milk proportions compared to the total.

Data on Table 6, indicate a difference observed in the winter samples from each of the regions (X^2 = 20.14). The samples from the northeast exhibited the greatest difference between observed and expected values.

Defect Characterization

The spoilage characteristics of winter milk samples are summarized in Table 7. The predominant defects were bitter (9 of 19 plants) and unclean (6 of 19).

Table 6. Contingency Table of Shelf Life Length of Winter Milks by Region

Observed (Expected)	Shelf Life[a] Short	Long	Row Totals	
Wisconsin	14[b] (17.1)[c]	31 (27.9)	45	
Minnesota	3 (10.3)	24 (16.7)	27	
Northeast	24 (14.9)	15 (24.1)	39	
Georgia	6 (7.2)	13 (11.8)	19	
Florida	9 (6.5)	8 (10.5)	17	
Column Totals	56	91	147	Grand Total, Winter samples

[a]Short = spoiled before 14th day
Long = not spoiled on 14th day

[b]observed value

[c]expected value - number of samples expected when there is no difference in proportions of SL and LL milk from each region as compared to proportions of SL and LL milks in all samples.

Table 7. Spoilage Characteristics[a] of Winter Milk from Six Regions

Region	Plant (No. of samples)	Spoilage Characteristics[b]
Wisconsin	1 (9)	B
	2 (9)	B A U
	3 (9)	B U L
	4 (9)	B R F U
	5 (9)	U R
Minnesota	1 (9)	L
	2 (9)	U L
	3 (9)	F L
Northeast	1 (9)	B F L
	2 (9)	B L
	3 (9)	B A
	4 (7)	L
	5 (5)	B
Kansas	1 (9)	L
Georgia	1 (7)	L
	2 (6)	B U
	3 (6)	L
Florida	1 (9)	U
	2 (9)	L

[a]Shown by > 1/2 of samples

[b]A = Acid F = Fruity M = Malty U = Unclean
B = Bitter L = Lacks Freshness R = Rancid

The spoilage characteristics of the summer milk samples are summarized in Table 8. Though the bitter (6 of 8) and unclean (8 of 8) defects were still present, notably more rancid samples (11 of 18 plants) were identified in the summer milks.

Table 8. Spoilage Characteristics[a] of Summer Milk from Six Regions

Region	Plant (No. of samples)	Spoilage Characteristics[b]
Wisconsin	1 (9)	R U L
	2 (9)	R F
	3 (9)	B A U L
	4 (9)	B U L
	5 (9)	U L
Minnesota	1 (9)	L
	2 (9)	L
	3 (9)	U R L
Northeast	1 (9)	R L
	2 (9)	R A L
	3 (9)	R A B U
	4 (8)	R B U L
Kansas	1 (9)	U
Georgia	1 (8)	R B U L
	2 (9)	R A L
	3 (6)	L
Florida	1 (9)	R
	2 (9)	R A B

[a]Shown by > 1/2 of samples

[b]A = Acid F = Fruity M = Malty U = Unclean
B = Bitter L = Lacks Freshness R = Rancid

The defect "lacks freshness" refers to milk that is not generally considered spoiled but has been in storage for a time, absorbing odors from other foods present in the refrigerated storage. In this study, the milks characterized as lacking freshness were not considered spoiled but did not have the clean taste of fresh pasteurized milk. Samples rejected before the 14th day of storage and characterized as lacking freshness may have contained off-flavor volatiles in detection threshold concentrations and were thus rejected by the panel.

It would seem that a different spoilage mechanism is in operation depending on the season. It has been demonstrated by other investigators (references) that different milk processing plants have different indigenous microflora that affect the microflora of the samples of each plant. The difference in spoilage characteristics between the winter and summer milk samples reflects this possible difference in winter and summer microflora in the individual plants.

Summary

Based on the 14-day storage study of this investigation, differences in shelf life were observed when samples were grouped by season and by region. Winter milks had more samples acceptable to the sensory panel on the 14th day of storage. This seasonal difference in shelf life, together with the differences in the defect characteristics of the samples, implies a different mechanism of spoilage during different seasons. Of the six regions studied, Minnesota had the largest proportion of LL milk samples, perhaps due to the quality of monitoring service provided by the Dairy Quality Control Institute. It is not known if similar systems exist for the other regions.

The notable defect characteristic for the winter samples was bitter and for samples from the same plants during the summer, rancid.

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The 3-A Sanitary Standards Program: A Review and A Look Forward

The 3-A Sanitary Standards and Accepted Practices for dairy processing equipment play an essential role in providing U.S. consumers with the highest quality, most wholesome - and safest - dairy products in the world. The 3-A Program, now over 50 years old, contributes significantly to public health and food safety by setting standards for the design, materials and fabrication of processing equipment. These requirements focus on the surfaces of the equipment which "are exposed to the product or from which liquid may drain, drop or be drawn into the product." (1) These product contact surfaces are the most critical to consumer safety and therefore must be readily cleanable, resistent to the harborage of bacteria and easily accessible for inspection.

A 14-page brochure, entitled, "The 3-A Story" gives a general overview of the 3-A Program and is available from the 3-A Sanitary Standards Committees. From this brochure, selected policy declarations of the 3-A Committees give an insight into the intent and scope of the 3-A Program.

"1. 3-A Sanitary Standards or 3-A Accepted Practices have as their purpose the establishment of design and fabrication criteria for cleanability of product contact surfaces for dairy processing equipment, and product protection (performance is excluded);
2. Only equipment that is available on the commercial market is subject for 3-A consideration;
3. Individual criteria must be based on public health significance;
4. Equipment without product contact surfaces (such as cabinets, dispensers, crates, floors, building construction) is not subject to 3-A criteria."

These policy statements as well as the entire 3-A Program are predicated on the **Voluntary** cooperation of the parties involved with assuring the safe and sanitary production of dairy products. The three groups that contribute to the 3-A Sanitary Standards Program are the original equipment manufacturers through their participation in the Dairy and Food Industries Supply Association's (DFISA) 3-A Task Committees, the dairy processors provide the representatives of the Sanitary Standards Subcommittee of the Dairy Industry Council (SSS-DIC), and governmental regulatory personnel (sanitarians) are represented by the U.S. Public Health Service (USPHS) and the International Association of Milk, Food and Environmental Sanitarians' Committee on Sanitary Procedures (IAMFES-CSP). Through the voluntary cooperation of these groups, the 3-A Sanitary Standards have become the model by which U.S. dairy processing equipment is designed. Although no force of law requires compliance to the 3-A Standards, the Program has achieved nearly unanimous acceptance by the dairy industry and government regulatory officials. This widespread acceptance and its voluntary nature make the 3-A Program truly unique in the public health and product safety fields.

Mutual Benefits of the 3-A Program

Each segment of the dairy industry benefits from the acceptance of the 3-A Sanitary Standards. For their voluntary cooperation in the 3-A Program the public interest in food safety is served and (2):

The Dairy Processor -

1. Knows they are in compliance with applicable sanitation codes,
2. Knows equipment bearing the 3-A Symbol can be cleaned satisfactorily,
3. Realizes lower cleaning costs and savings in labor,
4. Can expect inspections to be no problem when equipment complies with 3-A Standards for that item;

The Equipment Manufacturer sees -

1. Automatic acceptance of their product in a variety of markets,
2. Standarized equipment replacing custom-made items,
3. Advances [in the] study of design and materials which are important to the state of the art,
4. Design principles which can be used in new equipment even though no standards have been developed for that item;

And the Inspector/Sanitarian benefits through -

1. Uniform requirements by public health officials,
2. Refined inspection procedures,
3. Sanitary principles are identified which can be applied to other food equipment,
4. More and more sanitary codes are based on 3-A concepts,
5. Confidence in equipment design - their people had a voice in the development of the standard.

Outline of a 3-A Sanitary Standard

The uniformity of the 3-A Sanitary Standards is one of the many positive aspects of the 3-A Program. This uniformity is a direct result of each 3-A Standard containing at least six sections: **Scope, Definitions, Materials, Fabrication, Appendix** and **Effective Date.** (3) These standard sections set forth the requirements which must be met for equipment to bear the 3-A Symbol.

The **Scope** of a 3-A Sanitary Standard indicates what areas of the manufacture of a specific piece of equipment are covered by the standard and occasionally what aspects are not covered. Usually, a standard will "cover the sanitary aspects of...[the specific piece of equipment]." The **Definition** section defines product contact surfaces, non-product contact surfaces and specific terms associated with the equipment piece.

The bulk of most 3-A Sanitary Standards is contained in the next two parts: **Materials** and **Fabrication**. The **Mate-**

rials section defines the permitted materials for use in specified components of the processing equipment. The acceptable materials for product contact surfaces must be "corrosion-resistant, non-absorbent and non-toxic." Non-product contact surfaces are to be made of corrosion-resistant materials that are relatively non-absorbent, durable and easily cleaned. For the most part, stainless steel of the AISI 300 series (4) or corresponding ACI types(5) or other metal with the same physical characteristics are to be used. Other acceptable materials, depending on their use, are rubber, plastic, glass and other specific metal alloys.

The **Fabrication** section of a standard dictates that all product contact surfaces are to be at least as smooth as a No. 4 ground finish on stainless steel sheets. Further, it specifies that the surfaces be free of pits and crevices or other imperfections. This section also covers the joints, welds and gaskets to be used in the equipment. Joints are to be continuously welded, free of imperfections and at least as smooth as a No. 4 finish. The welds must be at least 1/4 inch, unless the thickness of one of the joined parts is less than 3/16 inch. In that case a weld may be 1/8 inch. Gaskets and o-rings are to have grooves with a depth and width of 1/4 inch or less. Finally, the Fabrication section also specifies that all internal angles on product contact surfaces of 135 degrees or less must have radii of at least 1/32 inch (1/4 inch is preferred). Depending on the piece of equipment covered by the standard, specific requirements are set forth for numerous other components.

The **Appendix** of a 3-A Sanitary Standard includes references to the composition of materials used, finishes permitted and other information specific to the construction or installation of the equipment covered. The **Effective Date** of most 3-A Sanitary Standards is one year after unanimous approval and signature of the standard by four sections of the 3-A Committees (SSS-DIC, USPHS, DFISA Task Committees, and IAMFES-CSP). Occassionally a standard will become effective in a shorter period of time due to rapid technology changes or immediate public health issues.

The 3-A Symbol

Once a 3-A Sanitary Standard has become effective, the 3-A Sanitary Standards Symbol Administrative Council accepts applications from equipment manufacturers for authorization to display the 3-A Symbol on specific pieces of equipment. The 3-A Symbol Administrative Council is made up of eight people, two each from the Dairy Industry Committee and the Dairy and Food Industries Supply Association, and four from the International Association of Milk, Food and Environmental Sanitarians.

To be granted authorization to display the 3-A Symbol, a manufacturer must certify that a specific piece of equipment complies with all paragraphs of all applicable standards. This is accomplished by:

1. Signing the printed declarations on the application;
2. Initialing every paragraph of pertinent 3-A Sanitary Standards;
3. Submitting a statement regarding the control systems used, and;
4. Supplying small parts or prototypes for review, if so requested by the 3-A Symbol Council.

The application is reviewed by the Symbol Council, and if all areas are in compliance, is approved. The manufacturer is then authorized to display the 3-A Symbol on that specific piece of equipment and product literature.

Recent and Upcoming 3-A Standards

In the past six months, four 3-A Sanitary Standards and one 3-A Accepted Practice have become effective (all in September 1990). Of these, the *3-A Sanitary Standards for Storage Tanks for Milk and Milk Products, No. 01-07* and the *3-A Sanitary Standards for Instrument Fittings and Connections Used on Milk and Milk Products Equipment, No. 09-08* were amendments updating old standards to keep pace with new technologies.

The remainder were new additions to the standards. The *3-A Sanitary Standards for Air Driven Diaphragm Pumps for Milk and Milk Products, No. 44-00* were drafted to assure proper cleanability of a piece of equipment increasing in use. The *3-A Sanitary Standards for Crossflow Membrane Modules, No. 45-00* resulted from the boom in microfiltration, ultrafiltration and reverse osmosis technology in the dairy industry. The *3-A Accepted Practices for the Sanitary Construction, Installation and Cleaning of Cross Flow Membrane Processing Systems for Milk and Milk Products, No. 610-00* is a companion piece to 3-A Standard No. 45-00.

At the most recent meeting of the 3-A Sanitary Standards Committees 20 tentative documents, with subjects ranging from fittings, valves and hose assemblies, to refractometers, sonic horns and optical sensors, were reviewed. The meeting, held November 5-9, 1990 in Milwaukee, Wisconsin, saw G.F. Rutkiewicz, Chairman of the SSS-DIC, preside over the joint sessions. Represented at these sessions were the Sanitary Standards Subcommittee of the Dairy Industry Council (SSS-DIC), the various DFISA Task Committees, the International Association of Milk, Food and Environmental Sanitarians' Committee on Sanitary Procedures (IAMFES-CSP) and the United States Public Health Service (USPHS).

From this joint 3-A meeting, three of the 20 tentative documents were approved for signature. The approved documents were for *Amendments to the 3-A Sanitary Standards for Fittings Used on Milk and Milk Products Equipment and Used on Sanitary Lines Conducting Milk and Milk Products (Fittings & Plug Type Valves), Parts I and II, No. 08-17*, new *3-A Sanitary Standards for Fittings Used on Milk and Milk Products Equipment and Used on Sanitary Lines Conducting Milk and Milk Products (Vacuum Breakers & Check Valves), No. 08-17M*, and revisions to *3-A Sanitary Standards for Air Eliminators for Milk and Fluid Milk Products, No. 29-01*.

For early 1991, plans on the agenda for the 3-A Committees include: (6)

1. Full revision of 3-A 18-00 (Rubber and Rubber-Like Materials), by the Rubber Task Committee;
2. Partial revision of 3-A 606-03 (Milking Machines) to provide CIP requirements, by the Milking Machine Task Committee;
3. Full revision of 3-A 607-03 (Spray Driers), by the Dry Milk Equipment Task Committee;
4. Full revision of 3-A 604-03 (Supplying Air Under Pressure), by the Air Under pressure Task Committee;
5. New standards for Pressure Reducing and Back Pressure Regulators. A proposal has been drafted and may be

reviewed by mail. If not, a Sanitary Fittings Task Committee meeting will be held.

In addition, the 3-A Novelty Equipment Task Committee is assigned the project of developing 3-A Accepted Practices for Frozen Dessert Novelty Systems using the International Ice Cream Assn.-Dairy and Food Industries Supply Assn.-U.S. Food and Drug Administration "Principles and Guidelines for Frozen Dessert Novelty Equipment" as the major resource.

For the next 3-A Committees meeting, scheduled for May of 1991, the various groups will consider for possible final approval standards covering single service container filling, dry milk sifting, flow metering, heat exchanging, level sensing and packaging equipment.

The 3-A Sanitary Standards Program, to keep pace with changing technologies, will continue to develop new design criteria. New equipment and processing systems will require new standards. Developments in food safety and sanitation procedures will require revisions to existing standards and/or new standards. This evolution of the 3-A Program will continue as long as dairy products are manufactured.

In the future, the principles of the 3-A Program may be adapted to other areas of the food processing industry. The structure of the Program and its reliance on voluntary compliance is an excellent model which could benefit any industry where sanitary equipment design is required. The 3-A Program has already been adapted for egg processing equipment, and portions of the Standards are also used in the brewing, chemical and pharmaceutical industries. Other industries that could benefit from a 3-A-like program include meat and seafood processing, frozen foods and cosmetics manufacturing. The success achieved by the 3-A Sanitary Standards Program, with cooperative efforts, can be duplicated by almost any food industry segment.

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News

Dr. Gilbert H. Porter

Northeast Dairy Practices Council

Dr. Gilbert H. Porter, retired Vice President of Research and Development for Agway, Inc., became the new Executive Vice President of the Northeast Dairy Practices Council on January 1, 1991. Cornell's Professor Emeritus, Richard P. March, who has provided leadership for the Council since its inception in 1970, retired at the end of 1990.

The Northeast Dairy Practices Council is a nonprofit organization of education, industry, and regulatory personnel concerned with milk quality and sanitation in the dairy industry throughout the 15 northeastern states from Maine to Virginia, including Ohio and Kentucky.

Dr. Porter was raised on a dairy farm in Westfield, Massachusetts. He went on to obtain his Bachelor's degree in Animal Husbandry at the University of Massachusetts. Graduate studies were pursued at the University of Connecticut where Dr. Porter earned the Master's degree in Dairy Science. While teaching and studying at the Pennsylvania State University, Dr. Porter was granted a Doctorate in Dairy Cattle Nutrition.

Following a 13-year career in agribusiness where he pioneered numerous developments in agricultural productive efficiency, Dr. Porter joined Agway, Inc., in 1969. He was named Director of Research in 1970, and two years later was elected a vice president of Agway. He retired from Agway on December 31, 1987.

Dr. Porter served for 17 years as Director of Cooperative Research Farms, a research organization sponsored by a consortium of regional farmer cooperatives throughout the United States and Canada. He was an active participant in the work of the National Joint Council on Food and Agricultural Sciences. He also served on the National Agricultural Research Council.

Dr. Porter's community activities included service on the New York's Onondaga County Food Advisory Council. He has been a member for nearly two decades of the New York State Fair Advisory Board. Dr. Porter and his wife, Shirley are active members of the Dewitt Community Church and live in Manlius, New York.

In December, the Council offices were moved from Ithaca to the Syracuse, New York area. The new offices are located at 5794 Widewaters Parkway, Dewitt, New York, and the mailing address is P.O. Box 4851, Syracuse, New York 13221. Telephone (315)449-7547.

Vulcan Establishes Cook-Chill Institute to Promote Better Understanding of Cook-Chill Process

In the kitchens of the nation's largest hospitals, schools, hotels and restaurants, foodservice professionals for years have been stirring and stewing over a food preparation concept called "cook-chill."

While gaining more acceptance in the U.S. market, this European innovation is not yet fully understood by the American foodservice industry. To address the growing need for information on cook-chill, Vulcan, a leading U.S. supplier of equipment used in the cook-chill process, has announced the formation of The Cook-Chill Institute. The Institute is committed to developing and disseminating accurate information and providing educational programs on cook-chill to promote better understanding and application of the cook-chill process among dietitians, chefs, foodservice directors and consultants.

Vulcan also announced key components of The Cook-Chill Institute -- the Cook-Chill Advisory Board, Regional Cook-Chill Centers and the Cook-Chill Information Bureau.

"Vulcan believes that cook-chill can revolutionize America's foodservice industry -- as long as the method is understood and properly employed," said Gordon Oates, Jr., executive vice president of Vulcan.

Vulcan introduced its cook-chill concept in the United States during the early 1980s. Vulcan has equipped more than 150 cook-chill systems and has provided consulting and training services on facility design, equipment needs and operation.

"The Cook-Chill Institute reflects our appreciation of the need for a national resource to which the foodservice industry can turn for accurate information on the cook-chill process," Oates said.

Cook-chill can play a significant role in addressing key issues that affect U.S. foodservice operations. Vulcan's Cook-Chill Information Bureau will research and distribute

information on such important concerns as food safety, quality, and nutritional value; menu planning; extending shelf life; and increasing staff productivity. An Information Hotline, (513)332-2159, operating weekdays from 8:30 a.m. to 4:30 p.m. (EST), provides access to the Information Bureau and its services.

Dr. David B. Pall, Founder Chairman of Pall Corporation, Is Honored by President George Bush with a 1990 National Medal of Technology

President George Bush Honors Dr. David B. Pall, Founder of Pall Corporation; With the National Medal of Technology

At a time when the United States' stature in science and technology and its global competitiveness are being questioned, the White House paid tribute to a group of scientists and engineers who have excelled in applying their scientific acumen to advances in technology which have been successfully commercialized. Dr. David B. Pall, founder of Pall Corporation, was awarded the National Medal of Technology by President George Bush, at a ceremony held at the White House on November 13, 1990.

The medal, America's highest honor in technology, is awarded annually by the President of the United States to recognize those who have made exceptional contributions to the well-being of the nation, through the development and application of technology.

The award was granted to Dr. Pall for successfully coupling inventive scientific research on the fundamentals of filtration with engineering technology, to provide a forty year series of products which have significantly improved safety, efficiency, and economy across a wide spectrum of industrial and health activities. These include filters and other porous devices used in medicine, biotechnology, pharmaceuticals, microelectronics, food processing, aircraft, chemical processing, and many other industries.

Dr. Pall has been granted 108 U.S. patents. His most recent project has resulted in a filter, now in use in several thousand hospitals, which is highly beneficial to patients receiving blood transfusions.

Pall Corporation, now with sales of almost $600 million a year, has a global reach and is the leading fine filter company in Europe and Japan as well as in the United States.

For more information contact Patrice Radowitz at (516)484-5400.

USDA Food Service Manuals Expanded

The Food Information Service Center (FIS) has expanded to ten the food service manuals initially funded by USDA's Food and Nutrition Service (FNS). In 1985 the Food and Nutrition Service and FIS published four manuals for food service supervisors. These manuals have been updated through 1990 and six new manuals have been added. The ten manuals provide guidelines and technical information on effective purchasing, product specifications and identifications, meal cost management, food facts, and the storage and protection of food products.

Although the manuals are prepared for food service supervisors in school lunch and other Federally funded programs, they are well suited for use in the private sectors. The manuals are useful to meal providers, food processors, food distributors, food service managers, meal planners, and program administrators.

In aggregate the manuals consist of about 3,600 pages (360 average) and are available at moderate costs from the Food Information Publishing Center, 21050 SW 93rd Lane Road, Dunnellon, FL 32630. Telephone (904)489-8919 or FAX no. (904)489-1872, Nita Bowne.

Dr. Damien A. Gabis (l), chief executive officer of Silliker Laboratories Group, Inc., and Dr. Russell S. Flowers, president of the Chicago Heights, IL, based organization, recently accepted the presentation sculpture "Moving Forward" as winners of the 1990 Chicago-area Small Business Award.

Silliker Laboratories Wins 1990 Small Business Award

Silliker Laboratories Group, Inc., a leading independent testing and consulting laboratory, was recently awarded the seventh annual Chicago-area Small Business Award. Silliker was chosen from 49 other finalists for this year's award which is sponsored by Arthur Andersen and Co. and the University of Illinois (Chicago).

Each year, the award recognizes a privately held owner-operator company for its excellence in sales growth, market share, job creation, and leadership in the small business community.

In accepting the award, Dr. Damien A. Gabis, chief executive officer of Silliker Laboratories Group, Inc., paid tribute to the company's retired founder, Dr. John H. Silliker, for establishing the tradition of excellence upon which Silliker Laboratories is built.

"When I joined Silliker Laboratories 20 years ago, Dr. Silliker always emphasized that serving our clients with our technical expertise and judgment was our top priority. This attitude remains the cornerstone of the Silliker organization," Dr. Gabis said.

Dr. Russell S. Flowers, president of the Chicago Heights-based organization, called the award a "testament to the company's commitment to integrity and to the people within the organization who have contributed to our growth."

Founded in 1961, Silliker provides chemical and microbiological analyses, technical and consulting, research and information services related to the safety, stability and nutritional value of food. Silliker laboratories are located in Chicago Heights, IL, Columbus, OH, Garwood, NJ, Stone Mountain, GA, Sinking Spring, PA, Carson, CA, Hayward, CA, and Mississauga, Canada.

For further information, contact Silliker Laboratories Group, Inc. at (708)756-3210.

Updates . . .

American Dairy Products Institute Announces 1991 Annual Meeting

The American Dairy Products Institute, national trade association of the processed dairy products industry, will hold its 5th Annual Meeting on April 10-11, 1991, at the Chicago Marriott/Downtown Hotel, 540 N. Michigan Avenue, Chicago, Illinois.

All evaporated and dry milk and whey products manufacturers, allied industry representatives interested in the processing, marketing, and utilization of these products, government and university representatives and end-products users are invited to attend the Annual Meeting.

Informative programs have been arranged for this event, with a wide range of subjects to be addressed by knowledgeable speakers from industry, state and national government, and academia. Meeting attendees will have an opportunity to discuss technological advances and exchange marketing strategies with colleagues from throughout the world who will be participating in the meeting.

As usual, an entertaining program will be available for attending spouses.

Additional information about the meeting can be obtained by contacting Dr. Warren S. Clark, Jr., Executive Director of the American Dairy Products Institute, 130 North Franklin Street, Chicago, Illinois 60606 (312)782-4888, or (312)782-5455; FAX (312)782-5299.

TAMFES Sponsors HACCP Workshop

The first workshop on Hazard Analysis Critical Control Point (HACCP) sponsored by the Texas Association of Milk, Food and Environmental Sanitarians will be held in Austin, March 26-27 at the Howard Johnson, South. For further information call Janie Park (512)458-7281.

•**March 12-14, Texas Association of Milk, Food and Environmental Sanitarians** will hold a training session entitled "Special Problems in Milk Plants" at the Howard Johnson, 8887 Gateway West, El Paso, Texas. For more information contact Janie Park of TAMFES at (512)458-7281. More dates and locations of similar training sessions sponsored by TAMFES are listed in the "Coming Events" section of this issue.

PACS Short Courses at the Pittsburgh Conference

Professional Analytical and Consulting Services (PACS) will offers a list of courses at the Pittsburgh Conference meeting March 3-10 in Chicago, IL. PACS provides thirty-nine short courses focused for lab operations. Training courses repeat every six months in Pittsburgh, PA and selected courses annually in San Francisco, St. Louis, and at the FACCS (October) and Pittsburgh Conference (March) meetings. On-site courses are available. For a description and registration form on specific courses write or call (412)457-6576 or (800)367-2587.

AAMFES To Hold Annual Meeting

The Alberta Association of Milk, Food and Environmental Sanitarians will hold their Annual Meeting on February 27, 1991, at the Faculty Club, University of Alberta. The featured speaker will be Dr. John Waters, Director of Communicable Disease Control and Epidemiology, Alberta Health Department. Subjects will be: Hamburger Disease Symptoms (*E. coli* 015787: Is it a Bum Steer?) For further information contact Karen Emde at (403)492-7601.

Continuing Education At The UW-River Falls

The Food Science program at the University of Wisconsin-River Falls is holding three training courses spring semester 1991 to provide the opportunity for continuing education for the dairy/food industry.

A basic cheese making short-course is scheduled for April 8-10. The course is co-sponsored by University Wisconsin-Madison and UW-Extension.

A detection of Antibiotics and Drug Residue workshop will be held April 14. It is sponsored by the Wisconsin Association of Milk and Food Sanitarians, Inc.

April 15-18, a training course on Membrane Processing will be held. It is co-sponsored by Klezade-Ecolab, Inc. and Niro Atomizer, Inc.

For information contact: UW-River Falls Conference and Events Office at (715)425-4484 or Dr. Purnendu C. Vasavada, professor of Food Science, at (715)425-3150.

Food and Environmental Hazards to Health

Carbon Monoxide Levels in Indoor Tractor-Pull Events - Manitoba, Canada

Carbon monoxide (CO) and other noxious gases produced by internal combustion devices are health hazards in enclosed spaces. In facilities such as underground garages and indoor arenas, CO is a particular concern because of its rapid toxic effects and potentially high concentrations. In February and November 1988, the City of Winnipeg Health Department (WHD), Manitoba, Canada, conducted surveys of two tractor-pull events in an indoor 15,000-seat arena to determine levels of CO. During the November event, an attempt was made to mitigate CO levels. This report summarizes findings from the two surveys.

A "tractor" is a truck or other vehicle modified to look like a farm tractor (e.g., large rear wheels and smaller front wheels) and powered by a variety of units (e.g., aircraft turbines and supercharged car engines). During a typical "pull," approximately 12 tractors compete in pulling a 40- to 50-ton sled across a 75-m (82-yd)-long dirt surface in the fastest time. A tractor-pull event lasts approximately 2 1/2 hours and involves 25 individual pulls.

Previous monitoring of CO in the arena's seating area during full-occupancy hockey games indicated CO levels of 0-10 ppm; an ice-edger and an ice-resurfacing machine, both of which emit CO, were used several times each during each game. The WHD's recommended indoor guideline levels are 33 ppm for a 1-hr exposure and 18 ppm for an 8-hr exposure.

To measure CO levels during the tractor-pull events, certified public health inspectors used a Gastech CO-82 Carbon Monoxide Detector to record levels before the events and at half hour intervals during the events at 25 seating locations at varying heights within the arena.

At the February event, measurements indicated an average level of 68 ppm at the start (8 p.m.) of the first of 25 pulls; however, several tractors had been running their engines before the first pull. By 10:30 p.m. (the end of the competition), the CO level had increased to 262 ppm. In general, CO levels were uniform throughout the seating area. During this event, however, the ventilation system had not been operating at full capacity, tractors had been allowed to run their engines before the event, and large doors to the area's ground floor had been closed.

During the November event, measures to decrease CO levels included reducing the number of pulls to 24, expanding the event by 2 hrs to permit decay in the CO level, and opening ventilating louvres in the arena roof. WHD inspectors used the same measuring apparatus to take readings at the same locations as in the February event. CO levels at the beginning of the event averaged 77.5 ppm and increased to 435.7 ppm by the event's close.

This evaluation indicated that the control measures were not effective in reducing CO levels. Participants did not want to retrofit their tractors with pollution-control devices because this would decrease the horsepower of the tractors. Therefore, WDH officials required that appropriate ventilation improvements be implemented before further tractor-pull events could be permitted in the arena. However, because one evaluation concluded that the costs to implement the ventilation improvements were prohibitive, a tractor pull scheduled for February 1989 was cancelled, and no further such events are to be held in the arena.

Editorial Note: Because CO poisoning is frequently not suspected in persons suffering from CO intoxication, morbidity from CO poisoning is difficult to estimate. Unintentional poisoning has resulted from exposure to high levels of CO from automobiles, ice-resurfacing machines, fork lifts, recreational vehicles, and kerosene heaters and other fuel-burning household devices. Current Environmental Protection Agency outdoor air quality standards permit 9 ppm CO as an 8-hr average and 35 ppm as a maximum 1-hr level. In the United States, there are no indoor air standards for CO. Japan has established a guideline of 10 ppm.

Because adverse effects have occurred in healthy persons who continuously breath CO levels of 15 ppm (and because susceptible persons may experience toxicity at lower levels), the levels attained in the Winnipeg arena during the tractor-pull events represented a potential health hazard to both participants and observers. However, the City of Winnipeg Ambulance Department, which provides staff and equipment for all major sporting events, did not report any incidents of CO intoxication during the tractor-pull events.

CO is a colorless, odorless, nonirritating gas produced by incomplete combustion of fuels and present in all exhaust and smoke, including cigarette smoke. CO is toxic because 1) it avidly binds to hemoglobin to form carboxyhemoglobin (COHb), which reduces the oxygen-carrying capacity of blood, and 2) it inhibits cytochrome oxidase within mitochondria, thereby poisoning cellular respiration. The latter effect is increased in cases in which tissue hypoxia already exists and in cases of chronic CO intoxication. The risk for toxicity is proportionate to metabolic rate, exercise, prolonged exposure, and high altitude. Populations at risk for CO poisoning include the elderly, the poor (during the winter heating season), pregnant women (because of risk to the fetus), and persons with heart disease, lung disease, or anemia.

Symptoms of mild to moderate CO poisoning are nonspecific; the most commonly reported symptoms are headache, dizziness, weakness, nausea, confusion, shortness of breath, and visual problems. In addition, CO exposure can cause or exacerbate cardiac abnormalities (e.g., angina), and low COHb levels can cause complex ventricular arrhythmias. Occult CO poisoning should be suspected when these symptoms occur in two or more persons who have a history of sharing enclosed quarters. A blood COHb level >2% in nonsmokers or >10% in smokers confirms CO

exposure; levels of ≥30% are commonly associated with severe symptoms and may result in neuropsychiatric sequelae. Because COHb levels may not reflect tissue levels, they should be interpreted cautiously - especially in cases of chronic CO intoxication. Home or worksite measurement of ambient CO levels may be necessary to establish the diagnosis in cases of chronic low-level exposure.

Treatment in milder cases consists of 100% oxygen; hyperbaric oxygen should be used to treat moderate to severe intoxication (COHb >40%), particularly in pregnant women or when evidence exists of neurologic changes or cardiac arrhythmias. Preventive measures include regular automobile maintenance; routine cleaning and adequate venting of gas-fired stoves, furnaces, and appliances; and adequate ventilation and pollution controls during indoor events such as tractor pulls.

MMWR 10/19/90

Imported Dengue - United States, 1989

In 1989, 30 states and the District of Columbia reported 94 cases of imported dengue (i.e., dengue-like illness following travel and apparent exposure outside the United States) to CDC. Twenty-two cases were serologically or virologically confirmed as dengue; 56 were serologically negative; and 16 could not be determined because of the lack of a convalescent serum sample. In four cases, the dengue serotype was identified by virus isolation.

Travel histories were available for 21 persons with confirmed dengue. Eleven infections were acquired in the Caribbean; five in Oceania; two in South America; and one each in Africa, Asia, and Mexico.

Twelve (55%) of the 22 confirmed cases were in males. Age was reported for 19 patients and ranged from 23 to 74 years (mean: 48 years). Most patients had symptoms consistent with classic dengue fever (e.g., fever, headache, and myalgia). One person with serologically confirmed dengue died with bilateral, diffuse pneumonia within 24 hours of return to the continental United States from St. Croix, U.S. Virgin Islands.

In addition to the cases reported above, nine cases of laboratory-confirmed dengue infections occurred in persons (some from the continental United States) who participated in relief duties on St. Croix in the aftermath of Hurricane Hugo, which struck the island on September 17-18, 1989.

Editorial Note: Dengue is an acute viral disease caused by any of four virus serotypes (DEN 1-4) and is characterized by sudden onset of fever, headache, myalgia, rash, nausea, and vomiting. Although most infections result in relatively mild illness, some may cause the severe form of the disease, dengue hemorrhagic fever (characterized by variable degrees of bleeding, most commonly petechiae, purpura, mild gum bleeding, nosebleeds, or menorrhagia and/or gastrointestinal bleeding). The most recent outbreak of dengue hemorrhagic fever occurred in Venezuela in 1989-90 and involved >3000 cases of severe dengue and 74 deaths.

In the Americas, dengue is transmitted by the *Aedes aegypti* mosquito. Although nearly eradicated in the 1960s, this species is now found in all tropical countries of the region. Dengue is endemic in Puerto Rico, many other islands in the Caribbean, Mexico, and several countries in Central and South America. Three of the four serotypes (DEN-1, DEN-2, and DEN-4) have been circulating in the Americas for several years. Although endemic transmission of DEN-3 has not occurred in the region in over a decade, this serotype can be reintroduced into the Americas and was isolated from a Florida resident who returned from Africa in October 1989.

Physicians should consider dengue in the differential diagnosis for all patients presenting with compatible symptoms and a travel history to tropical areas. When dengue is suspected, the patient's hematocrit and platelet count should be monitored for evidence of hemoconcentration and thrombocytopenia. For management of fever, acetaminophen products should be used instead of acetylsalicylic acid (aspirin). Acute (<5 days from onset) and convalescent-phase (>14 days from onset) serum samples should be obtained for serodiagnosis. Suspected dengue cases should be reported to state health departments along with a clinical summary, dates of onset of illness and blood collection, a detailed travel history with dates and location of travel, and other epidemiologic information (e.g., patient age and sex). Serum samples should be sent for confirmation through the state health department laboratory to: Dengue Branch, Division of Vector-Borne Infectious Diseases, Center for Infectious Diseases, CDC, GPO Box 364532, San Juan, PR 00936; telephone (809)749-4400; FAX (809)749-4450.

MMWR 10/19/90

Elemental Mercury Poisoning in a Household - Ohio, 1989

On November 22, 1989, a 15-year-old male who had been hospitalized in Columbus, Ohio, was diagnosed with acrodynia, a form of mercury poisoning. This report describes the investigation by the Columbus Health Department (CHD) to determine the source of the patient's exposure to mercury.

In early November, following an acute illness, the patient was diagnosed with measles. He was subsequently referred for psychiatric evaluation because of his declining performance in school and nonspecific complaints (e.g., aches, irritability, and inability to think clearly) that were presumed to be psychosomatic. On November 17, he was admitted to the hospital after is blood pressure measured 142 mm Hg systolic and 106 mm Hg diastolic. Additional manifestations noted at that time included rash, sweating, cold intolerance, tremor, irritability, insomnia, and anorexia. When analysis of a 24-hour urine collection detected a mercury level of 840 µg/L (reference: <20µg/L), acrodynia was diagnosed. On December 1, the patient's 11-year-old sister was hospitalized with hypertension, mild acrodynia, irritability, and mild generalized muscle weakness. Her 24-hour urine mercury level was 1500 µg/L. Although both parents were asymptomatic, their 24-hour urine mercury levels were 820 µg/L and 1250 µg/L.

On November 29, the CHD investigated the apartment where the family had lived since August 26, 1989. Neighbors reported that the previous tenant had spilled a large jar of elemental mercury within the apartment. Although this tenant could not be located for confirmation, mercury vapor concentrations in seven rooms ranged from 50-400 $\mu g/m^3$ (the Agency for Toxic Substances and Disease Registry's acceptable residential indoor air mercury concentration is $\leq 0.5 \mu g/m^3$). The apartment was sealed, pending decontamination efforts which are ongoing. In three other apartments in the same building, air mercury concentrations were less than the measuring instrument's detection limit of 10 $\mu g/m^3$. The CHD did not detect evidence of mercury cross-contamination in a mobile home where the patients' family had relocated in November 1989.

After both patients were diagnosed as having acrodynia with neuropsychiatric impairment, they were treated with oral 2,3-dimercaptosuccinic acid (DMSA). From December 1, 1989, to April 4, 1990, the male patient's 24-hour urine mercury values declined from 1540 µg/L to 101 µg/L. Except for a persistent mild tremor, acrodynia and other neurologic symptoms resolved following two 21-day courses of DMSA therapy. The female patient's course was complicated by a progressive sensorimotor peripheral neuropathy that caused profound upper and lower extremity weakness. During DMSA treatment, she gradually improved; within 3 months, she was able to walk short distances without assistance. By February 6, 1990, her 24-hour urine mercury excretion was 352 µg/L; DMSA therapy was continued.

Editoral Note: Although nonoccupational elemental mercury poisoning occurs less frequently than occupational mercury poisoning, cases of elemental mercury exposure and toxicity in children have been reported. Because mercury vapors are dense and tend to settle, children playing near the floor may be exposed of mercury if it is present. Moreover, children may be physiologically more susceptible to the health hazards of mercury exposure than adults.

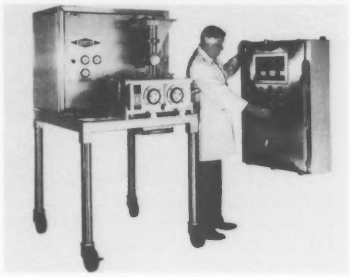
Elemental mercury (also termed metallic mercury or quicksilver) is volatile at room temperature, and its rate of vaporization is a function of both temperature and surface area. Mercury enters the bloodstream after it is inhaled; because of its lipid solubility, mercury crosses both the blood brain barrier and the placenta. Elemental mercury is excreted in the urine and has an elimination half-life of approximately 60 days.

Because of mild symptomotology and the potential for misdiagnosis, cases of mercury poisoning may not be readily recognized. Individual susceptibility to mercury poisoning varies considerably, and not all persons exposed will develop symptoms. Manifestations of mercury poisoning include intention tremor, memory loss, insomnia, timidity, gingivitis, diarrhea, anorexia, weight loss, and in severe cases, delirium. Acrodynia may be misdiagnosed as measles, other viral exanthems, or Kawasaki disease. Manifestations of acrodynia include a generalized rash; irritability; photophobia; profuse perspiration; and redness, swelling, and peeling of the skin on hands and feet. Although acrodynia is more common in infants and young children, it has been reported in adolescents and a 41-year old male.

Mercury is used in some school laboratories; in such settings, its ambient concentrations (and the safeguarding of mercury supplies) should be carefully monitored. Additionally, mercury is added into many household products, such as latex paints, adhesives, joint compounds, acoustical plates, and cleaning solutions. Because not all products that contain mercury are labelled as such, adequate ventilation must be ensured when using potentially toxic household chemicals.

MMWR 6/29/90

Industry Products



Fitzpatrick Features Easily-Cleaned Roll Compactor, Shows New USDA/3A Approved Components at IEFP '91

A portable Chilsonator® dry-powder compaction unit, designed for rapid disassembly and easy cleaning for applications in laboratory testing, process development and short production runs, will be highlighted by The Fitzpatrick Company at the IEFP '91 Exhibition, Booth #5444. In addition the company will display a new design of rotor/blade assembly for its FitzMill® comminution mill featuring USDA/3A approval for dairy processing applications.

The L-89 Chilsonator compactor offers greater capacity than previous portable compaction units. To increase cleaning efficiency, the model can be completely disassembled without tools, and features a separate control panel that can be remotely mounted to keep electric controls away from the machine during cleaning. To further enhance cleanability, the L-89 is mounted on a stainless steel base designed to present minimal horizontal surfaces, thus eliminating places for product to accumulate during operation.

Fitzpatrick's USDA/3A rotor, principal operating component of the company's newly developed DAAS06 FitzMill comminutor, features an assembly of 16 blades precisely grooved to position silicone O-ring seals between blades, closing those interfaces against product accumulation. Special lock nuts, which hold the blade and rotor assembly together, are sealed in like fashion. This provides the advantage of individually replaceable blades, while eliminating the need to dismantle the rotor/blade assembly for routine cleaning/sanitizing procedures.

The new rotor design also features solid Teflon split O-ring packing glands to seal the rotor/chamber interfaces per USDA/3A requirements.

All product-contact components of the new rotor assembly are stainless steel, polished to a smoothness exceeding the USDA-required #4 finish. The new rotor/blade assembly is offered as a retrofit to earlier USDA FitzMill comminutors, allowing upgrade to current dairy specifications without the expense of replacing the entire mill.

The Fitzpatrick Company - Elmhurst, IL

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GENE-TRAK Systems Announces Availability of the Colorimetric GENE-TRAK® Campylobacter and Yersinia Assays for Investigational Use in Food Testing

GENE-TRAK Systems announced the immediate availability of a new, colorimetric DNA probe test for the rapid detection of *Campylobacter* species in enriched food and environmental samples. A similar test for the detection of *Yersinia enterocolitica* in enriched food samples has also been made available.

Campylobacter is an important human pathogen and is recognized as one of the most common causes of enteric disease in the United States and throughout the world. The organism is commonly found in foods of animal origin, including dairy, poultry, meat and seafood products. The control of *Campylobacter* transmission represents an immense challenge to researchers working in the area of microbiological food safety.

In recent years *Yersinia enterocolitica* has received increased recognition as a significant human pathogen. Several outbreaks of gastroenteritis caused by the presence of *Yersinia* in foods has heightened concems of regulatory agencies to increase surveillance of food products. *Yersinia* has the ability to grow at cold temperatures and has been isolated from a variety of foods, including refrigerated meat and dairy products.

Use of the new Colorimetric GENE-TRAK® Assays would enable food laboratories to screen samples easily and quickly for the presence of *Yersinia enterocolitica* and *Campylobacter* species, including *Campylobacter jejuni, Campylobacter coli, Campylobacter laridis* and *Campylobacter fetus* subspecies *fetus*. The tests are recommended for investigational use only and would be beneficial in research applications which require rapid and accurate screening. Currently, these pathogens are detected through conventional microbiological methods, requiring a minimum of five days to obtain results. The new tests would enable detection of these pathogens in less than 2 1/2 days.

GENE-TRAK Systems - Framingham, MA

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Klenzade Introduces Solid Sani-Glide Conveyor Lubricant

Dairy and food processors now have a sanitizing conveyor lubricant in solid form. Klenzade, A Service of Ecolab Inc., has introduced Solid Sani-Glide®, a solid sanitizing conveyor lubricant that takes the water out of the cost.

Solid Sani-Glide is a soap-based non-food contact sanitizing detergent lubricant specially formulated for environmental sanitation of in-floor conveyors in the dairy and food processing industry. While lubricating the conveyor, Solid Sani-Glide helps control the growth and transmission of pathogenic microorganisms, such as *Listeria monocytogenes* and *Salmonella typhimurium*, by keeping conveyors free of slime and soil which can harbor bacteria.

Solid Sani-Glide and the entire Klenzade line of solid sanitation products outperform traditional liquid bulk products. By using solid products, processors can save up to 60 percent on freight bills and reduce inventory space by up to 70 percent.

Hazardous liquid spills as well as bulk lube filling errors and product mix-ups are eliminated by using Solid Sani-Glide. Solid lubes are not only safer and easier for workers to use, they are environmentally responsible. Solid Sani-Glide's nonphosphated chemistry helps minimize sewage effluent charges and does not require expensive retaining walls needed to secure bulk lube tanks. Solid Sani-Glide is an important part of the Klenzade Environmental Sanitation Program (ESP).

For more information on Solid Sani-Glide sanitizing conveyor lubricant and the Klenzade ESP:

Klenzade, A Service of Ecolab, Inc.-
St. Paul, MN

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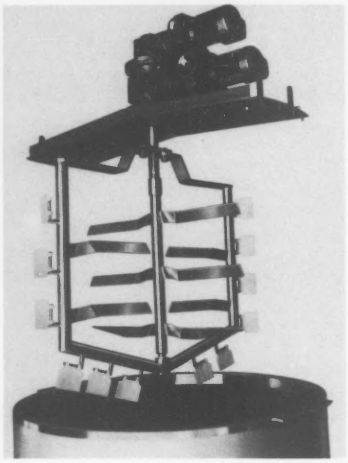

Walker Introduces Counter-Rotating Stainless Steel Tank Agitator

Walker Stainless Equipment Co., Inc. is now offering a counter-rotating agitator for heavy duty mixing and blending of highly viscous materials.

An outer agitating member with heavy duty molded nylon blades rotates to scrape the tank wall and bottom. The inner blades rotate in the opposite direction, blending and mixing the product. Uniform temperature distribution is achieved by passage of the contents over the heat exchange surfaces.

The Walker counter-rotating agitation system produces uniform mixing of stratified ingredients and product particulate at lower speeds with little shear effect. The inner and outer agitator assemblies have separate drives and can be rotated independently to allow adjustment for a greater variety of products.

The agitator unit is standard-equipped with heavy-duty, 2-speed, constant-torque, totally-enclosed motors. Variable speed drives are available for multi-stage process applications.

Walker Stainless Equipment Co., Inc., manufactures a variety of process, storage, and transport equipment for the dairy, beverage, confectionary, and food processing industries.

Walker Stainless Equipment Co., Inc. - New Lisbon, WI

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Yeast Identification Card for Use with Vitek System

Vitek Systems has a yeast test card designed for use with its Vitek Industrial Microbiology System, the only fully automated system for identification of the 36 most frequently isolated yeast and yeast-like algae.

Most identifications are complete in 24 hours. Sample handling requires only 60-90 seconds per test and results are objective and consistent.

The YBC or Yeast Biochemical Card is a sealed, disposable, 30-well card which contains 26 biochemical broths and four negative control wells.

The negative control wells provide base lines for the measurement of turbidity and pH changes in the biochemical wells.

Identification is made from an isolated colony and based on the cumulative results of biochemical reactions of the organism with known media in the card.

Vitek Systems - Hazelwood, MO

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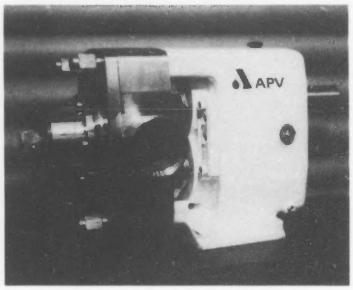

New Tanker Pump

New from APV Crepaco is the model T-3S/107/10 sanitary stainless steel pump specifically designed for mounting on tank trailers and tank trucks. Based on proven designs, this model features an aluminum gearcase to minimize weight, and a spring-loaded, diaphragm type relief device to protect the pump. Other components are interchangeable with APV Crepaco's existing sanitary and industrial pump models. Featuring 3-lobe stainless steel rotors, the pump has its primary use on food grade products such as milk, corn syrup, liquid sugar, fruit juices, edible oils, and chocolate.

The tanker pump is rated to 212 USgpm and to 145 psi operating pressure. Standard inlet/outlet connections are 3" bevel seat (ACME) threads. The sanitary tanker pump meets 3-A requirements and is furnished with a mechanical seal. Optional seal materials are available as well as packed gland for less severe, non-sanitary standards.

Whether dedicated or multi-purpose service, the T-3S/107/10 is readily cleanable while handling a wide range of products.

APV Crepaco, Inc. - Lake Mills, WI

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Ionpure Technologies Publishes Comprehensive New Catalog

Ionpure Technologies Corp. announces publication of a comprehensive, 94-page catalog "Products and Systems for Process Water."

Ionpure products and systems covered include ultrafiltration, reverse osmosis, auto deionization, service deionization, pretreatment and membrane filtration products and services. The catalog also features Ionpure's exclusive Continuous Deionization (CDI), a closed system which requires no chemicals for regeneration.

Ionpure services detailed in the catalog range from engineering and design support for major areas of microelectronics, pharmaceutical/biotech, hemodialysis and industrial applications to laboratory testing maintenance contracts and technical support.

For a free copy of this new catalog, which includes product specifications and ordering information:

Ionpure Technologies Corp. - Lowell, MA

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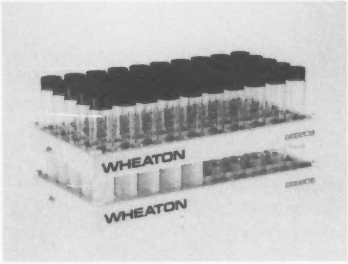

Wheaton 50 Position Polypropylene Rack

The Wheaton 50 Position Rack has a 5 x 10 well configuration that holds 50-30 mm tubes for use with your orbital shaker or shaker bath. Rack is made from durable, autoclavable, polypropylene that resists most organic reagents. Recessed wells provide stability for stacking racks. Each well has an opening in the bottom to facilitate drainage when used in a water bath. An alpha-numerically indexed vial grid makes sample identification easy.

Wheaton - Millville, NJ

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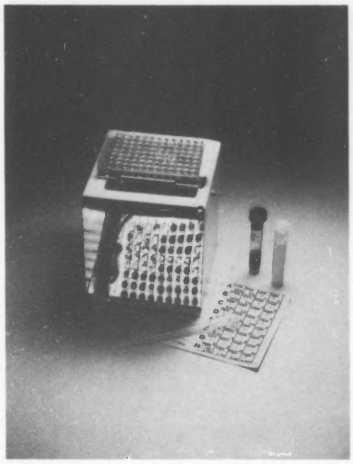

Pitman-Moore Introduces Mastitis Sensitivity Test

Recommending a mastitis treatment just got faster -- and easier.

Pitman-Moore, Inc., has introduced Mastassay™ Mastitis Sensitivity Test Kit, a new 4- to 12-hour test that helps veterinarians determine which antibiotic is required to treat clinical mastitis, and what antibiotic concentration will be most effective.

"Today's producers are concerned with the economics of resides resulting from overuse of antibiotics," says Jacquelyn Cash-Ott, Pitman-Moore product manager. "Their mastitis problems need to be solved quickly, and treated with an appropriate antibiotic, so they can keep cows producing and profitable. Mastassay™ provides accurate, in-clinic results, usually in 4 to 12 hours."

Cash-Ott says most sensitivity tests available today are conducted after culturing and identifying the organism affecting the cow. While tests pinpointing the organism may be helpful, she notes that these tests are complex, may require processing by an independent laboratory and take at least 36-48 hours to provide results.

"Mastassay won't determine which organism is affecting a herd," Cash-Ott says. "Instead, it indicates which antibiotic is needed to treat clinical mastitis. That's what producers want to know. They want to know which antibiotic will cure their cows' mastitis and get them back in production. And since Mastassay™ is conducted in the clinic, veterinarians can provide these important answers fast."

The sensitivity kit tests a small milk sample to determine which antibiotic will be effective in treating organisms infecting a cow's udder. Cash-Ott says milk samples contain the same concentration of bacteria the antibiotic will be fighting when the cow is treated, "so there is no need to standardize the bacterial concentration and test in artificial media where antibiotics may behave differently than they do in milk."

Veterinarians place the milk sample on a plate containing three to four wells for each of eight antibiotics at different concentrations: ampicillin, cephalothin, gentamicin, oxytetracycline, penicillin, trimethoprim/sulfadiazine, erythromycin and oxacillin. A color change in any of the wells indicates growth of the mastitis organism.

The well exhibiting no color change indicates that the corresponding antibiotic is effective at the corresponding antibiotic concentration against the organism, and the producer can begin immediate treatment with that antibiotic.

Cash-Ott says Mastassay™ reduces time lost culturing and identifying the organism and conducting more time consuming sensitivity tests.

Pitman-Moore, Inc. - Mundelain, IL

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STEEL IT Polyurethane System Incorporates Stainless Steel Leafing Pigment for Superior Surface Protection

The STEEL IT Polyurethane Coating System features a unique stainless steel leafing pigment, and provides optimum weather-, abrasion-, and corrosion-resistance in general maintenance applications. The easy to apply system yields a hard, non-toxic, metallic finish that protects a multitude of metallic and non-metallic surfaces from ultraviolet rays, chemicals, oils, alkalis, food acids, water immersion, abrasion, and high-pressure washdowns.

Comprised of STEEL IT Polyurethane #1002 applied over STEEL IT Weathering Primer #2203, the system adheres to surfaces aggressively, and is ideal for protecting structural steel and other metals. These single component coatings require no complicated mixing. Applied as they come from the can, they are air dried and require no baking or heating.

USDA-approved for use in the food processing and handling industry where incidental food contact may occur, STEEL IT Polyurethane #1002 blends polyurethane resin with Type 316L stainless steel leafing pigment to produce a rugged, non-toxic, satiny metallic finish. STEEL IT Primer #2203 combines a modified alkyd resin, selected silicates, and iron oxides with Type 316L leafing pigment to produce a long-lasting primer for structural steel and other metals requiring good rust-inhibiting qualities. The durable primer can withstand long periods of exposure in case of a delay in applying the STEEL IT Polyurethane #1002 finish coat.

Stainless Steel Coatings, Inc. - Littleton, MA

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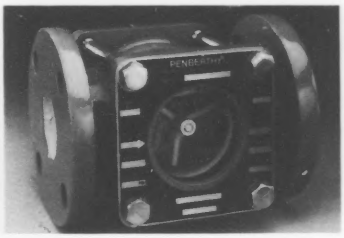

ANSI Approved Sight Flow Indicators

Penberthy, Inc. offers a full line of sight flow indicators, all built to ANSI specifications. Models are available featuring plain, flapper, rotor and drip-tube indication methods. Connections may be NPT or flange, 150, 300 or 600 lb. For severe applications, an FM-Approved dual window design is offered.

Sight flow indicators from Penberthy have single piece cast bodies. Standard materials include bronze, iron, carbon steel, stainless steel and TFE lined. A variety of optional body materials and glass shields are available to suit nearly any application.

For more information about Penberthy sight flow indicators (bulletin 3200):

Penberthy, Inc. - Prophetstown, IL

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New Catalog Summarizes Leeds & Northrup Instruments & Systems for Process Control

A new 36-page condensed catalog of instruments and systems for process control is offered by Leeds & Northrup.

Included are L&N recorders, single-loop controllers, data acquisition and distributed process control systems, energy management systems, analytical equipment, process transmitters, primary elements, parts, supplies, systems and training services. References to detailed L&N literature are included, as are business reply cards for further information.

Copies of this new catalog H0.0003-CA entitled "Solutions for Process Measurement & Control" are available:

Leeds & Northrup - North Wales, PA

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Insecticide Paint Additive

An outstanding product helps eliminate dirty, disease carrying insects before they plague your business. CPF-2D* insecticide paint additive is the most cost effective, environmentally prudent and best long term solution for controlling pests and their residues (cobwebs, nests, and bug dirt). EPA registered and licensed in every state. CPF-2D* is mixed with any exterior coating. The coating becomes a contact insecticide and will not harm humans or livestock when used as directed. Tested and used successfully in milk parlors, stables, chicken houses and barns. CPF-2D* is a long-term measure against insect headaches. Available nationwide.

Enviro-Chem, Inc. - Walla Walla, WA

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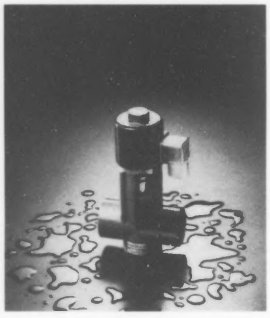

One Solenoid Valve Handles All Type Solutions

Introduction of a unique all-purpose Teflon® bellows solenoid valve had been announced by Plast-O-Matic Valves, Inc.

The development of this new thermoplastic valve represents a major engineering advancement because a single valve can now be used for virtually every type solution including acids, caustics, solvents, chlorine solutions and ultrapure liquids.

The most outstanding feature of this Series MSVT valve is a Teflon bellows which flexes to provide a barrier type dynamic seal. Since the Teflon is not subject to chemical attack, exceptional performance and a working life of more than 2,000,000 cycles is normal. The barrier type dynamic seal also eliminates leaks to the atmosphere which is critical in many industrial plant environments.

Further protection is provided by Plast-O-Matic's patented Fail-Dry® safety design which provides visual warning if seal malfunctions. This avoids costly shutdowns as valve continues to function.

Body materials are PVC, CPVC, Polypropylene, Teflon and PVDF (Kynar®). Sizes 1/8" through 1" with various pressure ratings.

Plast-O-Matic Valves, Inc. - Totowa, NJ

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Stainless Steel Thermometer Offers Unprecedented Ruggedness

The 386 model stainless steel thermometer from Atkins Technical of Gainesville, Florida now offers unprecedented ruggedness and is widely being used in areas where rugged, reliable tools are essential.

Food service personnel use the model with different Atkins probes for checking fryer vats, freezers/coolers, grill tops and food products.

Maintenance workers find the instrument extremely useful in "troubleshooting" possible temperature problems in equipment ranging from motor coils and bearings to air conditioning systems.

The digital thermometer has been made even tougher with the addition of membrane-type switches which are immune to moisture, dirt and damage by dropping. This switch arrangement also allows for one-handed operation.

The stainless steel housing protects the thermometer against damaging elements and features a sculptured hand-grip for non-slip use in areas where hands get greasy or dirty. The entire unit is small enough to fit easily into a shirt pocket or toolbox.

The thermometer features four models with varying ranges from -40 F to +1,832 F and can be switched to read in Fahrenheit or Celsius. The readings are accurate to within +/-1%.

The 386 series thermometer is priced at $129 and can be used with over 150 standard Atkins thermocouple probes.

Atkins Technical, Inc. - Gainesville, FL

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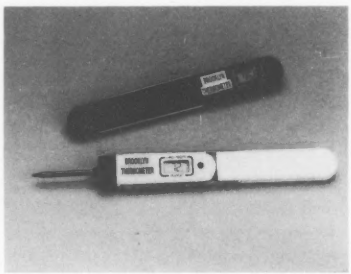

Fold-Up Pocket Digital Thermometer

These new Fold-Up Pocket Thermometers have just been introduced to Brooklyn Thermometer's digital product line. Compact size (5 1/2 x 3/4" x 1/4") they will fit into a shirt pocket but are rugged enough to be stored in a tool box or kit. They offer two wide temperature ranges (-40 to 120°F or 14 to 230°F) in 0.1° resolution (accuracy ±2°) with easy to read LCD display. The sturdy stainless steel stem has a piercing tip which can be safely stored away in its self-contained fold-up case. Useful in HVAC, lab testing, product and process testing, fieldwork and general industrial use.

Catalog No. 9867 has a temperature range from 14 to 230°F and No. 9868 from -40 to 122°F. They are very economically priced at just $24.90 complete with standard #393 watch battery. More information is available in Catalog #100 FREE of charge upon request.

Brooklyn Thermometer Co., Inc. - Farmingdale, NY

Please circle No. 256
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Federal Register

Additional Methods for Destroying Trichinae in Dry-Cured Ham and Dry Sausage

Summary: The Food Safety and Inspection Service (FSIS) has been petitioned to amend the Federal meat inspection regulations to provide additional methods for processing dry sausage and dry-cured ham to destroy trichinae (*Trichinella spiralis* larvae) which may be encysted in pork. FSIS has been petitioned to add one trichina destruction method for two size ranges of dry sausages and two trichina destruction methods for dry cured ham. FSIS is proposing to add these three methods to the Federal meat inspection regulations as additional methods accepted for use in the destruction of trichinae in dry sausage and dry-cured hams. Additionally, FSIS is proposing to add a statement to the current regulations to warn that trichina destruction methods only destroy trichinae and may not destroy all pathogenic bacteria that may be present.

Dates: Comments must be received on or before April 8, 1991.

Addresses: Written comments may be mailed to: Policy Office, Attn: Linda Carey, room 3171, South Agriculture Building, Food Safety and Inspection Service, U.S. Department of Agriculture, Washington, DC 20250.

For Further Information Contact: William Smith, Director, Processed Products Inspection Division, Science and Technology, Food Safety and Inspection Service, U.S. Department of Agriculture, Washington, DC 20250; (202)447-3840.

Parasitic and Predaceous Insects Used To Control Insect Pests; Proposed Exemption From a Tolerance

Summary: EPA is proposing to establish an exemption from the requirement of a tolerance for parasitic (parasitoid) and predaceous insects used to control insect pests of stored raw whole grains such as corn, small grains, rice, soybeans, peanuts, and other legumes either bulk or warehoused in bags where these insects are not expected to become a component of food. These insects may also be used as control agents in facilities and structures used for such storage, as well as general purpose food storage warehouses for disinfestation of areas not accessible to standard control measures where these insects do not become a component of food. This proposal is issued with the consultation and cooperation of the U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA).

Dates: Written comments, identified by the document control number, (OPP-300222), must be received on or before March 4, 1991.

Addresses: By mail, submit comments to: Public Docket and Freedom of Information Section, Field Operations Division (H7506C), Office of Pesticide Programs, Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460. In person, bring comments to: Room 246, CM #2, 1921 Jefferson Davis Highway, Arlington, VA 22202.

Information submitted as a comment concerning this document may be claimed confidential by marking any part or all of that information as "Confidential Business Information" (CBI). Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2. A copy of the comment that does not contain CBI must be submitted for inclusion in the public record. Information not marked confidential may be disclosed publicly by EPA without prior notice. All written comments will be available for public inspection in Room 246 at the address given above, from 8 a.m. to 4 p.m., Monday through Friday, excluding legal holidays.

For further information contact: By mail Mark Dow, Registration Support Branch, Registration Division (H7505C), Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460. Office location and telephone number: Room 716, CM #2, 1921 Jefferson Davis Highway, Arlington, VA 22202, (703)557-4354.

IAMFES Secretary Candidates

C. DEE CLINGMAN

Dee Clingman is Vice President of Quality Control for General Mills Restaurants, better known as Red Lobster and The Olive Garden restaurants. In this capacity he directs a 36 person department providing quality direction and food protection to over 800 restaurants in the United States and Canada.

Dee began his public health career over 20 years ago as a sanitarian in the Warren County Health Department in Ohio where he was responsible for all environmental health programs. He then directed the foodservice manager sanitation training and certification program for the Ohio Department of Health where he developed and implemented the nation's first pioneer program on such training and certification. Dee later went to the Chicago area as Director of Food Protection for the National Institute for the Foodservice Industry. There he developed and implemented a national uniform foodservice manager training and certification program under contract for the Food and Drug Administration. In 1979 he joined Red Lobster as Director of Quality Control and rose to his current position for General Mills Restaurants.

Dee holds a master of science degree in Environmental Health Engineering from the University of Cincinnati and a bachelors degree in Biology and Psychology from Bowling Green State University. He is a Registered Sanitarian in Ohio as well as in two other states.

Throughout his career Dee has been an innovator, a strategist, and a pioneer in new environmental health programs. Dee is the proud recipient of the IAMFES Harold Barnum Award (1983) for most outstanding Industry Sanitarian. He was also presented the Food Industry Sanitarian Award by the National Environmental Health Association in 1985 for his contributions to environmental sanitation in the food industry.

Dee has been elected or selected to participate in numerous national committees or task forces in the food protection area. He has made numerous public speaking engagements at state and national public health and industry organizations. He has been recognized by foodservice leaders and in industry publications for his accomplishments in advancing foodservice food protection.

Dee has been active in IAMFES for many years serving on the Editorial Board of the Journal of Food Protection and Dairy and Food Sanitation. He was Chairman of the Journal Foodservice Committee (1978-82). Dee has presented numerous papers at IAMFES annual meetings and has published articles in the Journal of Food Protection and Dairy and Food Sanitation. He was the initiator of the IAMFES Norbet F. Sherman Award. Earlier in Dee's career he was elected Treasurer of the Ohio Environmental Health Association for two terms.

Dee is 43 years old and has been married to his wife Joanne for 19 years. They have two sons and a daughter and live in Orlando, Florida.

GALE PRINCE

Gale is the Manager of Regulatory Compliance for the Kroger Company 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 13 years. At the store, he started in meat merchandising and worked his way to Sanitation Specialist and then to Director of Quality Control and Sanitation.

In both the above capacities, Gale's work is focused on quality control, sanitation, food safety and regulatory compliance. Operations involved with fresh and processed meat, fresh fruits and vegetables, bakeries, milk and ice cream processing, cereal grains and canned and frozen foods, are among these.

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.

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.

Affiliate News

Fall Dairy Conference Report
Ontario, California
September 25-26, 1990

The California Association of Dairy and Milk Sanitarians, the California affiliate of IAMFES, had their annual meetings September 25-26, 1990 at the Airport Hilton Hotel in Ontario, California.

Those in attendance were treated to a special welcoming address by the Honorable Howard Dabney, Associate Justice, California Fourth Appellate District. Justice Dabney is a graduate of California State Polytechnic State University in San Luis Obispo. He graduated with a B.S. degree in Dairy Husbandry and worked several years as a herdsman for a large California Dairy before attending law school. In his address, Justice Dabney, revealed that he still has a love for agriculture, particularly the dairy industry.

Topics presented to the 140 conference attendees were presentations on Milk Safety Issues; Producer Outlook; Environmental Concerns; and Regulatory Issues. Key speakers at the conference included Joe Smucker from the FDA office in Washington, DC; Damien Gabis, CEO of Silliker Labs and President-Elect of IAMFES; and Richard Eubanks of the FDA Western Region Office in San Francisco. Representing IAMFES at the affiliate meeting was Dee Buske, IAMFES Affiliate Liaison. Dee was the key speaker at the annual meeting banquet, Tuesday evening September 25. Her presentation was entitled "IAMFES and You."

Special presentations made at the annual banquet included the presentation of the CADMS "Sanitarian of the Year" award. It was presented to William "Bill" Green, Chief Chemist for the California Department of Food and Agriculture, Bureau of Milk and Dairy Foods Control Branch, recently retired. Bill has made many contributions to the California dairy and food industries through his analytical and testing work compiling statistical data supporting new and improved testing procedures. He is also a strong supporter of CADMS and IAMFES.

Another award presented was the IAMFES Membership Achievement Award for the greatest percentage increase in membership from last year to the present. This was the second consecutive year that CADMS has won this award. It was presented to CADMS President Joe Miranda by Dee Buske.

Another special award presentation, the Crumbine Award was presented to Alison Hudson representing the San Joaquin County Health Department. This award is presented to the Health Dept. or Regulatory Agency that improved regulatory compliance for their area.

An "added plus bonus" to the early birds arriving for the conference was a tour Monday evening, September 24, of the Golden Cheese Company of California in Corona. Golden Cheese is the largest Cheddar cheese plant in the world producing over 90,000,000 lbs. of cheese annually. Transportation for the tour was graciously donated by Dreyer's Grand Ice Cream and their bus is known as the "Rocky Road."

At the CADMS annual membership meeting, the following slate of officers were elected for 1991: President, Richard Bolman, Sonoma County Health Dept.; First Vice-Pres., Dennis Storms, Knudsen/Kraft; Second Vice-Pres., Tony Freeman, California Dept. of Agriculture, Bureau of Milk and Dairy Foods Control Branch; and Recording Secretary, Nancy Olson, California Dept. of Agriculture, Bureau of milk and Dairy Foods Control Branch. Next year's meeting will be held in Northern California.

Everyone attending the conference was in agreement that the topics presented were informative, educational and very timely. The speakers did a fine job in delivering their message and information. The overall excellence of the conference program was due to the hard work of the Planning Committee Chairman, Austin Olinger, with timely assistance from Dr. John Bruhn of the University of California, Davis campus.

Submitted by,
Joe Miranda, CADMS 1990 President

Upcoming IAMFES Affiliate Meetings

1991

MARCH

•**5-6, Virginia Association of Sanitarians and Dairy Fieldman Annual Conference** will be held at the Donaldson Brown Continuing Education Center in Blacksburg, VA. For more information contact Haney Hodges at (703)362-8877.

APRIL

•**3-5, Missouri Milk, Food and Environmental Health Associations' Annual Conference** will be held at the Ramada Inn, Columbia, MO. For more information contact Richard Janulewicz at (816)781-1600.

•**11-12, Nebraska Association of Milk and Food Sanitarians Annual Conference** will be held at the Omaha Douglas County Extension Office, 8015 West Center in Omaha, just off 84th and I-80. For further information contact Lois Clauson at (402)444-7196.

•**30, Associated Illinois Milk, Food and Environmental Sanitarians Annual Spring Conference** will be held at the Woodfield Hilton, Arlington Heights, IL. For more information contact Robert A. Crombie, Secretary AIMFES, 521 Cowles, Joliet, IL 60435 (815)726-1683 (Voice & FAX).

MAY

•**14-16, Pennsylvania Association of Dairy Sanitarians and Dairy Laboratory Analysts Annual Conference** at the Keller Conference Center, Penn State University, University Park, PA. For more information, contact Sid Barnard, 8 Borland Lab, University Park, PA 16802, (814)863-3915.

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(612)785-0484

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P.O. Box 248
Pantotoc, MS 38863
(601)489-1241

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Terry Carlile
P.O. Box 1182
Laramie, WY 82070
(307)876-2483

Preview of the 78th IAMFES Annual Meeting

The following is an abbreviated overview of the educational program for the 78th IAMFES Annual Meeting, July 21-24, 1991, The Galt House, Louisville, Kentucky. A more complete program will appear in the April Issue of Dairy, Food and Environmental Sanitation.

Monday, July 22

Field Representatives and Sanitarians All-Day Symposium

- Dairy Programs in Kentucky
- Brucellosis in Kentucky
- Dairy Forecast
- Hauler's Training
- Dairy Politics
- Field Representatives Handbook
- Antibiotics Control
- Milk Residues

Scientific Papers on Chemical Methods

- Fluorometric Analysis of Acid Phosphatase in Meats for Monitoring Cooking Temperatures
- Anion Exchange Diode Array HPLC Analysis of Heated Ground Beef
- A Low-cost Technique for Water Activity without Specialized Instrumentation
- Determination of Ozone Produced Oxidants and Byproducts in Artificial Seawater
- Detection of Antimicrobial Drugs Through Their Functional Group as Compared to Physio-Chemical or Immunological Methods

Scientific Papers on Water Quality and Safety

- *Cryptosporidium parvum*, A Newly Recognized Waterborne Pathogen
- Characterization of Plasmids from *Plesiomonas shigelloides* Isolated from Louisiana Blue Crabs
- Survival and Culturability of *Vibrio vulnificus* and Resuscitation of the Viable but Non-culturable Form in Artificial Seawater Microcosms
- Environmental Survey on Bacterial Distribution in Catfish Ponds
- Water Quality of Wells on Poultry Farms in Tennessee

Symposium on Role of Food Service in Quality and Safety of Foods

- Epidemiological Overview
- Current Regulations
- Food Service Industry
- Retail Food Industry
- A Practical View of the Sous Vide Issue from a Food Service Perspective
- Food Service Sanitation Certification Training - The Whys and Hows
- A Self Care Action Program (SCAP) Applied to Food Service Establishment
- Increase Quality of Food Service Inspections
- Improving Food Safety Education in Public and Private Schools
- A National Survey of Consumer Home Food Preparation Practices
- Who Participates in Voluntary Recycling Programs and Why?

Scientific Papers on Micro Pathogens and Spoilage

- The Effects of Storage Time and Temperature on the Growth of *Salmonella enteritidis* in Naturally Contaminated Eggs
- Growth and Production of Enterotoxins A and D by *Staphylococcus aureus* in Salad Bar Ingredients and Clam Chowder
- Thermal Resistance of *Listeria monocytogenes* in Raw Liquid Egg Yolk
- The Use of Bacteriocin-producing *Pediococcus* to Control Post-processing *Listeria monocytogenes* Contamination of Frankfurters
- Antibacterial Effect of Selected Naturally Occurring Chelating Agents on *Listeria monocytogenes*
- Inhibition of *Listeria monocytogenes* by Fatty Acids
- Factors in the Contamination of Beef Tissue Surfaces by *Salmonella typhimurium* Which May Influence the Antibacterial Action of Acetic Acid
- Effects of Ingredients on the Survival of *Campylobacter jejuni* in Processed Turkey Ham
- Influence of Modified Atmosphere Storage on the Competitive Growth of *Listeria* and *Pseudomonas* on Chicken
- Methods for Selective Enrichment of *Campylobacter* Species from Poultry for Use in Conjunction with DNA Hybridization Method
- Effects of Pasteurization and Storage Temperature on Vacuum-Packaged Sausage Spoilage

Tuesday, July 23

Symposium on Shelf Life of Milk and Dairy Foods

- Testing Methods
- Plant Environment/Shelf Life
- Quality Assurance/Shelf Life
- Other topics

Microbiological Methods Scientific Papers

- Isolation of *Clostridium perfringens* by Aerobic and Anaerobic Procedures from Ground Beef

- Recovery of Microorganisms from Ground Beef by Homogenizing with Hand Roller or Stomacher
- A Differential-Selective Medium and Simple Atmosphere for Recovery of *Campylobacter jejuni*
- Optimized Enrichment Methods and Selective Media for Recovery of *Campylobacter jejuni* from Broiler Chicken Carcasses
- Spoilage Rate Comparisons for Ground Turkey and Ground Beef
- Comparison of Methods for Molecular Epidemiology of *Listeria monocytogenes*
- Evaluation of Reagents for Use in Rapid Methods of Analytical Food Microbiology
- Development of an Enzyme-Linked Antibody Procedure for Detection of *Salmonella* using Hydrophobic Grid Membrane Filters
- Monitoring the Hygienic Status of Surfaces
- A Comparison of Calibration Data for Conductance Microbiology Using Spiked Margarine and Dairy Products and Naturally Contaminated Products

Symposium on the Use of Computers in Food Protection

(Topics to be announced later)

Plenary Session - Tuesday afternoon

- Food Safety Issues in Europe
- Seafood Safety
- Pasteurized Milk Ordinance Update
- National Conference on Food Protection

Wednesday, July 24

Dairy Foods Scientific Papers

- The Dispersal of Microorganisms by Cleaning Systems
- Chlorine Dioxide Foam Sanitation in Fluid Milk and Other Dairy Processing
- Determination of Atrazine in Milk by Enzyme Immunoassay
- A Rapid Bioluminescence Assay of Alkaline Phosphatase in Milk and Dairy Products Using the Charm II System
- Extending the Keeping Quality of Fluid Milk
- Effects of Oxygen Absorber and other Packaging Conditions on the Shelf Life of Dry Whole Milk
- Determination of the Incidence of Coliforms by Preliminary Incubation - One Way to Predict Milk Quality
- A Rapid Concentration Procedure for Microorganisms in Raw Milk
- Prevalence of *Salmonella, Campylobacter, Yersinia enterocolitica* and *Listeria monocytogenes* in Farm Bulk Milk Tanks

Water In Food Processing Symposium

(Topics to be announced later)

(New Event) Scientific Poster Session - Wednesday morning

- Effect of Packaging on Shrimps (*Penaeus* spp.) Quality during Ice Storage
- A Hazard Analysis Critical Control Point (HACCP) Program for the Production of Imitation Crab
- Background Levels and Radiation Dose Yield of o-Tyrosine in Chicken Meat
- H_2O_2 Induced Free Radical Damage on *E. coli*
- Growth Modeling of Proteolytic Strains of *Clostridium botulinum*
- *In vitro* inhibition of *Salmonella typhimurium* and *Escherichia coli* 0157:H7 by an Anaerobic Gram-positive Coccus Isolated from the Cecal Contents of Adult Chickens
- Survival of Food-Associated Pathogens Following Sonication
- Fate of *Salmonella* and *Listeria monocytogenes* in Commercial, Reduced-Calorie Mayonnaise
- Antimicrobial Activity of Sucrose Laurate, EDTA and BHA Alone and in Combination
- Microbiocidal Effectiveness of Glucose Oxidase on Chicken Breast Skin and Muscle
- Performance of a DNA Hybridization Method with Abbreviated Enrichment in the Detection of *Escherichia coli* in Naturally Contaminated Foods
- Use of Agar Dipslides for Hygiene Monitoring in a Bakery
- Comparison of Two Enzyme Immunoassays for the Recovery of *Salmonella* from Foods
- An Evaluation of the Conductimetric Method for Total Microbial Activity, Coliforms, and Yeast/Mold of Spices and Seasonings
- Edualette Test, A Proposed Revision to Serological Polyvalent Flagellar (H) Test
- Incidence of *Brucella* in Milk in Cajeme County and Fat Content

(New Event) Video Theatre - All Day

Educational videos will be shown on a regular schedule throughout the day for your review.

Symposium on Microbiological Issues for the 90's

- Concepts/Considerations
- Evaluation and Validation
- Facts/Fallacies
- New Horizons

Symposium on Laboratory Safety

(Topics will be announced later)

Guest Room Committment
GOOD UNTIL JUNE 19, 1991
Make Your Reservation Now

HOTEL RESERVATIONS
IAMFES

78th Annual Meeting
July 21-24, 1991
The Galt House
Louisville, Kentucky

Please check accommodation requested:

❑ Single (1 person)
❑ Double (2 persons 2 beds)
❑ King (2 persons 1 bed)
❑ Triple ❑ Quad

Special Requests _____

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Reservations must be received by hotel prior to arrival.

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SHARING WITH (Name) _____

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

SPECIAL REQUESTS _____

After June 19, 1991 reservations will be accepted on a space availability basis only. Reservations will be held until 6:00 p.m. on the date of arrival, unless guaranteed by one night advance deposit, payable by money order, certified check or a Major Credit Card.

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140 N. 4TH AVENUE
LOUISVILLE,
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78th IAMFES Annual Meeting Registration Form

Galt House - Louisville, Kentucky - July 21-24, 1991

(Use photocopies for extra registrations)

FOR OFFICE USE

Date Rec'd._____ First initial _____ Last name _____

ID#_____ Registration #_____

Sign up to become a NEW member*

❑ **Yes, I want to become a NEW member of IAMFES for $40 (Students $20) which includes 12 monthly issues of *Dairy, Food and Environmental Sanitation* and take advantage of the member discount.**

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

Title **Employer**

Mailing Address (Please specify: Home Work)

City **State** **Zip**

Fax # **Area Code & Telephone**

Please check where applicable:

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

Credit Card payments may be sent via Fax today! 515-232-4736

		Amount		Total Amount
Registration				
	*IAMFES Member (Banquet included)	$ 95 ($125 on-site)		
	Non-Member (Banquet included)	$135 ($165 on-site)		
	IAMFES Student Member	$ 20 ($ 50 on-site)		
	IAMFES Member One Day (Circle: Mon/Tues/Wed)	$ 45 ($ 55 on-site)		
	IAMFES Non-Member One Day (Circle: Mon/Tues/Wed)	$ 65 ($ 75 on-site)		
	Spouse/Companion (Name): _____	$ 15 ($ 20 on-site)		
	Children (12 & Over), Name _____	$ 15 ($ 20 on-site)		
	*New member with *Dairy, Food and Environmental Sanitation*	$ 40		
	*Student Membership (verification required) ❑ *Journal of Food Protection* or ❑ *Dairy, Food and Environmental Sanitation*	$ 20		
Other Fees: (Per Person)			# of tickets	
	Cheese & Wine Reception (Sun., 7/21)	FREE		- 0 -
	Belle of Louisville Dinner Cruise (Mon., 7/22)	Adult $30 ($35 on-site)		
		Children Under 12 -- $ 15 ($ 18 on-site)		
	IAMFES Awards Banquet (Wed., 7/24)	$ 25 ($ 30 on-site)		
Spouse/Companion Events:	They're Off - Lunch at Derby Cafe (Mon., 7/22)	$ 25 ($ 30 on-site)		
	Bardstown & Jim Beam Distillery, Lunch at Talbott Tavern (Tues., 7/23)	$ 25 ($ 30 on-site)		
	Shelbyville, Lunch at Old Stone Inn (Wed., 7/24)	$ 25 ($ 30 on-site)		

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Registration Information

Send payment with registration to IAMFES, 502 E. Lincoln Way, Ames, IA 50010-6666. Make checks payable to IAMFES. Pre-registration must be post-marked by July 10, 1991. The pre-registration deadline will be strictly observed. For additional information contact Julie Heim at 1-800-369-6337, 1-800-284-6336 (Canada).

Refund/Cancellation Policy

The IAMFES policy on meeting cancellation/refunds is as follows: "Registration fees, minus a $15.00 processing fee, will be refunded for written cancellations post-marked at least two (2) weeks prior to the start of the meeting. No refunds will be made for cancellations made less than two (2) weeks prior to the start of the meeting, however, the registration may be transferred with written notification to a colleague.

Exhibitor Information

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

New IAMFES Members

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

01-06 Storage Tanks for Milk and Milk Products

115 A-L Stainless Inc. (9/28/58)
113 Park St., South
Peterborough, Ontario, Canada K9J 3R8

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

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

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

172 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 AVP Crepaco, Inc. (4/29/57)
100 South CP Ave.
Lake Mills, Wisconsin 53551

325 Albin Pump, Inc. (12/19/79)
(Mfg. by Albin Motor, Sweden)
120 Interstate N. Pkwy. E. #208
Atlanta, Georgia 30339-2103

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

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Cedar Rapids, Iowa 52406

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

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

492 A. Gusmer Inc. (1/15/87)
Mfg. by Philip Hilge GmbH
27 North Avenue East
Cranford, New Jersey 07016

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

502 INOXPA, S.A. (4/27/87)
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c/. Telers, 54
17820 Banyoles (Verona) Spain

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

603 Johnson Pumps (UK) Ltd (8/16/90)
604 Highfield Industrial Estate
Edison Road, Eastbourne
East Sussex, England

325 Johnson Pumps (UK) Ltd (12/19/79)
U.S. Representative: Viking Pump, Inc.
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Highfield Industrial Estate
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East Sussex, England

373 Luwa Corporation (12/27/82)
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Charlotte, North Carolina 28297-6348

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Exton, Pennsylvania 19341-139

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364 Roper Pump Company (7/28/82)
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2255-1 Lois Dr.
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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

332 TCI-Superior (12/10/80)
611 Sugar Creek Rd.
Delavan, Wisconsin 53115-0953

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

26R Tri-Clover, Inc. (9/29/56)
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Ventura, California 93003

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A Unit of IDEX Corporation
406 State Street
Cedar Falls, Iowa 50613

5R Waukesha Pumps (5/6/56)
(A Unit of AMCA Int'l. Inc.)
1250 Lincoln Ave.
Waukesha, Wisconsin 53186

408 Westfalia Systemat (10/18/83)
(Mfg. by Westfalia, West Germany)
1862 Brummel Drive
Elk Grove Village, Illinois 60007

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

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100 South CP Ave.
Lake Mills, Wisconsin 53551

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

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

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

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

87 Cherry-Burrell Corp. (12/20/57)
(A Unit of AMCA Int'l., Inc.)
2400-6th St., SW, P.O. Box 3000
Cedar Rapids, Iowa 52406

486 Fowler Products Company (11/18/86)
150 Collins Industrial Blvd.
P.O. Box 1706
Athens, Georgia 30613-1706

558 SOAVI B. & FIGLI S.p.A. (1/3/89)
(not available in USA)
43100 Parma (Italy)
VIA M. Da Erba Edoari, 29A

425 TCI-Superior (8/31/84)
611 Sugar Creek Rd.
Delavan, Wisconsin 53115-0953

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

45 The Heil Company (10/26/56)
1125 Congress Pkwy.
P.O. Box 160
Athens, Tennessee 37303-0160

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

66 Kari-Kool Transports, Inc. (5/29/57)
P.O. Box 538
Beaver Dam, Wisconsin 53916

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

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

189 A & L Tougas, Ltee (10/3/66)
(not available in USA)
1 Tougas St.
Iberville, Quebec, Canada

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

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

08-17 Rev. Fittings Used on Milk and Milk Products Equipment and Used on Sanitary Lines Conducting Milk and Milk Products

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

260 APV Crepaco, Inc. (08-17 A&B) (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

443 Badger Meter, Inc. (5/1/85)
6116 East 15th Street
Tulsa, Oklahoma 74158

82R Cherry-Burrell Corp. (12/11/57)
(A Unit of AMCA Int'l. Corp.)
2400-6th St. SW, P.O. Box 3000
Cedar Rapids, Iowa 52406

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

509 Fitting Speciality (8/7/87)
1303 35th Street
Kenosha, Wisconsin 53140

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

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

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

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

287 Koltek, Inc. (1/14/77)
Div. of Alfa Laval
(Mfg. Koltek, Finland)
100 Pinnacle Way, Suite 165
Norcross, Georgia 30071

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

601 Nuae Gmbh (6/15/90)
Am Rotboell 5
6108 Weiterstadt 2
West Germany

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

602 Process Systems Company (8/15/90)
1610 South Maple Street
Ottawa, Kansas 66067

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)
250 Ramsdell Ave.
Buffalo, New York 14216

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

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

300 Superior Stainless, Inc. (11/22/77)
611 Sugar Creek Rd.
Delavan, Wisconsin 53115

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

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

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

589 Titan Industries (12/27/89)
11121 Garfield Ave.
South Gate, California 90280

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

278 Valex Products Corp. (8/30/76)
6080 Leland Street
Ventura, California 93003

08-17A Compression Type Valves

533 APV Crepaco, Inc. (5/21/75)
100 S. CP Ave.
Lake Mills, Wisconsin 53551

484 APV Rosista, Inc. (10/22/86)
(Mfg. by APV Rosista, Inc. W. Germany & Denmark)
1325 Samuelson Rd.
Rockford, Illinois 61109

566 Advance Fittings Corp. (3/31/86)
218 Centralia St.
Elkhorn, Wisconsin 53121

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

555 Cherry-Burrell Corp. (12/11/57)
2400 6th Street S.W.
Cedar Rapids, Iowa 52406

538 Cipriani, Inc. (7/31/86)
(Mfg. by Fratelli Tassalini, Italy)
23195 La Cadena Drive, Suite 103
Laguna Hills, California 92653

376 Defontaine, Inc. (1/25/83)
(Mfg. by Defontaine, France)
563 A.J. Allen Circle
Wales, Wisconsin 53183

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

559 Koltek, Inc. (1/6/89)
Div. of Alfa Laval
(Mfg. by Koltek, Finland)
100 Pinnacle Way, Suite 165
Norcross, Georgia 30071

570 LUMACO (8/9/89)
9-11 East Broadway
Hackensack, New Jersey 07601

594 Oden Corp. (3/6/90)
255 Great Arrow Ave.
Buffalo, New York 14207

483 On-Line Instrumentation, Inc. (10/15/86)
Rt. 376, P.O. Box 541
Hopewell Junction, New York 12533

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

149R Q-Controls (5/18/64)
Subsidiary of Cesco Magnetics
93 Utility Court
Rohnert Park, California 94928

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

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

467 Tuchenhagen North America Inc. (1/13/86)
(Mfg. by Otto Tuchenhagen, West Germany)
4119 W. Greentree Road
Milwaukee, Wisconsin 53209

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

08-17B Diaphragm-Type Valves

565 APV Rosista, Inc. (10/22/86)
(Mfg. by APV Rosista, Inc. W. Germany & Denmark)
1325 Samuelson Rd.
Rockford, Illinois 61109

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, TX 77060

544 Valex Corp. (8/30/76)
6080 Leland St.
Ventura, California 93003

08-17D Automatic Positive Displacement Sampler

291 Accurate Metering Systems Inc. (6/22/77)
(Mfg. by Diessel, Germany)
1650 Wilkening Ct.
Schaumburg, Illinois 60173

284 Bristol Engineering Co. (11/18/76)
210 Beaver St.
P.O. Box 696
Yorkville, Illinois 60560

08-17E Inlet and Outlet Leak-Protector Plug Valve

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

556 Cherry-Burrell Corp. (12/11/57)
2400 6th Street S.W.
Cedar Rapids, Iowa 52406

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

08-17F Tank Outlet Valve

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

534 Lumaco (6/30/72)
9-11 East Broadway
Hackensack, New Jersey 07601

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

08-17H Thermoplastic Plug Type Valves

577 Ralet-Defay (11/2/89)
(U.S. Agent GENICANAM, Chazy, NY)
66, Blvd. Poincare
1070 Brussels, Belgium

08-17I Steam Injected Heaters

560 Pick Heaters, Inc. (1/19/89)

P.O. Box 516
West Bend, Wisconsin 53095

09-08 Instrument Fittings and Connections Used on Milk and Milk Products Equipment

32 ABB Kent-Taylor Inc. (10/4/56)
A Subsidiary of Asea Brown Brveri, Inc.
(Formerly Taylor Instruments)
95 Ames Street
P.O. Box 110
Rochester, New York 14692

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

321 Anderson Instrument Co., Inc. (6/14/79)
RD #1
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

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

418 Niro Atomizer Food & Dairy Inc. (4/2/84)
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

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

444 Tuchenhagen North America, Inc. (6/17/85)
4119 Green Tree Road
Milwaukee, Wisconsin 53209

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

435 Sermia Equipment Limited (11/27/84)
(Not available in USA)
2511 Barbe Avenue
Chomedey, Laval, Quebec, Canada H7T 2A2

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

11-04 Plate-type Heat Exchangers for Milk and Milk Products

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

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

30 Cherry-Burrell Corp. (10/2/56)
(A Unit of AMCA Int'l. Inc.)
2400-6th St. SW, P.O. Box 3000
Cedar Rapids, Iowa 52406

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

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

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 698
Ferndale, California 95536

491 On-Line Instrumentation, Inc. (1/2/87)
P.O. Box 541
Hopewell Junction, New York 12533

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

575 Pro Sales, Inc. (10/13/89)

107 2nd Street NW
Auburn, Washington 98001

279 The Schlueter Company (8/30/76)
(Mfg. by Samuel Parker, New Zealand)
216 Center Ave.
Janesville, Wisconsin 53547

426 TCI-Superior (8/31/84)
611 Sugar Creek Rd.
Delavan, Wisconsin 53115-0953

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

12-05 Tubular Heat Exchangers for Milk and Milk Products

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

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

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

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)
(Mfg. by Stork, Netherlands)
P.O. Box 1258/Airport Parkway
Gainesville, Georgia 30503

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

13-08 Farm Milk Cooling and Holding Tanks

49R A-L Stainless Inc. (12/5/56)
113 Park St., South
Peterborough, Ontario, Canada K9J 3R8

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)
(Not available in USA)
1261 Industrial Rd.
Cambridge (Preston)
Ontario, Canada N3H 4W3

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

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

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

273 Niro Atomizer Food & Dairy, Inc. (5/20/76)
1600 County Rd F
Hudson, Wisconsin 54016

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

299 Stork Food Machinery, Inc. (11/17/77)
(Mfg. by Stork, Holland)
P.O. Box 1258/Airport Parkway
Gainesville, Georgia 30503

427 TCI-Superior (8/31/84)
611 Sugar Creek Rd.
Delavan, Wisconsin 53115-0953

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

346 B-Bar-B, Inc. (10/21/81)
E. 10th & McBeth, P.O. Box 909
New Albany, New York 47150

192 Cherry-Burrell Corp. (1/3/67)

(A Unit of AMCA Int'l., Inc.)
2400-6th St. SW, P.O. Box 3000
Cedar Rapids, Iowa 52406

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

324 Conoffast (11/29/79)
(Mfg. by ERCA, France)
1600 Harvester Road
West Chicago, Illinois 60185

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

352 GMS Engineering (1/12/82)
1936 Sherwood St.
Clearwater, Florida 34625

473 International Paper Company (6/12/86)
Extended Shelf Life Division
4020 Stirrup Creed Drive Bldg. 200
P.O. Box 13318
Research Triangle Park, North Carolina 27709

516 Leifeld + Lemke USA (9/18/87)
(Mfg. by Leifeld + Lemke, West Germany)
25 Whitney Road
Mahwah, New Jersey 07430

220 Tetra-Pak EquipUS (4/24/71)
2285 University Avenue
St. Paul, MN 55114
(formerly Liquipak)

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

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)
800 Kaderly Dr.
Columbus, Ohio 43228

511 Remy Division (8/14/87)
(Mfg. by E. P. Remy, France)
2096 Gaither Road, Suite 119
Rockville, Maryland 20850

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

351 Tetra Pak Inc. (1/7/82)
(Mfg. by A. B. Tetra, Italy)
889 Bridgeport Ave.
P.O. Box 807
Shelton, Connecticut 06484-0807

211 Twinpak, Inc. (Canada) (2/4/70)
(Not available in USA)
1840 Route Trans-Canada
Dorval, Quebec, Canada H9P 1J8

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)
(A Unit of AMCA Int'l., Inc.)
2400-6th St. SW, P.O. Box 3000
Cedar Rapids, Iowa 52406

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

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

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

412 Sani Mark, Inc. (11/28/83)
2020 Production Drive
Indianapolis, Indiana 46241

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

262 A-L Stainless Inc. (11/11/74)
113 Park St., South
Peterborough, Ontario, Canada K9J 3R8

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

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)
(Not available in USA)
RR #3, Site 41
Summerland, British Columbia V0H 1Z0

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

536 Stainless Fabrication, Inc. (7/14/88)
620 N. Prince Lane
Springfield, Missouri 65802

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

23-01 Equipment for Packaging Frozen Desserts, Cottage Cheese, and Similar Milk Products, as Amended

174 APV Crepaco, 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

499 Fords Holmatic, Inc. (3/19/87)
1750 Corporate Dr., Suite 700
Norcross, Georgra, 30093

222 Fort Howard Packaging Corporation (11/15/71)
P.O. Box 19130
Green Bay, Wisconsin 54307-9130

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

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

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

24-01 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 56301

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

25-01 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

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

564 Precision Stainless, Inc. (2/27/89)
3300 E. Pythian
Springfield, Missouri 65801

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

520 Stainless Fabrication, Inc. (12/8/87)
633 N. Prince Lane
Springfield, Missouri 65802

202 Walker Stainless Equip. Co., Inc. (9/24/68)
618 State St.
New Lisbon, Wisconsin 53950

26-02 Sifters for Dry Milk and Dry Milk Products

173 Blaw-Knox Food & Chemical Equip. Co. (9/20/65)
P.O. Box 1041
Buffalo, New York 14240

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

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

176 Sprout-Bauer Inc. (1/4/66)
(Subsidiary of Combustion Engineering)
Muncy, Pennsylvania 17756

27-01 Equipment for Packaging Dry Milk and Dry Milk Products

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

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

28-01 Flow Meters for Milk and Milk Products

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 Rd.
P.O. Box 23099
Milwaukee, Wisconsin 53223

518 Bailey Controls Company (10/16/87)
29801 Euclid Avenue
Wickliffe, Ohio 44092

265 Tokheim Automation (3/10/75)
P.O. Box 38269
Dallas, TX 75238
(formerly Emerson Elec. Co.)

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

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

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

Jersey C.I. UK

540 EXAC Corporation (8/12/88)
6410 Via Del Oro
San Jose, California 95119

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

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

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

512 Hoffer Flow Controls, Inc. (8/17/87)
149 Highway 26
Port Monmouth, New Jersey 07758

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

399 E. Johnson Engineering & Sales (8/3/83)
11 N. Grant St.
Hinsdale, Illinois 60521

475 Koltek, Inc. (7/15/86)
Div. of Alfa Laval
(Mfg. Koltek, Finland)
100 Pinnacle Way, Suite 165
Norcross, Georgia 30071

529 Krohne America, Inc. (5/18/88)
(Mfg. by Altometer, Holland)
One Intercontinental Way
Peabody, Massachusetts 01960

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

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

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

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

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

270 Taylor Instrument (2/9/76)
Combustion Engineering, Inc.
400 West Avenue, P.O. Box 110
Rochester, New York 14692

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

29-00 Air Eliminators for Milk and Fluid Milk Products

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

485 Koltek, Inc. (11/18/86)
Div. of Alfa Laval
(Mfg. by Koltek, Finland)
100 Pinnacle Way, Suite 165
Norcross, Georgia 30071

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

31-01 Scraped Surface Heat Exchangers, as Amended

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

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

323 Cherry-Burrell Corp. (7/26/79)
(A Unit of AMCA Int'l., Inc.)
2400-6th St., SW, P.O. Box 3000
Cedar Rapids, Iowa 52406

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

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

32-00 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

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

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

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

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

35-00 Continuous Blenders

578 ACT Laboratories, Inc. (11/3/89)
P.O. Box 1107
McMurray, Pennsylvania 15317

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

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

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

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

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

36-00 Colloid Mills

608 Kinematica (10/17/90)
170 Linden Street
Wellesley, Massachusetts 02181

293 Waukesha Pumps (8/25/77)
(A Unit of AMCA Int'l., Inc.)
1250 Lincoln Ave.
Waukesha, Wisconsin 53186

37-01 Liquid Pressure and Level Sensing Devices

576 Ametek/Mansfield & Green Division (10/13/89)
8600 Somerset Dr.
Largo, Florida 34643

318 Anderson Instrument Co., Inc. (4/9/79)
R.D. #1
Fultonville, New York 12072

481 Computer Instruments Corp. (8/14/86)
100 Madison Ave.
Hempstead, L.I., New York 11550

405 Drexelbrook Engineering Co. (9/27/83)
205 Keith Valley Rd.
Horsham, Pennsylvania 19044

423 Dynisco (6/15/84)
Ten Oceana Way
Norwood, Massachusetts 02062

459 Endress + Hauser, Inc. (10/17/85)
2350 Endress Place
Greenwood, Indiana 46142

524 Flow Technology, Inc. (1/14/88)
4250 E. Broadway Road
Phoenix, Arizona 85040

463 The Foxboro Company (12/6/85)
33 Commercial Street
Foxboro, Massachusetts 02035

557 Honeywell, Inc. (12/21/88)
Industrial Controls Div.
1100 Virginia Drive
Fort Washington, Pennsylvania 19034

598 Invalco, Inc. (3/22/90)
P.O. Box 556
Tulsa, Oklahoma 74101

572 ITT Conoflow (9/25/89)
P.O. Box 768
Rt 78
St. George, South Carolina 29477

396 King Engineering Corp. (6/13/83)
P.O. Box 1228
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

419 Niro Atomizer Food & Dairy Inc. (4/2/84)
1600 County Road F
Hudson, Wisconsin 54016

597 NUOVA FIMA S.p.A. (3/20/90)
(not available in USA)
Via C. Battisti 59
28045 - INVORIO (N0) Italy

523 Paper Machine Components, Inc. (1/3/88)
Miry Brook Road
Danbury, Connecticut 06810

554 Par Sonics, Inc. (11/30/88)
P.O. Box 1127
State College, Pennsylvania 16804

563 PI Components Corp. (2/13/89)
10825 Barely Lane, Suite H
Houston, Texas 77070

328 Rosemount Inc. (5/22/80)
12001 Technology Dr.
Eden Prairie, Minnesota

515 Setra Systems, Inc. (9/14/87)
45 Nagag Park
Acton, Massachusetts 01720

583 S.J. Controls, Inc. (11/11/89)
2248 Obispo Ave. #203
Long Beach, California 90806

498 Statham Division of Solartron Transducers (3/5/87)
2230 Statham Blvd.
Oxnard, California 93033

285 Tank Mate Div/Monitor Mfg. Co. (12/7/76)

P.O. Box AL
Elburn, Illinois 60119

410 Viatran Corporation (11/1/83)
300 Industrial Drive
Grand Island, New York 14072

569 WEISS Instruments, Inc. (5/24/89)
(Mfg. by Nuova-Fima, Italy)
85 Bell St.
West Babylon, New York 11704

600 Weksler Instruments Corporation
800 Mill Rd
Freeport, NY 11520-0808

525 Zantel Instrument (3/4/88)
P.O. Box 81248
Lafayette, LA 70598

38-00 Cottage Cheese Vats (In Press)

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 MikroPul Corporation (9/4/85)
10 Chatham Road
Summit, New Jersey 07901

456 C. E. Rogers Company (9/25/85)
P.O. Box 118
Mora, Minnesota 55051

42-00 In-Line Strainers

606 Cherry-Burrell/Superior Stainless (9/18/90)
Fluid Handling Division
611 Sugar Creek Road
Delavan, Wisconsin 53115

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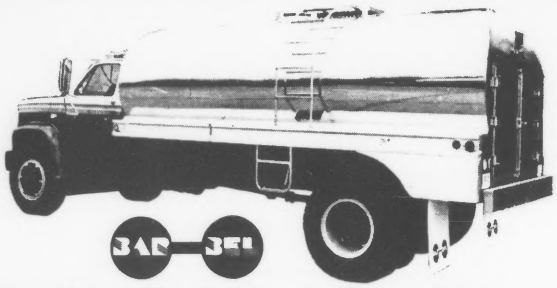

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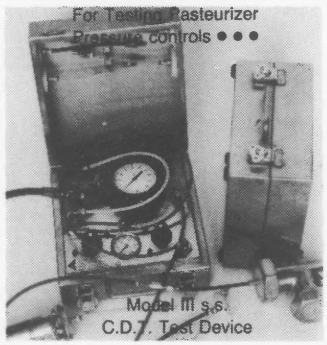

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1 — 7,000 Gal. Horizontal Storage Tank w/Agit.
2 — 6,000 Gal. Horizontal Cold Wall Tanks w/S.S. Front Heads.
5 — 2,000 Gal. Horizontal 50% Cold Wall Tank w/ Agit.
2 — 1,000 Gal. Vertical Cold Wall Tanks w/Top Agit.
2 — 1,000 Gal. Dome Top Pressure Wall Processors
1 — PR300 Curd Pump w/Drive.
1 — Q80-110 Cherry Burrell Filler w/Caser.
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Coming Events

1991

March

•**4-7, Better Process Control School.** For more information contact William Schafer, Ph.D., University of Minnesota, Department of Food Science and Nutrition, 1334 Eckles Avenue, Room 265, St. Paul, MN 55108, (612)624-4793.

•**4-8, Hazardous Waste Site Safety**. For more information contact the University of Florida, TREEO Center, 3900 SW 63rd Boulevard, Gainesville, FL 32608-3848 or call (904)392-9570.

•**5-6, Virginia Association of Sanitarians and Dairy Fieldman Annual Conference** will be held at the Donaldson Brown Continuing Education Center in Blacksburg, VA. For more information contact Haney Hodges at (703)362-8877.

•**6-7, CDR Cheese Research and Technology Conference** will be held at the Holiday Inn West Towne, Madison, WI. Sponsored by the Center for Dairy Research, University of Wisconsin-Madison. For additional information, call Sarah Quinones, at (608)262-2217.

•**6-8, Environmental Regulation Course**, sponsored by Executive Enterprises, Inc., will be held at Flamingo Hilton, Las Vegas, NV. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**7-9, Dairy Distribution Interchange**, sponsored by the International Dairy Food Association, will be held at the Royal Oceans Hotel, New Orleans, LA. For more information contact the IDFA, 888 Sixteenth Street, NW, Washington, DC 20006; (202)296-4250.

•**9, Hazardous Waste Site Supervision**. For more information contact the University of Florida, TREEO Center, 3900 SW 63rd Boulevard, Gainesville, FL 32608-3848 or call (904)392-9570.

•**10-13, IEFP '91**, sponsored by the Food Processing Machinery & Supplies Association, to be held at the McCormick Place, Chicago, IL. For information contact FPM&SA at (703)684-1080.

•**11-13, Environmental Regulation Course**, sponsored by Executive Enterprises, Inc., will be held at The Grand Hotel, Washington, DC. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**11-14, Better Process Control School**. For more information contact Robert Price, Ph.D., University of California, Department of Food Science, 250 Cruess Hall, Davis, CA 95616, (916)752-2194.

•**12-14, Environmental Regulation Course**, sponsored by Executive Enterprises, Inc., will be held at the Los Angeles Hilton & Towers, Los Angeles, CA. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**13, Indiana Dairy Industry Conference**, sponsored by the Food Science Department at Purdue University. For more information contact James V. Chambers, Purdue University , (317)494-8279.

•**18-20, Environmental Regulation Course**, sponsored by Executive Enterprises, Inc., will be held at The Palmer House, Chicago, IL. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**18-20, Better Process Control School**. For more information contact Jack Matches, Ph.D., University of Washington, HF-10, Institute for Food Science and Technology, Seattle, WA 98195, (206)545-1941.

•**18-21, Better Process Control School**. For more information contact Jorg Augustin, Ph.D., University of Idaho, Food Research Center, Moscow, ID 83843, (208)885-6456.

•**18-22, Molds and Mycotoxins in Foods,** sponsored by the American Association of Cereal Chemists, will be held in Lincoln, NE. For more information contact the American Association of Cereal Chemists, Short Course Program, 3340 Pilot Knob Road, St. Paul, MN 55121 or call (612)454-7250.

•**21-22, Clean Air Act From A to Z**, sponsored by Executive Enterprises, Inc., will be held at the Grand Hyatt Washington, Washington, DC. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**25-27, Environmental Regulation Course**, sponsored by Executive Enterprises, Inc., will be held at the Atlanta Hilton & Towers, Atlanta, GA. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**25-28, Better Process Control School**. For more information contact Winston Bash, Ph.D., Ohio State University, Food Industries Center, 140 Howlett Hall, 2001 Fyffe Court, Columbus, OH 43210, (614)292-7004.

•**25-28, Better Process Control School**. For more information contact Walter L. Clark, Ph.D., Chapman College, Food Science & Nutrition Department, 333 North Glassell, Orange, CA 92666, (714)997-6869.

•**25-29, Better Process Control School**. For more information contact Robert C. Wiley, Ph.D., University of Maryland, Food Science Program, Holzapfel Hall, I122A, College Park, MD 20742-5611, (301)454-2829.

•**25-29, Mid-West Workshop in Milk and Food Sanitation**, The Ohio State University, Department of Food Science & Technology, 2121 Fyffe Road, Columbus, OH 43210-1097. For more information contact Dr. David Dzurec (614)292-7723.

•**26-28, Environmental Regulation Course**, sponsored by Executive Enterprises, Inc., will be held at the Sheraton Society Hill, Philadelphia, PA. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**26-28, Western Dairy and Food Industry Conference** to be held at the University of California-Davis. For more information contact John Bruhn and Shirley Rexroat, Department of Food Science & Technology (916)752-2191.

April

•**1-5, Asbestos Abatement: Project Management & Supervision**. For more information contact the University of Florida, TREEO Center, 3900 SW 63rd Boulevard, Gainesville, FL 32608-3848 or call (904)392-9570.

•**2-3, Getting Started with HACCP**, sponsored by the American Association of Cereal Chemists, will be held in Chicago, IL. For more information contact the American Association of Cereal Chemists, Short Course Program, 3340 Pilot Knob Road, St. Paul, MN 55121 or call (612)454-7250.

•**2-5, Better Process Control School**. For more information contact C.E. Johnson, Ph.D., University of Wisconsin, Department of Food Science, Babcock Hall, 1605 Linden Lane, Madison, WI 53706, (608)263-2013.

•**3-5, Missouri Milk, Food and Environmental Health Association's Annual Conference** will be held at the Ramada Inn, Columbia, MO. For more information contact Richard Janulewicz at (816)781-1600.

•**8-9, Annual Meeting: National Cheese Institute and American Butter Institute** will be held at the Chicago Marriott Downtown, Chicago, IL. For more information contact the International Dairy Foods Association, 888 Sixteenth Street, NW, Washington, DC 20006, (202)296-4250.

•**10, 41st Annual University of Maryland Ice Cream Conference.** For more information contact Dr. James T. Marshall, Department of Animal Sciences, University of Maryland, College Park, MD 20742, (301)405-1375.

•**11-12, Nebraska Association of Milk and Food Sanitarians Annual Conference** will be held at the Omaha Douglas County Extension Office, 8015 West Center in Omaha, just off 84th and I-80. For further information contact Lois Clauson at (402)444-7196.

•**15-16, Clean Air Act From A To Z**, sponsored by Executive Enterprises, Inc., will be held at The Palmer House, Chicago, IL. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**15-16, Air Toxics Regulation Conference**, sponsored by Executive Enterprises, Inc., will be held at the Washington Hilton & Towers, Washington, DC. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**15-18, Better Process Control School**. For more information contact James V. Chambers, Ph.D., Purdue University, Food Science Department, Smith Hall, W. Lafayette, IN 47907, (317)494-8279.

•**16-18, Texas Association of Milk, Food and Environmental Sanitarians** will hold a training seminar entitled "Basic Pasteurization Course" at the Seven Oaks, 1400 Austin Hwy, San Antonio, TX. For more information contact Janie Park at (512)458-7281.

•**17-19, Shelf Life of Foods**, to be held in New Brunswick, NJ. For more information contact the Office of Continuing Professional Education, Cook College, Rutgers University, P.O. Box 231, New Brunswick, NJ 08903 or call (908)932-9271.

•**21-26, The National Conference on Interstate Milk Shipments** will be held at the Galt House, Louisville, KY. For additional information contact Leon Townsend, Executive Secretary/Treasurer, 110 Tecumseh Trail, Frankfort, KY 40601; (502)695-1088.

•**22-23, Pesticides: Strategic Planning For The Future**, sponsored by Executive Enterprises, Inc., will be held at the Grand Hyatt Washington, Washington, DC. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**22-23, Canadian Environmental Regulation Course**, sponsored by Executive Enterprises, Inc., will be held at the Holiday Inn Crown Plaza, Toronto, Ontario. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**29-May 2, Better Process Control School**. For more information contact Gerald D. Kuhn, Ph.D., Pennsylvania State University, Department of Food Science, 116 Borland Building, University Park, PA 16802-7501, (814)863-2965.

•**30, Associated Illinois Milk, Food and Environmental Sanitarians Annual Spring Conference** will be held at the Woodfield Hilton, Arlington Heights, IL. For more information contact Robert A. Crombie, Secretary AIMFES, 521 Cowles, Joliet, IL 60435 (815)726-1683 (Voice & FAX).

May

.**4-9, 1991 Food Structure Meeting** will be held at the Hyatt Regency Hotel in Bethesda, MD. For more information contact Dr. Om Johari, Scanning Microscopy International, P.O. Box 66507, Chicago, IL 60666-0507, or call (708)529-6677.

•**6-7, Air Toxics Regulation Conference**, sponsored by Executive Enterprises, Inc., will be held at Seattle Airport Hilton, Seattle, WA. For more information contact Executive Enterprises at (800)831-8333.

•**7-8, Canadian Environmental Regulation Course**, sponsored by Executive Enterprises, Inc., will be held at The Palliser, Calgary, AB. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**7-8, Clean Air Act From A To Z**, sponsored by Executive Enterprises, Inc., will be held at The Westin Oaks, Houston, TX. For more information contact Executive Enterprises at (800)831-8333.

•**9-10, Maximizing Product Safety Workshop** will be held at the Diagnal Data Corporation, Lakeland, FL. For more information contact the International Dairy Foods Association, 888 Sixteenth Street, NW, Washington, DC 20006; (202)296-4250.

•**13-15, Sanitation and Safety for the 90's**, sponsored by The American Sanitation Institute, for food processors and warehousers, will be held at the Hampton Inn-St. Louis Union Station. For more information and/or registration materials, contact Louann Morrow toll-free at (800)325-3371 or, in Missouri, (314)725-2555, or write The American Sanitation Institute, P.O. Box 24198, St. Louis, MO 63130.

•**13-16, Better Process Control School**. For more information contact D.L. Downing, Ph.D., Cornell University-NYSAES, Department of Food Science and Technology, Geneva, NY 14456, (315)787-2273.

•**13-16, Purdue Aseptic Processing and Packaging Workshop**, sponsored by the Food Science Department at Purdue University. For more information contact James V. Chambers, Purdue University, (317)494-8279.

•**13-17, Better Process Control School**. For more information contact Aurora S. Hodgson, Ph.D., University of Hawaii at Manoa, Department of Food Science & Human Nutrition, 1920 Edmondson Road, Honolulu, HI 96822, (808)948-6564.

•**14-16, Pennsylvania Association of Dairy Sanitarians and Dairy Laboratory Analysts Annual Conference** at the Keller Conference Center, Penn State University, University Park, PA. For more information, contact Sid Barnard, 8

Borland Lab, University Park, PA 16802, (814)863-3915.

•**16-17, Groundwater Contamination**, sponsored by Executive Enterprises, Inc., will be held at the Washington Hilton & Towers, Washington, DC. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**18-22, 72nd Annual National Restaurant Association Hotel-Motel Show** will be held at the McCormick Place, Chicago, IL. For more information contact the NRA, 150 N. Michigan Avenue, Suite 2000, Chicago, IL 60601; (312)853-2525, FAX (312)853-2548.

•**20-21, The Hazardous Waste Regulation Course**, sponsored by Executive Enterprises, Inc., will be held at the Washington Hilton & Towers, Washington, DC. For more information contact Executive Enterprises, Inc. at (800)831-8333.

•**21, Dairy Cost Accounting Workshop** will be held at the Chicago O'Hare Marriott, Chicago, IL. For more information contact the International Dairy Foods Association, 888 Sixteenth Street, NW, Washington, DC 20006; (202)296-4250.

•**22, U.W. Dairy Manufacturer's Conference** to be held at the Mead Inn, Wisconsin Rapids, WI. For more information, contact Bill Wendorff, Dept. of Food Science, 1605 Linden Drive, Madison, WI 53706, (608)263-2015.

June

•**24-25, The Hazardous Waste Regulation Course**, sponsored by Executive Enterprises, Inc., will be held at the O'Hare Marriott, Chicago, IL. For more information contact Executive Enterprises at (800)831-8333.

•**27-28, Chemical Labeling Conference**, sponsored by Executive Enterprises, Inc., will be held at the Sheraton Plaza Chicago, Chicago, IL. For more information contact Executive Enterprises at (800)831-8333.

July

•**11-18, International Workshop on Rapid Methods and Automation in Microbiology, XI**, and **Mini-symposium July 11-12th** at Kansas State University. Contact Daniel Y.C. Fung, Director, Tel (913)532-5654 or FAX (913)532-5681, 207 Call Hall, KSU, Manhattan, KS 66506.

•**16-18, Texas Association of Milk, Food and Environmental Sanitarians** will hold a seminar entitled "Basic Pasteurization Course" will be held at the Le Baron Hotel, 1055 Regal Row, Dallas, TX. For more information contact Janie Park of TAMFES at (512)458-7281.

•**21-24, International Association of Milk, Food and Environmental Sanitarians 78th Annual Meeting** to be held at the Galt House, Louisville, KY. For more information contact Julie at (800)369-6337 or (800)284-6336 (Canada).

To insure that your meeting time is published, send announcements at least 90 days in advance to: IAMFES, 502 E. Lincoln Way, Ames, IA 50010-6666.

To receive information on membership with IAMFES Circle 360 on this card

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

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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
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107	120	133	146	159	172	185	198	211	224	237	250	263	276	289	302	315	328	341	354
108	121	134	147	160	173	186	199	212	225	238	251	264	277	290	303	316	329	342	355
109	122	135	148	161	174	187	200	213	226	239	252	265	278	291	304	317	330	343	356
110	123	136	149	162	175	188	201	214	227	240	253	266	279	292	305	318	331	344	357
111	124	137	150	163	176	189	202	215	228	241	254	267	280	293	306	319	332	345	358
112	125	138	151	164	177	190	203	216	229	242	255	268	281	294	307	320	333	346	359
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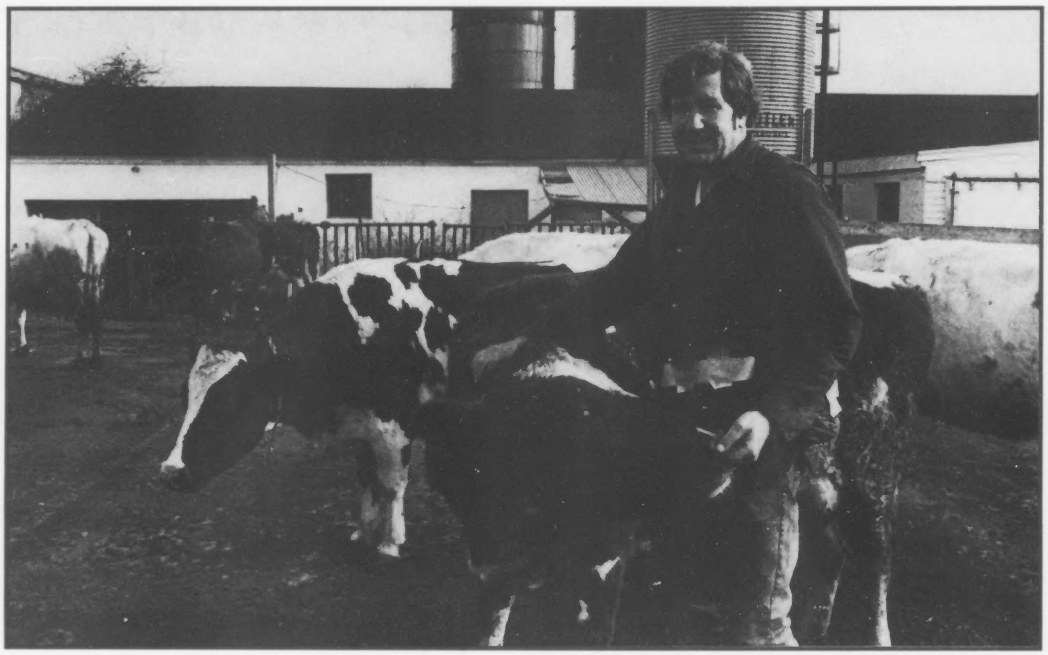
How do you tell a friend you've got to hit him with a heavy fine?



He's brought you a lot of milk over the years — and now you've got to bring him the bad news. But that's the rule — the guy whose antibiotics foul up the processing plant has to pay to clean it up.

The pity is that he could have caught that bad batch of milk before it even got into the silo.

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So be a good friend to ***your*** friend. Tell him it makes no sense for him ***not*** to do a Charm Farm Test. Especially since it's the only test around that closely matches the Charm II.

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