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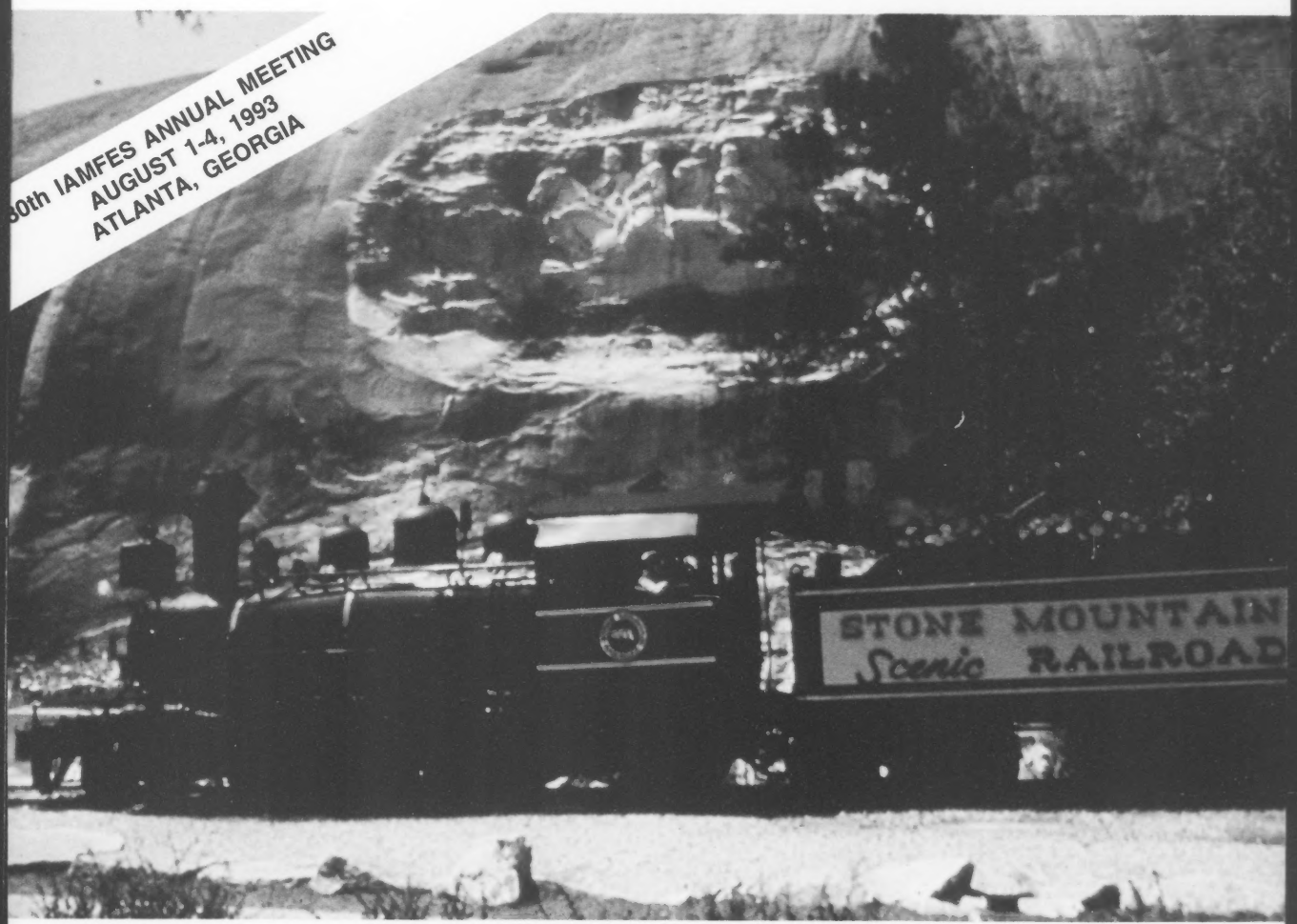
DAIRY, FOOD AND ENVIRONMENTAL

SANITATION

JULY 1993



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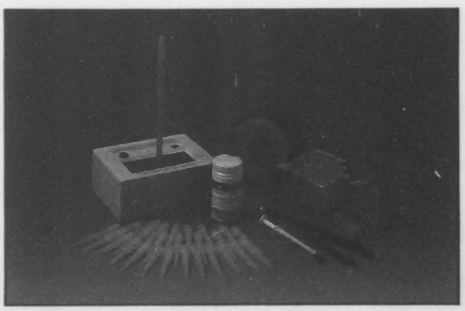

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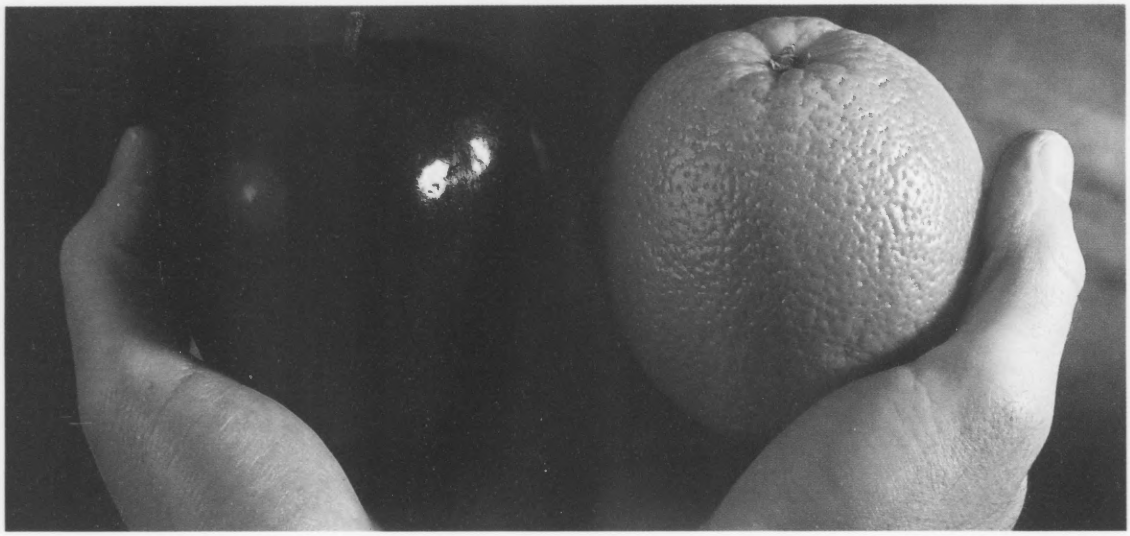

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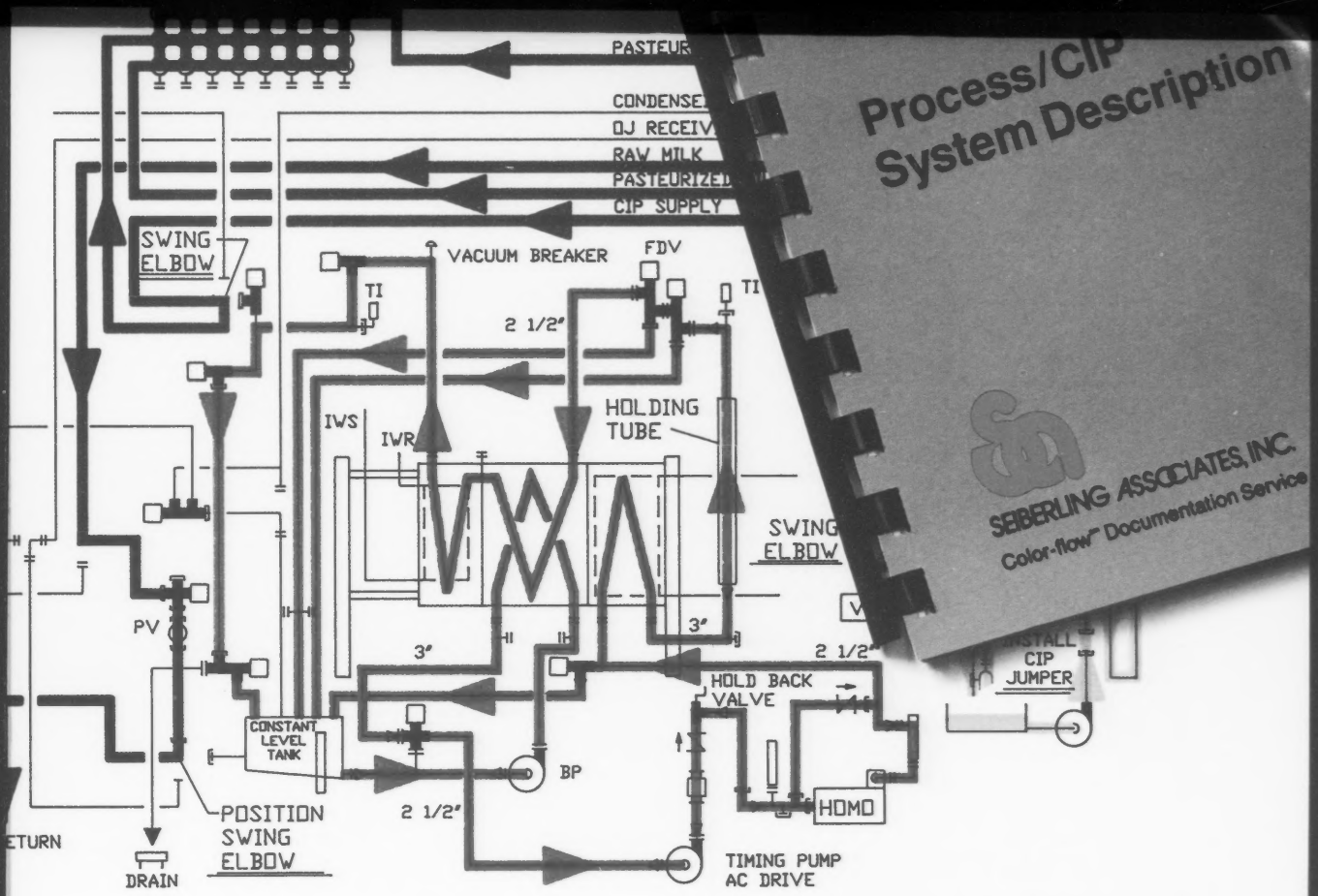

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ABOUT THE COVER . . . *Stone Mountain, Atlanta, Georgia. Photo courtesy of the Atlanta Convention and Visitors Bureau, Atlanta, Georgia.*

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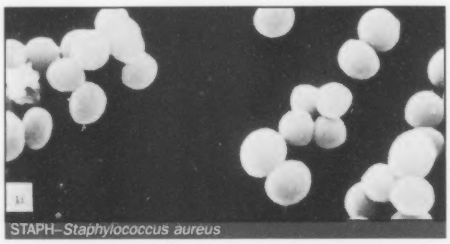
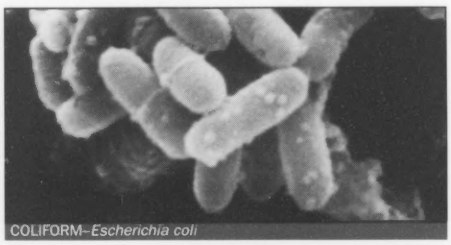
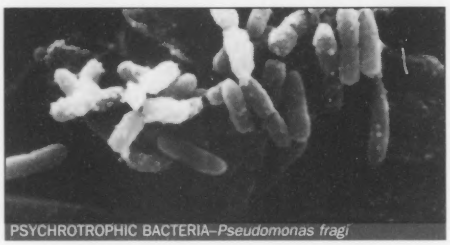
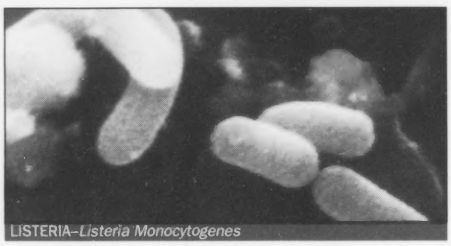

STAPH–*Staphylococcus aureus*


COLIFORM–*Escherichia coli*


PSYCHROTROPHIC BACTERIA–*Pseudomonas fragi*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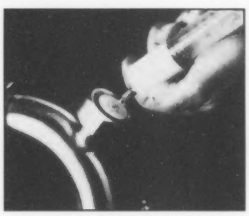

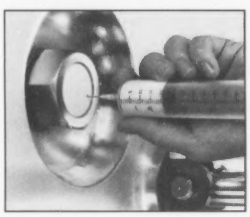

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Photographs of bacteria supplied by Dr. Edmund Zottola of the University of Minnesota, St. Paul, MN.

Thoughts From the President . . .

By
Michael P. Doyle
IAMFES President

Food Safety in the 21st Century

Food safety has in the 1990's come to the forefront among consumer concerns. Although today's food supply in the United States is among the safest in the world, recent outbreaks of *Escherichia coli* O157:H7 and a continuing increase in cases of salmonellosis indicate that problems exist. Pathogens have long been recognized as being associated with foods of animal origin, and thorough cooking combined with short holding times were used for many years to avoid illness. However, many of today's consumers have increased expectations about the safety of such foods. They do not know that foods derived from animals frequently are contaminated with pathogens or they incorrectly believe that the federal inspection program assures the safety of these foods. With this misunderstanding, consumers and foodhandlers abuse foods by undercooking, cross contaminating raw and cooked foods, and holding foods at inappropriate temperatures for extended periods of time. Some consumers even eat raw meat, poultry, and seafood, and drink raw or slightly heated milk.

A growing segment of the population that is highly susceptible to foodborne pathogens and that develop more severe illnesses than normal populations further complicates the challenge of providing safe food. Estimates indicate that by the year 2020 about 25% of the U.S. population will be 65 years of age or older. Increasing numbers of AIDS and transplant patients, individuals surviving longer with chronic illnesses such as cancer or cirrhosis, and the use of drugs and steroids result in immunocompromised populations that are predisposed to severe infections caused by foodborne pathogens. In addition, immunosuppressed populations are also susceptible to microorganisms in foods that are not usually harmful to normal, healthy individuals. These nuances further complicate the challenges of the food industry in providing products considered to be safe by consumers.

The food industry will enter the 21st century facing challenges that it has never faced before. It is confronted with an increasing population of consumers highly susceptible to foodborne pathogens as well as consumers wanting to eat raw or undercooked foods of animal origin, or who carelessly abuse such foods before consumption. There is clearly a need for innovative approaches to consumer education, to developing novel means of killing microbes in foods, and to reducing the carriage and prevalence of pathogens in and on animals used for food.

You can look to IAMFES in the 21st century to provide the forum to address these difficult issues.

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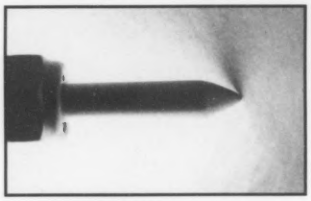
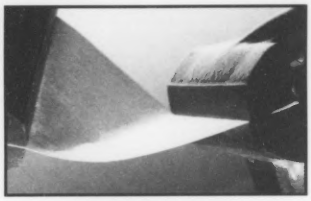


POKE IT



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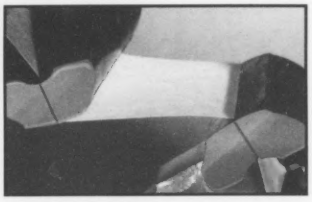

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On My Mind . . .

By
Steven K. Halstead, CAE
IAMFES
Executive Manager

. . . is our volunteer officers

As I have said many times in the past, volunteers are the life blood of any professional association. It is impossible to thank these individuals enough for the time, talents and just plain hard work that they contribute on our behalf.

I honestly don't know what would happen if no one wanted to be an IAMFES officer. In the four years I have been your Executive Manager, that hasn't been a problem. Each year we have been blessed with two outstanding candidates. The sad thing is that one of them has to lose.

IAMFES is now in the stage of its professional development where it is asking its officers to begin giving even before they take office. These pre-inauguration sacrifices come in the form of an expectation that the new officer will attend the meetings of the Executive Board (as a non-voting observer) in the time between being elected and actually taking office.

Over the past two years, we have been conducting a very intense "New Officer Orientation" shortly after the elections. Charlie Price, incoming Affiliate Council Chairperson and Michael Brodsky, incoming Secretary will be giving up a Friday and Saturday at the end of June to come to Des Moines for this program.

The goal of this orientation is to help the new officers become effective Board members in the shortest time possible. They will start the session by meeting the staff and will have the opportunity to spend some time with each staff person to learn what they do for IAMFES. Additionally, David Tharp, CPA, our Financial Manager, will spend time with them explaining our financial statements and our financial situation.

David Brown, Esq., our legal council, will also spend time with the new officers explaining the legal obligations involved in being a Board member of a not-for-profit organization. Mr. Brown will also cover corporate law as it pertains to associations and their Boards of Directors.

Most of Saturday will be spent in "skull sessions" in which we will review everything from the Policy and Procedures manual to Minutes of past Board Meetings; from the Constitution and Bylaws to the workings of our Committees, Task Forces and Professional Development Groups; from budget building to membership services; from annual meeting site selection to affiliate relations.

A very important part of this orientation is to establish the mindset of the roles of the volunteer versus that of the paid staff. It sounds easy enough to say "that the volunteers set the policy and the paid staff carry them out," but that mind set is not easy. Neither the Board member nor the association profits if either party loses sight of this distinction.

For our part, we are here to help the officer succeed. We want them to know that and to hold us accountable for that kind of behavior

We expect a great deal of our officers. The line officers are making a five year commitment. A commitment of time, talent and work. Lots of it. We couldn't exist without that commitment.

Thank you to all our officers; past, present and future.

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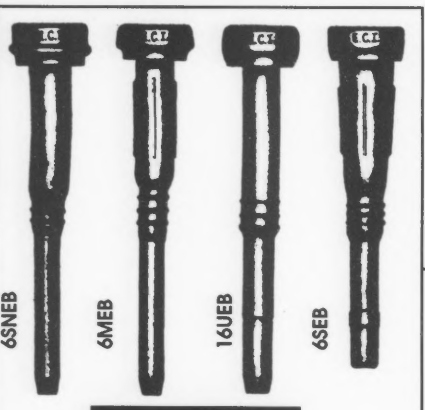

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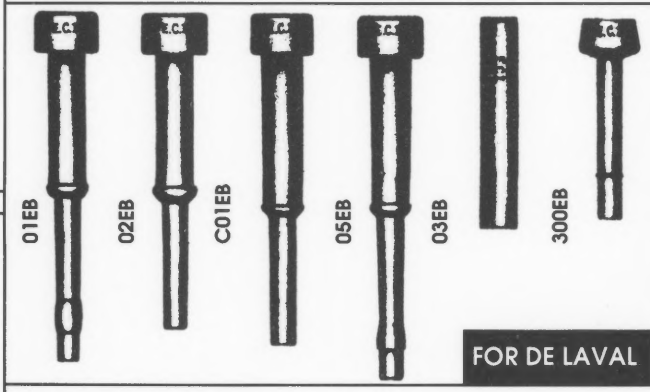

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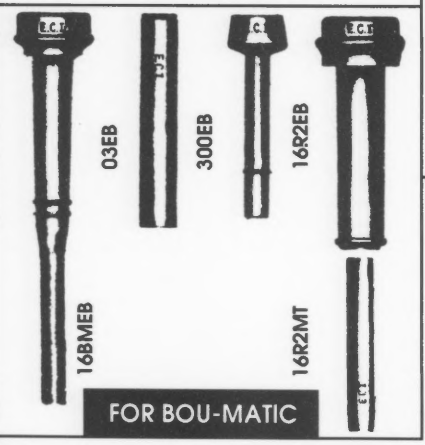

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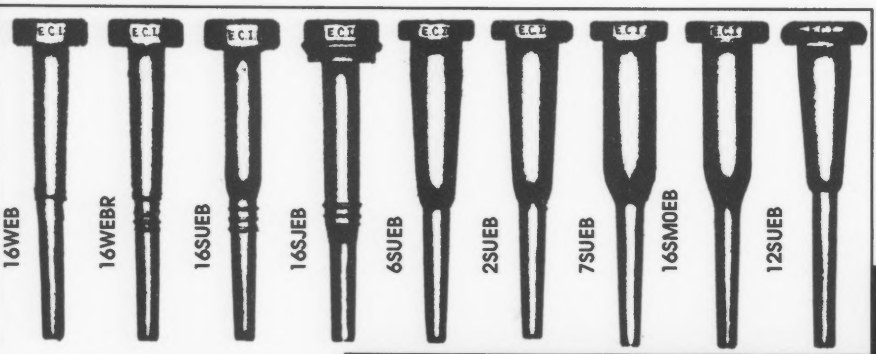

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Dairy, Food and Environmental Sanitation, Vol. 13, No. 7, Pages 387-388 (July 1993)

Health Inspections Then and Now

Rex T. Sherry, Chief, Training Branch, Division of Food and Drugs, Texas Department of Health, 1100 W. 49th Street, Austin, TX 78756

In the year 1836, when Texas was still a Republic, a law was enacted that stated in part, "food - the selling of flesh of animals not slaughtered, or slaughtered when diseased; or any broker, brewer, or distiller selling unwholesome food or drink shall be fined such sum adjudged by the court, and for the second offense, shall be fined and given 29 lashes on the bare back."

In the ensuing years, Texas mellowed somewhat and in 1883, the Texas Legislature enacted a statute that prohibited the manufacture and sale of adulterated foods and drugs. The State Health Officer was charged with enforcement of the Act and provided a budget of $2000.00. Government frugality interceded and the next appropriation was not until 1907. At that time, the Legislature enacted a Pure Food and Drug Act, patterned after the 1906 Federal Food and Drug Act, and a new agency was thus created to enforce the pure food laws. It was called the Dairy and Food Commission, with offices at the College of Industrial Arts in Denton, Texas.

In these early years, health fraud and medical quackery, such as "snake oil peddlers," consumed an enormous amount of time and resources. It seemed that every pitch man and con artist was out to sell the consumer a potion that would cure ailments such as cancer, impotence, fatigue, absent mindedness, dropsy, scurvy, obesity and baldness. To add to this dilemma, a continuous flow of sales pitches were made over the airwaves from powerful radio stations located along the Texas/Mexico border. Their 100,000 watt signals would reach into the northern hemisphere where homebound "shut-ins" were waiting by their radios for miracle cures. These radio listeners would respond by mail ordering all sorts of elixirs and tonics which guaranteed to cure all ills and restore health and happiness. During this tonic and hoodwinking era, a Dr. Brinkley from Del Rio, Texas was noted for his aphrodisiac potion made from goat glands.

In these early days, the processed food industry had its share of shenanigans perpetrated upon the consumer. As late as the 1940's, horse meat was substituted for ground beef, corn syrup blended with honey, oleomargarine passed off as butter, and blended syrup was sold as the pure thing. There were many other "short-cuts" to turn a quick profit. Granted, these scurrilous escapades did not make anyone sick . . . just lighter in the pocketbook.

A notable milestone was reached in 1961, when the Texas Legislature enacted the uniform Texas Food, Drug, and Cosmetic Act. This statute was conceived, drafted and promulgated by a cadre of State and Federal regulatory officials performing within the tenets of a professional organization known as the Association of Food and Drug Officials (of the United States). This organization, known today as AFDO, was founded in 1906 by Dr. Harvey W. Wiley, a food chemist with the U.S. Food and Drug Administration. To honor his distinguished career, the Harvey W. Wiley award is granted each year to a deserving food and drug official in the nation at their annual meeting. The 1993 annual conference is to be held in San Antonio during June 19-23.

To keep pace with an evolving technology in food and drug safety and efficacy, extensive amendments were made to the Texas Food, Drug, and Cosmetic Act by the Texas Legislature in 1985. These amendments were designed to promote conformance with the Federal Act and the Code of Federal Regulations. The most recent revision to the Texas Act was enacted by the 71st Legislature in 1989, when it was recodified to become Chapter 431 in the Health and Safety Code.

During the early 1960s to the late 1980s, the Division of Food and Drugs, Texas Department of Health (TDH), was staffed with only 15 field personnel. This small staff managed to inspect firms such as bakeries, beverage plants, candy plants, salvage operations, drug warehouses, drug manufacturers, methadone clinics, and retail food stores. After regular working hours, the staff would often times respond to emergencies such as truck wrecks, train wrecks, hurricanes, tornados and food-borne illness investigations.

Formal retail food inspection programs actually had origins with the promulgation of the June 1940 edition of the Ordinance and Code Regulating Eating and Drinking Establishments enacted by the U.S. Public Health Service. This code was adopted by many cities in Texas and used as a reference by the State Health Department. It had a non-weighted inspection form consisting of 17 items.

The 1940 Code endured until 1962, when the U.S. Department of Health, Education and Welfare (DHEW), Public Health Service produced a second Food Service Sanitation Manual. The accompanying inspection report had 118 weighted items totaling 298 points. On the exit interview, a demerit score was issued to the establishment. A demerit score of 20 or less meant the restaurant was substantially in compliance while a demerit score of 40 or over meant permit revocation.

Needless to say, this "numerical nightmare" was not well accepted by TDH and local jurisdictions. They felt if they couldn't understand it, how in the world could the industry understand it?

The most widely accepted food code produced by DHEW, U.S. Public Health Service, Food and Drug Administration, was the 1976 Food Service Sanitation Manual. It has an accompanying inspection report consisting of 44 weighted items totaling 100 points. A positive grade is issued to the establishment. A grade of 70 to 100 is generally acceptable, providing imminent health hazards are absent. A grade of below 60 means serious trouble and immediate attention by all parties.

As of this writing, a fourth retail food code is being drafted by a select group of FDA food specialists in Washington D.C. Reportedly, it is to be completed by March 1993 and ready for publication in the Federal Register shortly thereafter. From all indicators, the inspection report will not be weighted and holding/cooking temperatures will be revised. The new code will also be accompanied by a "state of the art" software program.

To address all aspects of the State's Food and Drug regulatory responsibilities, today's work force has more than tripled in size since 1960. Additional regulatory activities have been included such as tanning salons, medical devices, health foods, drug diversion and health fraud.

In the post WW II era, when a "health inspector" was hired, the job requirements were that they be warm and walking with an ability to count. The counting part was necessary since rodents leave calling cards and thermometers have numbers. A routine field assignment consisted of traveling by Greyhound bus for six weeks in West Texas inspecting greasy spoon restaurants in non descript dusty towns. In those days, health inspectors were as tough as pig snouts, by necessity!

Nowadays, when food and drug investigators travel, it is by airline or rental car. They have an arsenal of equipment including notebook computers, ink jet printers, data logger thermometers, pH meters, and camcorders. Their skills include proficiency in software programs such as Quattro Pro, Harvard Graphics, Wordperfect, and Fox Pro. Many have masters degrees in the Environmental Sciences.

The Division of Food and Drugs presently consists of seven Branches with a total staff of 120. The organizational Branches are Foods, Drugs, Compliance, Devices, Training, Accreditation, and Licensure.

It was realized early on by TDH administrative staff that training of field personnel was vital to a successful regulatory program. One primary objective for thorough training is to strive for uniformity within the inspectional ranks. With uniformity comes an appreciation and respect from the regulated industry that the agency is at least trying to establish a "level playing field."

To further promote uniformity of training standards, TDH has developed statistically valid examinations designed to measure the knowledge and skills of food service managers. Classroom training for food service managers is sponsored by community colleges, local health departments, and private industry groups. These programs are accredited by TDH in accordance with State statutes.

Most everyone is familiar with the old adage, "necessity is the mother of invention." That being a given, necessity for accuracy and cost containment factors contributed to the development of a restandardization examination to measure the knowledge and skills of a journeyman food service training officer. This examination tracks the 44 item food service inspection report and consists of 145 multiple choice questions relating to the FDA Food Service Sanitation Manual and the State Rules on Food Service Sanitation. This statistically valid examination utilizes a 70% passing score and pinpoints the strengths and weaknesses of a training officer in the six basic areas of the food codes. These six testing subscales relate to (1) food care; (2) personnel; (3) equipment and utensils; (4) cleaning, sanitization, and storage of equipment and utensils; (5) sanitary facilities and controls; and (6) construction and maintenance of physical facilities. This examination was developed in conjunction with the Southwest Region of the Food and Drug Administration. A video training tape was previously produced by TDH and FDA to compliment this examination.

The most current food safety trend that is sweeping the country is the implementation of the Hazardous Analysis and Critical Control Point (HACCP) concept into retail food protection. This concept was developed by the Pillsbury Company over 20 years ago under a contract with the National Aeronautics and Space Administration during the early space program. It was introduced to the regulatory community in Denver, Colorado, in 1971 at the very first Conference on Food Protection.

A Critical Control Point is an operation or step in an operation where a preventive or control measure can be exercised that will eliminate, prevent, or minimize a hazard that has occurred prior to this point. A hazard consists of physical, chemical or microbiological contamination of a food item within the preparatory chain.

On a national scale, the Food and Drug Administration (FDA) collaborated with the National Marine Fisheries Service (NMFS) and the Food Marketing Institute (FMI) to implement a seafood HACCP program in 14 national food chains. Training for the industry and regulatory representatives was hosted by TDH in the Dallas/Fort Worth area in September/October 1991.

In January 1993, FDA and NMFS collaborated with the National Restaurant Association (NRA) to incorporate a seafood HACCP program into several national restaurant chains. Again, Texas was the host State with training in the DFW area.

While HACCP is an excellent approach to food safety, it is by no means a panacea to public health. For example, the seafood industry is plagued with many naturally occurring toxic contaminants in fish that HACCP cannot touch. In other words, unavoidable things happen to the product before it reaches the retailer. A classic example is the Jack in the Box problem with *E. coli* in hamburger meat that made some 300 people sick in Washington State.

The TDH position on the HACCP concept in food safety is to apply it as an integral part of the everyday inspection process. To incorporate a successful HACCP program, there must be a joint effort. Essentially, HACCP must be "regulatory introduced" and "industry driven."

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Dairy, Food and Environmental Sanitation, Vol. 13, No. 7, Pages 391-394 (July 1993)

The Use of Rapid Methods for On-Line Monitoring

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The title for this piece should, in truth, be expanded to read "The Use of Rapid Methods for On-Line and At-Line Monitoring *and Control*." On-line monitoring, strictly speaking, is mechanically linked to the process flow. At-line monitoring can be performed *ad lib* and is not mechanically linked. But the final two added words emphasize the reason for *all* monitoring.

Without control, monitoring operations are a waste of time. Without control, quality control operations revert to the old belief, which is fortunately dying away, that quality can be inspected into a product. If an operation is out of control, or a material out of specification, no amount of inspection or data gathering is going to bring the process or product back into line. Steps must be taken to dynamically adjust the process.

The true object of quality, safety or attribute monitoring is to collect and analyze enough samples quickly so that the process can be corrected in "real-time." As soon as substandard materials are produced, the producer loses money. Those substandard products must be destroyed, reworked or sold at a loss. If the producer fails to efficiently discover these substandard articles, his losses are magnified by the market. Now he is looking at recalls, buyer complaints, performance failures for which he might be liable, bad publicity and potential loss of market, and even illness or injury. The bottom line is: monitoring and control can save money.

PROGRAM KEYS. How does an organization go about developing the capabilities for on-line monitoring? The first requirement is a management infrastructure that nourishes such programs. Effective programs start with a "top-down" policy statement.

1. **Management Support.** Management must support company or corporate quality programs. These programs should be under the Quality Assurance group. Note that the term is quality *assurance* not quality *control*. There is a vast difference between the two. Quality assurance is defined as:

"All encompassing programs, including but not limited to such aspects as quality control programs, setting of standards, evaluation of incoming materials, development of tracking and coding systems, and adherence to Good Manufacturing Practices (GMPs), designed to ensure to an established degree of confidence that products are produced, packaged, distributed and ultimately reach the consumer in a given condition." (1,2)

The key words are *all encompassing* and *degree of confidence*. These statements imply an organized and systematic (statistical) approach toward achieving the organizational goal. Also, observe that the quality control programs are only a part of the overall quality assurance effort. Quality control is really the inspection arm of the quality assurance effort and may be defined as:

"The scientific evaluation of production and production practices, consisting of on-line evaluation of raw materials, finished product and packaging materials to determine adherence to accepted standards."(1,2)

The importance of management support for these groups and programs must be reemphasized. Without such support, programs die, staff become disillusioned, and the company suffers. Quality staff must work to educate management that their operations should be considered cost-savings centers, not the cost-generating activities they are all too often considered to be, especially by the new generation of business-school-trained managers.

2. **The Plan.** Of course, management usually will not give the quality group *carte blanche* to go out and spend money to develop product protection and/or product quality systems. There has to be a plan of some sort. This is where TQM (Total Quality Management), SPC (Statistical Process Control) or a HACCP (Hazard Analysis at Critical Control Point) approach can be useful.

These programs are used as examples because by their very nature, they adhere to the two main components of the definition of quality assurance, *all encompassing* and *control*. Granted, the focus of HACCP is food safety, but its systematic approach—understanding the process, determining critical control points and developing the means to monitor, control and react to deviations—is basic to understanding and controlling any operation. (3) A quick review of the seven HACCP principles (4) will serve to emphasize the systematic approach inherent in this program.

1. Assess hazards associated with growing, harvesting, raw materials and ingredients, processing, manufacturing, distribution, marketing and consumption of the food.

Reprinted from June 1992, Baking & Snack

2. Determine critical control points (CCPs) required to control identified hazards.
3. Establish critical limits that must be met at each critical control point.
4. Establish procedures to monitor critical control points.
5. Establish corrective action to be taken when there is a deviation identified by monitoring a critical control point.
6. Establish an effective record-keeping system to document the HACCP plan.
7. Establish procedures to verify that the system is working.

Looking these over, they can also be used as a model for building a quality program. If that is the tack your company decides to take, however, you should strive to segregate the food safety issues addressed by HACCP and the quality issues.

So the keys to the on-line monitoring program are two-fold: management support and a plan. Which comes first may be debated, but each is needed before implementation.

GETTING GOING. Implementing the plan is the next step. The elements required for implementation were described, in part, in the seven HACCP principles. They can, in fact, be used as a guideline for implementation with one addition. That addition is development of product specifications. This may seem rather basic, but without well defined specifications, all quality efforts are in vain.

The development of a product and its specifications is usually a joint effort involving the marketing, research and development, engineering, quality assurance and the production groups. They must conceive and develop the product and make it run in a "real-world" environment.

Once the specifications have been finalized, the responsibility for maintaining them falls in the hands of production and quality assurance. Marketing's responsibility is only to sell the product.

The authors have not mentioned food safety specifications simply because the federal law requires packers to produce safe food, and liability protection demands safety. It is, therefore, a given.

1. **Assess the System**. A complete understanding of each product and all raw materials is essential. Know the product quality and safety requirements. Find where in the system product quality or safety could be compromised. Construct flow charts to better understand what is going on.
2. **Establish Monitoring Points**. Those points to assure safety may differ from those for quality. In making this assessment, ask questions such as: "If the system gets out-of-control at this point, what will happen to the product?" or "What are the chances of losing control of the process at this point?" It is obviously not possible to sample and monitor at all points on the line, so judicious selection of critical control points (CCPs) for safety or control points for quality is required.
3. **Establish Limits for Control**. This is, perhaps, the most difficult of the tasks involved in implementation. What are the limits that will provide a processor with safety and/or quality? This is also important because the monitoring point and limits affect what kind of testing or sampling will be done and if the system can use an automated unit. In baking cookies, for example, the percentage of moisture and the color of the cookie are considered important quality parameters. Control of these factors is affected by formulation and by the baking process, specifically oven temperatures. It is, therefore, essential to establish a range of moistures and cookie colors to work within. If the operator determines that the products are becoming too brown or too dry, he or she must make the proper adjustments. More on this later.

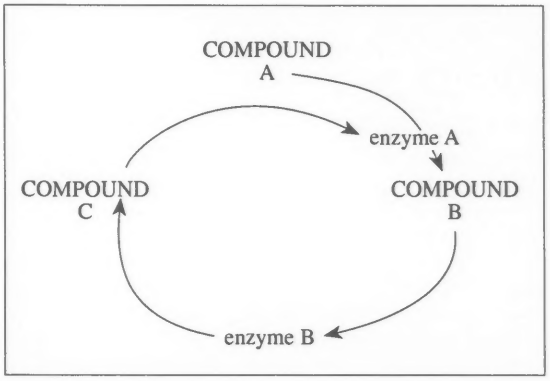
4-5. **Means of Monitoring and Corrective Actions**. These two principles are grouped because they should go hand-in-hand. The object of on-line monitoring is to get away from finished product sampling as a means of assuring quality or safety. It has already been stated, but it needs to be reiterated: You can't inspect quality into a product. By placing these two principles together, a processor takes the radical step of placing quality monitoring in the hands of the operators. Why not? They are the ones who know the system and how best to adjust it.

Provide operators with the simple tools to sample and evaluate and make decisions. It's not as difficult as many supervisors believe. Consider this all-too-common scenario: A member of the quality staff collects a sample and takes it back to the lab. By the time it is logged in, tested and the results examined, it may be an hour or more. What if the sample is out-of-spec? Production has now made an hour's worth of suspect product that must go on hold and still has to tell the operator to make adjustments. Let the operator do the whole thing. Mechanize the operator's station as much as possible to facilitate the monitoring and control steps.

6. **Record-keeping.** Good records are a necessity, and they need not be complicated. The use of "X-R" charts, well designed forms and simple tests allow easy recording of results. Automated systems almost always come equipped with recorder charts (temperature, time and pressure, for example), printouts or a means to get a detailed printout (computer controlled systems). With computers, it is possible to collect and act upon a huge amount of data.
7. **Verification that the System is Working**. This principle is basic common sense, but it is often ignored. This is where finished product sampling comes in. If random samples show something out-of-control, yet records say it is all in control, you know something is amiss. The divergence can be due to continuing to measure an already optimized variable when the problem has shifted into a different area that is not being monitored. Verification steps include, but are not limited to, record review, challenging on-line systems or staff with "spiked" or "known" samples, evaluating calibration records, walk-through inspections, instrument checks and upgrading the whole process as technologies improve or processes change.

RAPID METHODS. Use of the term "rapid" when discussing monitoring and control is almost repetitive. For a ma-

chine, system or test to be used on-line, it has to be rapid. The monitoring system or test must be such that an action is taken when a deviation occurs (principles 4 & 5). An example of such a system is one of the basics of all life, that is, the feedback action of enzymes in living systems as seen in Figure 1. Regulatory enzymes sense changes in concentrations of certain end products in the reaction and "signal" the reaction to slow or stop. They are, in essence, inhibited by the end product.



This same action should occur in a food plant. Let us examine how this can be done and some of the tools and instruments available to the baking and snack industry today.

There are four kinds of at-line and on-line monitoring. These are: rapid tests done by an operator, who must then take action; automatic monitoring devices requiring operator adjustment; automatic devices with control capabilities; and automatic devices with no control capabilities. In detail, these are:

Rapid Tests. There are a large number of rapid test methods on the market today. These range from simple self-contained tests for measuring different parameters such as fat or oil quality, chlorine in water and sugar concentrations to state-of-the-art instrumentation, such as NIR (near-infrared) to simple color charts. With these systems, the operator needs to collect a sample or series of samples, run his test(s), compare the data to standards or "X-R" charts and make necessary adjustments. To use the cookie example presented earlier, an operator would make adjustments to oven temperature based on color and moisture.

The self-contained tests are most effective with fluid systems (oil or water, for example). Blumenthal and Stier(5) recently described the criteria for an ideal frying oil quick test. This set of conditions can be modified to describe the ideal rapid test for use on a production line:

- Correlate with official and/or recognized methods.
- Provide an objective index/marker.
- Be simple to use.
- Be inexpensive for value received.
- Be safe for use in a food preparation/production area.
- Correlate to food quality.
- Be field-rugged, i.e., able to be used in the hostile environs of a plant.
- Allow for remote reinspection of results.

Many of these at-line quick tests can be retained by the operator for collection by quality control. This serves as a check on the operator and the test itself.

The application of easy-to-use instruments in plants is expanding rapidly. Operators may be asked to monitor pH, percentage of salt, moisture, color, viscosity or percentage of fat. Instruments available include meters using probes or electrodes for pH, salt and other parameters, those employing microwaves for moisture and/or fat determination and a variety of instruments using NIR or near-infrared. The latter is, perhaps, the most sophisticated of the lot. NIR applications include moisture determination in baked goods and measurement of moisture or other contaminants in oils and other fluids. Instrumental tests may involve at-line or on-line approaches.

The final kind of on-line test performed by the operator is the simplest. Many companies simply use color standards or photographs that allow the operator to directly compare product with accepted standards. Using the cookie example, companies may prepare photographs of products that are too light, too dark and acceptable. Operators compare product with the photographs and make necessary adjustments or pull unacceptable products.

To employ these operator level tests, the company must offer the line operator the job education and support to make the appropriate decisions. It is the responsibility of the quality assurance group to provide that education and to set the appropriate guidelines for evaluation. It is also this group's responsibility to evaluate any changes made to the product or process and inform the operations staff about how the changes will affect the product or process.

Automatic Monitoring Devices Requiring Operator Adjustment. There are many systems available in today's market that measure a parameter and have limited control capabilities. The most common parameters are time and temperature. Most baking or frying operations have systems that control the temperatures of the ovens or fryers, the length of the cook or the belts speed within set parameters. Unfortunately, variations in product quality require operators to "tweak" the controls on occasion. There are also systems without controllers, which require operators to monitor temperature gauges, recorder charts or digital readouts and make the appropriate adjustments. These are becoming increasingly rare. The final type of monitoring device in this class are units with alarms. The alarms prompt the operator to make the appropriate adjustments. On-line systems using NIR often offer this feature. If a system with alarms is installed, be sure that they get the operator's attention. Buzzers and flashing red lights work quite well; and be sure the alarm system is engaged.

Automatic Devices with Control Capabilities. These systems are the "wave of the future." With computer systems and chip technology improving almost daily, there is really no limit to the development of this kind of system. There are, in fact, some operations that are today fully automated. In these plants, the only persons visible on the production floor are mechanics or electricians, who monitor the equipment and controllers.

These kinds of automated systems are not new, however. There are many mechanical systems that have been and continue to be used. The most common is a feedback system

that shuts down a line if a stoppage occurs. This prevents product buildup, product damage and can significantly reduce waste. Another mechanical system is one that connects check weighers to filling machines. These systems are fitted with servo motors that adjust fill as weights are determined to be high or low. These systems can create more variability than is desirable, however.

These smart systems can be used in the manufacture of finished products or ingredients. Applications include monitoring salt, brix and/or viscosity of fluids, measuring different parameters such as free fatty acids in oils and weight control. In each of these applications, a sensor reads the product or ingredient flow and signals a unit operation upstream to make an adjustment. For example, if a corn syrup of a given brix is required for a formulation, the sensor will signal the on-line blending system to increase or decrease the flow of water.

Automatic Devices with No Control Capabilities. This final category is also becoming more in vogue. These systems have numerous applications for both quality assurance and food safety. The systems are designed to insure that the finished product meets a given specification, be it fill weight, appearance of the product or package, or a safety issue. The units that perform this function either assure that the particular specification is met or eliminate units that do not. Examples are automatic scales, metal detectors, foreign object scanners, electronic sorters, programmable cameras and checkweighers. They may be designed for feedback control of upstream operations but in most practices are not.

Of these systems, the automatic "statistical" scales used for packaging are the one that present the greatest savings potential to the baker or snack food producer. These units have a set number of scales, which are continuously "read" by the computer. When the combined weight of three or four of these scales or pans is determined to be at or near the target, the contents of those pans are dropped into the waiting pouch, bag or container. Unlike volumetric fillers, which packers tend to adjust a bit high to assure that a target fill is met, these systems can significantly reduce the amount of product the packer ends up "giving away." As an example, before switching to such systems, a nut processor was overfilling 1/2-oz (14-g) packages by two grams to assure a proper fill. The scale system reduced the overfill by 1 1/2 g, which gave the producer an extra package for every ten filled. The units also provide the packer with a much more consistent fill.

Systems like metal detectors, checkweighers or foreign object scanners can be set to scan the product, the filled package or a packed case. If the unit is defective, that is, a low weight or foreign material is detected, that unit is removed from the line. This is usually done with air, a plunger or by diverting the suspect unit. Products rejected from these systems are usually not tested to determine why they were rejected, unless the number of rejections is high. This signals a potential problem. As an example, if a metal detector begins kicking out every package, it says that there is either a serious problem or the detecting unit has gone "haywire."

Electronic sorting is the last "no control" topic for discussion. The limits to this technology are boundless, especially with continuing improvements in both computers and programmable cameras. Sorters can be set up to remove foreign materials, damaged or scratched units, off-color pieces, tree nuts with adhering skin, deformed units and more. An example of the potential for such systems may be found in the pizza industry. Scanners are set to count the number and arrangement of different toppings on individual pizzas and reject those that have, for example, only six pieces of pepperoni instead of seven.

Perhaps a fifth category could be added: the line operator. Each and every line person should be watching the line. They should report deviations, remove suspect or damaged product and act as a first line of defense in product safety and quality.

Rapid at-line and on-line monitoring and control is here to stay. The potential for quality and safety enhancement of foods and ingredients are enormous. For example, automatic statistically controlled scales usually pay for themselves within a year. Moving control testing from the lab to the line— where it really belongs—is something all processors will probably move to, if they haven't already. It is not something gone simply "jumps into," however. The costs and benefits need to be examined. One doesn't test or monitor simply for the sake of testing and monitoring. If your records show that metal contamination has never been an issue, it is essential to ask the question, "Is it really necessary to install metal detectors on-line?"

Management support, a plan for controlling the operation and well defined specifications are necessities. Companies need to be willing to provide the necessary education to their staff who will be involved with doing the testing and/or maintaining the equipment. As monitoring and control operations become more sophisticated, so must the operators. Management must realize that maintenance and monitoring of the equipment take on an added dimension. One issue the quality or maintenance staff must be aware of with any monitoring device, be it a state-of-the-art sorter or a simple pH or salt meter, is that people tend to take such units for granted and neglect to standardize or check their operation. Routine checks and standardization steps need to be developed, and records of such actions maintained. So no matter how sophisticated a program or instrument, it all boils down to the individual worker or workers. They need the tools, education and support of management to effectively monitor—and control—product quality.

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Irradiation of Meat and Meat Products to Ensure Hygienic Quality*

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ABSTRACT

Refrigerated foods of animal origin, particularly poultry and pork are often contaminated with certain pathogenic microorganisms, such as *Salmonella*, *Campylobacter*, *Listeria*, *Yersinia*, *Aeromonas*, and with parasites like *Toxoplasma* and *Trichinella*. Since irradiation has been confirmed as a very efficient method for the production of healthy, wholesome and microbiologically safe food, this paper does not review all aspects of hygienic quality of irradiated meat and meat products, but rather discusses the results of experiments from recently published papers on irradiation of meat and meat products and considers the future of irradiation technology.

INTRODUCTION

The FAO/WHO (9) defines food hygiene as "precautions and measures that should be taken during the manufacture, handling, storage, and distribution of foods if a satisfactory, healthy and wholesome product is to be the result." These aims can only be achieved by means of many hygienic measures, and food irradiation is one of the newest and a very promising one. Of course, the process itself can not remove responsibility from the other segments of the food chain for maintaining a high degree of safety.

In May 1992, WHO (1) reported conclusions of the international panel reaffirming that the process of food irradiation, when carried out under good manufacturing practices (GMP), would not introduce any food composition changes that can produce, from a toxicological point of view, an adverse effect on human health. The panel based its toxicological evaluation on a review of more than 200 studies on irradiation of food. Regarding nutritional adequacy, it concluded that food irradiation carried out under applicable GMPs will not introduce nutrient losses that would impose an adverse effect on the nutritional status of individuals or populations. However, the panel felt that changes in the content of vitamins known to be sensitive to irradiation should be monitored. The panel further concluded that under GMPs, the process would not introduce changes in the microflora of food which might increase microbiological risk to consumers. Dr. Fritz Kaferstein, Chief of WHO's Food Safety Unit, called the campaign for public acceptance of food irradiation a "carbon copy" of the story of pasteurization, whose introduction at the turn of the century was slowed by misinformed opponents. He said that the technology of food irradiation is "badly needed" in a world where food-borne diseases are on the increase.

It is generally accepted that it is impossible today to guarantee the production of refrigerated foods of animal origin, particularly poultry and pork, without the presence of certain pathogenic microorganisms, such as *Salmonella*, *Campylobacter*, *Listeria*, *Yersinia*, *Aeromonas* and, when meat is raw, parasites like *Toxoplasma* and *Trichinella*.

Consumers demand today, and more will demand in the next century, natural, nutritious and good tasting food that is fresh or fresh-like, with extended shelf life and preferably nonfrozen. Because irradiation of refrigerated vacuum-packaged pork loins at a dose of 3 kGy and stored at 2 to 4°C can extend shelf life of the product up to 91 days without microbial spoilage (20), irradiation should be considered as a key technology to meet the demands of present and future meat and poultry markets.

Since irradiation has been confirmed to be a very efficient method for the production of healthy, wholesome and microbiologically safe food, this paper is not intended to review all aspects of hygienic quality of irradiated meat and meat products, but rather to discuss the results of experiments from recently published papers on irradiation of meat and meat products and to consider some prospects for this technology.

INACTIVATION OF MEAT-BORNE PARASITES OF MAN

Several meat-borne parasites of man that are transmitted in raw or improperly cooked meat can be controlled by irradiation. *Toxoplasma gondii*, *Trichinella spiralis*, *Cysticercus bovis*, and *Cysticercus cellulosae* may be efficiently controlled by irradiation.

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The bovine and porcine tapeworms, *Cysticercus bovis* and *Cysticercus cellulosae*, respectively, can be rendered incapable of development and presumably incapable of infecting man by doses of irradiation in the range of 0.40 to 0.60 kGy (15).

When *Trichinella spiralis* encysted larvae are eaten with raw meat or improperly cooked meat products from pork or many other wild mammals, cyst walls are digested, and the free larvae mature in 2 to 4 days producing a second generation of 1,000 or more larvae filtering throughout the body. Many cases of the disease can lead to death. Brake et al. (4) found that 0.30 kGy of radiation blocked maturation of *T. spiralis* from infected pork when ingested. These data were the basis for the U.S. FDA regulation allowing control of *T. spiralis* in pork carcasses or fresh, nonheat-processed cuts of pork carcasses by the use of ionizing radiation at doses of 0.3 to 1.0 kGy (35,36,37).

Toxoplasma gondi is an intracellular protozoan parasite than can be transmitted to man in raw or improperly cooked beef, mutton or pork. Work of Dubey et al. (6) has provided evidence that radiation doses of 0.25 kGy or greater will inactivate *T. gondi* in pork tissues.

ELIMINATION OF BACTERIAL PATHOGENS FROM FRESH MEAT AND POULTRY

The microbiological safety of irradiated meat and poultry is affected by most of the factors that interact with any other food processing technology. Thayer et al. (30) presented a list of factors having influence on safety of irradiated meats; these are: the types and numbers of potentially pathogenic microorganisms; the relative resistance to ionizing radiation of the pathogens as compared with normal microbial flora; the ability of these pathogens to compete with the normal microbial flora after irradiation treatment; the irradiation dose, temperature, and atmosphere; the presence of food additives; the food pH, water-activity, surface area, and composition; packaging of the irradiated product; and possible interaction of the irradiation treatment with any other processing treatment.

The papers reporting elimination of bacterial pathogens from fresh meats and poultry can be roughly divided into two groups. In the first group, the pathogens of concern in meats or poultry are artificially inoculated, with the number of cells several times higher than normally occurring in meats, and their radiation sensitivity being tested under various conditions. In the second group of papers, the normally contaminated meat or poultry, delivered from processing plants or grocery stores, is tested for presence of the pathogens before and after irradiation.

From the experiments with artificially inoculated samples, the D_{10} values (the dose required to eradicate 90% of the population) for some pathogens irradiated in meat or poultry can be summarized as follows:

- *Salmonella* 0.20-1.29 kGy (most 0.4-0.7kGy)
- *Campylobacter* 0.14-0.32 kGy
- *Listeria* 0.20-1.03 kGy (usually: 0.4-0.6kGy)
- *Yersinia* 0.04-0.21 kGy
- *Aeromonas* 0.14-0.19 kGy

The large differences in the D_{10} values are due to many reasons. One reason not related to the technology of irradiation is the different radiosensitivity of different strains (22), but some parameters of irradiation can influence D_{10} values as well. Addition of sauce to ground beef in filet americain (26) or change in irradiation temperature (31,32) can influence the effects of irradiation quite significantly. The amount of delivered radiation also can influence the D_{10} values (14). Because bacteria in meat can be in various stages of maturity, a small irradiation dose can result in a relatively large reduction in bacteria numbers due to higher radiation sensitivity of the microorganisms in the log phase of growth. With an increased dose, the amount of eradicated bacteria per unit of delivered energy can be smaller (Table 1).

Table 1

D_{10} values of irradiation destruction of *Listeria monocytogenes* in BNT* medium and in chicken meat [after Huhtanen et al. (14)].

	BNT medium			Chicken meat		
	D_{10} values for different dose intervals (kGy)					
Strain	0-0.5	1.0-2.0	0-2.0	0-0.5	1.0-2.0	0-2.0
V7	0.26	0.40	0.34	0.29	0.62	0.53
RmI	0.22	0.34	0.29	0.28	0.61	0.44
RmII	0.24	0.31	0.28	0.37	0.80	0.53
Murray B	0.26	0.38	0.34	0.20	0.80	0.41
Scott A	0.32	0.34	0.33	0.20	0.59	0.42
V97	0.32	0.42	0.39	0.28	0.93	0.49
ATCC	0.30	0.49	0.34	0.25	1.03	0.43
Mean	0.27	0.35	0.33	0.27	0.77	0.46
Std dev	0.04	0.09	0.04	0.06	0.17	0.05

* BNT - mixture of 0.4% of nutrient broth (Difco) and 1.5% trypticase soy broth with glucose (BBL).

From many of the experiments, suggestions concerning radiation efficiency in eradication of pathogens are presented. Some of them give the basis for the development of predictive equations for eradication of some pathogens. These predictive equations may be used by regulatory agencies and the poultry industry (31, 32, 33). In some experiments, after irradiation with doses theoretically large enough to destroy all inoculated bacteria, some bacteria are still present in irradiated samples (12), or grow after several days of refrigerated storage (39). These results, however should not support the suggestion of Varabioff et al. (39) that irradiation may not be effective in destroying *Listeria* (Table 2), and yet it may remove the incentive to practice appropriate husbandry and hygiene. Refrigeration, modified-atmosphere packaging, or heat pasteurization do not remove the responsibility from food processors and distributors to follow the rules of good manufacturing practice. Similarly, resistance of the spores of sporogenous bacteria to low-dose irradiation (3,11,23,26) should not stop the introduction of irradiation technology to food manufacturing inasmuch as

Table 2

Log_{10} of *Listeria monocytogenes* (cfu/g) in inoculated chicken with and without irradiation at 2.5 kGy [after Varabioff et al. (39)].

Days	Unirradiated		Irradiated	
at 4°C	Air	Vacuum	Air	Vacuum
0	7.3	7.3	ND	ND
4	8.3	8.3	ND	ND
7	8.2	8.0	ND	3.5
11	9.8	8.9	ND	3.8
15	9.4	8.7	ND	3.6

ND = not detected
Day 0 = third day after inoculation and second day after irradiation of the chicken

heat pasteurization has been accepted. The data from Table 2 support the decisions of the U.S. Food and Drug Administration (38) to allow irradiation of chicken packaged under air and not in vacuum, so not only *Clostridium* but also *Listeria* growth can be prevented.

Aerobic conditions in any commercial package can easily change, even when meat or poultry has been only wrapped in foil. Lambert et al. (16,17,18) tested the combined effect of modified atmosphere packaging and irradiation at 0.5 and 1 kGy on toxin production by *Clostridium botulinum* in fresh pork inoculated with *C. botulinum* spores and stored at 5, 15, and 25°C. At 15°C, irradiated and nonirradiated products packaged with 10 or 20% headspace oxygen were toxic after 14 days. For products packaged with 0% oxygen and an oxygen absorbent, toxin was detected after 21 days in nonirradiated samples and after 43 days for products treated with an irradiation dose of 1 kGy. Initial packaging of products with O_2 seemed to enhance toxin production by *C. botulinum*, probably as a result of increased CO_2 enhancing spore germination. No toxin was detected in any product stored at 5°C. In the other experiments, 20% O_2 or five levels of CO_2 atmospheres and the same irradiation doses were tested. In all of the samples during storage at 15°C, low-dose irradiation delayed toxin production.

Competitive growth of chicken skin microflora and *Clostridium botulinum* type E after irradiation with a dose of 3 kGy was studied by Firstenberg-Eden et al. (10). This dose of irradiation reduced the natural flora from 10^4 to 10^6 to 10 to 500 cells/7cm^2, whereas *C. botulinum* type E (Beluga) spores were reduced only by one $\log_{10}$. At 10°C, the irradiation survivors of the natural flora were able to multiply and produce off-odors within 8 days, under both aerobic and anaerobic conditions, whereas the *C. botulinum* survivors could produce toxin within 14 days. At an abuse temperature of 30°C, the natural microflora survivors grew faster than *C. botulinum* spores and produced off-odor before the sample was toxic. Results obtained in this study indicate that it is highly unlikely that irradiating chicken carcasses with dose of 3 kGy would result in hazard from *C. botulinum* type E.

Effects of heat and ionizing radiation on *Salmonella typhimurium* in inoculated (10^9 cells/g) mechanically deboned chicken meat were examined by Thayer et al. (33). Heating the inoculated meat before irradiation did not sensitize the bacteria so much to the effect of radiation, as radiation made the *Salmonella* sensitive to the effect of heat. The effect of irradiation temperature was not significant in samples heated after irradiation. The increased gamma-radiation, dose-dependent sensitivity of irradiated *Salmonella* in mechanically deboned meat to heat did not change even when irradiated meat was stored for periods of up to 6 weeks at 5°C before heating. The doses of 1.5 kGy at 0°C followed by heating at 60°C for 2 min inactivated all CFU even when heating was applied after 2, 4, or 6 weeks. The authors concluded that irradiated poultry will be much safer for the consumer than expected because the irradiation treatment made any surviving cells of *Salmonella* more sensitive to heat.

From the experiments where normally contaminated meat or poultry, delivered from processing plants or grocery shops, was tested for the presence of pathogens before and after irradiation, slightly different results of meat or poultry irradiation were obtained as compared with experiments described above, where meat and poultry were artificially inoculated with pathogens. On the basis of the statement of Urbain (34) that the threshold dose for identifiable irradiation flavor is 2.5 kGy and after the regulatory decision of U.S. Food and Drug Administration permitting application of 1 kGy irradiation for pork and 3 kGy for poultry (35 - 38), most of the experiments were conducted by applying doses of 1 to 3 kGy.

Three experiments describe the effect of 1 kGy dose of irradiation on microflora of pork loins (21), or ground pork (7,8). Microflora in pork loins irradiated at 1 kGy were reduced with the greatest effect on mesophiles and psychrotrophic spoilage organisms. Clostridia and staphylococci were also reduced in irradiated pork when compared with nonirradiated samples. These differences were even greater at day 21 of storage (Figures 1 and 2). In the vacuum packaged ground pork, numbers of naturally occurring mesophiles, psychrotrophs and anaerobes or facultative anerobes were reduced by irradiation, whereas lactic acid bacteria were least affected. Added sodium acid pyrophos-

Figure 1. Comparison of growth of clostridia on pork loins treated with 1 kGy and pork loins with no irradiation treatment [after Mattison et al. (21)].

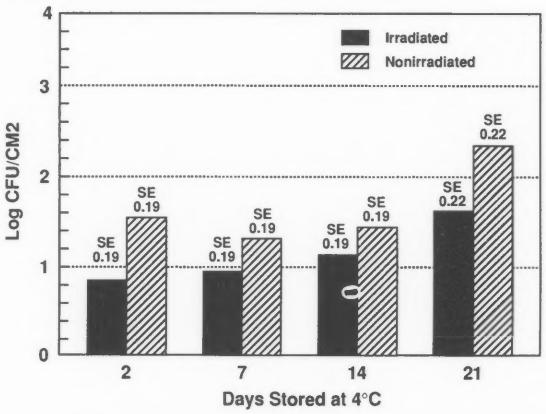
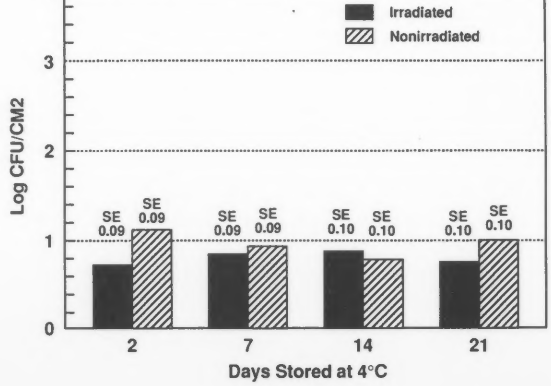


Figure 2. Comparison of growth of staphylococci on pork loins treated with 1 kGy and pork loins with no irradiation treatment [after Mattison et al. (21)].



phate (0.4%) contributed two additional days to inoculated, irradiated pork shelf-life but had no effect on naturally occurring microflora. Characteristics of the bacterial cultures (720 isolates) isolated from irradiated and nonirradiated vacuum-packaged ground pork held at 5°C over a 12-day storage period showed a shift from Gram-negative (96% of initial microflora) to Gram-positive microorganisms for both meats. Only 24% isolates of nonirradiated meat were characterized Gram-positive at the onset of spoilage (9 days at 5°C), whereas the irradiated meat microflora had 66% characterized as Gram-positive shortly after irradiation and increased to 97% after 9 days at 5°C. Results of these experiments suggest that 1 kGy irradiation of pork meat, especially when comminuted, had no positive effect on the hygienic quality of the meat.

On the other hand, data of Tarkowski et al. (28,29) and Heath et al. (13) illustrated how the risks of salmonellosis from raw beef or chicken can be reduced with a dose of 1 kGy (Table 3). Dickerson et al. (5) demonstrated that irradiation of 2-3 kGy effectively destroyed all *Salmonella* on chicken. Lamuka et al. (19) also reported complete elimination of *Salmonellae* from freshly processed chicken carcasses with dose of 2.5 kGy. In the same experiment, *Campylobacter* and *Yersinia* were reduced to nondetectable levels after irradiation. During postirradiation storage at 4°C, the cells recovered from injury and multiplied as evidenced by continued growth. In unirradiated samples the bacteria multiplied about 2 times faster than in the irradiated product.

Table 3
Effect of irradiation of chicken meat on number of samples presumptive positive for *Salmonella* after storage for 2, 4, and 8 days at 4°C [after Heath et al. (13)]

Storage (days)	Irradiation (kGy)			
	0	1	2	3
Thighs[1]				
0	33/33			
2	26/33	0/33	0/33	0/33
4	23/33	0/33	0/33	0/33
8	23/33	0/33	1/33	0/33
Breast pieces[1]				
0	23/33			
2	20/33	0/33	0/33	0/33
4	13/33	0/33	0/33	0/33
8	30/33	0/33	0/33	0/33

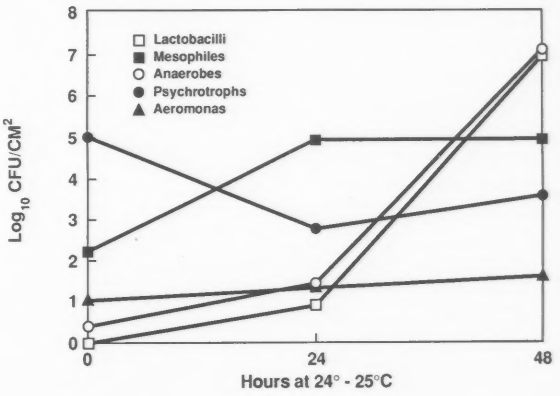
[1]Number positive for *Salmonella* out of the total number of samples.

Changes in microflora of vacuum-packaged pork loins, gamma-irradiated at 3 kGy, were analyzed by Lebepe et al. (20). This dose of irradiation extended the microbiological shelf life of vacuum-packaged pork loins stored at 2-4°C to more than 90 days compared with 41 days for nonirradiated loins. *Enterobacteriaceae* were affected most by radiation. Among the pathogenic bacteria surviving 3 kGy irradiation, *Salmonella* and *Campylobacter* were absent even after 48 hours of temperature-abuse (24-25°C). No *Enterobacteriaceae* were detected in pork chops prepared from the irradiated pork loins and held under refrigeration display (5-7°C) for 10 days. However some samples throughout the experimental period at 2-4°C, tested positive for *Yersinia* spp. by enrichment, which indicated that this bacterial genus survived 3-kGy irradiation in very low numbers (<2 cells/cm^2) but did not grow in meat thereafter. Possible detrimental effects from the medium selected for enumeration of *Enterobacteriaceae* cannot be discounted. Two irradiated samples throughout the experimental period at 2-4°C, tested positive for *L. monocytogenes*. *A. hydrophila* cells were also reduced by the irradiation relative to unirradiated samples (Table 4), but the reduction was not as great as would be expected from the data presented by Palumbo et al. (24). During simulated temperature abuse (24-25°C and 24 or 48 hours exposure), after 63 days of refrigerated storage of irradiated pork loins, *Aeromonas* spp. were found in all temperature-abused samples. The growth of *Aeromonas hydrophila* and other bacteria as the result of simulated temperature-abuse of vacuum-packaged, irradiated pork loins are shown on Figure 3.

Table 4
***Aeromonas hudrophila* detection after enrichment from irradiated and nonirradiated vacuum-packaged pork loins stored at 2-4°C** [after Lebepe et al. (20)]

Days of refrigerated storage	irradiated loins Log_{10} cfu/cm^2	nonirradiated loins
0	0.97	0.97
3	<0.30	1.23
7	<0.30	1.23
14	1.74	2.11
21	0.66	1.19
28	0.57	2.17
35	<0.30	2.12
42	<0.30	2.51
49	<0.30	
56	2.39	
63	1.06	
70	1.51	
77	0.90	
84	1.69	
91	1.73	
98	0.71	

Figure 3. Mesophilic, psychrotrophic and anaerobic or facultative anaerobic bacteria and lactobacilli in vacuum-packaged, irradiated loins during simulated mishandling at 24° - 25°C [after Lebepe et al. (20)].



ELIMINATION OF BACTERIAL PATHOGENS FROM PROCESSED MEAT AND POULTRY

Thayer et al. (30) reviewed studies on irradiation of processed meats to ensure microbiological safety. Bacon, ham, frankfurters, corned beef, pork sausage, and enzyme-inactivated beef, chicken, and other poultry had been irradiated with doses of 5 to 45 kGy to study whether irradiation

can provide an alternative to thermal processes for the preservation of meat and meat products. Appropriate 12D values for *C. botulinum* in cured meats were 32 kGy for ham and 43 kGy for enzyme-inactivated shelf-stable meats such as chicken. No data are available on pathogens eliminated with low-dose irradiation of processed meats. Recently, Will et al. (40) tested low-dose radiation preservation of vacuum-packaged sliced corned beef, but no information about pathogen elimination was presented. Barbut et al. (2) examined sensory properties of irradiated turkey frankfurters without any test of microflora elimination. Stekelenburg (27) carried out irradiation experiments with pre-packaged, sliced, cooked meat products with low and normal sodium content and concluded that Enterobacteriaceae could be effectively inactivated in refrigerated or frozen products by irradiation at a dose of 1 or 2 kGy, respectively, provided the number of these bacteria was below 10^3 to 10^4 per g.

CONCLUSIONS

From this review it can be concluded that irradiation of meat and poultry should be introduced as an industrial practice to benefit both consumers and producers. However, sharing the opinion of Dr. Fritz Kaferstein (1), Chief of WHO's Food Safety Unit, that food irradiation introduction to the market is a "carbon copy" of the story of pasteurization, one should remember how pasteurization technology has been developed from its beginnings to the present. The most important information about meat and poultry irradiation is now available to start industrial application of this technology. The time has come to master the process for each particular group of products in combination with many other technological treatments. Advances in the technical parameters of electron-beam linear accelerators give the possibility of installing the facilities in the processing lines of meat or poultry industry, creating many new technological options. The high dose rate of electron beam linear accelerators makes it possible to use simultaneous heat and irradiation treatment of some fresh or processed meat and poultry, as it was done with eggs in a gamma irradiator by Schaffner et al. (25). By using some shielding, a high-power microwave heater could be installed in front of the irradiation area to raise the temperature of the product in very few seconds to a lethal temperature for most of the bacteria contaminating meat. For fresh meats the temperature shouldn't exceed 50°C to avoid denaturation of the main fractions of meat proteins. Then one-sided irradiation of products with thickness of about 3 cm could be performed in an additional few seconds, and the product could enter the chilling area. If the results of such combined treatments would be similar to those obtained by Schaffner et al. (25) for eggs, the doses of 1 kGy or less and a mild heat treatment can bring to the food market a new generation of meat and poultry products. Such products should have extended shelf-life, fresh appearance, and what is most important, should have higher degree of safety.

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Custard's Last Stand

Dr. David E. Kaplan, C.H.O., R.S.,
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Here we go again.....trying to educate those in the retail food business about proper handling and storage practices of that delectable, savory, scrumptious, and seemingly innocuous organoleptical wonder.....the classic custard pie. You know, the one that was fresh baked from frozen today, or yesterday, or several days ago, and left out on display at room temperature for consumers to purchase. There are also others that are equally luscious.....the ones already baked and shipped to the supermarkets in non-refrigerated trucks.

We all know the ever-present potential for problems associated with custard pies and their cousins. These indeed have had an excellent track record for nurturing the growth of organisms responsible for foodborne illness. Chief among these culprits are staphylococcus and salmonella. Food products frequently involved in staph intoxications include custards and pastry fillings. Lightly cooked foods containing eggs and egg products are implicated in outbreaks of salmonellosis. (1)

WHAT EXACTLY IS CUSTARD?

Webster defines custard as a sweetened mixture of milk and eggs that is baked, boiled, or frozen. Custard has been around for many years and has been recognized as a product requiring proper serving and storage temperatures. Almost 30 years ago, Ehlers (2) indicated that custard and custard-like products are frequently involved in disease outbreaks and should be cooled to 40°F within one hour after preparation. They should not be taken from refrigeration exceeding one hour for display. Furthermore, all such products should be destroyed if they are over one day old. Exceptions are for hot custard which must be kept at a serving temperature above 150°F. According to Salvato (3), custard-filled pies, puffs, eclairs, and similar pastries, to be considered safe, should be cooled to 45°F within one hour after heating and maintained below 45°F. Today, outbreaks are probably less frequent due to a combination of better handling and packaging, as well as luck. However, the prospect of illness still remains.

SURVIVAL OF THE FITTEST

Basic microbiology teaches us that spores may survive extreme conditions of heat and freezing. Vegetative cells are capable of reproducing, unlike spores. Vegetative bacteria may be destroyed by high temperatures, but are also more resistant to low temperatures. Some may even survive freezing as well. (4) When heat is applied to custard in the pie-baking process, it does not matter whether or not the product was frozen. One can readily see the problem in basic sanitation which includes handling.

POTENTIALLY HAZARDOUS FOODS

According to CMR 105 590.001 of the Massachusetts State Sanitary Code (5), custard products are considered to be PHF's because they are 1) capable of supporting microbial growth and 2) have been heat treated during the cooking process. In a recent conversation with FDA, this was further clarified by indicating that although vegetative cells may be destroyed, spore-formers are not. Additionally, there is no laboratory data or evidence from manufacturers to prove that custard pies are not PHF's. Manufacturers have not submitted any valid evidence that have clearly demonstrated that these products have pH's < 4.6 or $< 0.85a_w$.

Several years ago, one local health department challenged a well-known pie company by asking them to submit evidence that their products had the above pH and water activity parameters and were therefore not PHF's. Unable to do so, the products were banned from sales in that town. Another baker of pastry style products also failed to demonstrate this and subsequently had to keep its products either hot or cold.

WHY ALL THE FUSS?

During a routine inspection of a supermarket, I observed 23 custard pies stacked three deep on a display counter in front of the bakery. The manager seemed to feel that the health risk was none-existent because the pies were made with what he termed "non-fresh" eggs. Furthermore, the practice of non-refrigerated storage and display had been an on-going practice for as long as he could remember. One might get the feeling that a special "grandfathering arrangement" had been instituted here, since the practice was well established.

At another location of the same supermarket chain, bakery personnel were not sure how long the custard pies had been on display at room temperature. After persistent questioning, it was determined that about one hour had elapsed from cooling to display. Needless to say, I ordered the products in both stores refrigerated. My curiosity about

storage and display in stores beyond my jurisdiction led me to observe similar results in other supermarkets, as well as several smaller independent grocery stores.

It is quite obvious that this practice is widespread. In larger stores, pies are shipped frozen and then baked on the premises. An interesting observation was made when the store-baked frozen pies were not refrigerated, but the delivered commercially baked products were. In three other stores, the exact opposite occurred. Adding insult to injury, I found that those commercially baked products which are shipped in non-refrigerated trucks, travel several days in varying ambient temperatures. After unloading, the pies sit for additional amounts of time and are never placed under refrigeration.

Managers, bakery department personnel, and buyers, need to be educated. Responses for justifying non-refrigeration included package labels listing preservatives, "strong cartons", plastic wrap, and expiration date labels. One store had a label on a pie box indicating a two-day shelf life and stamped "refrigerate after opening". Obviously this carton was not hermetically sealed to achieve and maintain commercial sterility under non-refrigerated storage and distribution. Thus the consumer may be purchasing a product which has been on the shelf for a maximum of two days thinking that bacterial growth will be stopped by placing the pie in the refrigerator after opening the carton. Well, we all know the answer to that one.

Other store managers seem to have great faith in preservatives and feel that this justifies leaving custard pies at room temperatures. While it is not the intent of this article to discuss the chemistry and vast numbers of food additives, it is beneficial to mention the ones most commonly appearing on pie labels. Some manufacturers list additives without indicating whether these are in the crust or the filling. *The bottom line is whether or not these additives effectively inhibit the growth of staphylococcus and salmonella organisms in a non-refrigerated PHF ... the very egg custard filling itself.* And if they do, for how long and under what conditions? Table 1 (6) shows four common additives, their types, and specified uses and restrictions. These additives can also be found in food products other then those listed. Table 2 (7) also shows three common types and their uses. Similar descriptions can be found in 21 CFR CH.1 (4-1-91) Edition (8), U.S. Food and Drug Administration, HHS.

Table 1. Selected Food Additives, Types, and Specified Uses or Restrictions

ADDITIVE	TYPE	SPECIFIED USES /RESTRICTIONS
Potassium Sorbate	Preservative	Cheese
Sodium Benzoate	Preservative	Fruit Preserves Oleomargarine Artificially Sweetened Fruit, Jelly & Preserves
Sodium Proprionate	Preservative	Bakery Products Fruit Jelly Cheeses
Sodium Tripolyphosphate	Miscellaneous	Food Starch Modifier

Table 2. Three Common Additives and Their Respective Types and Uses

Potassium Sorbate	Antimicrobial	Flavoring Agent pH Control Agent for Baked Goods, Fillings, Puddings, Syrups
Sodium Benzoate	Antimicrobial	Flavoring Agent
Sodium Proprionate	Antimicrobial	Used in Flour Flavoring Agent in Baked Goods

REGULATORY COMPLIANCE

105 CMR 590.003 (A) 2 (9) states that "the temperature of a PHF shall be 45°F or below", and section 590.006 (A) (10) states that "PHF's shall be held at an internal temperature of 45°F or below." No observations anywhere indicated full compliance.

Massachusetts considers custard pies as PHF's and refrigeration is required. Responsibilty for enforcement is left to local boards of health. Maine and New York allow up to two days of no refrigeration. However, New York regulations are vague. California also has unclear requirements. In New Hampshire and Rhode Island refrigeration is the rule. In other states, where ambiguity and vagueness occur, the state sets the policy, and whether or not enforcement takes place locally is not clear.

CONSERVATIVE APPROACH FOR SAFETY

In light of the unsubstantiated and unsupported documentation that custard pies are not PHF's, it is suggested that a conservative and preventive approach be undertaken. Don't accept excuses for non-refrigeration such as "we don't have room" ....."no one ever got sick as far as I know"....."the pies have preservatives in them".....and "we've always done it this way." Insist upon refrigeration, and if necessary ask the management to obtain valid data from the manufacturer that has been submitted to FDA. That should be sufficient.

THE SOLUTION

There is hope, and light is at the end of the tunnel. One large supermarket chain has taken the initiative to minimize a health risk. A clearly visible black and white large print sign in their bakery departments now reads "CUSTARD PIES ARE NOW LOCATED IN THE SELF-SERVICE REFRIGERATOR SECTION". ..... Such a simple solution!

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Dr. David E. Kaplan is a practicing Commonwealth of Massachusetts Board-Certified Public Health Officer and Registered Sanitarian. He was the former HSA V Regional Coordinator of Health Promotion Sciences for the Massachusetts Department of Public Health and served as consultant to the Department's Division of Environmental Epidemiology and Toxicology.

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IAMFES Sustaining Member

News

Michael Brodsky

IAMFES Secretary Winner

Michael Brodsky, through the vote of the IAMFES membership, will begin his term on the IAMFES Executive Board in August, 1993.

Michael graduated from the University of Toronto in 1967 with a B.Sc. He continued his studies at the School of Hygiene in Toronto and obtained a Diploma in Bacteriology in 1968 and his Masters Degree in Microbiology in 1971. Michael was certified as a Specialist in Public Health and Medical Laboratory Microbiology by the American Academy of Microbiology in 1975 and as a Registered Microbiologist in Food, Dairy and Sanitary Bacteriology by the Canadian College of Microbiologists in 1980.

Following graduation, Michael was hired by the Laboratory Services Branch of the Ontario Ministry of Health and was appointed as a Research Scientist in Environmental Bacteriology in 1972. In 1979, Michael became Head of the Antigen-Antisera Production Unit in the Central Public Health Laboratory in Toronto until his venture into private business in 1980.

In 1982, the Government of Ontario made Michael an offer he could not refuse. He accepted the position of Chief, Environmental Bacteriology for the Ministry of Health. He recently also assumed responsibility for Microbiological Support Services and Animal Unit.

In addition to his position with the Laboratory Services Branch, Michael has developed a short course "Quality Assurance for Microbiology Laboratories" which he teaches under the auspices of AOAC International. Michael continues to take an active role in a number of professional associations and has recently served as President of the Ontario Food Protection Association; Local Arrangements Chair for IAMFES '92; and Chairperson of the Official Methods Board of AOAC International. He is also involved with and chairs many other internal and external scientific advisory committees. Michael has published more than 30 scientific papers, has developed and chaired many scientific seminars and symposia and has given numerous presentations to both the international scientific community and the community-at large.

New Forms Help Dairy Producers with Mastitis Treatment Records

Many dairy producers can achieve better mastitis control and improved milk quality by using new drug treatment record forms that are now available. The forms are designed to make it easier to keep drug treatment records, says Jeff Reneau, dairy scientist with the University of Minnesota's Extension Service.

The forms are contained in a booklet called the "Clinical Mastitis Evaluation and Treatment Record." The booklet is available free to veterinarians, county extension agents and dairy field plant representatives. The mastitis committee of the American Association of Bovine Practitioners developed the booklet, and The Upjohn Company is funding its printing and distribution.

The booklet is designed so the forms it contains can be copied. Producers can keep copies at the farm in either a three-ring notebook or in plastic spiral binders.

"The current federal Pasteurized Milk Ordinance (PMO) requires producers to keep records on all drug treatments," says Reneau. "However, such records also provide much needed insight into better control and prevention of clinical mastitis."

The new booklet contains four forms: Daily Treatment Record, Individual Cow Drug Treatment and Residue Test Record, Clinical Mastitis Evaluation, and Key: Individual Cow Treatment Record.

To obtain copies of the new forms, contact your veterinarian, county extension agent or dairy plant field representative.

For more information please call Jeff Reneau at (612)624-4995.

International Conference to Explore Mexican Frozen Food Market

The International Frozen Food Association (IFFA) will host "The Emerging Mexican Frozen Food Market — A Guide to Doing Business in Mexico," November 14-16, 1993 at the Stouffer Presidente Hotel in Mexico City, Mexico.

IFFA is the international organization dedicated to advancing the interests of the frozen food industry worldwide. Its members include frozen food processing companies, associations, individuals and suppliers who work together to maintain open communications on trade, technology, legislation and regulation. The Mexican market is one aspect of IFFA's mission to promote the worldwide use of frozen foods.

"The conference will bring together industry leaders from around the world for the first and most comprehensive overview of the marketing opportunities in North America's rapidly emerging and newest market for frozen foods," said IFFA President Edward H. Coale.

Coale also believes the conference is crucial because it will examine the market within the context of recent developments in the North American Free Trade Agreement (NAFTA).

The conference sessions will address Mexico's business environment, consumer attitudes and company case studies. Hands-on sessions will explore the critical issues that affect this market, including government/business partnerships, consumer trends, marketing and business climates, and NAFTA.

"The conference programs will serve as a catalyst for new opportunities — a forum for sharing vision and building partnerships," said Keith Klingenberg, president of The TLC Group, Inc. and conference participant.

Lily Noon, president of Noon International, Inc., also believes the conference will play a critical role in the development of this emerging market.

"Attending the upcoming conference will help to dispel many of the misconceptions about doing business in Mexico," she said.

Mexican government officials, experts in the field of marketing and economics, and individuals involved in processing, distributing and selling frozen foods at the retail and foodservice levels will be featured sources of information.

Many industry leaders already are planning to take advantage of this unique opportunity to explore the new Mexican market for frozens.

"We view Mexico as our number one near-term opportunity and plan to take advantage of programs such as the IFFA Mexican Conference to help us maximize that opportunity," said Victor J. Sossi, vice president international, ConAgra Frozen Foods.

"This IFFA Conference is a perfect opportunity in assisting frozen food executives to better understand the dynamics of Mexico's frozen market," agreed F. Stanley Sena, senior vice president, Americold Corporation.

The conference also includes a tour of the Perinorte project, a new development destined to become a major distribution center in Mexico City. The project includes a 900,000 square foot warehousing complex and a retail mall in which Mexico's largest supermarket — Gigante — is the anchor store. Toll roads are under construction that will connect the Perinorte project to other metropolitan areas of Guadalajara and Toluca.

Participants also will have the opportunity to explore some of Mexico City's retail food stores.

For more information on the 1993 IFFA Conference, call Kimberly Huston, IFFA's deputy director general, at (703)821-0770.

Somatic Cell Count Limit for Grade A Milk will Drop July 1

Data collected by the University of Minnesota suggest that most of the state's dairy herds are already meeting a tougher federal standard for somatic cell count (SCC) in Grade A milk that will take effect soon. The legal SCC limit for Grade A milk will drop from one million to 750,000 on July 1 of this year, says Jeff Reneau, dairy scientist with the University of Minnesota's Extension Service.

High levels of somatic cells in milk result when white blood cells enter the cow's udder to combat infection. The number of somatic cells monitors the degree of subclinical mastitis in a herd.

"As of July 1, any Grade A herd with three of the last five somatic cell counts greater than 750,000 will be degraded to Grade B," says Reneau. "Grade B producers are exempt from the 750,000 standard for now. The legal bulk tank SCC for Grade B producers will remain at one million. Grade A herds that are degraded to Grade B status will have to re-apply and have a full inspection to be reinstated to Grade A status."

Only milk from Grade A herds can be processed for sale as fluid milk for drinking. Milk from Grade B herds is used to manufacture dairy products such as cheese and ice cream.

Jerry Hammond, University of Minnesota agricultural economist, checked the milk price differential between Grade A and Grade B herds for March of this year. During March, Minnesota dairy producers with Grade B herds received about $1.03 per hundredweight less for their milk than producers with Grade A herds. That differential amounts to $643.75 per month or $7,725 per year for a 50-cow herd averaging 15,000 pounds of milk per cow per year.

There is no way to determine the exact number of Minnesota dairy herds that will be affected by the new SCC standard. However, the University of Minnesota has been collecting SCC data on herds enrolled in the state's Dairy Herd Improvement Association (DHIA), and will continue to do so through the end of 1993. There are currently 6,252 Minnesota herds enrolled in DHIA, or about 45 percent of all the dairy herds in the state. Minnesota DHIA herds represent 337,176 cows, a little over half of all the dairy cows in the state.

"A total of 5,756 DHIA herd somatic cells counts were analyzed between March 23 and April 22 of this year," says Reneau. "During this one month period, 345 DHIA herds, or 6 percent, were above the 750,000 level on test day. The test day level is compiled from individual samples taken from all lactating cows in the herd. Thus, the test day level may be higher than the actual bulk tank SCC for 'shipped milk' on that corresponding day. That's because milk from certain high SCC cows may not be included in the bulk tank for shipping."

Reneau notes that for those herds consistently over 750,000 in SCC, there is still time to comply with the new standard before July 1.

For more information please call Jeff Reneau at (612)624-4995.

New Book Investigates Capillary Gas Chromatography in Food Control and Research

Capillary gas chromatography now offers food analysts and researchers many advantages in speed, accuracy and diversity of findings.

A new book, *Capillary Gas Chromatography in Food Control and Research*, provides a guide and reference to capillary gas chromatography analysis of food, food components, and trace and ultratrace contaminants.

Edited by Dr. Reiner Wittkowski, Max von Pettenkofer-Institute, Federal Health Office, Germany, and Dr. Reinhard

Matissek, Institute of Food Chemistry, Federal Association of the Confectionery Industry, Germany, the book provides a comprehensive survey of capabilities, applications and new developments for all types of food and food-related analysis.

Each chapter in the book is written by a specialist on the topic discussed and contains many tables and figures, giving illustrative examples of quantitative output. While fundamentals and theoretical background are presented, the emphasis is on practical problem solving in a wide range of applications.

This new book will be a valuable aid to food scientists and chemists, food technologists, analytical chemists, and those in related fields such as toxicology and medicinal chemistry.

Contents of the book include: I. CAPILLARY GAS CHROMATOGRAPHY: 1. Fundamental Aspects of Capillary Gas Chromatography, 2. Separation System Considerations; II. ANALYSIS OF FOOD INGREDIENTS: 1. Components of Foods with a High Carbohydrate Content, 2. Fats and Compounds in Fat-Containing Foods, 3. Aroma Compounds, 4. Stereodifferentiation of Chiral Flavor and Aroma Compounds, 5. High Molecular Weight Compounds; III. ANALYSIS OF RESIDUES AND CONTAMINANTS: 1. Pesticide Analysis, 2. Contaminant Analysis, 3. Headspace Gas Chromatography of Highly Volatile Compounds.

Capillary Gas Chromatography in Food Control and Research. Editors: Dr. Reiner Wittkowski and Dr. Reinhard Matissek. ISBN: 1-56676-006-2, 1993, 380 pages, 6x9, softcover, $75.00. Available from Technomic Publishing Company, Inc., 851 New Holland Avenue, Box 3535, Lancaster, PA 17604, U.S.A. Telephone: 717-291-5609, FAX: 717-295-4538. A detailed brochure describing this book is available from the publisher upon request.

Updates . . .

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For more information please contact Dr. Purnendu C. Vasavada, Department of Animal and Food Science, University of Wisconsin - River Falls, River Falls, WI 54022; Phone: (715)425-3150, FAX (715)425-3785.

**Additional speakers and companies will be identified in the final program*

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COMPANY _____

ADDRESS _____ CITY _____

STATE _____ ZIP _____ COUNTRY _____

Mail to: Dairy and Food Industries Supply Association EXPO '93, 6245 Executive Boulevard, Rockville, MD 20852-3938. Fax 301-881-7832.

Federal Register

Department of Health and Human Services

Food and Drug Administration

Lead-Soldered Food Cans

Agency: Food and Drug Administration, HHS

Action: Proposed Rule

Summary: The Food and Drug Administration (FDA) is proposing to prohibit the use of lead solder in cans that contain food. This prohibition, if adopted, will apply to both domestic and imported foods. While the agency is also proposing to find that a prior sanction exists for the use of lead solder in food cans, FDA tentatively concludes that available toxicological and lead exposure data demonstrate that this use of lead solder may be injurious to health. Exposure to very low lead levels has been associated with adverse health effects in fetuses, infants, and children. Moreover, the current daily dietary lead intakes of infants and children approach or may exceed the provisional total tolerable intake level (PTTIL) that the agency has established for lead for these population groups. Therefore, because the use of lead solder in food cans has been found to add lead to food, FDA is proposing not to codify in its regulations the prior sanction for this use of this ingredient. FDA is also responding to a citizen petition requesting that the agency require that warning labels be placed on food cans that contain lead solder.

Elsewhere in this issue of the Federal Register, the agency is announcing the withdrawal of a proposal that would have set a tolerance for lead in evaporated milk and evaporated skim milk packaged in lead-soldered cans.

Dates: Written comments by August 20, 1993. Proposed compliance date for all affected products initially introduced or initially delivered for introduction into interstate commerce is 6 months after date of publication of the final regulation in the Federal Register.

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

For Further Information Contact: Sandra L. Varner, Center for Food Safety and Applied Nutrition (HFF-335), Food and Drug Administration, 200 C St. SW, Washington, DC 20204, 202-254-9511.

Federal Register/Vol. 58, No. 117/Monday, June 21, 1993/Proposed Rules

Department of Health and Human Services

Food and Drug Administration

Food Labeling: Nutrient Content Claims and Health Claims; Restaurant Foods

Agency: Food and Drug Administration, HHS

Action: Proposed Rule

Summary: The Food and Drug Administration (FDA) is proposing to amend its food labeling regulations by removing the provisions that exempt restaurant menus from the requirements for how nutrient content claims and health claims are to be made. The agency is also proposing to modify the provisions that delay the effective date of these regulations for small restaurant firms for 1 year. FDA is proposing these actions following a reconsideration of the provisions in question.

Dates: Written comments by August 16, 1993. The agency proposes that any final rule that may issue based on this proposal become effective 4 months after the date of publication of the final rule in the Federal Register except as may be otherwise specified in the text of §§ 101.10, 101.13(q)(5), and 101.14(d)(2)(vii)(B) and (d)(3).

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

For Further Information Contact: F. Edward Scarbrough, Center for Food Safety and Applied Nutrition (HFS-150, Food and Drug Administration, 200 C St. SW, Washington, DC 20204, 202-205-4561.

Federal Register/Vol. 58, No. 113/Tuesday, June 15, 1993/Proposed Rules

HAZCON-Based Total Quality Management

Hazard and Quality-Assured Recipe Development for Chilled, Stored Foods (Part XV)

O. Peter Snyder, Jr., Ph.D.
Hospitality Institute of Technology and Management,
830 Transfer Road, Suite 35,
St. Paul, MN 55114

Introduction

There are two goals in recipe development. First, **the process must meet minimum safety standards** (not maximum standards, because maximum standards destroy food quality). Second, **the food must meet specific customer needs and expectations better than competitive products.**

The following considerations must be taken into account in developing a recipe process for a chilled food system.

1. The recipe or formulation, as produced by specific equipment, must meet the expectations and requirements of the consumer better than competitive products.
2. The method of preparation must be feasible for adaptation to a chilled stored food system.
3. Storage stability must be determined in terms of both sensory and microbiological quality as influenced by formulation, preparation method, packaging, storage temperature, and length of storage time.

Product Safety

Zero Risk

The primary concern of preparation and storage of products in a chilled food system is to "zero" the risk of pathogen growth and contamination and limit the rate of spoilage.

Hurdles

Scott (1989) discussed suitable combinations of growth-limiting factors at sub-inhibitory levels (hurdles) that can be devised to prevent the growth of certain microorganisms. Knowledge and use of a combination of hurdles or barriers for a variety of microorganisms is valuable in product development in allowing predictions of microbial stability and safety of food formulations. A combination of hurdles is particularly important with refrigerated foods, since **storage temperature** is frequently the primary hurdle, and temperature fluctuation and abuse is common. Other hurdles or barriers which are considered to be inhibitory are: modification of water activity with the addition of salt and sugar (sucrose); addition of chemical preservatives [i.e., butylated hydroxy anisole (BHA), tertiary butylhydroquinone (TBHQ), sodium nitrite]; addition of organic acids (e.g., lactic, citric, acetic and sorbic); addition of competitive bacteria and their metabolic by-products (i.e., lactic acid bacteria and production of lactic and acetic acid, and nisin); and modified atmosphere packaging (vacuum, CO_2, N_2).

Food Process Variables

Foods possess attributes that influence microbial growth These are: the chemical, physical, and biological characteristics such as nutrient composition of the food; natural antimicrobial factors in the food; and the pH, water activity (a_w), and Eh (oxidation-reduction potential) of the food. Process factors also influence microbial survival and colonization. These factors include heating, irradiation, and even acquisition of microorganisms from contaminated equipment. Environmental factors such as storage temperature and/or atmosphere allow growth of particular microbial flora.

Recipe or Formulation Attributes

The recipe or formulation must produce a food product that provides consumer satisfaction for flavor, texture, aroma and appearance. It must provide a balanced nutrient profile whenever possible.

Cost

It must meet cost constraints. For example, in order to reduce the cost of many casseroles, soups, and stews, the protein ingredient such as meat, poultry, fish, or cheese can be reduced. A high quality product can still be achieved with the addition of lower priced ingredients such as vegetables, pastas, rice, legumes, and soy protein. When a major ingredient becomes too expensive, or if product quality decreases or is not acceptable, further recipe development must take place or another recipe should be substituted.

Employee Capability

Product preparation must be within the capabilities of the employees. Recipe flow diagrams can be used to optimize the safety and simplicity of preparation with the least number of ingredients and steps.

Chilled Food Recipe Development

Select a recipe or food formulation that has proven to be well liked for its sensory characteristics for a number of years, or use a new recipe or formulation that has been given an acceptable sensory evaluation by an employee-customer/consumer panel.

Small Scale Testing

The recipe or formulation must be **carefully tested on a small scale**. All ingredients must be converted to weight

percent. Product temperatures must be carefully monitored and recorded. This includes temperatures of ingredients, time and temperature during heating process, time and temperature during chilling process, as well as time and temperature for storage. Aerobic plate counts (APC) should be taken at critical steps in the process. These counts can be used as microbiological control standards for safety improvement and quality stability of the process.

Information from small scale laboratory preparation must be applied and redefined for large scale production in kettle cookers and tank chillers. For example, cheese sauce produced in 1-gallon quantities in the laboratory within 20 minutes will have a different flavor and texture when compared to cheese sauce prepared in the kettle cooker requiring 45 minutes preparation time. The laboratory process must duplicate exactly the time-temperature process when the recipe is expanded.

Ingredient Specifications

Food ingredient specifications must be determined. For example, specifications should be written for percent solids in tomato sauce, grade of meat, type and size of potatoes to use in stew. Writing specifications for ingredients ensures uniform quality and sensory attributes from batch to batch. Once the specifications are set, ingredients with even slightly changed specifications cannot be used without testing.

Microbiological Specifications

Microbiological specifications must be written for ingredients so that the microbial quality of products can be controlled. **Microbial levels** of ingredients for the production of quality products should be as follows:

Raw meat, poultry and fish	< 10,000 APC/gram < 100 coliform/gram < 10 *Escherichia coli*/gram < 100 *Staphylococcus aureus*/gram
Vegetables, fresh	< 10,000 APC/gram
Dried ingredients	< 10,000 APC/gram (APC = aerobic plate count)

Preparing products from ingredients of specified microbial quality is one way of delaying spoilage and preventing foodborne illness hazards. **The fewer the spoilage organisms in the food, the better is the quality. The fewer the pathogens, the less risk if there is a small deviation in cooking process or pasteurization.**

Factors for Improved Quality Assurance and Shelf Life Extension

As covered by Scott (1989), chilled foods should have a combination of hurdles (barriers) to control pathogenic and spoilage microbial growth during storage. If products have received a *Salmonella* spp. 7D pasteurization, the vegetative cells of pathogens will have been adequately reduced in number. However, spores of both pathogenic and spoilage microorganisms will survive and will have the potential for outgrowth if environmental conditions (temperature, pH, a_w, Eh) and time permit growth during storage, distribution, and use.

GRAS

For years, food scientists and food processors have worked to find additives to extend the shelf life of chilled foods. There are a wide variety of Generally Recognized As Safe (GRAS) additives for this purpose. Those additives and their usage levels are listed in 21 Code of Federal Regulations, 1991, parts 170 through 174.

Temperature

The main means of **controlling and inhibiting outgrowth** of both spoilage and pathogenic bacteria in chilled foods beyond 5 days is **storage at 28°F to 30°F (-2.2°C to -1.1°C)**. Food stored at these temperatures will eventually spoil or deteriorate in quality (i.e., develop off-flavors and odors) due to microbial growth and/or oxidative changes of food components that occur slowly over a long period of time. This time can range from days to years, depending on the food or food product. It also depends on the oxygen that leaks through a flexible package wall. The storage stability and safety of chilled foods is increased when low temperature refrigeration is used in combination with another preservative or barrier, such as brief storage time.

Acid Ingredients

Acid

The pH of a food product is dependent upon its constituent ingredients. The pH of meat, fish, poultry, and most vegetables is slightly acidic (pH 5.5 to 6.8), and most fruits are moderately acidic (pH 3.0 to 4.6). Some food ingredients are alkaline, such as egg whites, with pH above 7.0, and baking soda, with pH above 8.0.

Organic acids, whether naturally present in foods, accumulating as a result of fermentation, or intentionally added during formulation, have been used for years to control microbial spoilage (Beuchat and Golden, 1989) and to preserve foods for future use. The mode of action of organic acids is attributed to pH reduction of surrounding media, depression of intracellular pH by ionization of the undissociated acid molecules, and by disruption of cell membrane permeability. While pasteurized foods (with vegetative cells destroyed) are safe when the pH is below 4.6 because *Clostridium botulinum* is controlled, when the pH is even less than 5.4, there is still a significant increase in stability because 5.4 is well below optimal pH, 6.0 to 7.0, for growth. Remember, **even small multiple hurdles can lead to stable products**.

Citric acid is present in many fruits, especially citrus fruits (lemons, oranges, and grapefruit). Notermans et al., (1985) reported that when cooked potatoes were dipped in a solution containing 1 percent citric acid and 2 percent ascorbic acid, growth and toxin production of *Clostridium botulinum* was inhibited in vacuum-packed cooked potatoes. Fischer et al. (1985) determined that when hard-cooked eggs were stored in a solution containing 0.75 percent citric acid

and 0.2 percent sodium benzoate, inoculated cultures of *Salmonella typhimurium*, *Yersinia enterocolitica*, *Escherichia coli*, and *Staphylococcus aureus* were reduced. Moustafa and Marth (1988) demonstrated that *Listeria monocytogenes* could be inactivated and growth could be inhibited by 0.3 percent potassium sorbate at a pH below 5.0.

Bacterial Cultures as Microbiological Antagonists

Bacterial Cultures

Lactic acid bacteria [*Lactobacillus*, *Lactococcus* (group N streptococci), *Leuconostoc*, and *Pediococcus*] have been used in the preservation of food for centuries. Cultures of these bacteria are used in the production of yogurt, cheese, salami, sauerkraut, and pickles. These bacteria produce both lactic and acetic acids which inhibit the growth of other microorganisms as the pH of the surrounding media decreases. These bacteria also produce hydrogen peroxide, which has an antagonistic effect on the growth of *Staphylococcus aureus* and *Pseudomonas* spp. Another antibacterial substance produced by lactic acid bacteria is diacetyl, which is inhibitory for yeasts and some bacteria (Daeschel, 1989). *Streptococcus lactis* subsp. lactis lowers the pH of foods in which it grows and produces the bacteriocin, nisin. Nisin inhibits spore outgrowth and controls growth of some pathogens.

In 1955, Saleh and Ordal demonstrated that if canned, frozen chicken a la king was temperature abused, it could develop botulinal toxin. They demonstrated that the addition of 10^8 cells per gram of a nisin-producing *Streptococcus lactis*, a non-nisin-producing mixture of *Streptococcus* and *Leuconostoc*, or *Lactobacillus bulgaricus* to sterilized chicken a la king, an inoculum of 20 *Clostridium botulinum* spores per gram was prevented from germinating or producing toxin during 5 days of temperature abuse at 86°F (30°C). The product pH dropped from 6.2 to 4.3 during the abuse period. They also reported that the lactics had limited effectiveness in unsterilized products that had high populations of normally present organisms. However, these authors recommended that antagonistic microflora be added to frozen food to inhibit *Clostridium botulinum* growth and toxigenesis if the products could be temperature abused. Gobas (1989) reviewed the use of competitive inhibition of pathogens by lactic acid bacteria. Another bacteria that can produce inhibitory compounds is *Bacillus subtilis*, which produces the bacteriocin subtilin.

Water Activity

Water Activity

The growth and metabolism of microorganisms depends on the presence of water in an available form. The water activity (a_w) of a food provides a measure of the amount of water available for microbial growth. Generally, bacteria require a_w above 0.91 for growth. A notable exception is *Staphylococcus aureus*; its a_w for toxin production is above 0.86. The water activity for yeast and mold growth is above 0.60 to 0.65.

As the available water in a system is decreased, growth of microorganisms becomes slower or is inhibited. In a chilled food system, decreasing the water activity of a food product can be accomplished by:

1. **Addition of salt and sugar**. However, both of these ingredients may have an adverse effect on the flavor of food if added in excessive amounts. Conversely, if they are omitted from a recipe formulation, the a_w of the food product can be expected to be higher.
2. **Concentrating the product**. If recipe formulations (i.e., soups, stews, and sauces) specify water or other liquid ingredients such as milk or juices as a part of their preparation, the liquid ingredient can be decreased and added to the product at the time of preparation and service. Water also can be vaporized from the food as it is being processed, thus increasing solute concentration as well as decreasing the amount of water in the system. The production of a concentrated product is a very good method of decreasing the a_w of chilled food products. It can also dramatically reduce the cost of packaging materials and required storage space.

Oxidation-Reduction Potential

Eh (oxidation-reduction potential) of the atmosphere surrounding food has an effect on the growth of microorganisms within the food. Modified or controlled atmosphere packaging usually refers to incorporation of specific gases (carbon dioxide or nitrogen) or evacuating air from the package (vacuum packaging). Modifying, controlling, or removing gases from within food packages may inhibit the growth of spoilage microorganisms such as *Pseudomonas*, but will allow the growth of *Clostridium botulinum* and *Listeria monocytogenes* (above an oxygen level of 4 percent) if high moisture chilled food products are stored at temperatures above 38°F (3.3°C).

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Part XV will be continued in the August issue of Dairy, Food and Environmental Sanitation.

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Food and Environmental Hazards to Health

Coccidioidomycosis — United States, 1991-1992

During 1991, reported cases of coccidioidomycosis (i.e., valley fever) in California increased more than three-fold over the annual number of cases reported since 1986; during 1992, the number of reported cases increased 10-fold. Coccidioidomycosis, a fungal disease caused by *Coccidioides immitis*, is endemic in certain parts of Arizona, California, Nevada, New Mexico, Texas, and Utah. Sporadic cases occur each year in parts of the United States in which the disease is not endemic and may present diagnostic difficulties and laboratory hazards because health-care workers may be unfamiliar with coccidioidomycosis. Recent increases in California and reports of isolated cases in areas without endemic disease suggest that physicians and laboratory personnel should be alert to the possible role of *C. immitis*. This report summarizes the occurrence of coccidioidomycosis in California during 1991 and 1992 and highlights three cases that occurred in areas in which the disease is not endemic.

Outbreak in California

In 1991, 1208 new cases of coccidioidomycosis were reported to the California Department of Health Services (CDHS), compared with an average of 450 cases per year during the previous 5 years. Of these cases, 959 (80%) were reported from Kern County, where coccidioidomycosis is known to be endemic and where the county health department serves as a referral laboratory for coccidioidomycosis serologic tests. Of all cases reported to CDHS in 1991, 765 (63%) were reported from October through December. In 1992, 4541 cases of coccidioidomycosis were reported to CDHS. Of these, 4198 (92%) were reported from the central valley and southern California, including 3027 (67%) from Kern County. Reports from the Coccidioidomycosis Serology Laboratory of the University of California at Davis, a reference laboratory that receives specimens from areas of California other than Kern County, also documented an increased incidence in 1991 and 1992.

Nonendemic Coccidioidomycosis

Although no national surveillance system exists for coccidioidomycosis, each year several cases are reported to CDC that occur outside of the southwestern United States, where the disease is endemic. Three such case-reports follow.

Case 1. In September 1992, a 24-year-old black man from Virginia developed pulmonary coccidioidomycosis 2 weeks after driving through California. He was admitted to a hospital after a chest radiograph indicated bilateral lower lobe infiltrates with extensive mediastinal and hilar lymphadenopathy. He was presumed to have bacterial pneumonia and was treated with antibiotics. Efforts to diagnose the pneumonia, which included bronchoalveolar lavage and transbronchial biopsy, were unsuccessful until an open-lung biopsy was performed. Culture of the biopsy specimen grew *C. immitis*. The patient was treated with an intravenous antifungal agent and was discharged after 12 days.

Case 2. In August 1992, a 13-year-old black male from Georgia developed symptoms that included hoarseness, noisy breathing, and difficult breathing 2 months after visiting southern California, Nevada, and northern Mexico. During initial evaluation, a laryngeal mass was detected; a laryngeal papilloma was suspected. Treatment with steroids and bronchodilaters resulted in symptomatic improvement. In October 1992, a subsequent laryngoscopy detected diffuse granular tissue on the larynx. Histopathologic examination of the biopsy revealed spherules of *C. immitis* and culture of the biopsy specimen grew *C. immitis*. The patient was treated with an intravenous antifungal agent and, after 5 days, was discharged on an oral antifungal agent.

Case 3. In October 1992, a 30-year-old black woman, who had previously resided in Arizona, was hospitalized in Florida because of chronic disseminated coccidioidomycosis. A slant of *C. immitis* culture isolated from her blood was inadvertently broken in the hospital's microbiology laboratory. The fungus had not been handled in a biological cabinet. The spill was promptly cleaned and disinfected. No subsequent evidence of clinical infection was found in potentially exposed laboratory personnel.

Editorial Note: *C. immitis* resides in the soil in certain parts of the southwestern United States, northern Mexico, and a few other areas in the Western Hemisphere. Infection is caused by inhalation of airborne, infective arthroconidia, one stage in the organisms's life cycle. In the host, these conidia convert into

endosporulating spherules, the organism's other morphologic form. The disease is not transmitted from person to person.

A substantial proportion of adults who are long-time residents of areas where the disease is endemic have evidence of prior infection with *C. immitis* by positive coccidioidin or spherulin skin tests. However, in addition to sporadic disease, these areas also experience outbreaks, demonstrated by the recent sharp increase in disease incidence in California. The current outbreak in California may be associated with weather conditions, especially a recent protracted drought followed by occasional heavy rains. The magnitude of the outbreak may be partially explained by recent migration of persons previously unexposed to *C. immitis* into areas of California where coccidioidomycosis is endemic. This outbreak illustrates how factors such as weather and demographic changes can affect the emergence of public health problems from infectious diseases.

Approximately 60% of persons infected with *C. immitis* remain asymptomatic. Symptomatic coccidioidomycosis has a wide clinical spectrum, ranging from mild influenza-like illness to serious pneumonia to widespread dissemination. Dissemination outside the lungs occurs in approximately 0.5% of infections. Coccidioidal meningitis is a particularly serious manifestation of disseminated coccidioidomycosis. Among persons who become infected, blacks, Filipinos and other Asians, Hispanics, and women who acquire the primary infection during the later stages of pregnancy are at increased risk for disseminated coccidioidomycosis. Extrapulmonary coccidioidomycosis is an acquired immunodeficiency syndrome-defining illness when it occurs in a person with evidence of infection with human immunodeficiency virus.

Infection with *C. immitis* in persons residing outside coccidioidomycosis-endemic areas may occur as a result of travel in these areas, laboratory exposure, or inhalation of contaminated fomites (e.g., soil, cotton, packing material, or museum artifacts) taken from areas with endemic coccidioidomycosis.

In laboratory cultures, *C. immitis* develops the highly infectious mycelial form and may pose a hazard to laboratory workers if arthroconidia from cultures are inadvertently aerosolized. When clinical laboratories handle *C. immitis*, laboratory activities should be performed at biosafety level 3. Subculturing or harvesting of arthroconidia and opening tubes containing cultures of *C. immitis* should be performed only in an appropriate biological cabinet. Agar slants or bottles should be used, instead of petri dishes, for the isolation of *C. immitis*. If a plate culture is prepared, the plate should be sealed with adhesive tape once growth is evident, and the culture plate should be destroyed after 10-14 days. Cultures sent through the mail should be packaged and labeled in accordance with regulations concerning the interstate shipment of etiologic agents.

Clinicians should consider the diagnosis of coccidioidomycosis in persons with undiagnosed respiratory illnesses or syndromes that could represent disseminated coccidioidomycosis for those who reside in, or have traveled to, areas where the disease is endemic, or who have had occupational exposure to *C. immitis*. Laboratory personnel should be reminded of necessary safety precautions when handling *C. immitis*.

Morbidity and Mortality Weekly Report, 1/22/93

Industry Products

Introducing the Split Cap Sampler

The Split Cap Sampler (SCS) is an in-line single service needle sampler built into a standard size stainless steel end cap and uses standard dairy grommets. The SCS can be removed and replaced with a stainless steel end cap when not in use. The Split Cap Sampler is available in 2" or 2 1/2" sizes. The SCS features:

- No permanent sampling holes in product lines
- Movable sampling sites
- Up to 4 grommets per cap
- Easy installation without tools
- No specialized, high cost sample membrane, change grommets for only 10 cents each
- Meets 3-A standards
- Patented design

Charm Sciences, Inc. - Malden, MA

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Spectrochrom, Ltd. Introduces New Meat Freshness QuickKit®

Spectrochrom, Ltd., a chemical testing and research laboratory located in Ogden, Iowa, introduces a new meat freshness screening kit. The meat freshness QuickKit® was recently unveiled at the Pittsburgh Conference held in Atlanta, Georgia. Cost effectiveness, ease of use, rapid turnaround time and the ability to screen samples on-site are benefits of this new kit.

In today's world, food safety continues to become a growing concern. The meat freshness QuickKit® enables it's user to quickly screen meat for freshness. Utilizing a reliable and simple to use thin layer method the meat freshness QuickKit® allows its user to screen meat with only 30 minutes of actual hands on work, with additional time needed for extraction of the meat and development of the TLC plate. Instead of sending a sample to a laboratory and waiting one to two weeks for results, the meat freshness QuickKit® allows you to screen the sample on-site in your facility and have data back quickly.

Each QuickKit® is accompanied by a VHS video tape containing complete instructions for the kit.

Spectrochrom, Ltd. - Ogden, IA

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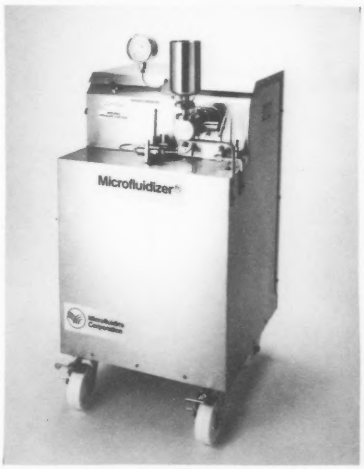

Microfluidics Corporation Adds Electric Laboratory Model to Product Line

Microfluidics Corporation has expanded its line of high performance mixing equipment with the addition of an electrically-powered laboratory model. The introduction of the M-110EH Microfluidizer® offers a solution for processors in the pharmaceutical, biotechnology, cosmetic, chemical and food processing industries with an unsatisfactory air supply for the existing pneumatically-powered models.

With the M-110EH, the benefits of the patented Microfluidizer technology combine with the convenience of an electrically-powered unit. This machine can process sample sizes from 120 ml. to continuous and generate liquid pressures up to 25,000 psi. The M-110EH is both sanitary and durable and is guaranteed scalable to Microfluidics' pneumatic or electric, pilot plant and production equipment.

As with all Microfluidizers, the key to superior results is the patented interaction chamber. It is here that shear, impact and cavitational forces combine to achieve submicron particle size reduction and uniform distribution. This unique module employs no moving parts so results are consistent and scaleup from laboratory to production guaranteed.

Microfluidics Corporation - Newton, MA

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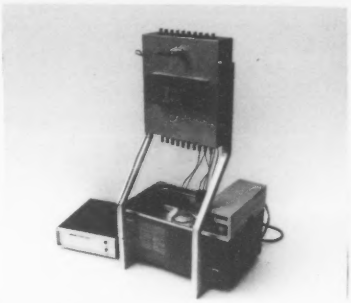

Condensing Air Drier

In many laboratory applications, evaporation of water from the sample is very undesirable. To restore water content, and at the same time, to be able to keep the flasks open or to draw the gas sample from the head space, a new Condensing Air Drier was developed.

Up to ten flasks can be connected to the overhead heat exchanger containing straight 1/2" stainless pipes embedded in a solid aluminum block. The entire assembly is cooled by a solid state thermoelectric device to the uniform temperature of 1°C. The majority of water in the air is condensed on the tube walls and drips back to the laboratory flasks restoring the original moisture. Flasks can be room temperature or heated. In case the head space gas after leaving the sample bottle has to be perfectly dry, chemical desiccants can be connected in line with the thermoelectric condenser.

Dimensions of the Condensing Air Drier are 18"H x 14"W x 7"D (450mm x 355mm x 170mm), weighing 22 lbs. (10kg), and requires between 50W to 100W of power to operate.

Columbus Instruments - Columbus, OH

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New Sparta Kitchen Brush Directory

Sparta introduces the new Kitchen Brush Directory; your guide to over 60 specialized brushes to meet your kitchen's needs.

All Sparta brushes are designed and constructed for a specific kitchen use. The Kitchen Brush Directory illustrates the use for high quality, specialized brushes to help keep your kitchen or food processing area efficient and sanitary. Sparta's high quality standards are recognized and recommended by professional chefs worldwide.

Sparta Brush Company is a leading manufacturer of high quality specialized brushes for the food service and food processing industry. For more information on the Kitchen Brush Directory call or write today.

Sparta Brush Company - Sparta, WI

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bioMérieux Vitek Offers Rapid Tests for E. coli

In light of a growing number of *E. coli* infections linked to poultry and meat products nationally, processors are looking with renewed interest at rapid tests and equipment designed to help in testing for these and other pathogens.

bioMérieux Vitek markets a wide range of test kits and instruments for detecting and identifying *E. coli*.

Until now, methodology required a minimum of four days to prove the absence of *E. coli* in test samples. However, more rapid and sensitive assays have been developed. By incorporating specific fluorogenic substrates into culture media, it's now possible to confirm the presence of *E. coli* with the aid of an automated instrument in as little as four hours.

The Bactometer® can be used to detect *E. coli* and other coliforms. A GNI Test Card is also available for use with the company's VITEK® automated microbiology identification system. This card may be used to identify Gram-negative organisms, such as *E. coli*. bioMérieux Vitek's ATB® Identification system utilizes two test strips, the ID32E and ID2GN, for detection of *Enterobacteriaceae* and other Gram-negative nonfermenting bacilli. The company's API® 20E manual test kit is yet another alternative for detecting *E. coli* organisms.

bioMérieux Vitek, Inc. - Hazelwood, MO

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Model RFM-91 Multi-Scale Automatic Digital Refractometer with 3 New Fructose Scales

Kernco Instruments Co., Inc. is pleased to introduce its new Model RFM-91 Multi-Scale Automatic Digital Refractometer. This model will measure seven (7) separate parameters; such as direct fructose measurements in 3 scales: 42%, 55%, and 90%, with accuracy of ±0.04%, sugar % (Brix) and temperature compensated sugar (Brix) in a range of 0-95% with accuracy of 0.04%, and readability of 0.01%; will measure refractive index range of 1.33300-1.52000 with readability of 0.00001 R.I. and accuracy of 0.0006 and will read out in Zeiss Scale of 14 to 105 down to 0.1 Zeiss units.

This model may be used with a batch or continuous flow cell accessory. It has an RS232 interface for downloading to a printer or computer.

The RFM-91 comes with selector switch for the various scale readings.

The RFM-91 is intended for total solids (sugar) or fructose determination of the full range of confectionery products - syrups, honey, fondants, jams and other preserves. Even hard-to-read substances such as tomato products, mustard, and chocolate do not require filtering or cutting prior to measurement. The beverage and juice manufacturer, as well as coffee concentrate manufacturers, will find this model to be an essential instrument for their quality and production control analysis. Unlike the conventional Abbe type refractometer with its closing prism box, the prism surface is entirely open, permitting the sample to be smeared on. There is no necessity to remove solids such as pits or pulp from the sample, and there is only one surface to clean after taking the reading.

The RFM-91 is designed as an all purpose instrument, equally suitable for the quality control laboratory and on the factory bench. There is no telescope and thus no setting required. The sample is merely applied to the prism surface, the read button pressed, and the solids reading noted from the digital display.

Kernco Instruments Co., Inc. - El Paso, TX

Please circle No. 269
on your Reader Service Card

FMI Valveless Metering Pumps for 1993

New 28 page fully illustrated Catalog 401-93, covers Metering Pumps, Dispensers and Accessories available from Fluid Metering, Inc. These unique valveless piston-type metering pumps feature low-dead volume, better than 0.1% repeat accuracy, flows from microliters to 2400 ml/min. and pressures to 100 psig. These pumps are ideal for the precise handling of solutions, suspensions, slurries, and gases.

New for 1993 are the patented FMI Series STH pumps called the "Living Hinge." These pumps are specifically designed for the OEM market requiring low flow, compact size, low cost and high accuracy.

The NEW Models RH-LF and Q-LF are ULTRA Low-Flow Pumps Heads for zero dead volume applications. The integrally molded ports are designed to accept standard 1/8" or 1/16" OD micro-bore tubing.

Also new in the 1993 Catalog are a line of High Temperature Isolation Gland Heads with capability of 350°F and pressures to 100 psig.

The catalog details operating principles, pump capacities, motor characteristics, materials of construction, prices and ordering instructions. Most FMI catalog items are available off the shelf for immediate shipment.

Fluid Metering, Inc. - Oyster Bay, NY

Please circle No. 270
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Complete Line of Sterile Prepared Plated Media Offered

Becton Dickinson Microbiology Systems, Cockeysville, MD, announces the immediate availability of a complete line of new BBL® Sterile Pack Prepared Media for improved quality assurance. The validated sterile plates help a laboratory or manufacturing facility achieve increased confidence in the maintenance of sterility throughout clean-room operations or core environment testing. The new formulations are available both as sterile contract plates, sterile RODAC® plates and sterile 100 mm and 150 mm plates.

To achieve and maintain sterility, all BBL Sterile Pack Prepared Media are gamma-irradiated, and feature a unique three bag system, wherein a sterile third bag is provided rolled-up inside the sterile double-bag unit. This sterile third bag can be used as a transport container out of a clean room environment.

The entire assembly, including the innovative third bag, is gamma-irradiated following AAMI guidelines, and is validated as sterile from point of manufacture to use. A lot-specific Quality Control Certificate is included in every package.

BBL® Sterile Prepared Plated Media are available in the following formulations, packages of 10 sterile contact plates or 10 sterile RODAC Plates: Trypticase® Soy Agar with Lecithin and Polysorbate 80, formulated to neutralize quaternary ammonium compounds and phenolic disinfectants; Trypticase Soy Agar with Lecithin, Polysorbate 80 and Penicillinase to neutralize quaternary ammonium compounds, phenolic disinfectants, penicillin and cephalosporin antibiotics; D/E Neutralizing Agar, containing lecithin to neutralize quaternary ammonium compounds, polysorbate 80 to neutralize phenolic compounds, sodium bisulfite to neutralize aldehydes, sodium thioglycollate to neutralize mercurials and sodium thiosulfate to neutralize chlorine; Sabouraud Dextrose Agar, recommended for the recovery of fungi (molds and yeasts), that contains no additives for the neutralization of disinfectants; Sabouraud Dextrose Agar with Lecithin and Polysorbate 80, recommended for the recovery of fungi (molds and yeasts) and to neutralize quaternary ammonium compounds and phenolic disinfectants.

Becton Dickinson Microbiology Systems - Cockeysville, MD

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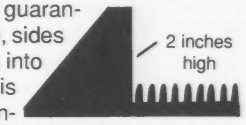
HighWall™
DISINFECTANT MAT™

430-2006 Standard Rubber
430-2007 Chlorine Resistant

Now, for applications requiring deeper foot immersion, try our new **HighWall™** mat. You can be sure that footwear is sanitized and the soles scrubbed clean. Full 2" height guarantees that sanitizing solution contacts sole, sides and welt area of boots, penetrating even into deep treads. Depth of sanitizing solution is three times that of our standard Disinfectant Mat™. Footwear gets a thorough bath to eliminate both bacteria and soil.

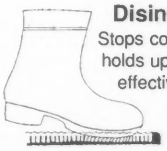


Double-action. The new HighWall™ Disinfectant Mat™ features the same double-action that made our standard Disinfectant Mat™ famous. Rubber fingers scrub soles of shoes clean, holding them out of accumulated sediment, while sanitizing solution disinfects them. Step off clean *and* sanitary.

Larger size assures compliance. New 32" x 39" size is 60% larger to cover most doorways and guarantee that personnel will not bypass the footbath. It is long enough for workers to step in it with *both feet* without breaking their stride.

Extra design features. For safety and compliance the mat features a "safety yellow" 2" ramp edge. Interior corners allow use of simple hand pump to empty spent sanitizing solution without spilling on the floor. Available in Standard or Chlorine Resistant Rubber.

Other Sanitation Products & Accessories



Disinfectant Mat™ Sanitizing Footbath
Stops contaminants at the door. Exclusive design holds up to 5 quarts of sanitizing solution. Proven effective in years of dairy and food plant use.

430-2005 Standard Rubber
430-2000 Chlorine Resistant Rubber

Test Strips
Economical strips allow quick and easy check of sanitizing solution strength.

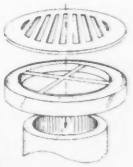
387-3294 Iodine, 25-100ppm
387-3296 Quat. 100-400ppm
387-3425 Chlorine, 10-200ppm

Hand Dip
High visibility imprint and low cost make this a must for your plant!

430-2010 Hand Dip Basin
430-2011 Wall Mount Bracket
083-2001 Hand Dip Wall Sign

Hand Pump
Use with High Wall™ Mat to empty without spilling.

065-2918 Hand Pump



Assur-Ring®
Works 24-hours a day to solubilize soil deposits and control oders in floor drains.

800-5070 Blue - for cold water/ low flow
800-5075 Red - for hot water/continuous flow

Footbath Sign
Enhances employee awareness of sanitation program.

083-2002 Footbath Sign, 7" x 10"

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Affiliate News

Upcoming IAMFES Affiliate Meetings

1993

AUGUST

• **1-4, 80th Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians, Inc.** to be held at the Stouffer Waverly Hotel, Atlanta, GA. For more information please contact Julie Heim at (800)369-6337 (US) or (800)284-6336 (Canada).

• **17-19, Special Problems Course**, sponsored by the Texas Association of Milk, Food and Environmental Sanitarians, will be held at the Seven Oaks Hotel, 1400 Austin Hwy, San Antonio, TX. For more information, please contact Ms. Janie F. Park, TAMFES, P. O. Box 2363, Cedar Park, TX 78613-2363, (512)458-7281.

SEPTEMBER

• **16-17, Minnesota Sanitarians Association, Inc.'s Annual Meeting** will be held at the Earl Brown Center, St. Paul, MN. For more information contact Paul Nierman at (612)785-0484.

• **20-22, New York State Association of Milk and Food Sanitarians 70th Annual Conference** will be held at the Holiday Inn, Genesee Plaza, Rochester, NY. For more information contact Janene Gargiulo at (607)255-2892.

• **22-23, Third Annual Joint Conference of the South Dakota State Dairy Association and Dairy Fieldmen's Association** will be held at the Ramkota Inn, Watertown, SD. For more information contact John Parsons, Dairy Science Department, (605)688-4116.

• **27, California Association of Dairy and Milk Sanitarians** will hold their Annual Meeting at the Ontario Hilton, Ontario, CA. For more information contact John Bruhn, University of California-Davis, at (916)752-2191.

• **28-30, Wyoming Environmental Health Association Annual Education Conference**, in conjunction with the Wyoming Public Health Association, will be held at the Casper Hilton Inn, Casper, WY. For further information contact Kenneth Hoff at (307)235-9340.

OCTOBER

• **6-8, Kansas Association of Sanitarians 64th Annual Educational Conference** will be held at the Doubletree Hotel, Overland Park, KS. For more information contact Galen Hulsing at (913)233-8961.

• **7-8, Fourteenth Annual Joint Educational Conference** sponsored by the Wisconsin Association of Milk and Food Sanitarians, Wisconsin Environmental Health Association and Wisconsin Dairy Plant Fieldmen's Association, will be held at the Chula Vista Resort, Wisconsin Dells, WI. For further information contact, Neil Vassau, Publicity Chairperson, P.O. Box 7883, Madison, WI 53707, (608)267-3504.

• **13-14, Iowa Association of Milk, Food and Environmental Sanitarians, Inc. Annual Meeting** will be held at the Ramada Inn, Waterloo, IA. For more information, please contact Dale Cooper at (319)927-3212.

• **21-22, Michigan Food Protection Seminar** to be held at the Bill Oliver Caberfae Motor Inn, Cadillac, MI. For more information call Bob Taylor, IAMFES Delegate and Meeting Liaison, at (517)335-4297.

• **26, Associated Illinois, Milk Food and Environmental Sanitarians Annual Meeting** will be held at the Carlisle in Lombard, IL. For more information call Bob Crombie at (815)726-1683.

• **26-28, Basic Pasteurization Course**, sponsored by the Texas Association of Milk, Food and Environmental Sanitarians, will be held at the Le Baron Hotel, 1055 Regal Row, Dallas, TX. For more information, please contact Ms. Janie F. Park, TAMFES, P. O. Box 2363, Cedar Park, TX 78613-2363, (512)4458-7281.

NOVEMBER

• **15-17, Pennsylvania Association of Dairy Sanitarians and Dairy Laboratory Analysts Fall Meeting** will be held at Penn State University, University Park, PA. For more information, contact Mike John at (717)762-7789.

WAMFS Celebrates 50 Years!!

This the year 1993, is our Golden Anniversary. On June 19, 1943, 15 people met at the Hotel Retlaw, Fond du Lac, Wisconsin for the purpose of organizing a Wisconsin group of sanitarians. These 15 charter members formed the Wisconsin Milk Sanitarians Association, now known as the Wisconsin Association of Milk and Food Sanitarians. It was intended that the meeting would permit the formal organization of a Wisconsin group of milk sanitarians to formulate an affiliate that would immediately be a part of the International Association of Milk and Food Sanitarians, Inc. now known as IAMFES, Inc. To that end this group of sanitarians had also invited the President of the International, Mr. C. A. Abele. The chairman of the committee to form our organization was K. G. Weckel, Associate Professor of Dairy Industry, University of Wisconsin, Madison, WI.

From this small beginning of 45 members, our association has grown to some 350 members. There are many members who have helped this affiliate become an effective force in the field of sanitation, health, and education not only in Wisconsin, but throughout the United States and the World. From the group of 15 men who formed our affiliate to the present membership, we have had dedicated people who have served our association over the past 50 years. Our affiliate has been the host for the IAMFES annual meeting five times since we became an affiliate. Our affiliate has won many of the awards that are given at our annual meetings over the years. Our affiliate has met the challenge that our charter members envisioned when forming our association.

We will be celebrating our Golden Anniversary at our Joint Conference this fall which will be held at the Chula Vista Resort, Wisconsin Dells, Wisconsin on October 7-8, 1993. We will invite our two living charter members, L. Wayne Brown and Evert Wallenfeldt as our honored guests. We will also invite all of our Past Presidents, and our IAMFES President. We are planning a luncheon on the last day of our conference to be followed by a program dedicated to our anniversary and the history of our organization. More information will be available as our fall conference program progresses.

Affiliate Council Candidate Winner

A vote of the IAMFES Affiliate Delegates selected Susan S. Sumner as the new Affiliate Council Officer. Susan will serve one year as Affiliate Council Secretary, then move on to serve as Affiliate Council Chairperson for one year, sitting on the Executive Board through her term of office as Chairperson.

Susan S. Sumner is an Assistant Professor/Extension Food Microbiologist at the University of Nebraska-Lincoln. She is an active researcher in the area of foodborne bacterial pathogens and works closely with the food industry on issues related to the microbiological safety of foods. Her current projects include investigations to prevent and eliminate *Salmonella* on poultry and *Escherichia coli* O157:H7 on meat. Susan teaches Quality Assurance at the University of Nebraska. She also conducts HACCP, food safety/sanitation and quality control workshops in Nebraska. Prior to her academic appointment, she was a Project Microbiologist II and Assistant Manager in the Eastern Microbiology Laboratory at the National Food Processors Association in Washington, DC.

Susan received her B.S. degree in Food Science from North Carolina State University and her M.S. and Ph.D. in Food Science/Food Safety and Toxicology from the University of Wisconsin-Madison at the Food Research Institute.

Susan has been active in IAMFES for many years. She is currently a member of the Editorial Review Board of the *Journal of Food Protection*; the affiliate representative for the Nebraska Association of Milk and Food Sanitarians; a member of the Applied Laboratory Methods Professional Development Group; and a member of the Undergraduate Recognition Task Force. Susan is the past-chair of the Nebraska Affiliate of IAMFES.

Susan's other professional memberships include: Institute of Food Technologists, Regional Communicator for IFT, Food Microbiology Division IFT, Extension Division IFT, Dairy Technology Division IFT, Ak-Sar-Ben Section IFT (member-at-large, alternate councilor, executive committee, board of directors, American Society for Microbiology, Sigma XI, Phi Tau Sigma, Phi Kappa Phi, General Foods Graduate Fellowship 1984-87.

Susan has presented numerous papers at local and national meetings and is the author of over 25 research articles and extension publications. She participates in regional workshops on food safety. She is currently involved in an extension project to improve food safety training of foodservice personnel and in a NSF/Agriscience Summer Institute at Kansas State University.

Susan is married and has one son.

Tennessee Affiliate Holds 14th Annual Meeting

The 14th Annual Meeting of the Tennessee Association of Milk, Water and Food Protection was held June 4, 1993 at the Ramada Airport, Nashville, TN. Dr. Ann Draughon, President presided and welcomed the 48 members and guests to Nashville.

Hugh Wilson served as Session Chairman. Dr. Bill Morris of the University of Tennessee, Knoxville, spoke on new food labeling regulations.

Dennis Lampley presents presidential plaque to Dr. Ann Draughon

Dennis Lampley presents service award for outstanding service to the Association to Earl Morgan

John Sanford of the Tennessee Department of Agriculture, updated the group on the actions of the 1993 Interstate Milk Shippers Conference.

After a milk break, Emily McKnight of the Tennessee Department of Agriculture, updated the group on certified dairy laboratory programs.

Jim Nance of the Agricultural Resources Division of TDA, spoke on conservation cost-sharing programs offered by the Department of Agriculture.

Bryan Anthony, a graduate student at the University of Tennessee spoke on the Cryptosporidium outbreak in Milwaukee.

Earl Morgan gave the invocation before the buffet luncheon. After lunch, Dee Buske, of Des Moines, IA, updated the group on IAMFES activities, including the upcoming annual meeting.

Dr. Ann Draughon presided over the business session. The Audit Committee Report was given by John Sanford. Mary Lou Hopper gave the Membership Committee Report. It was voted unanimously to dispense with the reading of the Minutes. Dennis Lampley gave the financial report. Ronnie Wade gave the Nominating Committee Report, and the following officers were elected by acclamation:

President	Wayne Crabtree, Athens
President Elect	Ernest Yates, Cross Plains
Vice President	Dr. Genevieve Christen, Knoxville
Sec/Treasurer	Dennis Lampley, Bon Aqua
Archivist	Ruth Fuqua, Mt. Juliet
Board Member at Large	Gail Smith, Chattanooga
Past President	Dr. Ann Draughon, Knoxville

Service award plaques were presented to Dr. Ann Draughon for outstanding leadership as president. Earl Morgan - outstanding service to the Association and Herbert Holt - outstanding service to the dairy industry of Tennessee.

Jerry Baggett of TDA served as door prize chairman with everyone in attendance receiving at least one door prize.

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Synopsis of Papers for the 80th Annual Meeting

The following are abstracts of papers to be presented at the 80th Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians, Inc., to be held in Atlanta, Georgia, August 1-4, 1993.

ANTIMICROBIAL ACTIVITY OF LACTIC ACID BACTERIA ISOLATED FROM READY-TO-EAT TURKEY PRODUCTS, Arthur J. Maurer and Judith L. Aulik*, Ph.D. candidate, 260 Animal Sciences Building, 1675 Observatory Drive, University of Wisconsin-Madison, Madison, WI 53706

Various ready-to-eat turkey products were purchased and their spoilage flora examined to isolate lactobacilli to screen for antimicrobic substances. Selective plating procedures, in addition to standard plate counts, were used to isolate lactic acid bacteria (LAB). The catalase-negative, gram-positive bacilli underwent carbohydrate fermentation tests to determine their genera and species. In order to screen for the production of antibiotic substances, the flip-plate method of Kekessy and Piguet (1970) was used. Several strains of lactobacilli were found to be inhibitory to the gram-positive flora of these products. Spent culture media from the inhibitory LAB were neutralized, filter-sterilized, and incorporated into agar for spot-plate testing. At pH 7, activity was abolished. However, at pH 6, media from one strain of *L. sake* and one strain of *L. curvatus* showed narrow spectrum inhibition of three strains of lactobacilli. Media obtained from an unidentified *Pediococcus* sp. inhibited one Streptococcus and one strain of *L. coryneformis*.

EFFICACY OF USING ANTAGONISTIC MICROORGANISMS TO INHIBIT PSYCHROTROPHIC PATHOGENS IN REFRIGERATED, COOKED POULTRY, Y.-Y. Hao*, R.E. Brackett and M.P. Doyle, Food Safety and Quality Enhancement Laboratory, University of Georgia, Food Science and Technology Department, Griffin, GA 30223-1797

The ability of 7 antagonistic bacteria to inhibit growth of *Aeromonas hydrophila* K144 (AH) and *Listeria monocytogenes* Scott A (LM) in refrigerated, cooked chicken breast was studied. Cooked chicken breasts were inoculated to result in populations of 10^1 or 10^5 cfu of AH and LM/g. Breasts were then inoculated with individual antagonistic bacteria to result in 10^3 cfu of antagonists/g. Treated samples were packaged and incubated at 5° or 15° C for 2 or 1 weeks, respectively. Populations of the two pathogens were determined periodically using starch ampicillin agar (AH) or modified Oxford agar (LM). Antagonistic bacteria differed significantly in their ability to inhibit growth of the two pathogens. In general, *Carnobacterium piscicola* LV17, *Lactobacillus bavaricus* MN, *Leuconostoc paramesenteroides* OX, and *Lactococcus lactis* 11454 were most effective at inhibiting growth of AH or LM. However, initial populations of LM or AH and incubation temperature affected the efficacy of antagonists to inhibit the pathogens. After 1 week incubation at 15° C, breasts inoculated to contain 10^1 cfu pathogens/g and not treated with antagonistic bacteria contained as much as 1.5 and 2 $\log_{10}$/g more AH and LM, respectively, than treated breasts. Antagonistic bacteria tested that were less effective at inhibiting growth of AH and LM included *Lactobacillus sake* Lb 706, and *Pediococcus acidilactici* strains M and PAC 1.0.

THE ROLE OF METABOLIC INTERMEDIATES IN THE INHIBITION OF *SALMONELLA ENTERITIDIS* BY A *VEILLONELLA* SPECIES, Arthur Hinton, Jr.*, Assistant Professor, Michael E. Hume, and John R. DeLoach, Auburn University, Department of Botany and Microbiology, Auburn, AL 36849-5407

A veillonellae bacterium was isolated from the cecal contents of adult chickens. The *Veillonella* was grown on an agar medium supplemented with either tartrate, lactate, pyruvate, malate, fumarate, or succinate and on a control agar medium that contained no added supplements. *Veillonella* growth was overlaid with fresh agar media, and *S. enteritidis* was spread on the surface of the overlay. *Veillonella* inhibited the growth of *S. enteritidis* on media supplemented with tartrate, lactate, malate, fumarate, or succinate; but growth of *S. enteritidis* was not inhibited on control media or media supplemented with pyruvate. The pH and the concentration of acetic and propionic acid of control and supplemented broth media inoculated with *Veillonella* were also measured. Inhibition of the growth of *S. enteritidis* was related to the ability of *Veillonella* to convert the metabolic intermediates into inhibitory concentrations of acetic and propionic acids.

INHIBITION OF *LISTERIA MONOCYTOGENES* AND OTHER BACTERIA BY SODIUM DIACETATE, Lakshmi Addala and Leora A. Shelef*, Department of Nutrition and Food Science, Wayne State University, Detroit, MI 48202

Growth and survival patterns of *L. monocytogenes* strain Scott A in media containing acetic acid, sodium acetate, combination of the two, and sodium diacetate ($CH_3COOH.CH_3COONa$) were studied, and effects of acetate concentrations, media pH, and temperature evaluated. Sodium diacetate was the most effective inhibitor in the pH range of 5.0-6.0. Minimum inhibitory concentrations in BHI broth (pH 5.4-5.8) decreased with decrease in temperature, from 35 and 32 mM at 35° and 20°, respectively, to 25 mM at 5°C. Addition of sodium diacetate (21 and 28 mM; 0.3 and 0.4%) to ground beef suppressed total aerobic counts during refrigerated storage. Although the meat pH decreased to 5.0-5.2 by the addition of the compound, a significant part of the antimicrobial effect was attributed to the diacetate. Sodium diacetate suppressed growth of two additional *L. monocytogenes* strains and gram-negative bacteria consisting of *Escherichia coli*, *Pseudomonas fluorescens*, *P. fragi*, *Salmonella enteritidis*, and *Shewanella putrefaciens*, but had no effect on *Yersinia entercolitica*, *Enterococcus faecalis*, *Lactobacillus fermentis* or *Staphylococcus aureus*. The use of sodium diacetate is recommended to control growth of listeriae in prepared foods, particularly in meat, poultry and fish products.

ANTIMICROBIAL EFFECTS OF TRISODIUM PHOSPHATE AGAINST BACTERIA ATTACHED TO BEEF TISSUE, J.S. Dickson*, C.G. Nettles and G.R. Siragusa, U.S. Department of Agriculture, ARS, Roman L. Hruska U.S. Meat Animal Research Center, P. O. Box 166, Clay Center, NE 68933

Beef tissue was inoculated with *Salmonella typhimurium*, *Listeria monocytogenes* and *Escherichia coli* O157:H7. The tissue was sanitized with trisodium phosphate at 25°C, 40°C and 55°C with contact times of up to three minutes, at a minimum concentration of

8%. Reductions in bacterial populations of 1 to 1.5 $\log_{10}$ cycles were seen on lean tissue with the Gram-negative pathogens, although less reduction in population was seen with *L. monocytogenes*. Greater reductions in bacterial populations were observed on adipose tissue, with maximum reductions of 2 to 2.5 $\log_{10}$ cycles and 1 to 1.5 $\log_{10}$ cycles for the Gram negative and Gram positive pathogens, respectively. Typically greater reductions in bacterial populations were seen as the temperature of the trisodium phosphate solution increased. Beef tissue was inoculated with *E. coli* ATCC 25922 and sanitized with 8% trisodium phosphate using a model carcass washing system. Population reductions on lean tissue were comparable to those observed in the laboratory with *E. coli* O157:H7. However, greater reductions were observed on adipose tissue from the model system, suggesting that the physical washing procedure may have contributed to the reduction in the bacterial population.

ANTILISTERIAL ACTIVITIES OF LACTIC ACID SALTS IN SAUSAGE AND THE RELATIONSHIP TO PH AND WATER ACTIVITY , Leora A. Shelef, Professor, Department of Nutrition and Food Science, 3009 Science Hall, Wayne State University, Detroit, MI 48202

Sodium, potassium, and calcium salts of lactic acid are approved GRAS additives in foods to enhance flavor, increase water holding capacity and for other purposes. Antimicrobial activities, of the Na salt in particular, have been reported, and evidence is accumulating for antilisterial activity of the salt in meat products. Additions of 4% Na or K lactate to cooked pork liver sausage containing 2% NaCl followed by heat sterilization and artificial inoculation with *L. monocytogenes* strain Scott A suppressed cell growth for 10 days at 20°C, and growth suppression was enhanced at 5°C during storage for 50 days. Growth was inhibited at either storage temperature by the addition of 3% of Ca lactate, and cell numbers declined by ~ one log cycle. Water activity of the sausage was 0.965, and levels were reduced by ≤0.01 units with additions of the lactates. The product pH was 6.04, and levels increased by less than 0.05 units with additions of the Na or K salts, and decreased by 0.6 units with the Ca salt. Analysis of the data showed listeriostatic effects in the product at combinations of mean water activity of 0.951 and pH of 6.08 (Na and K lactate), and of mean water activity of 0.968 and pH of 5.52 (Ca lactate). These water activity thresholds are somewhat higher than those reported for *L. monocytogenes* in humectant-adjusted broth.

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

Fluid milk samples were obtained from the 38 fluid milk dealer processors in Pennsylvania on more than 200 occasions during the past two and one-half years. These samples represented all fillers except dispensers and all products processed by each plant. They were selected from conveyors or cold rooms and held for 10, 12 or 14 days at 7.2°C (45°F) prior to testing and tasting. Initial studies showed that about 90% of samples remained of acceptable flavor for 10 days, but that only 62% of samples were acceptable after 14 days. Following education programs and individual assistance, holding times were set for 12 days at 7.2°C (45°F). Following four rounds of samples from the 38 plants which demonstrated that 92% of samples remained acceptable, the Pennsylvania open dating regulation was extended to 12 days. Monitoring shows about 95% compliance. Bacterial results showed that about 30% of samples had bacterial counts of less than one coliform, and less than 20,000 SPC per ml. at the end of the 12-day holding. Dairy processors requested that educational, individual assistance, testing, and tasting programs continue. The goal was to demonstrate that fluid milk could be processed and packaged which would be of acceptable flavor after 14 days. This was achieved with 92% of samples in late 1992. If product temperatures do not exceed 7.2°C (45°F), the 14-day open date represents the actual keeping quality which consumers can expect.

CONTROL OF BIOFILM BACTERIA IN DAIRY SWEET WATER (COOLING WATER) SYSTEMS, Melvin H. Czechowski*, Ph.D., Senior Microbiologist, and Mark J. Banner, Ph.D., Diversey Corporation, 1532 Biddle Avenue, Wyandotte, MI 48192

Slime (found to be mostly biofilm) in dairy cooling (sweet) water systems is very common, and may lead to plugging, corrosion and product contamination problems. Controlling slime is therefore important, and a study was conducted to determine the effectiveness of biocides. Slime on stainless steel coupons was exposed to biocides (with and without scalants and corrosion inhibitors), and the number of viable bacteria in the slime determined by swab/rinse techniques. Biocides were also tested against suspended bacteria in cooling water. Glutaraldehyde, quaternary ammonium compounds (QAC), glutaraldehyde with QAC, polymeric biguanide, hypochlorite and pH control killed suspended and biofilm bacteria. However, biocides were less efficacious against biofilm bacteria than suspended bacteria. Biocide effectiveness varied as to biocide type, concentration, application time and interaction with phosphate scalant and corrosion inhibitor. Results indicate that appropriate application of scalants and corrosion inhibitors and biocides can effectively control bacteria in biofilms and reduce potential problems.

INHIBITION OF GRAM-POSITIVE PATHOGENS IN COLD-PACK CHEESE MADE FROM CHEESE CONTAINING NISIN, T.L. Yezzi*, Research Assistant, A.B. Ajao & E.A. Zottola, Department of Food Science and Nutrition, University of Minnesota, St. Paul, MN 55108

Research has shown that the incorporation of nisin into food products inhibits gram (+) pathogenic microorganisms. In research reported earlier, our laboratory was able to manufacture Cheddar Cheese with up to 1200 IU nisin per gram of cheese.

Cold-pack cheese was manufactured using the nisin containing cheese. Cold-pack cheese made this way was inoculated with *L. monocytogenes* V7, *S. aureus* 196E or *C. sporogenes* PA3679 spores. Fifty gram samples were sealed in plastic pouches. Samples inoculated with *L. monocytogenes* V7 were stored at 4, 7, and 23°C. Samples containing *S. aureus* 196E cells and *C. sporogenes* PA3679 spores were stored at 23 and 37°C. The cold-pack cheese samples were examined for numbers of viable bacteria or spores at 0, 3, 7, 14, 21, 28 and 56 days.

All samples showed some reduction in numbers of microbes over time. A greater reduction in the total number of microorganisms was observed as nisin concentration and temperature was increased. Numbers of *Clostridium* spores and *S. aureus* cells were reduced from 1000 to <3 and <10 per gram respectively in 28 days. *L. monocytogenes* was reduced from 2,000 to 10-100 in 21 days. After 21 days the number of *L. monocytogenes* persisted at levels of 10-100 cfu/g cheese. It appears that using nisin-containing cheese as an ingredient in cold-pack cheese is effective in controlling these gram (+) pathogens.

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Coming Events

1993

August

•1-4, **80th Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians, Inc.** to be held at the Stouffer Waverly Hotel, Atlanta, GA. For more information please contact Julie Heim at (800)369-6337 (US) or (800)284-6336 (Canada).

•**10-11, Mini Workshop on the Management of Refrigerated and Frozen Foods in the Distribution System**, sponsored by Purdue, Michigan State and Ohio State Universities, will be held at the Hilton Inn at the Airport, Indianapolis, IN. For program information please contact James V. Chambers, Purdue University, at (317)494-8279, William C. Haines, Michigan State University, at (517)355-2176 or Winston D. Bash, Ohio State University at (614)292-7004.

•**16-20, Special Problems in Milk Protection**, sponsored by the USPHS/FDA State Training Branch and the Pennsylvania Department of Agriculture to be held in Harrisburg, PA. For course information contact Richard Eubanks (301)443-5871 or Paul Hogue (717)787-4316.

•**17-19, Special Problems Course**, sponsored by the Texas Association of Milk, Food and Environmental Sanitarians, will be held at the Seven Oaks Hotel, 1400 Austin Hwy, San Antonio, TX. For more information, please contact Ms. Janie F. Park, TAMFES, P. O. Box 2363, Cedar Park, TX 78613-2363, (512)4458-7281.

September

•**9-10, Wisconsin Laboratory Association Annual Meeting** will be held at the Paper Valley Hotel, Appleton, WI. For more information please contact Wisconsin Laboratory Association, P. O. Box 28045, Green Bay, WI 54304.

•**16-17, Minnesota Sanitarians Association, Inc.'s Annual Meeting** will be held at the Earl Brown Center, St. Paul, MN. For more information contact Paul Nierman at (612)785-0484.

•**17, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in Seattle, WA. This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**18, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in San Francisco, CA. This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**20-22, New York State Association of Milk and Food Sanitarians 70th Annual Conference** will be held at the Holiday Inn, Genesee Plaza, Rochester, NY. For more information contact Janene Gargiulo at (607)255-2892.

•**20-24, Special Problems in Milk Protection**, sponsored by the USPHS/FDA State Training Branch and the Nevada Department of Human Resources to be held in Reno, NV. For more information contact Richard Eubanks (301)443-5871 or Joseph Nebe (702)687-4750.

•**22-23, Third Annual Joint Conference of the South Dakota State Dairy Association and Dairy Fieldmen's Association** will be held at the Ramkota Inn, Watertown, SD. For more information contact John Parsons, Dairy Science Department, (605)688-4116.

•**27-30, Insect Cell Culture and Protein Expression with Baculovirus Vectors,** sponsored by the American Type Culture Collection's Laboratory Workshops Department, will be held in Rockville, MD. For more information, please contact ATCC Workshops Manager, 12301 Parklawn Drive, Rockville, MD 20852, (301)231-5566, FAX (301)770-1805.

•**28-29, California Association of Dairy and Milk Sanitarians** will hold their Annual Meeting at the Ontario Hilton, Ontario, CA. For more information contact John Bruhn, University of California-Davis, at (916)752-2191.

•**28-30, Wyoming Environmental Health Association Annual Education Conference**, in conjunction with the Wyoming Public Health Association, will be held at the Casper Hilton Inn, Casper, WY. For further information contact Kenneth Hoff at (307)235-9340.

October

•**2, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in Orlando, FL. This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**2-7, 36th Annual National Conference and Exposition of the Environmental Management Association** will be held at the Holiday Inn Surfside, Clearwater Beach, FL. For further information on EMA and its national conference, please contact EMA, 4350 DiPaolo Center, Suite C, Dearlove Road, Glenview, IL 60025-5212, (708)699-6362 or (708)699-6EMA, FAX: (708)699-1703.

•**3-8, 1993 National Safety Council Congress and Exposition "World Class Solutions"** will be held at the McCormick Place, Chicago, IL. For more information, please contact Robin L. Ungerleider at (708)775-2303.

•**6-8, Kansas Association of Sanitarians 64th Annual Educational Conference** will be held at the Doubletree Hotel,

Overland Park, KS. For more information contact Galen Hulsing at (913)233-8961.

•**6-9, 1993 Dairy Foods Industry Convention**, sponsored by the Milk Industry Foundation, National Cheese Institute, International Ice Cream Association and American Butter Institute, along with their suppliers, will be held at the Palmer House Hilton, Chicago, IL. For more information, please contact Mary Vanderbeck at the International Dairy Foods Association, (202)296-4250.

•**7-8, Fourteenth Annual Joint Educational Conference** sponsored by the Wisconsin Association of Milk and Food Sanitarians, Wisconsin Environmental Health Association and Wisconsin Dairy Plant Fieldmen's Association, will be held at the Chula Vista Resort, Wisconsin Dells, WI. For further information contact, Neil Vassau, Publicity Chairperson, P.O. Box 7883, Madison, WI 53707, (608)267-3504.

•**8, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in Atlanta, GA. This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**9, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in Atlanta, GA (suburbs). This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**12-15, DNA Fingerprinting**, sponsored by the American Type Culture Collection's Laboratory Workshops Department, will be held in Rockville, MD. For more information, please contact ATCC Workshops Manager, 12301 Parklawn Drive, Rockville, MD 20852, (301)231-5566, FAX (301)770-1805.

•**13-14, Annual Conference of the North Central Cheese Industries Association** to be held at the Sheraton Inn Airport Hotel, Minneapolis, MN. For further information contact E.A. Zottola, Executive Secretary, NCCIA, PO Box 8113, St. Paul, MN 55108.

•**13-14, Iowa Association of Milk, Food and Environmental Sanitarians, Inc. Annual Meeting** will be held at the Ramada Inn, Waterloo, IA. For more information, please contact Dale Cooper at (319)927-3212.

•**16, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in Denver, CO. This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

To insure that your meeting time is published, send announcements at least 90 days in advance to: IAMFES, 200W Merle Hay Centre, 6200 Aurora Avenue, Des Moines, IA 50322.

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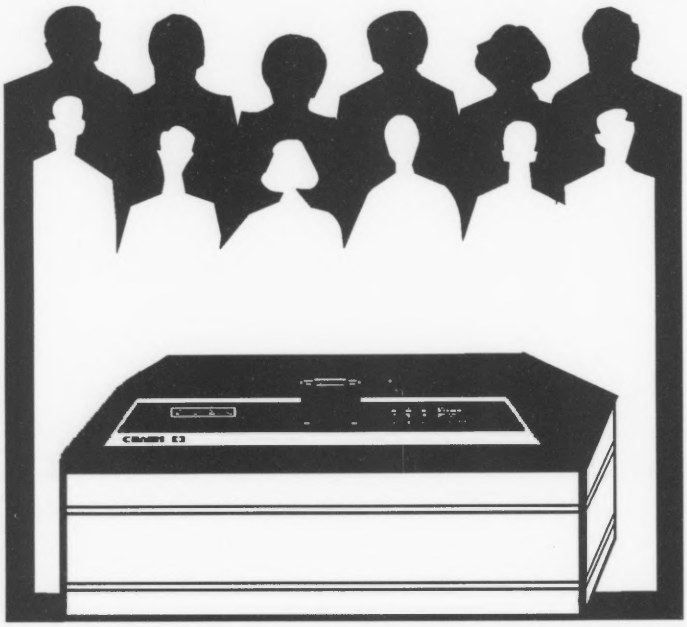

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