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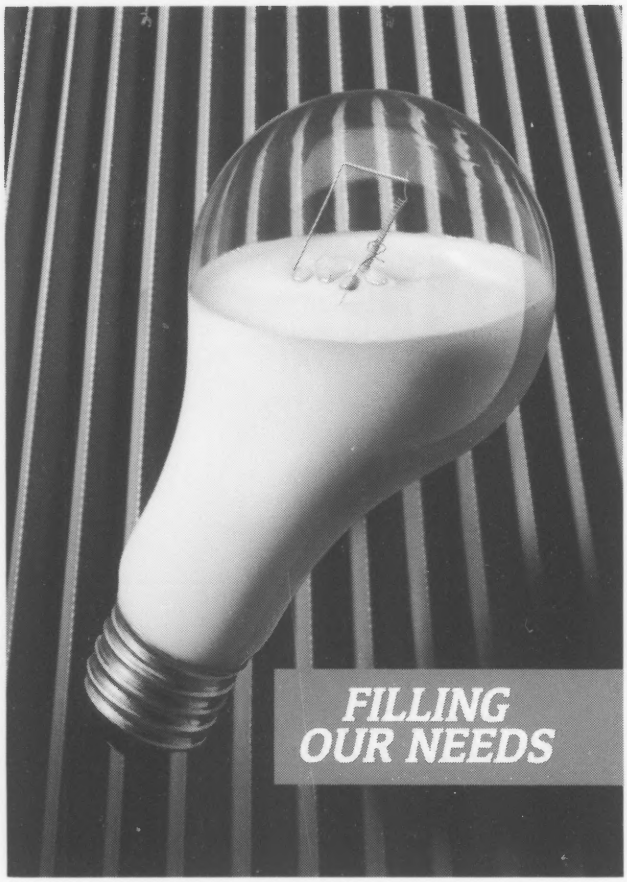

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Thoughts From the President . . .

By
Ron Case
IAMFES President

In this issue you will find the preliminary program for the 77th annual IAMFES meeting. Bob Sanders, your president-elect, is in charge of this year's program. Gale Prince is chairing the program advisory committee which has worked since last year's meeting to plan and develop the program. They have done an excellent job of putting together a three day meeting which covers topics of interest for all members.

The meeting starts on Sunday, August 5, 1990. Committees will meet on Sunday morning and afternoon. That evening the Ivan Parkin Lecture will be given by George M. Burditt, Esq. This keynote address will give you a view of "Sanitation From Another Perspective." This will be followed by a wine and cheese reception at which you may renew old acquaintances, meet new attendees and visit the supplier exhibits.

Technical sessions start Monday morning and run through Wednesday. Some of the highlights of these sessions will be symposia and sessions on:

- HACCP
- Listeria
- Safety of Minimally Processed Refrigerated Foods
- Biofilms
- Chemical Residues
- Global Aspects of Foodborne Disease
- Communicating Food Safety Concerns
- Solid Waste Disposal
- Dairy and Food Microbiology
- Food Sanitation

Wednesday there will be a special session for Dairy Fieldmen which will deal with current technical and regulatory problems. Tuesday afternoon there will be a combined session on the Challenge of the 90's and the Food Protection Professional Role.

Illinois and Wisconsin are working together to put on this year's meeting. They have great activities planned for Monday and Wednesday night. The Chicago area has many exciting things for families to do. Take some time to enjoy them while you are there.

You can get more details of the meeting in this issue. I look forward to seeing you in August in Arlington Heights.

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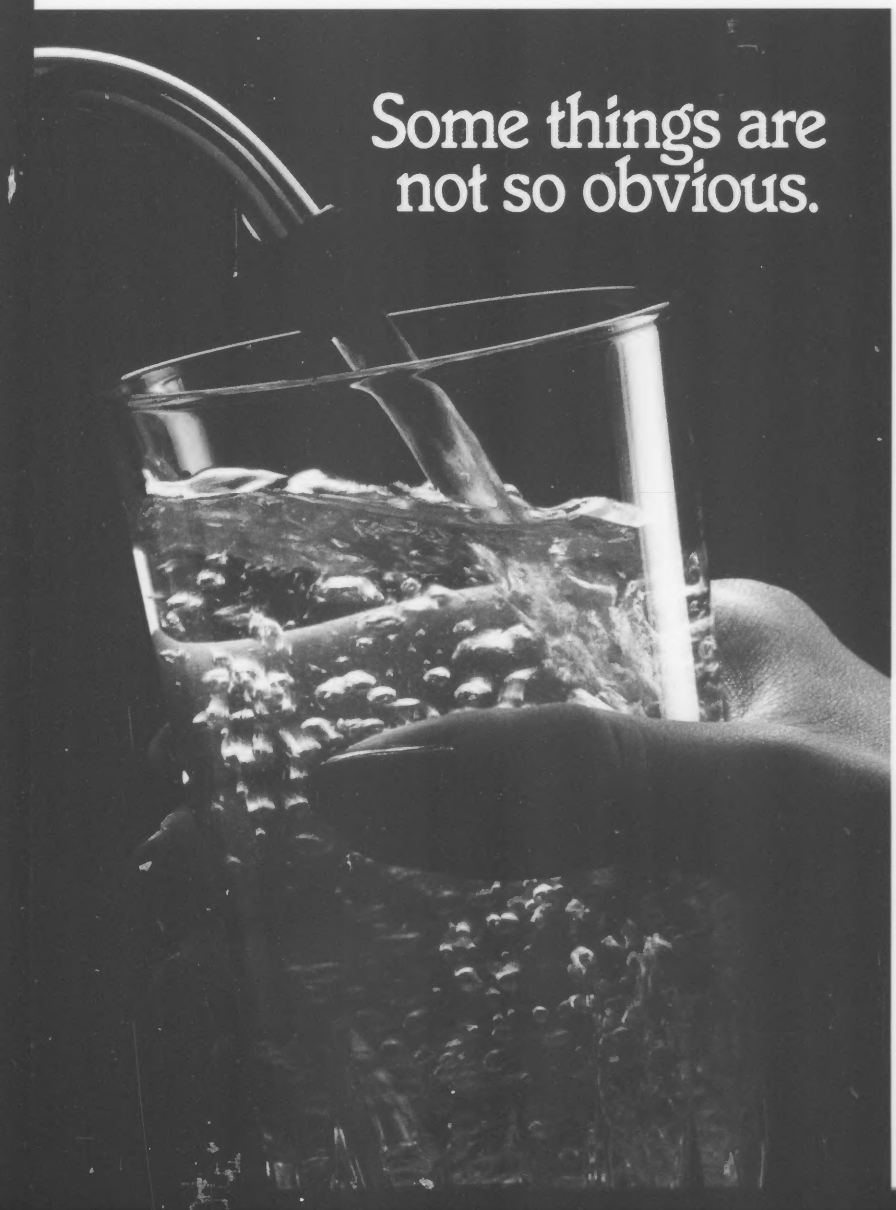

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Microorganisms and Refrigeration Temperatures

Jeffrey L. Kornacki, Ph.D. and Damien A. Gabis, Ph.D.
Silliker Laboratories, Inc.
1304 Halsted, Chicago Heights, IL 60411

Dr. Gabis and Dr. Kornacki are President and Manager of Technical Services of Silliker Laboratories, Inc., respectively.
The following article originally appeared in the June, 1989 edition of SCOPE, a quarterly technical bulletin published by Silliker Laboratories.

Following the introduction of mechanical refrigeration after World War I, it was commonly assumed that holding foods at -1°C to 10°C was adequate to ensure their safety. Since then, a number of harmful microorganisms have been observed to grow, and in some cases produce toxin(s), in foods at refrigeration temperatures(11).

Furthermore, other harmless microbes are often found in food which can grow under refrigerated conditions and spoil the product. Pathogenic (disease causing) and non-pathogenic microorganisms capable of growth at commercial refrigeration temperatures are referred to as psychrotrophs(5).

The following report examines the use of low temperature storage to ensure food safety through the inhibition of microbial growth.

Microbial growth is known to occur between -10°C to 90°C. Within this range, temperature influences the lag phase, growth rate, maximal cell density, nutrition, and physiology of a microbial population(6). The same temperatures affect various microbes in different ways.

Four groups of microorganisms can be distinguished by their growth response to temperature (Table 1).

Table 1. Cardinal temperatures (°C) of four groups of microbes [a]

	Maximum	Optimum	Minimum
Mesophiles	35-50	30-45	5-15
Thermophiles	60-90	55-80	38-50
Psychrophiles	15-20	10-15	-5- +5
Psychrotrophs	30-35	25-30	-5- +5

a Adapted from references 6 and 9.

These are psychrophiles, mesophiles, thermophiles, and psychrotrophic microbes. Psychrophiles, mesophiles, and thermophiles have optimal growth temperatures at low, moderate, and higher temperatures, respectively(6).

Psychrotrophs are microbes that can grow at 7°C and below regardless of their optimal growth temperature(16). Often psychrotrophs are mesophiles with respect to their optimal growth temperature. Psychrotrophs are a diverse group of microorganisms including some gram-positive and gram-negative bacteria; aerobes, anaerobes, facultative anaerobes, and microaerobic organisms; sporeformers and nonsporeformers, as well as some yeasts and molds(6). Several genera and some species of microbes capable of growth at 7°C or below are listed in Table 2.

Table 2. Minimum Growth Temperatures (°C) of Selected Microorganisms

Microorganism	Minimum Growth Temperature	Microorganism	Minimum Growth Temperature
Bacteria			
Acetobacter	5	*Pseudomonas*	4
Acinetobacter	4	*P. fluorescens*	0 to 4
Aeromonas	5	*Salmonella*	5 to 10
Alcaligenes	b	*Serratia*	4 to 5
Arthrobacter	5	*Staphylococcus*	5 to 10
Bacillus	b	*S. aureus*	5 to 10
Brevibacterium	5	*Streptococcus*	b
Chromobacterium	2	*Streptococcus faecalis*	5 to 10
C. flaviatile	4	*Streptomyces*	b
C. lividum	2	*Vibrio*	4
Citrobacter	b	*Xanthomonas*	>5
Clostridium	b	*Yersinia*	4
C. botulinum	3.3 to 10	*Yersinia enterocolitica*	0 to 4
C. putrefaciens	0		
Corynebacterium	b	**Yeasts**	
Cytophaga santha	<0	*Candida*	0
Enterobacter	b	*C. humicola*	0 to 1
Erwinia	b	*C. lipolytica*	5
Escherichia	b	*Cryptococcus*	b
E. coli	5 to 10	*Rhodotorula*	-10 to -1
Flavobacterium	5	*Saccharomyces*	0 to 7
Gluconobacter oxydans	7	*Torulopsis*	0
Klebsiella	b		
Kurthia	5	**Molds**	
Lactobacillus	2	*Aspergillus*	b
Leuconostoc	5	*Botrytis cinerea*	-1
Listeria	1	*Cladosporium*	-5 to -8
Microbacterium	≤10	*Mucor mucedo*	0
Micrococcus	b	*Penicillium*	b
Moraxella	2	*Rhizopus stolonifer*	5
Propionibacterium	2 to 3	*Trichothecium*	b

[a]Adapted from references 2,6,7 and 8
[b]Genera which include psychrotrophic

Food spoilage may be caused by any of the four previously mentioned microbial groups, but only microbes capable of growth will cause spoilage in foods held under refrigeration(6).

Food Spoilage by Psychrotrophic Microorganisms

Growth of psychrotrophic microbes to high populations in food products can result in a variety of defects which may include a wide-range of off-flavors as well as physical defects. For example, some enzymes (lipases) produced by some psychrotrophs will act on fats in foods resulting in rancid flavors. Other enzymes (proteases) which may be produced by psychrotrophs will break down proteins in foods resulting in bitter flavors.

From a food spoilage perspective, psychrotrophic microorganisms are the single most important group of organisms present in dairy products(16). Cousin authored a comprehensive review on psychrotrophs and their impact on dairy products(4). Due to the wide diversity found among psychrotrophic microorganisms and the great

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diversity of refrigerated foods, it is difficult to generalize food spoilage defects whichpsychrotrophic growth produces in foods. Many psychrotrophs, however, produce heat-resistant enzymes (e.g., proteases and lipases) which adversely affect product quality during storage. Consequently, heat treatment of raw foods, in which substantial multiplication of psychrotrophs had occurred prior to heat treatment, may be insufficient to protect the food from spoilage by the heat resistant enzymes even though all the psychrotrophs have been killed. Hence, the microbiological quality of raw foods affects the quality and shelf-life of the finished product.

Psychrotrophic Pathogenic Microorganisms in Foods

Processors and consumers found they were able to increase the microbiological shelf-life of foods with the advent of mechanical refrigeration. The benefits of mechanical refrigeration were two-fold: it permitted fresh foods to become available for longer periods and thus increased their distribution over wider geographical areas(11).

By the mid-1950's, however, it became evident that mechanical refrigeration was insufficient to completely inhibit the growth of food spoilage organisms and the growth of various spoilage bacteria, yeast and molds was observed in a wide variety of meat, fish, poultry and dairy products(11).

Until relatively recently, it was assumed, that mechanical refrigeration was sufficient to prevent the growth of pathogenic and toxigenic foodborne pathogens. This assumption was challenged in the early 1960's by the discovery that a psychrotrophic bacterium, *Clostridium botulinum* type E, was implicated as the etiological agent in botulism outbreaks from consumption of fish products(11).

In the intervening years, the number of psychrotrophic microbial pathogens have grown to include strains of non-proteolytic *C. botulinum, Yersinia enterocolitica,* enterotoxigenic *Escherichia coli, Listeria monocytogenes,* and *Aeromonas hydrophila*(11). Furthermore, refrigeration temperatures have been shown to enhance the survival of some non-psychrotrophic pathogenic bacteria, namely, *Campylobacter jejuni* and *Brucella*(11).

It is assumed by some, however, that freezing is adequate to destroy microorganisms. Microbes differ widely in their response to freezing. Most bacterial spores and some vegetative cells survive freezing virtually unchanged(6). Psychrotrophic microorganisms will grow in previously frozen foods if the foods are subjected to temperature abuse (e.g., partial thawing).

The Effect of Temperature Abuse on Food Safety and Microbial Growth

At some point during the distribution of a refrigerated food product, manufacturers should assume that temperature abuse will occur(9). This may permit conditions which allow the growth of additional pathogens such as strains of *Salmonella, Staphylococcus aureus, Vibrio parahaemolyticus,* and *Bacillus cereus* which have been shown to grow at temperatures between 5°C and 12°C(11).

Furthermore, slight temperature changes can have a profound effect on the growth of psychrotrophic pathogens and spoilage organisms. In one dramatic example, a strain of the psychrotrophic spoilage microorganism *Pseudomonas fluorescens* stored at 0.0°C and 0.5°C exhibited generation times of 30.2 and 6.7 h, respectively(6). Hence, only a 0.5°C increase in temperature resulted in nearly a five-fold increase in the microbial growth rate. Therefore, a food product with an average shelf-life of 20 days at 0.0°C, contaminants with this strain may spoil in four days at 0.5°C.

The infectious dose for *Listeria monocytogenes* is not yet known(13). It is assumed that this dose is quite low, possibly 100-1,000 cells(13). Rosenow and Marth(13) calculated that a population of ten *L. monocytogenes*/quart in fluid milk products would reach an average population of 540/quart in 14 d if stored at 4°C. However, the same initial population of *L. monocytogenes* in these products would theoretically reach 5.7 x 10^4/quart in half the time (7d) if stored at 8°C(13). Since the usual maximum time between processing and consumption of fluid milks is 14 d, the public health consequences of slight temperature changes in cold food storage temperature may be grave. Given widespread environmental contamination with *Listeria*(3), food processors must assiduously guard against post-processing microbial contamination of food prior to cold storage.

Recommendations for Control of Psychrotrophs in Foods

The information presented herein indicates that food manufacturers cannot rely upon mere refrigeration to prevent growth of harmful and/or spoilage microorganisms. Food manufacturers are strongly encouraged to implement control systems which prevent contamination by psychrotrophs and their growth in products which require refrigerated storage.

Two excellent approaches to control the presence and growth of psychrotrophs in food manufacturing facilities include the implementation of a Hazard Analysis Critical Control Point (HACCP) system and incorporation of appropriate microbial inhibitors in the product formulation(9).

Incorporation of multiple microbial inhibitory factors in the formulation of a product decreases the potentiality of a microbial problem. Such factors, referred to as "barriers" or "hurdles," may include acidification, reduction of water activity, addition of preservatives, and modified atmosphere packaging(9). An excellent example of the use of "hurdles" can be found in the manufacture of pasteurized process cheese spreads where a combination of heat treatment, limited water activity, low pH, salts, and antimicrobials are combined to produce a shelf stable and safe product(1,9,14,15). Reducing food storage temperature even lower, (e.g., from 40°F to 38°F to 35°F) may be one of the most practical "hurdles" which can be used to inhibit microbial growth.

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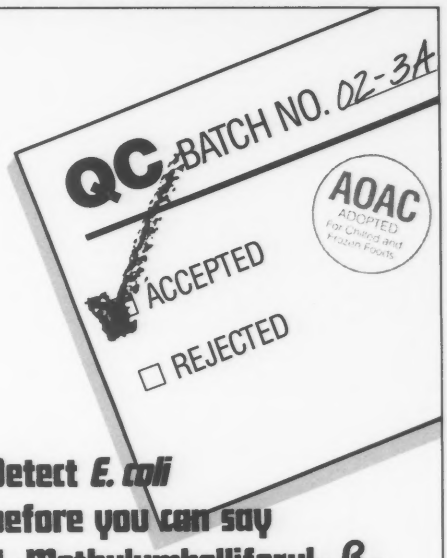

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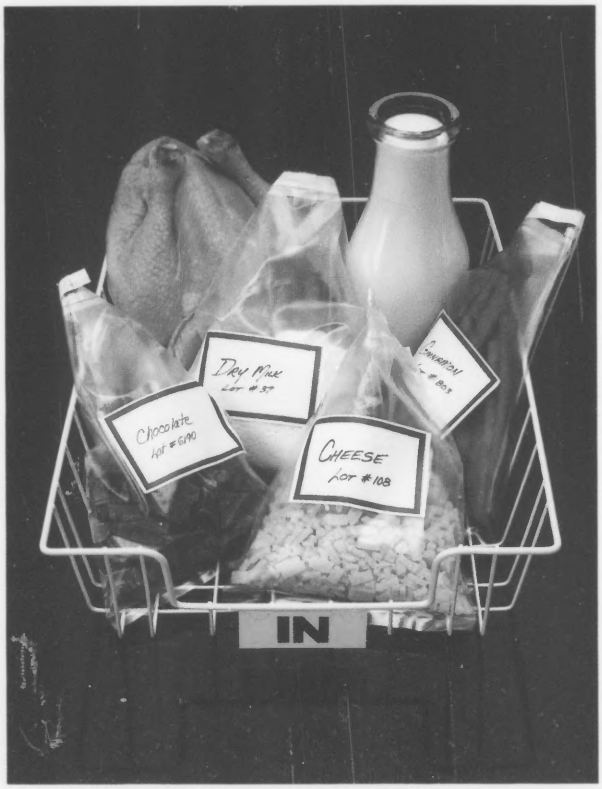

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Food Safety 2000

Applying HACCP for Food Safety Assurance in the 21st Century

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As we prepare for the year 2000 and the 21st century, it is appropriate to take a long-range view of what is necessary for maintaining both an optimum quality of life and a balanced approach to maximum food safety. The question is, "What must we do now to assure a long, disease- and illness-free life for the residents of the U.S. and still impose as few restraints as possible on the pleasure of eating?" For example, the food system could be made much safer overnight if all that we ate was canned, thermally processed food or dry food formulated to the technically correct degree that pet food is. Our lives would certainly be more nutritionally correct if we did away with all fast food operations, particularly those serving high-calorie meals that contribute to high fat, salt, and sugar levels in our diets. Also, there is no nutritional need in the U.S. for most snack foods. Nonetheless, all of these must remain in the future as a part of our diets because this country is a democracy, and because we want to maintain a balance in our lives between pleasure and ultra-conservative safety.

Two facts remain as we deal properly with the question of safety. First, there will be a degree of quality degradation the safer we make the food. Thermally processed, sterilized food is certainly safer than raw food. However, we could never eat raw salads again if we take this approach. Second, the best control is to reduce the hazard level in the system, or to remove the hazards from the system at the input to our food system. It is also appropriate to recognize that for all hazards there is a threshold for injury, illness, or disease. If we stay below the threshold, then we can project that we are doing our best to balance quality and safety of food in our lives.

The System

There are three components to the food system which must be covered. These are: the input to the system, the processes, and the output from the system. This paper looks at each of these components, and discusses the hazards and causes for foodborne illness, and methods for removing and preventing the causes of illness.

A schematic drawing of the food system is shown in Figure 1. The input to the system is the environment, with its contaminants, and the people who harvest from the environment. This input brings our foods through a distribution system via a wholesale processor to the retail processing world.

The second step is the retail process, which converts raw ingredients into finished products consumed by the public. The greater the contamination of products from the input, the more the process will cost to reduce the contaminants of the raw ingredients to a safe level. For example, the more we allow aflatoxin-producing mold to grow on grains and nuts, the more money must be spent to remove foods containing aflatoxins from the system; the greater the *Campylobacter* contamination of raw chicken, the more costly cross-contamination prevention becomes.

The third step is the output, which is what we have as a result of the input and process. Let's look at each of these components. We will begin with the output because it controls the requirements of the input and process steps of the system.

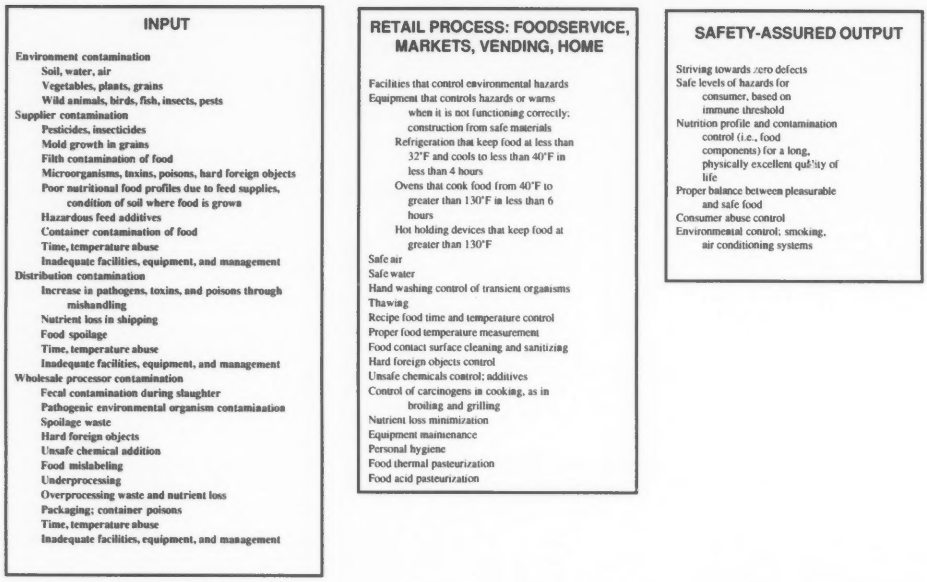
The Analysis of the Output from the System

The zero-defect goal. At the output from the system, we must strive for zero defects in food safety. It is completely unacceptable to consumers that there is a risk in eating food. Consumers want to believe that the food supply is wholesome and safe. They do not want their lives shortened by unsafe food processing and handling practices. People are forgiving if they believe that the food supply system does its best to provide them with safe food. On the other hand, consumers are outraged if they believe there are ignorant, unethical, or dishonest people handling the food they will consume. While zero defects are unattainable, just as it is impossible to totally exclude microorganisms from food, it is a very accepted objective towards which to strive. It means, then, that there will be an evolutionary improvement by the companies of the food system year after year in making food safer for the consumer.

Immunity levels of people who consume the food. The constraint on the system really comes from those who consume the food. Therefore, the first food safety specification is tied to consumers.

There are two groups of people to be considered. The first group is made up of people with normal to high immunity thresholds. These people have high levels of stomach acid and excellent balanced microflora in their

THE SYSTEM FOR HACCP-BASED FOOD SAFETY ASSURANCE



intestinal tracts, which tend to suppress and control naturally occurring pathogens in the food. Their immune systems have tolerance for toxins, poisons, antibiotics, and other forms of chemicals in the food. Their systems also have the ability to metabolize the body's nutrients properly throughout their lives.

The second group is the immune-suppressed population. This group includes babies, pregnant women, people on antibiotics, the elderly who take medications, transplant patients, and people with AIDS and other immune-suppressing diseases. Their food must have very low levels of pathogenic contamination because they have little or no ability to neutralize pathogenic microorganisms or chemicals.

A food profile. Food components and contaminants that must be controlled in the diet in order to assure a healthy body and a long life include nutrients and a proper mixture of microorganisms. Components to be controlled are pathogens, toxins, and poisons, which include pesticides and insecticides, carcinogenic cooking by-products, and allergy-producing chemicals in the foods.

Food safety vs. "cosmetics". In achieving a safe food supply, we must also consider that there probably will be a trade-off in the cosmetics of the food. Today the agricultural world attempts to make the food as symmetrical, colorful, blemish-free, and large as possible. Historically, these are signs of excellence to the consumer. To have a worm in an apple, for instance, is totally unacceptable. This is a much different attitude than the one found in Europe, where actual sweetness and freshness are desired, and blemishes are tolerated. At the same time, at the output, the food must be pleasurable. It must look pretty; the presentation must be artful, and the flavor, texture, and satiety of the food must meet customer expectations. It does no good to create the perfect nutritional food that no one wants to eat. There have been many examples of nutritionists creating nutritionally perfect food and populations rejecting it in favor of products with very poor nutritional quality.

Consumer abuse. We must also consider consumer abuse of the food. When people are given food to take home from the restaurant or buy food at the market, they must understand that the food is perishable and must be handled properly. We must also minimize nutrient destruction in careless food preparation or in the hot holding of food for hours before service.

Environmental control. Environment also plays a role. When people dine in a cigarette smoke-filled environment, there is an increased lifetime risk. Air conditioning systems can be source of mold and *Legionella* bacteria.

Analysis of the Input to the System

Environment contamination. In order to provide the customer with a product that is both safe and pleasurable, we must be aware that we live in the real world of environmental contamination, and it will always be so. Let's begin this section be examining the environment.

First of all, the soil on earth is contaminated with millions of microorganisms per gram, which include the pathogenic bacteria *Clostridium botulinum, Listeria, Yersinia,* and *E. coli*, as well as yeasts and molds. The soil also has a mixed mineral and nutrient content that effects the nutrient profile of the foods grown in or on the soil. There can be as much as a 200 percent difference in the nutrient quality of a product grown in two different soils.

There are also problems with the water in various parts of the U.S. The water contains unknown chemicals coming from run-off and discharge of waste treatment plants. The problem of getting water from the Mississippi River in New Orleans, Louisiana, for instance, has often been discussed among water purity experts. In spite of all of the effluents dumped by chemical plants into the

Mississippi River, there is no real evidence of increase in cancers or shortening of life in New Orleans because of poor water quality. This is an example of technology's ability to produce safe, clean drinking water.

A secondary problem associated with water is the discharge of pathogenic bacteria, viruses, parasites, and protozoa from either an animal or human source into a local water supply, which then can cause many people to become ill. There is the problem of contaminated sewage infecting shellfish beds. It happens in recreation areas where human waste is discharged too close to stream and lake water, thereby contaminating it. It can occur when babies play in lakes, and they excrete pathogens into the water.

In the environment, we are also worried about our air. Yeasts and molds are found in air. There is ozone build-up from some air cleaners. Insects in the air can become incorporated into the products during processing. Dirt and microorganisms that are carried by dirt and dust particles can get into food.

We know that air is a major source of low level food product contamination, which can increase to high levels if the conditions are present for multiplication, as in post-processing contamination of pasteurized milk at milk plant filling stations.

Vegetation, plants and grains are never sterile. Cow intestines can become colonized with pathogens such as *E. coli* when they eat grass containing the fecal material of other animals. Plants and grains will have a wide range of pathogens such as *C. botulinum* and *B. cereus* from the soil. When analyzed with very sensitive instrumentation, it is often found that there are very low levels of toxins and poisons produced in plants and grains when they grow. When plants and grains are harvested, it is not unusual for hard foreign objects such as sticks and stones to be harvested as well. These must be removed or they will cause broken teeth or choking.

Wild animals are a source of contamination. They leave pathogens in their natural habitats, which are transferred to our living environment. Birds are notorious for excreting pathogens. In a recent survey, birds flying over Colorado and Utah were noted to have carried many pathogenic organisms from the sea coast in their fecal material. We must also be concerned about microbiological and chemical contamination in the fish that grow in run-off water.

Supplier contamination. Farmers and fishermen are the suppliers who form the first line of critical control points. At this stage, there are many contaminants that are found in or on food. Farmers may add pesticides and insecticides to foods at unsafe levels. Toxins can be produced by molds in improperly stored grains. Filth contamination of fruits and vegetables from worms, beetles, flies, and rat hair, feces, and urine can be present. The people who harvest the food may not wash their hands after using the toilet. Irrigation water can be very contaminated.

The fish that are harvested from the sea must be evaluated for toxins, poisons, parasites, and pathogenic microorganisms. Meat has microbiological contamination and contamination from hard foreign objects, such as veterinarians' needles that have broken off during injection. If poultry have hazardous levels of microorganisms it is because the animals have eaten pathogenic microorganisms that have colonized the gut.

It is important to consumers that meat has a high nutrient profile and low fat content. Consumers want poultry and poultry products that are low in fat and have excellent nutrient profiles. They want fruits and vegetables that have been grown in soil that provides high levels of nutrients.

Also associated with the supply system is the potential for toxins and poisons from containers used to bring foods from the fields to the processing plants.

After harvesting, decay and rotting can occur unless steps are taken to slow this process as much as possible. Excellent temperature control and, when appropriate, low surface water activity will slow the yeast and mold growth. Throughout this process, the ultimate safety of the product will be very dependent on the cleanliness of the supplier. Fishing boats must be kept clean and sanitized and the fish kept at 30°F. Management is the key to success. Managers must be knowledgeable and practice good operating procedures.

Distribution contamination. Once products are harvested or brought from the ocean, they must be transported to the wholesale processor. In all cases there is a degradation of product during this time. Lettuce from the field begins to wilt. Fish from the sea begin to spoil and become toxic. Animals under stress grow more pathogenic microorganisms in their intestines. Molds grow on the grains and nuts. There is nutrient loss in all products during this storage and shipping period. Much of this damage is due to inappropriately high temperatures, lengthy distribution times, and unsanitary transportation conditions. Again, preventing time and temperature abuse, providing excellent equipment, and keeping facilities clean and sanitary come from management control.

Wholesale processor contamination. Hazardous levels of toxins, poisons, and microorganisms in the food can be found at the wholesale process level.

In poorly controlled animal slaughtering operations there is a high level of contamination of fecal organisms from the hide or intestines of the animal onto the surface of the meat. This leads to great potential for customer illness. Generally today there is a lack of microbiological control of raw product. Even though the USDA talks about wholesome food, there are no microbiological standards for raw foods of all kinds. There are a few incomplete microbiological safety standards for processed food. Standards such as zero *Listeria* contamination of processed food are not realistic when one understands how much *Listeria* is consumed in raw foods each day. There is also the problem of product spoilage because of poor temperature controls and filth in some processing plants.

Hard foreign objects may accidentally be incorporated into the products. These include stones, stems, metal, insects, etc. If they are harmful or cause customer dissatisfaction, they must be removed.

Sometimes when a processor attempts to save a poor quality product, the product is washed with chlorine or adulterated with various chemicals in order to make it appear better than it is. For example, years ago, hydrogen peroxide was used as a preservation agent by the milk industry because it inactivated high levels of microorganisms. It also improved the taste of the milk.

This practice was considered to be deceptive and was therefore banned by the government.

Along with chemical addition, adulteration of the food is a concern. In thousands of instances last year, food was recalled because of adulteration. Adulteration occurs because of some processor's carelessness or fraudulent actions. Adulteration of food has always been a problem in the U.S., more so in the past than it is today.

Mislabeling can also be a problem. Sometimes it is fraudulent, especially in cases when some inexpensive fish is being sold as more expensive varieties. It is critical today that processors correctly identify ingredients. Many consumers have allergic reactions to some foods and totally rely on labels to avoid problems.

There is also the problem of incorrect processing. If the food is underprocessed, then spoilage occurs and pathogens may multiply, e.g., *Staphylococcus aureus* in milk and cheese, and *E. coli* in hamburger. If it is overprocessed, there is unnecessary nutrient loss.

The relationship between overprocessing and packaging is an interesting one. For instance, when the processors can food, they strive for a microbiological safety factor of only one surviving *C. botulinum* spore in 10^{12} grams of food. However, when the cans come out of the retort and are cooled, the seams of the cans are so weak that they can leak, and the food can be recontaminated from the water used in cooling. The actual probability of contamination becomes one in 10^{6} grams of food. In reality, the food is being overcooked without the processor recognizing that the critical control is the cooling process after cooking. The same is true for the plastic bags being used today in cooking processes. The weakest points are the bag walls with pinholes and the seals in the bags, which may allow pathogens to enter the product during cooling.

Even though containers are quite safe today, one must also be careful of poisons from containers such as tin-lined cans or cans with lead-soldered seams.

Again, time and temperature abuse also plays a role. In order to avoid abuse, the food must be kept as cold and reasonably dry as possible, and must be rapidly available to the consumer. The Japanese have taught us the role of Just-In-Time inventory management, which is critical to safe food.

As before, hazards occur because of unclean, unsanitary facilities. Equipment must be easy to clean and kept sanitized to prevent cross-contamination. Professional leadership from management is necessary in keeping facilities properly cleaned and sanitized.

Process Controls at the Retail Level

The retail level consists of the entire foodservice industry: foodservice, supermarkets, the vending market, and the home. All of these institutions take the food from the wholesale world and provide it in an edible form to the consumer.

Facilities and equipment. The first critical points are the facilities and equipment that are used. A critical factor is that facility and equipment design is not based on the hazards that come in on the food. There are many pathogenic organisms that grow below 40°F. Yet, national government refrigeration standards have not been changed to include protection against these organisms. To have safe food storage, meats, poultry, and fish must be stored below 32°F, and fruits and vegetables, below 35°F. The government regulations today look at facilities as being a food safety hazard, yet there is no instance of a facility being a part of a food safety problem. The hazards from facilities are human occupational or fire hazards, in which case, for example, grease may have built up to create the hazard. There is a false reliance on National Sanitation Foundation standards, which are fundamentally simple equipment construction standards, and do not deal with controlling the performance of equipment so that food is kept safe. For instance, food must be heated from 40°F to 130°F in less than six hours, or there can be excessive microbiological growth. This is not stated as a requirement today. The result is that many pathogens are allowed to multiply during the cook cycle in slow cook ovens. There should be diagnostic controls on equipment so that if heaters are failing, compressors are not working efficiently, or other situations are developing, the equipment will indicate to the operator that it is not functioning properly, cannot comply with FDA/USDA tolerances, and must be repaired immediately.

Facility designers do not understand and are not trained in food safety. Therefore, many facilities are not designed for adequate cleanability, or for installation of equipment with performance capability to adequately control hazards.

Refrigeration, which includes walk-ins and reach-ins, is the major cause of foodborne illness today. This has occurred because the national standards for refrigeration were a compromise between the refrigeration manufacturers and the government, based on a perceived price that food operators would pay for equipment. When refrigeration standards were implemented, there was insufficient consideration of the food microbiological hazards. For example, refrigerators are not designed to cool any quantity of food or to maintain temperature if their doors opened.

Ovens may have a good appearance, but the thermostats are very cheap and oven temperatures can easily fluctuate +/- 25°F. The thermostat on an oven has no relationship to actual food temperature. Food pathogens are controlled by knowing the temperatures of food during the oven cooking process.

Hot holding of food on steam tables is inadequate. When the temperature on the bottom of a steam table is measured, it is often over 212°F, the middle of the pan is 150°F, but the surface of the food is in the range of 120°F to 115°F because of evaporative cooling. Hot bars are as inadequate as steam tables for maintaining FDA required temperatures.

Air. A potential source of contamination is air. Today air is unfiltered and uncontrolled in the retail food environment. This leads to contamination of food as it sits on tables and display cases.

Water. While we rely on safe water, there is now a national program to raise the pH of water to 8.0, which will in turn drastically reduce the effectiveness of sanitizers used in that water with a higher pH.

Hand washing. Most hand washing processes are not designed to remove the microbiological hazards. The object is to remove the transient organisms from the surface of the hands and from the fingertips and under the

fingernails. Hand washing should not disturb the resident bacteria in the skin of the hands because the pH and health of the hands must be maintained. Today the government allows people to use alcohol and chemical washes to supposedly eliminate fecal organisms from the hands. Tests for these hand sanitizers were done incorrectly and the data are inaccurate; kill is actually much less than quoted. There will be major foodborne illness outbreaks if hand sanitizers are used instead of correct hand washing techniques.

Thawing. Thawing continues to be a problem when food items are thawed in sinks with flowing water. There is no documented research to indicate this practice is safe. On the other hand, there are a number of research studies which indicate that food can be thawed safely sitting on a table overnight in a restaurant kitchen.

Temperature control. Probably the industry's greatest mistake is that it does not measure and control temperature correctly. Recipes state cooking temperatures, e.g., cooking food in a 350°F oven or on a 350°F grill, etc., but recipes are not designed to identify actual food temperatures. This is a critical need if we are to have safe food handling. Bacteria die as a function of the food temperature, not of the equipment. The stem thermometer, which the government endorses today, is totally inadequate for measuring food temperature. Until the government endorses and requires the purchase and use of thermocouples, there will be no food safety.

Cleaning and sanitizing. The cleaning and sanitizing processes and controls, again, are based on false assumptions. It is well-recognized that sanitizers are neutralized by dirty surfaces. While it is known that surfaces must be washed and rinsed before they are sanitized, the government regulations state that the cleaning rag must be kept in a sanitizer bucket. As a result, very few people use soap and water to clean tables, slicers, etc., before they apply sanitizers. The result is, essentially, zero sanitizer effectiveness.

There is no evidence of foodborne illness due to inadequate dish washing performance of pot and pan sinks, or floors, walls, and ceilings. Yet, there is a tremendous effort on the part of sanitarians to constantly insist on improved tile, more stainless steel in the kitchen, etc.

Hard foreign objects. The retail food laws do not deal with the hazard of hard foreign objects in food. Yet, insurance companies report that they pay five times more money for hard foreign object damage to the mouth and throat than they do for all of the foodborne illnesses.

Chemical control. The retail food industry must also keep chemicals out of the food. For instance, there is a false safety factor in terms of the backflow prevention valves that are required on all sinks and air gaps in the plumbing code. Actually, the only backflow prevention problem is in vending machines, with carbonated gas getting back into copper lines, and the acid dissolving copper into the water system. When one examines the three backflow prevention valves that are available for carbonated machines, one realizes that they are unreliable, and there is no adequate procedure for checking or controlling this problem, especially by the manager.

Accidental poisoning is one of the most difficult problems to control. The containers that hold highly toxic cleaning compounds, in many cases, have the same appearance as food containers. Employees may accidentally use the contents of such a container, thinking it holds food. Chemicals used to clean equipment are not always rinsed out or neutralized, and customers are poisoned.

Food additives such as MSG sometimes are added in excess. While there are a wide range of approved food additives in FDA regulations, most have an upper limit. The facts about this are difficult to find in government regulations, but no operator should be allowed to use a substance such as MSG or nitrate without evidence that the added amount is being controlled.

Carcinogens and heavy metals in cooking. Char-broiling and char-grilling, which cause carcinogenic chemical deposition from the smoke on the surface of foods, are still allowed. This smoke pollutant also gets into the environment through the ventilation system, causing problems with the ozone layer in the upper atmosphere. Equipment that contains copper, lead, cadmium, zinc, and other heavy metals is still being manufactured. Food contamination occurs when acid contact leaches these metals from the surfaces. If this type of food is ingested, people become ill.

Minimizing nutrition loss. In the retail world today, there is almost no attempt to hold and prepare food to minimize nutrient loss. Freshly steamed or microwaved, vegetables will have 20 to 30 percent more nutrients than those hot-held on steam tables for an hour. Thiamine is destroyed in pork when it is cooked well done.

Equipment maintenance. There is no provision for equipment maintenance and calibration in the industry. If equipment is not maintained, e.g., if the compressor condensing coil is not clean, then the refrigerator will lose 6 percent of its cooling capacity for every 10°F air increase. Thermostats on all heating and cooling devices must be calibrated regularly because they are very unstable and easily drift.

Personal hygiene. Another critical element that must be controlled in the process is personal hygiene. There is a false assumption on the part of the government that the action of sending people home when they feel sick provides protection. This is not true because people shed some pathogenic microorganisms up to forty days before they actually feel ill. When these people do not wash their hands, foodborne illness is easily spread. Handkerchiefs are allowed into a kitchen when it is known that *Staphylococcus aureus* bacteria will survive on a handkerchief for thirty days.

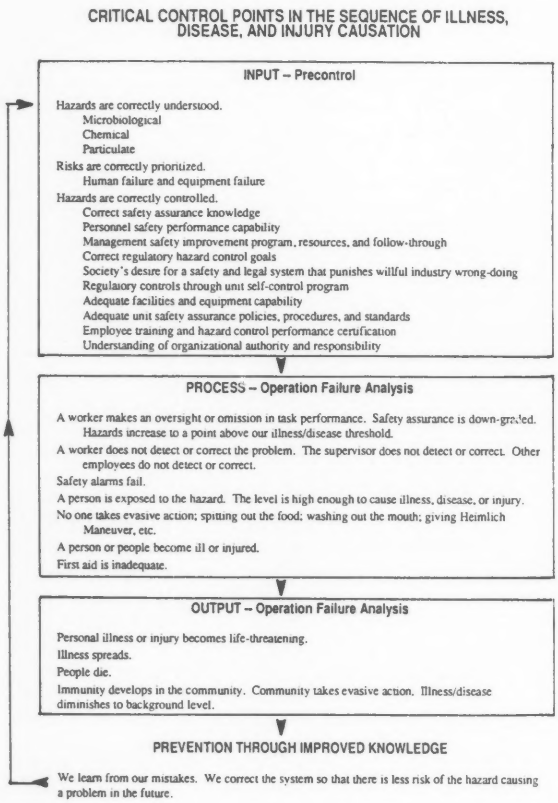
Cooking for pasteurization. Finally, there is the problem of food pasteurization and control of microorganism multiplication. The government regulations are extremely inadequate in dealing with the time-temperature relationships of the growth and death of microorganisms. For example, in Minnesota, food must be at 40°F or below, or 150°F or above. This implies that bacteria grow as fast at 95°F as at 50°F, which of course, is not correct. Pathogens take hours to multiply one generation at 50°F and minutes at 95°F. More importantly, the pathogenic microorganism growth temperatures are 32°F to 127.5°F. Therefore the government standards do not correctly encompass the range for hazards found in food handling

practices.

Acid pasteurization. Because of raw egg contamination with salmonellae, all salad dressings having eggs as an ingredient are assumed to be contaminated with *Salmonella* and other bacterial pathogens. If the dressing is not made to have a final pH of less than 4.1 and held for twenty-four to twenty-eight hours before use to allow the acid to dissolve the bacteria, the pathogens will not be destroyed. People will be made ill.

Causes of Problems and Hazards

In order to control the hazards we must understand the critical elements of control and then design a system that assures the ever-increasing probability of control as we learn from our mistakes. The critical elements of control are shown in Figure 2.



Current hazard information. The first major cause of problems is that there is no national tracking of actual causes of foodborne illnesses. The last update was done by Frank Bryan in 1982. The Centers for Disease Control states that while they do receive foodborne illness reports, they do not have the resources to compile and publish this information. In Minnesota, even though there has been an annual short summary of foodborne illness cases, this summary lacks the technical information required to improve the system's prevention elements. It does not include information on procedures that were followed incorrectly. It does not indicate what controls failed. It is very important, if we are to have assured safety, for the government to find out why each foodborne illness occurred. Then, the industry can train people so that these hazards can be avoided. Today the government only tells us how many people were made ill and to cook food well. When we do receive information, it is at best one to two years after the foodborne illness occurred. Some reasons for this are: lack of knowledge, forgetfulness, inadequate equipment, inadequate management, etc. When the industry knows what controls are inadequate, it can modify the controls and train its people to exercise more effective control of these hazards.

Nutritional hazards. Hazards are not limited to simply short-lived foodborne illnesses. They also include hazards that effect long-term quality of life, e.g., having an adequate amount of calcium and fiber in the diet. We have known for fifty years that the best diet is a balanced one, with moderation of protein and fat, and a substantial quantity of fruits and vegetables. Interestingly, this is not what is found pleasurable to eat by many people. Hence, food companies promote food items that are pleasurable but are not a part of the best nutritional profile for longevity. Classic examples are Burger King, Wendy's and McDonald's, which sell foods that are not well-balanced nutritionally. One must nonetheless be honest and agree with the argument that we all have the choice to eat at these establishments or to eat a well-balanced meal elsewhere. As long as these types of fast food operations exist, the fast food industry will have an effect on the long-term life expectancy of the American population, and will place an economic burden on the elderly who suffer from heart disease, cancer, and other ailments related to eating habits in early life. Another contributing factor is the lack of nutritional education of food preparation personnel. The results are no consideration of nutrition when developing menu items and the destruction and loss of many nutrients in preparation.

Education's role. At the core of the problem is the fact that many people claim to be food experts but have never been educated in food science and technology. The food scientist/technologist has a fairly balanced understanding of what needs to be done in order to assure food safety.

However, many government leaders and inspectors are not educated in the science and technology of food hazard identification and control, as discussed above. While a few at the working level have the knowledge, there are those at higher government levels who refuse to use and implement safety precontrol through HACCP. Therefore, today in most places in the U.S., aesthetics and cleanliness drive the government food safety programs when in fact there is no relation between these and safety.

Government publications are not always truthful. In fact, raw food and to a degree, pasteurized food, coming from FDA/USDA-inspected plants are hazardous to one's health. We know that 3 percent of the milk in the U.S. today contains *Listeria* at low levels. We know that many vegetables on the salad bar also contain *Listeria*. We

know that the foods coming from meat, poultry, and fish processing plants are all contaminated with a variety of pathogenic organisms. It is true that the food is wholesome if we define "wholesome" as "nutritious." However, to be safe and not cause illness, we are told to cook food to well done. This is not an effective strategy for the future. We do not want to eat canned food only. The answer is for processors to give us food that has a low enough toxic, pesticide, and pathogenic contamination to be safe for consumption in a raw stage. This does not mean zero microorganisms or toxins. It means that the level must be below that at which we are made ill or at which our life spans are effected. If processors do not have the correct knowledge, they cannot begin to establish food safety programs.

If we are to have a safe food supply, then, people must be certain that they understand the correct knowledge BEFORE they are allowed to have any role in our food system, i.e., the input, process, or output. This group includes: farmers, animal growers, fishermen, food inspectors, sanitarians, process safety certifiers, food technologists, children and adults who prepare food in the home, communicators, teachers, equipment and facility designers, government building and plumbing inspectors, foodservice owners, operators, and employees.

An interesting example of lack of control is the problem of home canning. Anyone can buy a home pressure cooker and home-can low acid foods without any education in how to do it safely. Granted, there are publications for people to read if they take the time to ask for them. Most people, however, simply experiment on their families. The end result is a number of deaths each year from *C. botulinum* toxin in home-canned food. There should be a national program that prevents purchase of home-canning equipment and forbids canning without a two- or three-hour course in safe home-canning procedures. This is not an infringement of one's right in a democracy. People do not have a right to hurt other people through ignorance.

Government regulations. Another problem is that the government bases its regulations not on hazards and actual illness cases and causes, but rather on the out-dated viewpoint that cleanliness means safety. Cleanliness, except in the case of a food contact surface, has nothing to do with actual safety. Safety is really only a function of washing hands and food contact surfaces, cooking foods to a sufficiently high temperature to inactivate the vegetative pathogens, and cooling leftovers rapidly. The government regulations must be changed to prioritize the critical factors that deal with the actual hazards that make us ill. They must define the best controls to prevent the hazards from causing illness. I believe that today's experts would agree that adequate knowledge to achieve food safety is available. The government simply is not using it, and the industry is not sufficiently afraid of the negative consequences of consumer outrage and industry costs to apply it.

Industry management. Effective industry management is closely related to the effectiveness of government regulations. Today, people can enter the retail food industry without any demonstration of food safety knowledge, or any indication that they will be ethical and honest in the production of their food. They are not required to show how they will maintain control over food safety. Until our regulations are changed so that owners are required to show competency in food safety BEFORE they are allowed into the food production and service system, there will never be adequate control.

Inspection is not prevention. Another cause related to foodborne illness is government reliance on inspection instead of prevention. Fifty years ago, it was thought that inspection of a finished product or a facility would prevent a hazardous product from getting to the customer, thus assuring safety. Today, with the development of the understanding of what makes up a total quality assurance process, we know that this is not true. We know that inspection of products is a very inefficient way to find defects. With inspection only, when a defect rate is as high as one in 100, almost 100 percent testing would be needed to find the few instances of toxic and contaminated food that will make someone ill. Each day we consume more than 750 million meals in the U.S. In reality, very few of these cause foodborne illness. What we must have is a prevention system built on management knowledge and commitment to make sure that the knowledge is used in the process. Prevention must be based, then, on the real hazards and causes of foodborne illness, not on filth. Then it must include the best controls in terms of policies, procedures, and standards that the owner/operator is willing to enforce and that the government indicates are adequate to assure food safety.

Finally, control must be in the hands of unit operators and employees on the line. The line employee who is performing the task is the one who can do 100 percent inspection by asking the question, "Did I do this task to the company safety standard?" Employees must check each task as it is performed according to the standard for that task. They must have the equipment, such as thermocouples, to see that safe food temperatures are being met. They must be able to do simple microbiological food preparation surface sampling to be sure that the cleaning and sanitizing process is effective. When an item is unsafe, it must be thrown out.

Prevention of Foodborne Illness

Education. The prevention process for assuring that we are learning from our mistakes and moving towards a zero defect objective is really very straightforward. We must educate everyone to understand the fragile nature of our food and how easy it is to allow it to become unsafe for consumption. Everyone must be taught the tremendous importance of not keeping food too long, understanding that it is perishable, and maintaining temperatures correctly. For example, people must use the proper instrument, i.e., a thermocouple, which will measure temperatures rapidly at a very small point, in order to see that the food is pasteurized adequately. The use of the stem thermometer with its two-inch sensing area leads to many control problems.

Food safety knowledge base. In order to prevent inadequate knowledge as a cause of illness, we need a national food safety reference database. It will include proven lists of all hazards, causes, and levels at which the hazards, i.e., toxins, chemicals, microorganisms, and hard

foreign objects, become hazardous. Once this knowledge is available on a national computer knowledge base, the best control procedures can be identified. These would be improved with experience, and thoroughly tested and documented to verify that there is very little risk of failure.

Precontrol certification. We must educate and certify members of the retail food industry in the correct safety assurance knowledge, and verify performance capability BEFORE they are allowed to operate.

The precontrol certification process for food safety today is one of receiving approval for the facility blueprint. This provides no control. All this does is to fill a kitchen with stainless steel equipment, tile, and cement. It does nothing to assure the safe performance of equipment, that safe food handling procedures and standards are known by each employee, and that there is an effective management system for the safe performance of employee tasks.

In order for a process to be certified as safe, the following elements must be present:

A. Commitment by owners, supervisors, and employees to be ethical, honest, and to operate safely;
B. Owner-specified correct hazard knowledge and control procedures that best suit the operation;
C. Training and pre-operational safety performance certification for each person in the operation;
D. Line employee control through supervisory coaching and direction;
E. Assurance of adequate supplies and equipment to support safe performance;
F. Employee participation to improve system safety performance;
G. Statistical process control at the employee level to substantiate that the system is in control;
H. Use of knowledge of how to improve the system by revising system operating procedures to achieve a lower degree of risk in the future.

Microbiological specifications. Another element of control is to apply microbiological specifications in the form outlined by the International Commission on the Microbiological Specifications of Foods. In this microbiological specification system, the sampling plan to find out if there is adequate microbiological quality is based on four factors: *n*, *c*, *m*, *M*. In this system, *n* is the number of sample units taken from a lot; *c* is the maximum number of marginally accepted sample units in the sample; *m* is the marginally accepted counts per gram; *M* is the unacceptable counts per gram. A random sampling of *n* sample units is drawn from a lot and each sample unit is analyzed separately. The lot is rejected if the counts in any sample exceed *M*, or if more than *c* of the *n* sample units have counts greater than *m*, otherwise the lot is accepted. This is a very effective way to set up allowable microbiological contamination levels of food.

One federal and state government agency needs to coordinate the entire safety effort. In reality, occupational, nutritional, and food safety all come under the same principles of safety control. The same process for HACCP applies to all three. In the same manner, alcohol abuse prevention is conveniently included in these groups and is controlled through the principles of HACCP. Today, because there is such a diversity of government agencies involved in restaurant operations, e.g. plumbers, electricians, building inspectors, food inspectors, etc., and each agency upholds its own opinion, there is a confusing array of standards for the industry to follow. In fact only a few standards are necessary to work effectively towards the goal of zero foodborne illness.

Management control. Finally, the industry must realize that the real critical control is at the employee level, where tasks are done out of respect for management, and employees know the consequences for failure to work to the company's operating procedures and standards. There must be leadership and management by example in a unit if there is to be safety assurance. Government regulatory procedures in the future must include checks on whether or not there are prevention systems functioning in operations to assure food safety at all times.

Summary

If the food we eat is to be safe, we must move from a concept of safety through government inspection. We must change to understand that the employee doing food handling tasks must know the hazards and follow tested, proven safety assurance procedures and standards 100 percent of the time. Because employees can be forgetful, the supervisor must provide positive reinforcement to assure that performance is always up to standard. Employees can then provide 100 percent surveillance by checking each task done and asking, "Did I do this food handling task so that it is safety assured?"

In addition, we must apply the principles of HACCP to prioritize action. If a problem is not related to a hazard that can cause illness, injury, or death, then it must be a second priority until there are zero defects in safety assurance.

When everyone in the food system, from grower to server to consumer, is able to certify that they know the hazards and have followed adequate safety-assured control procedures, we will be able to come closer and closer to the objective of zero defects in food safety.

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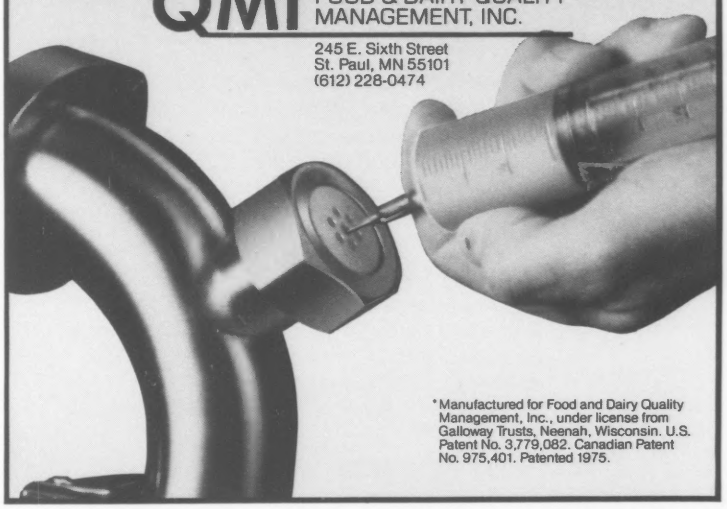

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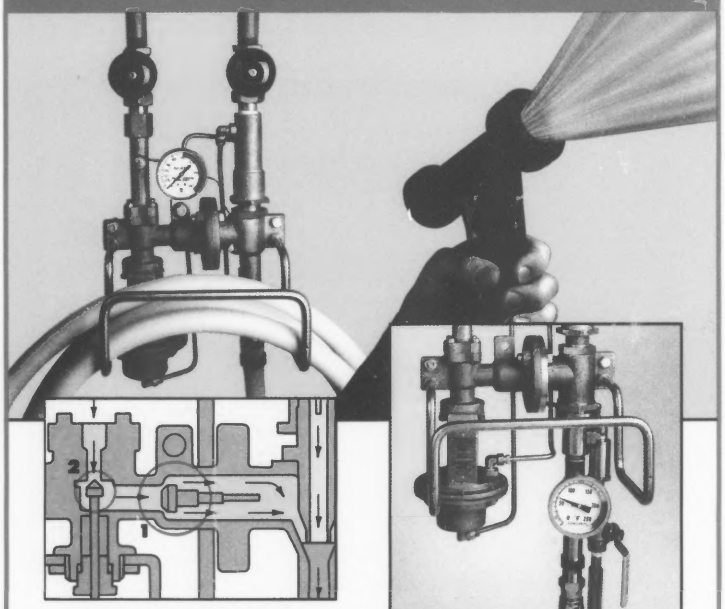

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Mycotoxins and Food Safety

by

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The following article originally appeared in the September, 1989 edition of SCOPE, a quarterly technical bulletin published by Silliker Laboratories

Molds, outside the scientific community, are generally viewed as harmless, though irritating, fungi capable of growing virtually anywhere there is moisture. In certain foods, such as cheese, specific molds play an integral role in the manufacturing and/or ripening process. Some molds, however, can produce mycotoxins (fungal toxins) in foods which upon consumption may be fatal to man and livestock.

The following report concerns mycotoxins, their historical significance, environmental factors influencing the growth and survival of mycotoxigenic fungi, and methods to detect mycotoxins in foods.

Fungi, which include molds and yeasts, range from mildew to mushrooms. Mildew is a common problem in nearly every humid environment, while mushrooms to the trained harvester, can be a delectable treat. However, when inedible or poisonous mushrooms are ingested the results can be devastating. Ingestion of the toxin produced by the mushroom, *Amantia phalloides*, also known as the "death cup," resulted in the emergency liver transplants of four adults in October, 1988(25).

Mycotoxins are secondary fungal metabolites and thus not components of typical metabolic pathways required for cell growth. They may be end-products of fungal cellular metabolism, act hormonally in fungal cell differentiation or act like an antibiotic against microbial competitors and predators(20).

The first recorded foodborne disease attributed to the consumption of mycotoxins occurred in medieval France(12). This large-scale epidemic, which claimed thousands of lives, occurred among peasants who had consumed rye bread contaminated with the mold *Claviceps purpurea*. The disease was then called the "Fire of St. Anthony" due to burning sensations in the extremities and hallucinatory symptoms associated with the disease(12).

During World War II, psychrotrophic molds grew in grains left unharvested due to manpower shortages in the Orenburg Province of the USSR(5). Toxins produced by *Fusarium poae, Fusarium sporotrichoides,* and *Cladosporium* resulted in the disease Alimentary Toxic Aleukia. Roughly 10% of the population was affected with mortality rates among the afflicted as high as 60% in some locations(5).

A more recent instance of mycotoxicoses occurred in England in the 1960's. Described as the "Turkey X disease", more than 100,000 turkey poults died after consumption of feed contaminated with aflatoxin B_1(5). Aflatoxin B_1 has been shown to be one of the most carcinogenic naturally occurring substances known(6).

Factors Affecting Fungal Growth and Toxin Production

Mycotoxigenic fungi, given proper environmental conditions, can produce relatively large quantities of mycotoxin. In field situations, given a suitable substrate, the most important factors for mycotoxin production are temperature and moisture. Molds are mesophilic microorganisms with optimum growth temperatures between 25°C-30°C. Generally, mycotoxin production does not occur below 13.5 to 14.5% moisture whereas, maximum toxin production occurs between 18-25% moisture(5). Consequently, it is very important during storage of cereals and grains to keep the moisture level below 14%. Food commodities high in carbohydrates, such as cereals and grains, are good substrates for mold growth and toxin production.

Toxin Producing Fungi in Foods

Table 1 lists mycotoxigenic mold genera and their associated toxins found in cereal products. Table 2 presents molds isolated from various food and agricultural commodities and their potential mycotoxins(5).

Table 1. Mold genera and their associated mycotoxins which can occur in cereal products.

Aspergillus toxins	*Fusarium* toxins
Aflatoxins	Zearalenone
Sterigmatocystin	T-2 toxin
Ochratoxins	Deoxynivalenol
Penicillic acid	Nivalenol
Kojic acid	Diacetoxyscirpenol
	Moniliformin
***Penicillium* toxins**	
Citrinin	***Alternaria* toxins**
Ochratoxins	
Penicillic acid	Alternariol
Rubratoxins	Alternariol (monoethyl ether)
Cyclopiazonic acid	Altertoxin 1
Patulin	Tenuazonic acid
Pennitrems	Altenuene
Viomellein	

Table 2. Summary of selected reports of isolations of potentially toxic molds from various foods.[o]

Commodity	Potentially toxic genera/species found		Potential mycotoxins
Flour, bread, cornmeal, popcorn	*Aspergillus flavus ochraceus versicolor* *Cladosporium, Fusarium*	*Penicillium citrinum, citreo-viride cyclopium martensii patulum puberulum*	Aflatoxin, ochratoxin sterigmatocystin, patulin, penicillic acid
Peanut, in-shell pecans	*Aspergillus flavus parasiticus ochraceus versicolor* *Fusarium, Rhizopus, Chaetomium*	*Penicillium cyclopium expansum citrinum*	Aflatoxins, ochratoxin, patulin, sterigmatocystin
Apples , apple products	*Penicillium expansum*		Patulin
Meat pies, cooked meats, cocoa powder, hops, cheese	*Aspergillus flavus* *Cladosporium*	*Penicillium viridicatum roqueforti patulum commune*	Aflatoxins, ochratoxin, patulin, penicillic acid
Aged salami and sausage, country cured ham, moldy meats	*Aspergillus flavus ochraceus versicolor*	*Penicillium viridicatum cyclopium*	Aflatoxins, ochratoxin, patulin, penicillic acid, sterigmatocystin
Black and red pepper macaroni	*Aspergillus flavus ochraceus*	*Penicillium species*	Aflatoxins, ochrotoxin
Dry beans, soybeans	*Aspergillus flavus ochraceus versicolor* *Alternaria, Cladosporium*	*Penicillium cyclopium viridicatum citrinum expansum islandicum viticae*	Aflatoxins, ochrotoxin, sterigmatocystin, penicillic acid, patulin, citrinin, griseofulvin
Refrigerated and frozen pastries	*Aspergillus flavus versicolor*	*Penicillium cyclopium citrinum, martensii olivino-viride palitans puberulum roqueforti viticae viridicatum*	Aflatoxins, sterigmatocystin ochratoxin, citrinin, patulin, penicillic acid
Moldy supermarket foods	*Aspergillus species* *Fusarium oxysporum solani*	*Penicillium cyclopium*	Penicillic acid, T-2 possibly other *Penicillium* toxins
Foods stored in homes, both refrigerated and nonrefrigerated	*Aspergillus species*	*Penicillium species*	Aflatoxin, kojic acid, ochratoxin A, patulin penicillic acid

[o] Adapted from reference 5 and used with permission.

Aspergillus flavus commonly infects cereal grains and *Aspergillus parasiticus* is a common inhabitant of peanuts; their toxin occurrence is based on the mold's airborne or soil-based ecological niche, respectively(8). Aflatoxin B_1, the most carcinogenic of the mycotoxins, derives its name from *Aspergillus flavus*, the mold from which it was first isolated. The principle aflatoxins consist of aflatoxin B_1, B_2, G_1 and G_2 based on their migration and blue (B_1 and B_2) or green (G_1 and G_2) fluorescence after thin layer chromatography and ultraviolet illumination. The toxicity of the aflatoxins prompted the FDA to set an enforcement level of 20 ppb total aflatoxins in food destined for human consumption, and depending on use, 100-300 ppb in animal feed(13).

Dairy cattle consuming grains contaminated with aflatoxin B_1 can convert B_1 to another toxin known as aflatoxin M_1. This metabolite is also a carcinogen. Aflatoxin M_1 is found in the milk of these dairy cattle at 1-2% of the level of aflatoxin B_1 consumed(24). Infants and young children may be more susceptible to aflatoxin M_1 than adults, hence the FDA requires that dairy foods contain less than 0.5 ppb aflatoxin M_1(13).

The *Fusarium* species most often occur in moist, cool conditions and consequently can be a problem during storage of grains. Data indicate that the four most important *Fusarium* mycotoxins, from the standpoint of human exposure, are deoxynivalenol, nivalenol, T-2 toxin and zearalenone(23).

The Food and Drug Administration (FDA) demonstrated that 60% of commercial breakfast cereals tested contained deoxynivalenol (DON) at 100 parts per billion (ppb)(29). DON, also known as vomitoxin due to its emetic activity in swine, induces feed refusal and growth suppression in swine(15). It is also a potent protein synthesis inhibitor of animal cells(30). Recently, vomitoxin has been shown to cause gross alterations in the immune system of mice(14).

Citrinin and *Ochratoxin* are kidney toxins produced by *Penicillin* species which may act synergistically (i.e., the toxicity of one may be enhanced by the other). There is considerable evidence linking human nephropathy to populations in the world where the incidence/levels of *Ochratoxin A* are high(18). This disease, called Balkan endemic nephropathy, occurs in regions of Bulgaria and Romania where the populations consume locally grown and stored barley.

Alternaria species are widely recognized as being responsible for the post-harvest decay of many fruits and vegetables(26). This genus produces at least 10 different *Alternaria* metabolites of which five are likely to be toxic to laboratory mammals (Table 1)(33).

The Role of Crop Harvest, Storage and Damage on Mycotoxin Contamination

Mycotoxin contamination of cereal grains is common when these crops are either damaged or harvested and stored in conditions favorable for mycotoxin production. An example of this mycotoxin contamination in the United States and Canada is wheat scab where levels as high as 8 ppm of DON have been observed(11,28). Wheat scab is characterized by mold growth and pink discoloration of commodities such as white winter wheat. This mycotoxin contamination has prompted regulatory limits for DON in grains and cereal products by Canada, the Soviet Union, and the U.S., ranging from 500-2,000 ppb for products destined for human consumption to 4,000 ppb for animal feed ingredients(31).

Corn crops have natural barriers to protect the ear from being destroyed. When these barriers are penetrated, mycotoxigenic strains of fungi can infect and produce toxins. Penetration of these barriers by molds can result from plant stress brought on by drought, temperature abuse, or insect invasion.

The European corn borer (*Ostrinia nubilalis*) is an example of an insect bearing a mycotoxigenic mold, which penetrates plant tissue(19). This insect, in its first generation around June, infects the corn stalk. The second generation corn borer attacks the high moisture ear of the crop in late July and August. The corn borer penetrates the ear silk and digests the corn as it moves down the corn crevices. This insect carries *A. flavus* in its gut, and liberates mold spores of *A. flavus* upon defecation. These can germinate and eventually produce aflatoxin in the corn.

Effect of Processing on Mycotoxins

Some mycotoxins are resistant to stress and survive harsh processing conditions. Food processing of commodities contaminated with aflatoxins, DON, and zearalenone have been studied in an attempt to predict where the highest concentration of mycotoxins will be found following processing. Aflatoxins are stable in peanut materials at room temperatures but can be destroyed during the roasting process(32). Most aflatoxin is found in steep-water solubles and fiber fractions following wet milling of aflatoxin contaminated corn. The starch

fraction, most important by way of human consumption, was not shown to be contaminated(2).

Wheat contaminated with DON was milled to bran, shorts, reduction flour, and break flour fractions(1). Briefly, following milling, the highest DON concentration was in the bran. Cleaning and milling were not effective in removing DON. DON was not destroyed during baking(1). El Banna et al.(9) showed that 81% of the aflatoxin activity remained following fermentation of Egyptian bread while 45% of the aflatoxin remained after baking. These same authors also showed these two processes had no effect on DON levels(10).

During the wet-milling process, zearalenone contaminated corn concentrates in the product fractions in the order of gluten > milling solubles > fiber > germ. As with aflatoxin, starch is relatively void of any zearalenone. The author(3) warns that during wet-milling zearalenone concentrates in fractions generally used for animal feed. This toxin causes infertility and reduced litter size in swine. Other domestic animals are similarly affected(6). This can have significant economic impact on livestock owners(3).

The degree to which a particular mycotoxin will survive food processing depends upon the particular process and the temperature/physical parameters of the process. The dilution of a contaminated ingredient can be relied on to lower the degree of mycotoxin contamination provided mycotoxigenic molds are not producing toxin.

The FDA allowed dilution or blending of contaminated 1988 corn with non-contaminated corn below listed action levels for use as animal feed only. The FDA stated that reconditioning is acceptable only for the 1988 corn crop due to the abundance of drought-induced aflatoxin contaminated corn(6).

Detection and Quantitation of Mycotoxins

Increased regulation and concern about mycotoxins in foods have spurred interest in the development of accurate, rapid, and economical detection methods. An excellent review on mycotoxin detection was authored by Bullerman(4).

Sampling raw commodities, particularly grains and nuts, is the most critical aspect of mycotoxin detection. For example, consider a mound of peanuts in which certain kernels are contaminated with aflatoxin producing strains of *A. flavus*. Toxin production by the mold will be concentrated in the kernel. It has been shown that 1,100,000 ppb aflatoxin B_1 can be produced in a single peanut kernel(7). If during sampling, this contaminated kernel is not included, the result of the analysis will be flawed. To diminish chances of obtaining such a non-representative sample, multiple samples of at least 10 pounds of peanuts should be taken and ground to pass through a No. 20 seive to distribute any mycotoxin present(27).

The analysis of mycotoxins can be accomplished through a variety of methods. Methods for the analysis of mycotoxins have been approved by the Association of Official Analytical Chemists (AOAC), the American Association of Cereal Chemists (AACC), the International Union for Pure and Applied Chemistry (IUPAC), and the American Oil Chemists' Society (AOCS). Aflatoxins have been analyzed by Thin Layer Chromotography (TLC)(17,27), High Performance Liquid Chromatography (HPLC)(17), Mass Spectroscopy(21), and recently by immunological methods using antibodies directed toward toxins(16).

A major portion of aflatoxin detection has been done by TLC. AOAC approved aflatoxin testing procedures include Chemical Branch (CB) and the Best Foods (BF) methods(27). These procedures extract aflatoxin from commodities with organic solvents. The CB method purifies the extract using column chromatography. The final extracts are visualized with ultraviolet illumination on TLC plates which reveals their characteristic migration and fluorescence.

The TLC procedure can take between two and four hours depending on the extraction and chromatography procedure. This time-consuming process is expensive due to the chemicals, labor, and equipment involved, and is hazardous due to exposure of laboratory workers to organic solvents. The HPLC procedures can detect mycotoxins at very low levels in food. However, these methods require expensive analytical equipment and highly trained personnel for operation.

Rapid Methods for the Detection of Mycotoxins

Difficulties associated with the TLC and HPLC analysis of mycotoxins have led to the development of rapid immunological methods which rely on antibodies binding to the toxins and their direct quantitation or elution for HPLC. Antibodies are proteins produced by the immune system in response to a foreign substance in the organism. These toxin specific antibodies, generally produced in goats, rabbits or mice, are used in very specific, sensitive immunological assays.

One assay is called an Enzyme Linked Immunosorbent Assay or ELISA(22). Briefly, extracted mycotoxin from a food sample competes with a mycotoxin-enzyme conjugate for binding sites of solid phase antibody. After washing, a colorimetric substrate is added which will change color in the presence of the enzyme. The degree of color change, proportional to the amount of toxin present, can be determined visually or with a spectrophotometer.

Another immunological test method employs aflatoxin specific antibodies chemically attached to a matrix in a column(16). These immunoaffinity columns bind aflatoxin in the sample. The amount of aflatoxin present following elution can be measured in a fluorometer following addition of a fluorescence enhancing bromination solution. Alternatively the aflatoxin can be eluted from the column and measured by HPLC.

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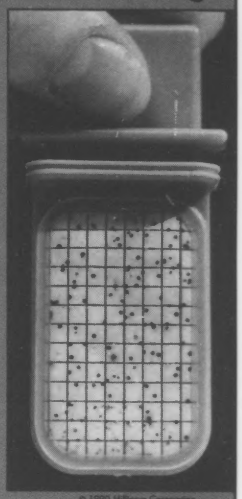

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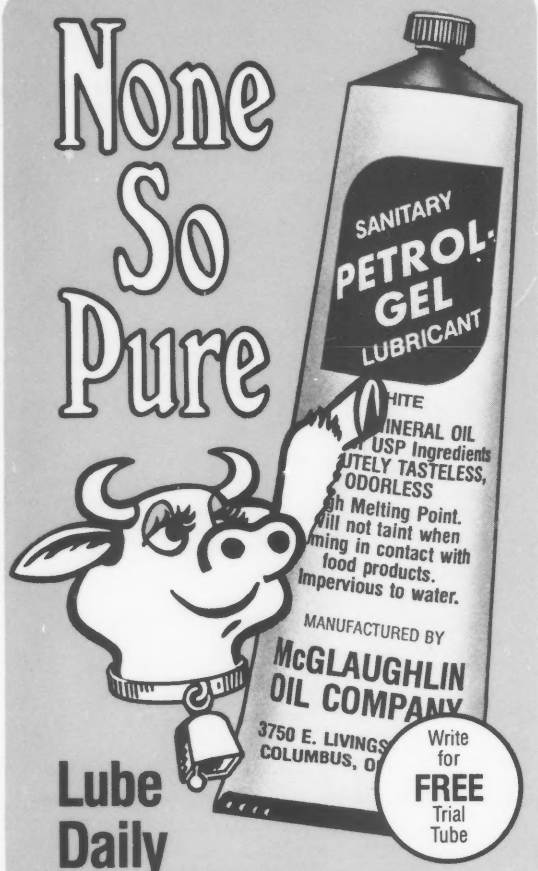

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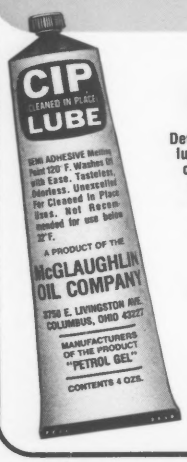

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Microbiological Analysis of Bulk-Tank Milks on BloodAgar: Comparison with Regulatory Methods and Influence of Sample Collection and Handling Factors

by
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Abstract

The procedure of analyzing bulk-tank milk on blood agar has become a common method for veterinarians and mastitis specialists to monitor mastitis and milk quality. Because of the common use of this procedure, a study was designed to investigate the importance of sample collection and handling factors on the results of such analysis and to compare these results with standard regulatory procedures.

In 3 experiments, bulk-tank milks from 50 dairy herds were examined in parallel by surface colony counts on blood agar and standard pour-plate procedures for the standard plate count (SPC) and preliminary incubation (PI). The influence of site of sample collection and mixing was investigated. Microbiological counts by all 3 methods from bulk-tank milk samples (n=20) obtained from tank outlet valves were significantly ($P < 0.05$) elevated when compared to surface and subsurface samples obtained from mixed or unmixed bulk tanks. The elevated bacterial counts in tank outlet valve samples make this sampling site inaccurate for assessment of mastitis and milk quality. The influence of sample handling was investigated using 4 samples obtained from each of 20 bulk-tank milks. Bacterial concentrations from samples stored for an average of 3 h at ambient temperature showed significant increases ($P < 0.05$), while those frozen at -20°C for 7 days showed significant decreases ($P < 0.05$), when compared with samples immediately plated or stored for 18 h at refrigerator temperatures (4°C). The influence of daily variation on bacterial counts was investigated using samples collected on 8 consecutive days from each of 10 dairies. Variation among days was considerable, but not significant ($P > 0.05$). For all samples in the study, mean bacterial counts determined on the surface of blood agar exceeded counts determined by pour-plate procedures for the SPC and PI.

Results of microbiological analysis of bulk-tank milks were influenced by sampling site and sample handling factors. Microbiological culturing of bulk-tank milks on the surface of blood agar plates is useful in identification of mastitis pathogens. However, bacterial counts determined by surface colony techniques are not the same as the SPC.

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Introduction

Microbiological analysis of bulk-tank milks is used in assessment and monitoring of mastitis and milk quality (*1,3-19,21-25*). Regulatory agencies and milk plant laboratories use the standard plate count (SPC) and preliminary incubation (PI) procedures in evaluating the microbiological quality of bulk-tank milks (*2,12,15,21*). Although these procedures enumerate bacteria present, specific microorganisms present are not identified. To identify bacteria present in bulk-tank milk samples, veterinarians and mastitis specialists commonly culture bulk-tank milk on the surface of blood agar plates (*1,3-5,8-14,16-18,22-25*). The primary use of this technique is in the identification of mastitis pathogens (e.g., *Streptococcus agalactiae, Staphylococcus aureus*) (*1,3-5,8-14,16-18,22-25*). Because results are available from the SPC and from analysis on blood agar, attempts have been made to compare such results (*4-5,12*). It has been reported that bacterial counts determined on the surface of blood agar plates are approximately equivalent to the SPC (*5*). In other studies, the opposite has been noted (*6,7*). Because these methods use different media and incubation procedures, the results may not be expected to be equivalent. One purpose of the present study was to compare results obtained from enumeration of bacteria on the surface of blood agar plates with results from the SPC and PI.

Proper sampling and sample handling techniques are necessary in order to obtain meaningful results from microbiological analyses of bulk-tank milk samples. In routine regulatory work, representative samples are aseptically collected from well-mixed bulk tanks (*15*). Samples submitted by veterinarians and mastitis specialists to nonregulatory laboratories for microbiological analysis of bulk-tank milks on the surface of blood agar are not always appropriately collected and/or properly stored prior to culturing. Factors which may influence the results of microbiological analyses of bulk-tank milks include the mixing of milk prior to sample collection, the site of collection, diurnal variation, and the conditions of sample storage (*2,8-9,15,19,21*). We are unaware of specific studies on the influence of these factors on the results of microbiological analysis of bulk-tank milk on blood agar. Because of the increasingly common use of this procedure, it appeared useful to evaluate these factors and to compare the results of surface colony counting techniques on blood agar with results from pour-plate procedures for the SPC and PI.

Sampling and sample handling factors that might influence the results of microbiological analysis of bulk-

tank milks were studied and results obtained from the surface of blood agar plates were compared to those determined by SPC and PI counts. Factors that influence the results and interpretation of microbiological analysis of bulk-tank milk on the surface of blood agar were documented.

Materials and Methods

Dairies

Bulk-tank milk samples (n = 50) were collected from dairy herds based upon reasonable access and producer cooperation. Experiments were conducted from July 1987 to January 1988.

Experimental Design

In experiment 1, the influence of site of sample collection and mixing of bulk-tank milks was investigated using 5 samples collected from each of 20 bulk-tank milks. Samples included mixed surface and subsurface, unmixed surface and subsurface, and outlet valve samples. Outlet valve samples were collected after approximately 2 liters of milk were allowed to run through the valve, but without disinfecting the valve opening. Surface samples were collected from within 3 cm of the milk surface, while subsurface samples were collected 50 cm from the milk surface. Mixed samples were collected after 5 min agitation of individual tanks (*15,21*), while unmixed samples were collected 20-30 min after shut-off of the tank agitator. In a preliminary experiment, samples in round bottom flasks (to simulate bulk-tank conditions) were placed in a refrigerator undisturbed and surface and subsurface samples were collected at placement and 1, 2, 3, and 4 h thereafter. Because the preliminary experiment did not indicate major differences in bacterial concentrations for surface and subsurface samples until samples were held $\geq$ 2 h, and because samples were collected from commercial dairies during the summer in North Carolina, it was not considered appropriate to allow milk to remain without agitation for longer periods. All samples were placed on ice, transported to the laboratory, and immediately plated.

In experiment 2, the influence of sample handling methods was determined using 4 samples collected from the subsurface of each of 20 bulk tanks after 5 min of tank agitation. The collection procedures and collection site were standardized to give samples as nearly identical as possible. One sample was stored in an insulated container (without ice) at ambient temperature, and 3 samples were immediately placed on ice upon collection. A thermometer was placed in each container and the temperature was recorded. All samples were immediately transported to the laboratory. Samples stored at ambient temperature and 1 of the 3 samples per tank stored on ice were plated immediately upon return to the laboratory. One of the 2 remaining samples per tank was refrigerated overnight (18 $\pm$ 2 h at 4°C) and then plated, while the other was frozen for 7 days at -20°C, thawed, and subsequently plated.

To study the variation among days for samples collected from tanks on 10 dairies (experiment 3), subsurface milk samples were collected on each of 8 consecutive days from tanks following agitation for 5 min. Upon collection, samples were frozen at -20°C. All samples from individual farms were plated and analyzed on the same day.

Sample Collection

Bulk-tank milk samples (10 ml) were collected by use of sterile, individually packaged, 55-cm insemination pipettes fitted with sterile syringes. Surface samples were collected from within 3 cm of the milk surface, while subsurface samples were collected 50 cm from the milk surface.

Microbiological Methods

Bacterial concentrations (CFU/ml) were determined by 3 methods for each sample. Methods included surface counts of bacteria determined on 5% sheep blood agar plates without esculin and standard pour-plate procedures for the SPC and PI. Surface colony bacterial counts were determined as described previously on blood agar plates after 48 h of incubation at 35°C (*11,25*). Standard pour-plate procedures were used for the SPC and PI (*15*).

Statistical Analysis

Experiment 1 was analyzed as a randomized complete block (RCB) experiment with 5 treatments. Treatments were mixed surface, mixed subsurface, unmixed surface, unmixed subsurface, and outlet valve. Bulk tanks were considered as blocks. Experiment 2 was also analyzed as an RCB with bulk-tanks as blocks. The treatments were the 4 sampling methods (insulated container, ice storage with immediate plating, ice storage with plating after refrigeration, and ice storage with plating after freeze and thaw). Experiment 3 was also analyzed as an RCB with days considered as treatments and farms considered as blocks.

Data were analyzed either arithmetically or as $\log_{10}$ transformations, using a computer statistical program employing analysis of variance (ANOVA), regression and correlation procedures (*20*). Comparison among means was via the Duncan Multiple Range Test (20).

Results

Influence of sample site and mixing

Mean $\log_{10}$ transformations of bacterial concentrations analyzed for sample site and for mixing effect by counting methods from experiment 1 are depicted in Table 1. Mean bacterial counts differed significantly among farms, by sample site, and for counting methods. Mean bacterial counts for samples collected from tank outlet valves were significantly higher than remaining treatment means for all counting methods (Table 1). Other than the significant increases for tank outlet samples, sampling site or mixing did not significantly influence counts (Table 1). Surface colony bacterial counts on blood agar were significantly higher than those determined by the SPC and PI.

TABLE 1. Bacterial counts by counting method for experiment 1

Counting method	Sample	Mean ± SD bacterial concentrations: Log_{10}	Transformed[a]
Surface count[b]	Mixed surface	3.83 ± 0.73	6,800
Surface count	Mixed subsurface	3.85 ± 0.64	7,100
Surface count	Unmixed surface	3.95 ± 0.60	8,900
Surface count	Unmixed subsurface	3.89 ± 0.69	7,800
Surface count	Outlet	4.42 ± 0.59[†]	26,300
SPC[b]	Mixed surface	3.54 ± 0.60	3,500
SPC	Mixed subsurface	3.57 ± 0.64	3,700
SPC	Unmixed surface	3.53 ± 0.59	3,400
SPC	Unmixed subsurface	3.55 ± 0.57	3,500
SPC	Outlet	4.04 ± 0.94[c]	11,000
PI[+]	Mixed surface	3.57 ± 0.85	3,700
PI	Mixed subsurface	3.61 ± 0.83	4,100
PI	Unmixed surface	3.63 ± 0.84	4,300
PI	Unmixed subsurface	3.67 ± 0.86	4,700
PI	Outlet	4.24 ± 1.18[c]	17,400

[a]Back transformation from log_{10} values given in first data column.

[b]Surface count = CFU/ml on blood agar; SPC=CFU/ml by standard plate counts; PI = CFU/ml by preliminary incubation.

[c]Significantly different from remaining treatment means within counting method, $P < 0.05$.

TABLE 2. Mean bacterial counts by sample handling methods (experiment 2)

Storage Method	Counting Method	Mean ± SD bacterial concentrations: Log_{10}	Transformed[a]
On ice	Surface counts	3.71 ± 0.56	5,100
(3 hours)	SPC	3.60 ± 0.55	4,000
	PI	3.64 ± 0.58	4,400
At ambient temp	Surface counts	3.91 ± 0.47[b]	8,100
(- 3 hours)	SPC	3.77 ± 0.47[b]	5,900
	PI	3.74 ± 0.60[b]	5,500
Refrigerated	Surface counts	3.82 ± 0.63	6,600
(18 hours)	SPC	3.68 ± 0.63	4,900
	PI	3.58 ± 0.60	3,800
Frozen	Surface counts	3.68 ± 0.54[b]	4,800
(7 days)	SPC	3.40 ± 0.53[b]	2,500
	PI	3.45 ± 0.46[b]	2,800

[a]Back transformation from log_{10} values given in first data column.

[b]Differed significantly, $P < 0.05$, from samples held on ice.

TABLE 3. Mean ± SD for bacterial concentrations for all days by dairy (experiment 3)

Dairy	Surface counts	SPC	PI
1	98,900 ± 70,700	39,500 ± 31,700	28,700 ± 17,600
2	9,400 ± 12,600	9,500 ± 15,800	10,300 ± 14,900
3	5,300 ± 3,800	1,000 ± 200	2,000 ± 2,700
4	43,600 ± 55,500	4,900 ± 3,700	7,600 ± 3,500
5	77,800 ± 46,000	5,200 ± 2,400	19,100 ± 36,900
6	900 ± 600	400 ± 200	400 ± 300
7	2,300 ± 1,800	1,000 ± 600	800 ± 500
8	33,500 ± 13,500	13,300 ± 5,700	9,200 ± 5,500
9	1,600 ± 2,000	400 ± 200	500 ± 400
10	37,900 ± 41,500	5,900 ± 11,800	3,000 ± 3,400

Influence of sample handling

Mean bacterial counts for sample handling treatments by counting methods are depicted in Table 2. Bacterial counts differed significantly among farms, sample handling methods, and for counting methods. The mean time from collection to return to the laboratory for all samples was 179 ± 55 min. For samples placed in the insulated containers at ambient temperature and without ice, the mean (± SD) temperature was 23.6 ± 2.3°C. Mean bacterial counts for samples stored at ambient temperature were significantly higher than the remaining treatments for all counting methods. Values for samples stored on ice and immediately plated were not significantly different from iced samples stored overnight at refrigerator temperature. Samples frozen for 1 week prior to quantification gave a significant decrease in counts. Samples quantitated by the surface colony technique were significantly higher ($P < 0.01$) than those determined by SPC and PI.

Influence of day to day variation

Means for bacterial counts by counting method and herd for experiment 3 are depicted in Table 3. There were significant differences among dairies. Although variability was considerable, there were no significant difference for days within dairies.

Correlation and regression analysis on data collected in all experiments

Mean bacterial counts analyzed as log_{10} transformations for all 250 samples in experiments 1-3 were 3.88 ± 0.69 (7,600 bacteria/ml) for surface colony count methods, 3.55 ± 0.66 (3,600 bacteria/ml) for SPC, and 3.59 ± 0.78 (3,900 bacteria/ml) for PI. Mean bacterial counts determined by the surface colony method were significantly higher than those determined by SPC and PI. Regression analysis indicated the relationship between log_{10} surface colony counts and log_{10} SPC was described by the equation:

$$log_{10} \text{ surface counts} = 1.105 + 0.78 (log_{10} \text{ SPC}).$$

Correlation coefficients for bacterial counts determined by the 3 methods on the total of 250 samples from the study indicated correlations between surface colony counts and SPC ($r = 0.27$) and PI ($r = 0.47$). A correlation of 0.59 was also present between SPC and PI. Correlations were 0.75 between log_{10} surface counts and log_{10} PI, and 0.86 between log_{10} SPC and log_{10} PI.

Discussion

Several important factors influencing the results of microbiological analysis of bulk-tank milks were documented in the present study. Means for tank outlet valve samples exceeded other sampled sites by a factor of approximately 3 to 4. If the tank outlet is the only sampling site available, samples should be collected after careful cleaning and sanitizing of the exterior of the outlet (*21*) and flushing the outlet valve by allowing milk to

flow from the outlet. In tank milk agitated for 5 min and in milks allowed to settle in the tank for a period of 20-30 min, there was no significant difference in bacterial counts in samples collected from the milk surface or a site 50 cm below the surface. Although a time period of 20-30 min may not be considered a strong test of the difference related to sampling site, this time was chosen since many bulk tanks are set to automatically agitate as often as twice per h. It was also not considered appropriate to allow the tanks to stand without agitation for longer periods of time, in view of possible producer objections. These results indicate that samples from surface or subsurface sites from a well-mixed tank would be useful in microbiological analysis of bulk-tank milks. Agitation for a period of 5 min is recommended (*15*). For tanks with a volume >5678L, an agitation for 10 min is recommended(15). The influence of agitation on bulk-tank milk bacterial counts has been suggested to be due to "sweep up" of bacteria in the cream layer of milk with settling(*15*). The preliminary experiment suggested that this factor may become important after approximately $\geq$ 2 h of settling. Obviously, the ability to obtain a representative sample determines the results obtained.

Sample handling factors influenced the results of bulk-tank milk analysis. Storage for a period of approximately 3 h at 25°C produced an average increase of 44% in bacterial counts, as compared to samples held on ice. Sample storage overnight at refrigerator temperature did not significantly influence bacterial counts. Freezing of samples for a period of 7 days was associated with an average decrease of 25% in bacterial counts, as has been previously reported (*19*). The influence of storage conditions should be considered in evaluation of results of microbiological analysis of bulk-tank milks. Samplers and haulers must be cautioned on proper handling techniques, since handling in the period prior to plating can strongly influence the results of such analysis.

Although significant differences were not found for days within dairies, there was considerable variability in samples collected on consecutive days. This variability exceeded the 10% variation expected from SPC determination on duplicate samples (*15*). Results obtained from a single sample could be quite misleading. This supports recommendations that samples from 3 to 5 days should be collected, frozen, and pooled in the laboratory for analysis (*8-9*). Although variation among days for dairies was not statistically significant, the variability was to such an extent that some of the higher values could trigger regulatory action.

It has been stated that bacterial counts determined by surface colony counting on blood agar are equivalent to those obtained from the SPC (*4*). These results do not support this assertion, in that mean bacterial counts made on the surface of blood agar exceeded those determined by the SPC and PI. This difference can be explained by differences in media used for the procedures, temperature of incubation, and the specific procedure used. The types of bacteria contained in the milk samples analyzed may explain how well results from the procedures compare. Some samples may contain bacteria that grow better on blood agar or at the temperature employed. The procedure used here has been previously described (*11,25*) and is similar to procedures used in some veterinary practitioners' laboratories. Although more sophisticated quantitative techniques are available, the purpose was to determine how the values obtained from commonly employed procedures compared to regulatory methods. The average correlation of 0.27-0.28 between bacterial counts made on the surface of blood agar plates and those determined by SPC, indicates that only 10% of the variation between values for the two counting methods is explained by a linear relationship. Bacterial counts determined on the surface of blood agar plates should obviously not be considered the same as counts made by the SPC.

Veterinarians and mastitis specialists utilize microbiological analysis of bulk-tank milk on the surface of blood agar in assessment and monitoring of mastitis and milk quality. These results document that such counts may differ considerably from results obtained from standard regulatory procedures. In addition, these results document that sample site selection and handling factors known to be critical for reliable evaluation of bulk milk for regulatory purposes are also important for evaluation of milk on the surface of blood agar plates. Users of the procedure of analysis of bulk milk on blood agar need to be aware of the potential differences between the results and standard regulatory procedures and the influence of sample site and sample handling factors. Evaluation of bulk-tank milk on the surface of blood agar would appear most useful in identification of mastitis pathogens. Utilization of results from evaluation of bulk-tank milk on the surface of blood agar in combination with results from standard regulatory procedures would appear to provide the maximal amount of information.

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The Dairy Industry in Arizona: Organization, Processing and Quality Control

by
Moshe Raccach[1]

Abstract

The dairy industry in Arizona was studied in terms of its organization, processing, quality control and regulatory aspects. Most of the milk producers in the state are organized in a cooperative which supplies most of the 12 dairy processing plants with milk and other products. Most dairy products are manufactured in the state with the exception of ripened cheese. The quality control programs are elaborated and covers both the chemistry and microbiology of the products. The dairy industry is regulated by the state dairy commissioner and the FDA. The state has criteria covering maximum levels of bacteria and chemical residues such as pesticides and aflatoxins.

Introduction

The state of Arizona has an estimated population of over 3,700,000. The dairy industry revolves around 150 dairy farms of which about 120 are organized in a cooperative. The dairy producers in the cooperative have on the average 600 cows per unit and an average daily milk production of 37,457 lb per unit with a total of about 4.5 million lb a day (5). Milk production per cow, in Arizona, was at a record high in 1987 attaining an average of 15,911 lb when the national average was slightly below 14,000 lb (1). The trend, in dairy farms, is of fewer but larger units. There are 12 dairy processing plants in Arizona making raw and pasteurized fluid milks, coffee creamers, buttermilk, yogurt, sour cream, cottage cheese, cheese base for processed cheese, butter, milk powder, buttermilk (butter serum) powder, ice cream, frozen yogurt mix, etc. One can find manufacturers such as Amador Goat, Beals Dairy, Carnation, Jackson Foremost, La Corona Foods, Safeway, Schreiber Foods, Shamrock Foods Company, Ultra Products, United Dairymen of Arizona, and others. In 1982, packaged fluid milk was second by value of product shipments ($127 million) among the top 10 manufactured food products in Arizona (4). The cash receipts from marketing dairy products in Arizona was about $173 million in 1986 (9).

As one can see, the dairy industry in Arizona has quite an economical impact. Thus, this industry was the subject of this study particularly from the organization, processing, quality control and regulatory aspects.

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Organization of the dairy industry

Eighty percent of the dairy producers are organized in a cooperative which provides them with a marketing arm, supplies at cooperative price, quality control of both milking management (equipment and milking procedure) and milk, and transportation of the milk to processing plants. The cooperative has a board of directors, and is set up with the following entities: dairy council, quality control department, processing plant, transportation department, supplies store, sales department and a cheese store. The cooperative is a major supplier of milk and other dairy products to dairy and other processing plants in and out of state. By virtue of having a processing plant the cooperative serves also as a buffer to the milk processing system. It has the ability to process milk surpluses above the need of the processing plants.

Another interaction among processing plants is the production of dairy products by one plant for others. Yogurt is a typical example.

The dairymen are professionally organized as the Arizona Dairy Technology Society maintaining periodic and annual meetings featuring guest speakers from academia, industry and government covering topics of interest.

Milk Packaging and Processing

Upon the arrival of a shipment of raw milk at a dairy processing plant it is subjected to a battery of tests known as "Dock Tests" which include titratable acidity, antibiotic residues, flavor, temperature, and general cleanliness. The criteria call for a temperature of 7°C and below, and no zone r 16 mm with *Bacillus stearothermophilus* disc assay method. Many dairies use the Charm test II for antibiotics to obtain results within 10-12 min as compared to 2.5 hr with the disc method. The results from the Charm test are confirmed with the disc method.

Certified Raw Milk and Raw Dairy Products

Raw milk collected in Arizona had a bacterial count of s10,000 CFU/ml in 88% of >100 samples tested. This level constitutes 10% of the criterion (100,000 CFU/ml) for raw milk for pasteurization.

Under the amended revised Arizona statute (House Bill 2074, 1984), as with some other states, the sale of certified raw milk and raw dairy products is allowed within the state. Products from both cows and goats are available especially in some health food stores. Certified raw milk and raw dairy products have to comply with the same health and sanitation criteria prescribed for grade A pasteurized milk and dairy products (Table 1).

Table 1. The State of Arizona Microbiological Criteria.

Grade A Product	SPC[1]	Coliform
Raw Milk, at pick up	100,000[2]	-
Raw Milk, commingled	300,000	-
Certified raw milk	20,000	<10
Pasteurized milk (all fat levels)	20,000	<10
Raw cream/cream for ice cream	500,000	-
Pasteurized milk/or cream for ice cream	50,000	-
Cultured milk	-	<10
Sour cream	-	<10
Cottage cheese (all fat levels)	-	<10
Yogurt (all fat levels)	-	<10
Light/heavy whipping creams	20,000	<10
Creamer/half & half	20,000	<10
Egg nog	20,000	<10
Ice cream/milk	50,000	<20
Frozen custard	50,000	<20
Soft serve	50,000	<20
Nonfat dry milk	30,000	<10

[1]Standard plate count.
[2]Maximum level per ml or g.

This means a standard plate count and a coliform level of 20,000 and <10 CFU/ml, respectively for certified raw milk. Certified raw milk and raw dairy products must be displayed separately from their pasteurized counterparts, and they must bear a label with a principle display panel stating: "Raw Milk Product" for raw dairy products, and the following stated for certified raw milk: "Raw Milk: Not Pasteurized and May Contain Organisms Injurious to Your Health." The same bill, mentioned above, requires that cows and goats producing raw milk for consumption be tested annually for both *tuberculosis* and *brucellosis* using the ring test method. The requirement that raw milk for consumption and its products be free of *Salmonella* has been dropped. The significance of this amendment is, that it is not required to test raw milk for *salmonellae*. Certified raw milk was implicated in *salmonellosis* outbreaks in California in 1971-75, and 1977-78 involving about 49 cases (6).

Pasteurized Milk, Chocolate Milk, and Coffee Creamers

Raw milk is separated into skim and cream (about 40% fat). The skim milk is mixed with the cream to formulate the various products containing 1, 2, 3.25 and 10.5, 18% fat etc.

Pasteurized milk products - The raw milk is heated to 32-38°C and homogenized. Plate pasteurization with a time-temperature combination such as 18 sec at 78-79°C is used. Some plants use extra holding time. Chocolate milk is pasteurized for 18 sec at 81°C. In both instances the heat treatment exceeds the minima prescribed by the Code of Federal Regulations (15 sec at 72°C and at 74.4°C, respectively).

Coffee creamers - The raw material with 10.5% butterfat, is heat treated by an ultra-high-temperature (UHT) process (4 sec, 130°C). About 1 million lb or more of the raw material is processed monthly. Two types of dairy creamers are manufactured: refrigerated and shelf stable. The "refrigerated" product is filled in presterilized commercially available single-service containers, sealed and stored (1.7 - 3.3C) till shipped. The shelf stable product is processed using an aseptic system. To produce a "commercially" sterile product an aseptic system must meet 3 basic conditions: the food system must be sterile, the container must be sterile, and the filling environment must be sterile. An aseptic process using nonmetal containers usually includes formation of the packaging material, filling the container with the heat treated food system, and aseptically sealing the container (7). The shelf stable creamer is filled into single service containers. These containers are formed on the premises from a plastic material sterilized, with a combination of hydrogen peroxide and heat, immediately before formation. Hydrogen peroxide was approved by the FDA in 1981 (11) as a sterilant for packaging materials used in aseptic systems. Tests are conducted to assure that residues of hydrogen peroxide do not exceed legal amounts. The aseptic ("bacteria free") environment during filling is obtained using positive pressure of filtered air or gas such as nitrogen.

Cultures

The cultures used in cultured dairy products are lactic acid bacteria of the dairy type such as group N streptococci and the thermophilic cultures of yogurt. The starter cultures are either lyophilized or frozen concentrates. When cultures are used they are either of the direct set type or they are propagated in either a special tank or a bioreactor to obtain the bulk culture for inoculation of the milk. Usually, a bioreactor is housed in a separated area with positive pressure. The bioreactor is equipped with stirring capability, pH and temperature controls. The culture medium is mixed, heat treated, and inoculated with the desired culture. Cultures are allowed to grow in the bioreactor until the carbohydrates are exhausted. A backup culture is always available in case of a failure. Bacteriophage problems are rare, if any, probably because of a sound sanitation program.

Buttermilk

A similar process was described by Chandan (3): milk is standardized to 10% solids non fat, pasteurized (30 min 85°C or 2.5-5 min 88-91°C), homogenized, inoculated with a direct set buttermilk mixed starter culture containing the acid producers *S. lactis* subsp. *lactis*, *S. Lactis* subsp. *cremoris*, and the flavor (diacetyl) producers *L. cremoris* and/or *S. lactis* subsp. *diacetilactis*. The inoculated milk is incubated 14 - 16 h at 22°C till a pH of 4.5 is attained. The product is broken; in some instances butter flakes and salt are blended in. The product is packaged and cooled till shipment.

Cheese

Two types of cheese are made by the companies surveyed: cottage cheese and a cheese base for processed cheese.

Cottage cheese - Both cultured and acidified cottage cheese are manufactured. Cottage cheese is made with a culture induced coagulation time as short as 3.5 h. This process is sometimes shortened by the use of an acidulant such as delta gluconolactone.

Cheese base - This product is made by ultrafiltration and is further processed to manufacture processed cheese. About 35 million lb of raw milk are processed monthly. Ultrafiltration is used in the manufacturing of several cheeses such as Camembert and Coulommiers (8). Kosikowski (8) and Potter (10) described the process of ultrafiltration as follows: The milk is cycled across a semipermeable membrane (cellulose acetate, polyamid, etc.) which

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may be plates, straight or spiralling tubes. The membrane allows water, and low molecular weight compounds such as salts to pass. These constitute the ultrafiltrate or permeate. The material retained by the membrane (proteins, fat, insoluble salts, etc.) is the retentate or liquid precheese. The cycling of the retentate across the membrane continues till the desired solids level is achieved. Concentrations of 5 to 6 fold are sometimes necessary. The lactose is isolated from the permeate and sold as an ingredient to other industries such as baby food manufacturers.

The precheese is fermented, heat treated, and packaged. At this point the cheese base is ready for further processing.

Yogurt

This is made with 2% milk. A milk mix is prepared using milk, milk powder, gelatin, sugar, etc. The mix is batch pasteurized (82°C, 30 min), homogenized, and cooled to 43°C. Plain yogurt and two types of flavored yogurt are made: Sundae and Stirred (Swiss) styles. The following is a description of the yogurt processes based on Kosikowski (8). For the Sundae style, fruits are placed in the bottom of the cup and then it is filled with the inoculated milk mix. The uniqueness of this process is that the milk mix is blended with fruit extracts and is not the plain type encountered with other manufacturers. The cups are incubated at 43°C until the desired pH is attained usually within 4 - 6 h, then the cups are placed in a cooler. In the case of the Stirred yogurt, the inoculated milk mix is incubated in a vat till the desired pH is attained. The yogurt is stirred, pumped through a pipeline connected to a fruit feeder. The fruit puree is blended with a sweetened base yogurt and filled in cups. The cups are placed in a cooler. Yogurt is manufactured under a number of labels for shipment in and out of Arizona.

Nonfat Milk Powder and Butter

These products are considered among other things the "steam" valve of the milk manufacturing system in this area. In instances where surpluses of milk are available, they are processed into nonfat milk powder and butter. These products are compatible as they do not compete with each other for raw materials. There was a strong domestic use and commercial export of nonfat milk solids in 1989 according to the USDA Department of Economic Research Services but this is not the case with butter (5). A price of 90¢ a pound for nonfat milk powder was in effect.

Nonfat milk powder - Milk is separated into cream (35-40% butterfat) and nonfat milk. The milk is dried in a spray drier. The fluid is atomized into minute droplets to enhance drying. The droplets come in contact with hot (about 200°C) air and drying is a matter of seconds. The dry powder drops to the bottom of the dryer and is collected and packaged.

Butter - The cream is pasteurized, churned at about 10°C (fat globules clump together and form butter granules which separate from the water phase or serum also known as buttermilk), washed, salted (1.4 - 1.5% to a maximum of 2.2%), worked (to disperse salt and divide water to small droplets), and packaged. The Buttermilk (water, lactose, milk proteins, about 5% butterfat, salts etc.) collected in the process is dried into a powder which is used for ice cream and bakery products.

Ice Cream and Other Frozen Products

Ice Cream - The liquid and dry ingredients are mixed, pasteurized (common time-temperature combinations are 71°C for 30 min or 82°C for 25 sec), homogenized, cooled (4.4°C), chilled (-5.5°C) and whipped in an ice cream freezer (at this time nuts and fruits may be added) and the semisolid mix is packaged and hardened at about -30°C.

Frozen yogurt mixes - These are made from milk or milk solids which were fermented in a similar way to yogurt. The fermented mix is frozen and sold as a soft serve item.

Eskimo - These are frozen in a brine maintained at about -26°C.

Quality Control

The quality control programs vary in volume from one facility to another. In some instances, an expenditure of at least $150,000 a year is encountered. The quality control program starts with the dock tests which were discussed earlier and continues to include the following groups of tests:

Chemical and proximate analyses - Butterfat, protein, lactose, solids, pH, titratable acidity, aflatoxins and pesticide residues.

Microbiological analyses - Standard plate count (SPC), direct microscopic count (DMC), laboratory pasteurization count (LPC), coliform, yeasts and molds count (YMC), hemolytic bacteria count, *Mycoplasma*, rope bacteria, somatic cell count, sterility tests, and pathogens such as *Salmonella, Yersinia,* and *Listeria.* Pasteurized products (depending on the product) are subjected to microbiological analyses such as SPC, coliform, YMC, sterility tests, and pathogens. These tests are done either on or off the premises.

Methodology & Equipment

The Multispec - The use of the Multispec (Foss Food Technology Corp. Eden Prairie, MN) is quite pervasive. This instrument measures the level of butterfat, protein and lactose in milk. The analysis is based on absorption of infrared (IR) energy at specific wavelengths by carbonyl groups in ester linkages of fat molecules, by peptide linkages between amino acids of protein molecules, and by hydroxyl groups in the lactose molecules. The Multispec is attached to a personal computer to facilitate logging and printing the data.

Gas liquid chromatograph (GLC) - GLC with electron capture detection is used to scan milk for residues of the chlorinated hydrocarbon pesticides such as DDE, dieldrin, BHC, methoxychlor, heptachlor epoxide, hexachlorobenzene, etc.

High pressure liquid chromatograph (HPLC) - HPLC equipped with an ultraviolet detector is used extensively in the detection of aflatoxins M_1 (4-hydroxy B_1) & M_2 (4-hydroxy B_2) in milk. HPLC is also used for the detection of sulfonamide residues in milk, in addition to the Charm test.

Babcock test - This test is used for the quantitative analysis of fat combining sulfuric acid extraction, centrifugation, and reading the column of fat in the milk test bottle. Both the Nebraska and the Pennsylvania methods are in use.

Milk solids - The indirect measurement of solids (100% - % moisture) is done using regular and vacuum ovens at temperatures ranging from 85-165°C.

Regulatory Aspect

The dairy industry in Arizona is regulated by the State Dairy Commissioner and by the Food and Drug Administration. Recently, the Arizona legislature has voted to set up the State Department of Agriculture which will take regulatory responsibilities.

The State Dairy Commission - This agency has a regulatory capacity for both the consumer and industry. The regulatory activity includes plant inspections and taking of both product and environmental samples. The chemical analyses such as aflatoxins, pesticide and sulfonamide residues are done by the State Chemist Laboratory. The microbiological work is done by the Laboratory Services of the State Department of Health. The regulatory statute is based on both the Grade A Pasteurized Milk Ordinance (PMO) (12), and the Interstate Milk Shipper (IMS). The state has a set of criteria for chemicals, bacteria, and temperature.

The microbiological criteria are shown in Table 1. Grade A raw milk for pasteurization may not exceed a SPC of 100,000/ml and 300,000/ml at pickup and after it has been commingled, respectively. These products should not exceed a level of 1,000,000 of somatic cells. Effective July 1, 1986 the maximum level of somatic cells was reduced from 1,500,000 to the current level of 1,000,000. Grade A pasteurized milk and milk products and certified raw milk (for consumption) may not exceed a SPC of 20,000/ml and a coliform level of 10. The phosphatase test is applied to pasteurized milk and milk products and these should have <1 fg/ml by the Scharer rapid method (2) or equivalent. Grade A aseptically processed milk and aseptically processed milk products should not show bacterial growth by specified test. The required maximum level of <10 coliform per g of nonfat dry milk is lower than the level of 90 per g as prescribed by the United State Public Health Service. Many dairies attain zero coliform in their grade A pasteurized milk. The FDA is leaning toward requiring a zero level of coliform in grade A pasteurized milk.

The criteria for chemicals such as DDT, TDE, and DDE (individually or combined) must not exceed 1.25 ppm (on fat basis). Aflatoxins are tolerated up to a level of 0.5 ppb. Inhibitory substances such as sulfonamides should be absent. The detection level of these compounds is 5 ppb (10 ppb for sulfamethazine). Additional information on pesticides/herbicides residues is summarized in the Code of Federal Regulations, Title 40, Part 180.

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News

Silliker Laboratories Expands to Ohio

Silliker Laboratories, a leading independent, testing, consulting and research laboratory, specializing in the food industry, opened their eighth new laboratory facility in Columbus, Ohio on February 6, 1990. The expansion into Ohio will provide a regional service to help new and existing clients eliminate hazards of foodborne illness, promote product quality and meet standards set by regulatory agencies.

Silliker Laboratories of Ohio, Inc., situated on the Ohio State University Research Park, will benefit from the University's Department of Food Science and Technology which does extensive food science research, and will also offer hands-on experience to budding scientists who want to apply their skills in the food industry. According to Dr. Damien Gabis, President of Silliker Laboratories, the campus setting of the facility will be a first for a U.S. based food testing laboratory.

Dr. Edward R. Richter, the appointed Director and Vice President of the Ohio laboratory, has a strong background in the food microbiological field. His expertise in research methods for *Salmonella* and other foodborne pathogens will be a definite asset to Silliker and its clients. Prior to his new position, Dr. Richter was Corporate Research Microbiologist at the Thomas J. Lipton, Inc. Company, located in New Jersey, and an assistant professor of Food Science and Nutrition at The Ohio State University. Dr. Richter will continue to teach at OSU as an adjunct professor. Mary Joan Klatt, formerly the Special Projects Manager at the Silliker Chicago Heights facility, will be Laboratory manager for the Ohio facility. She will assist Dr. Richter in launching the new lab.

Silliker Laboratories, well known for its expertise and experience in the food industry, provides high quality service in areas such as: **Analytical Microbiology**--testing for foodborne pathogens such as *Salmonella, Listeria,* and spoilage organisms that compromise product quality and shelf-life; **Analytical Chemistry**--analysis for nutritional labeling, mycotoxins, pesticides, toxic residue testing, vitamins, minerals, cholesterol and fiber; **Research Services**--studies for shelf-life determination, pathogen challenge studies, collaborative studies of new analytical methods, and microbiological thermal death-time studies; **Technical Services**--in-plant problem solving, food microbiological and chemical hazard control programs and sanitation audits; and **Information Services**--laboratory short courses, custom videotape training programs and slide and presentation graphics, technical bulletins and literature searches.

Silliker Laboratories of Ohio, Inc. is located at the Ohio State University Research Park, 1224 Kinnear Road, Suite 114, Columbus, OH 43212. For more information and a fee schedule contact Dr. Edward Richter, Director and Vice President, at (614)486-0150.

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Centennial Year for the Dairy Manufacturing Short Courses

The Department of Food Science and Cooperative Extension are proud to announce that 1990 is the centennial year for the Dairy Manufacturing Short Courses at the University of Wisconsin-Madison. In 1890 the University of Wisconsin established the first dairy school in the United States. That first short course in dairying included instruction on milk composition, milk testing, butter making and cheese making. The "Dairy School" was initiated after the introduction of the famous Babcock Test for fat in milk by the noted agricultural chemist, Dr. Stephen Moulton Babcock in 1890.

In the past 100 years, over 10,000 Wisconsin, national and international students from the dairy industry and allied industries have been trained in dairy manufacturing short courses covering butter making, cheese making, ice cream making, milk pasteurization,

milk quality and dairy manufacturing principles. This year, short courses will be offered in ice cream making, milk pasteurization and cheese making.

Various activities are being planned to celebrate the centennial of the Dairy Manufacturing Short Courses at the University of Wisconsin. The activities will be culminated with a special Centennial Dinner to be held on September 27, 1990, during the Centennial Cheesemakers Short Course. Past graduates of dairy manufacturing short courses at the University of Wisconsin that would like to be informed of centennial activities should send their name, address, and short course attended to: Dr. Bill Wendorff, Extension Dairy Manufacturing Specialist, Department of Food Science, University of Wisconsin, 1605 Linden Drive, Madison, WI 53706.

Plastic Packaging and the Environment

Solid Waste

Keeping pace with the disposal of solid waste is a worldwide environmental problem. Limited land for landfill in many nations has made waste a major issue for years. Only in the last decade has the United States been confronted with this difficult challenge.

Landfill space is diminishing at a time when the solid waste stream is continuing to increase. Americans throw away an average of 3.5 pounds of waste a day, nearly a half a ton per person per year. This amounts to 150 million tons a year, a figure that is expected to increase to more than 180 million tons by the year 2000.

Finding Solutions

To handle solid waste disposal, the Du Pont Company and several U.S. federal agencies recommends a four-tiered approach to solid waste management:

- •waste minimization
- •recycling
- •waste-to-energy incineration
- •landfilling

Eighty percent of the solid waste stream in the U.S. is currently landfilled, 10 percent is incinerated and 10 percent recycled. The Environmental Protection Agency recommends recyclable plastics be increased to 25 percent of the waste stream by 1992.

What's in our garbage? By weight, paper and paper board products account for 35 percent of the total municipal solid waste stream. Yard and food wastes make up 29 percent. Rubber and leather, textiles, wood and miscellaneous items make up approximately 11 percent. Metals and glass contribute another eight to nine percent each. Plastics contribute a total of seven percent.

Plastics in the Waste Stream

Plastics are noted as a major contributor to the solid waste stream, due in part to their high visibility in the products we use. Plastic packaging accounts for about half of the plastics in the waste stream. In recent years, significant progress has been made on several fronts to reduce the volume of plastics packaging waste.

Waste Minimization

One important area of progress has been in the amount of material used in manufacturing plastic packaging, thereby reducing the contribution of solid waste.

Du Pont has an active internal waste minimization program. The less material the company uses in its manufacturing process, the less it has to dispose of. Du Point is serious about minimizing waste. It uses raw materials more efficiently today than ever before. As a result of higher first-through yields and recovery, the company recycles nearly one billion pounds of polymers a year in its manufacturing processes--without a compromise in product quality.

Plastics Recycling

Recycling of plastics is emerging as an important part of the solution to the solid waste issue and is expected to increase significantly as post-consumer collection methods are increased, improvements in sorting various plastic polymers are overcome, and plastics recycling is recognized as an economical alternative to manufacturing virgin resin.

New technologies are being explored to manufacture useful products from various types of recycled plastics. Plastic materials have become second only to aluminum in recycling value and their durability, processability and versatility offers a future for plastics recycling.

One example of this bright future is the recently announced joint venture agreement between the Du Pont company and Waste Mangement, Inc., the largest waste management company in the world. It will be the largest plastics recycling and reprocessing operation in the country. The facility is expected to start up in early 1990 and will have a capacity of up to 40 million pounds annually. The companies are convinced the venture will demonstrate that recycling of plastics can make an important contribution to the solution of the solid waste crisis.

Successful recycling of plastics has already been accomplished with polyethylene terephthalate (PET) soft drink containers and high density polyethylene (HDPE) milk and juice containers.

Recycling of PET soft drink containers increased to 20 percent of all PET containers manufactured in 1988. The goal of the plastics industry is to increase the recycling of PET into useful products, such as fiberfill used in sleeping bags, ski jackets, and automobile seats to 50 percent by 1992.

More than 70 million pounds of HDPE were recycled from milk and juice containers in 1988 into outdoor furniture, trash cans, toys, and other usable goods. This is expected to increase to 660 million pounds per year by the mid-1990's.

New developments in recycling plastics include the recycling of polystyrene foam products used in food service. Major new recycling plants for foam are being

started up by Mobil and Amoco to recycle foam products into usable products such as industrial packaging and insulation.

New technologies now available for the recycling of commingled plastics hold great promise in expanding mixed plastics recycling. Du Pont supports industry organizations and programs which are working to increase recycling. Du Pont spearheaded the formation of the Council for Solid Waste Solutions.

The Council is working to offer guidance and national solutions for the disposal of plastics. Du Pont also serves on the executive board and was a charter member of the Plastic Recycling Foundation, which sponsors research to improve plastics recycling and demonstrate recycling techniques, and the National Association for plastic Container Recovery, which was established to facilitate the economic recovery of plastic containers.

Incineration

Practical long-term solutions to plastic waste disposal must include resource recovery through waste-to-energy incineration systems. Most plastics are excellent energy sources and burn cleanly. Properly designed and operated systems can help conserve dwindling landfill space by reducing up to 90 percent the amount of solid waste while they help conserve coal and petroleum reserves. By the year 2000, it is expected that more than 20 percent of the country's municipal solid waste will be disposed of by waste-to-energy plants, up from approximately 10 percent in 1988.

The new incinerators produce electricity or steam for heat by burning solid waste. Petroleum-based plastics can be the most BTU productive among all materials found in the waste stream, in some cases recovering nearly 30 percent of the energy that went into production of the materials. The plants provide tangible economic benefits to the municipalities they serve, while meeting stringent air quality standards through the use of available pollution control technology.

Waste-to-energy incineration is more widely used by other countries to dispose of solid waste. Incineration use approaches 50 percent in Sweden, Switzerland and West Germany, and 70 percent in Japan.

Among the barriers to widespread adoption of resource recovery of plastics in the U.S. are public misunderstanding of potential pollution and by-products, concern over site selection, the relatively high cost of modern facilities, and lack of national standards for design, operation and performance of waste-to-energy incineration systems.

Landfill

About 80 percent of post-consumer waste is presently disposed of in landfills. And while the amount of solid waste continues to grow, a third of U.S. landfills are expected to close in the next five years.

Many existing landfills in this country have reached full capacity or have closed because of environmental concerns. Acceptable sites for new landfills or other waste disposal facilities have been difficult to find, resulting in dramatically increased waste disposal costs in some areas of the country.

Even as progress is made to increase the contributions of source reduction, recycling waste-to-energy incineration to solid waste disposal, Du Pont believes landfills will have to continue to accommodate some of the nation's solid waste. Properly designed and safely operated landfills must continue to be built to handle noncombustible, nonrecyclable waste.

Plastics Degradability

Du Pont introduced the polymer used in the degradable six-pack ring connector some 20 years ago and will continue its research into degradable polymers.

The company believes there is a definite role for plastics with enhanced degradability. But there are concerns. There is a need to proceed with caution.

There is also mounting evidence that no material -- food, paper, plastic, aluminum or tin -- degrades significantly in a landfill.

Future Challenges

Plastics are enormously beneficial to society. They have created a technological revolution that has produced the safety, lowest cost food delivery system in the world. Plastics have improved the quality of life for all with major advances in health, transportation, and a myriad of other areas. Members of the plastics industry must be socially responsible, creative problem solvers and cooperative partners in the challenge of managing solid waste.

The U.S. plastics industry is working to decrease the environmental impact of plastic packaging in a number of ways. The industry is committed to a higher rate of recovered materials and to decreasing the amount of plastics used in packaging without diminishing the integrity or purpose of the packaging. Increased recycling and further development of degradable plastics also can play a part in helping to combat solid waste problems -- and allow consumers to continue to receive high-quality plastic packaging with its many safety and convenience benefits.

For more information contact Paul H. Wyche (302) 774-1942.

AFFI Urges Significant Food Industry Representation on FDA Task Force

The American Frozen Food Institute (AFFI) has urged the secretary of Health and Human Services to include "significant representation of individuals knowledgeable about the food industry" on its newly established Advisory Committee on the Food and Drug Administration.

The committee, charged with examining the mission, responsibilities and structure of FDA, will make recommendations to the secretary on how FDA can be strengthened to benefit public health.

In a letter to Louis W. Sullivan, M.D., secretary of Health and Human Services, AFFI commended the

formation of the task force. "Our members are subject to the jurisdiction of FDA and have a keen interest in ensuring that it is appropriately funded and staffed with well-qualified individuals," stated AFFI President Steven C. Anderson.

Anderson continued, "AFFI believes that creation of such an advisory committee is of critical importance to the future of the organization and direction of FDA and will have an enormous impact on how FDA fulfills its responsibilities of protecting the public health.

"For this reason, and because of the enormous responsibilities of FDA over the regulation of foods, AFFI believes that it is wholly appropriate that the committee, when constituted, include significant representation of individuals knowledgeable about the food industry and FDA as well."

Anderson asserted, "We believe this to be critically important in light of the fact that no commissioner in recent memory has assumed the position of Commissioner of Food and Drugs having had the benefit of significant prior experience with the food industry or with food issues.

"While we understand that there are important segments of the American economy that are also subject to regulation by FDA, we believe that the food industry must be accorded an appropriate share of representation on the advisory committee. By doing so, you will ensure that the advice and recommendations you receive reflect information about a large and important segment of industry subject to regulation by FDA," Anderson concluded in his comments to Sullvan.

AFFI is the national non-profit organization that has represented the interests of the frozen food industry for nearly 50 years.

For more information contact Traci D. Vasilik (703)821-0770.

Canada Host of 23rd International Dairy Congress

More than 5,000 participants from over 50 countries will meet in Montreal October 7 to 12, 1990 for the 23rd International Dairy Congress and Exposition 1990. Delegates will hear over 200 speakers address subjects covering all aspects of the dairy industry from biotechnology to food safety, quality assurance and marketing.

During scientific poster sessions, delegates will discuss the latest research papers and developments.

"This prestigious gathering will provide the opportunity for colleagues from around the world to meet, discuss and share knowledge and experience in all aspects of 'Dairying in a Changing World,' our theme for this first congress to be held in North America," said Mr. Kempton Matte, Chairman of the Organizing Committee.

A special international display of products at the Congress will allow delegates to see and discuss new products, packaging and ideas.

Technical tours of the Canadian dairy industry will be available as well as many social activities.

The Congress will be held in conjunction with Exposition 1990 where 150 suppliers will exhibit products and services used by producers, processors, packagers, distributors and retailers involved in the dairy industry.

To receive a registration and program brochure and to present a poster session, please contact:

Mr. Richard Stern
Executive Director
23rd International Dairy Congress
P.O. Box 2143, Station D
Ottawa, Ontario
K1P 5W3

Tel: (613)238-4116
FAX: (613)238-6247
Telex: 053-3952

The International Dairy Congress is sponsored by the International Dairy Federation, an international association of 33 member countries dedicated to the exchange of experience and information in the international dairy field.

Northland Food Laboratory, Inc. of Green Bay has Received USDA/FSIS Recognition

Northland Food Laboratory, Inc. of Green Bay, Wisconsin has been recognized by the USDA/FSIS (Food Safety Inspection Service) for analysis of *Listeria monocytogenes* and *Salmonella* in meat and poultry samples.

This laboratory is on a select and limited number of laboratories with this type of recognition. Northland Food Laboratory, Inc. is able to perform these and many other analyses on any and all types of foods and dairy products.

Contact Mark Kinderman or Steve Kohl for the USDA/FSIS laboratory number and recognition documents at (414)336-7465 or FAX at (414)336-0647.

Your USDA inspector must have the laboratory number and letter of acceptance prior to inspection.

Updates

Northern California Institute of Food Technologists Announces Expo Theme

The Northern California Institute of Food Technologists (N.C.I.T.) announces the theme for its 1990 Suppliers Expo to be "New Challenges in Food Technology." The event will be held at the Oakland Convention Center on May 22, 1990 and will run form 3:00 P.M. to 6:30 P.M. This will be followed by an Industry Reception with door prize drawings. Admittance is free to Food Industry Professionals.

For information on exhibiting or attending, please contact Pat Stull, Expo Publicity Chairman, c/o Pacific Coast Companies, 2424 Fourth Street, Berkeley, CA 94710 (415)549-3535, FAX (415)549-0890.

The Annual Meeting of the Tennessee Association of Milk Water and Food Protection will be held May 31, 1990 at the Ramada Inn, Spence Lane, Nashville, TN. For more information, contact Dennis Lampley (615)360-0157.

3-A Symbol Council Address Change

Effective April 1, 1990, the 3-A Symbol Council will be located in Cedar Rapids, IA. The new address is:

3-A Symbol Council
Executive Plaza Building
Suite 404
4404 1st Avenue, SE
Cedar Rapids, IA 52402
Walter Laun, Administrative Officer

Automation in the Food Industry

The Food Processing Automation Conference, scheduled for May 6-8, 1990 in Lexington, Kentucky, will feature new techniques in four thrusts of automation technology. Extensive developments will be reported about sensors, machine vision, computer controls and automated inspection.

This major technology conference is presented by the Food and Process Engineering Institute of ASAE, with the University of Kentucky, Department of Agricultural Engineering as local host.

Chairman Fred A. Payne, food engineer, University of Kentucky, reports that the committee has been able to attract speakers from all aspects of the food industry. Researchers, industrial users, systems designers and equipment suppliers will discuss the rapidly changing technologies of automation.

A complete proceedings will be published for the Food Processing Automation Conference. For complete details and registration information contact the Food and Process Engineering Institute at ASAE (616)429-0300, FAX (616)429-3852.

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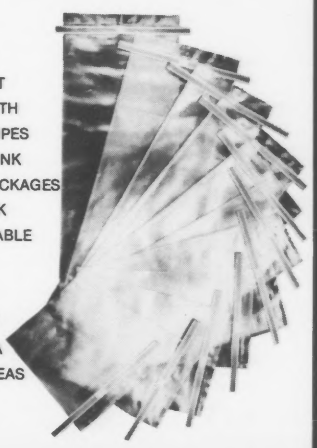

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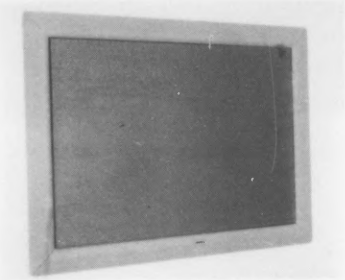

Liberty Introduces the New Super Kleen Tacky Mat

Liberty Industries created the original contamination control dry mat, Tacky Mat, over 30 years ago. A unique adhesive coated material removes dirt from the soles of shoes, heels, casters and cart wheels as they pass over the mat.

The new Super Kleen Tacky Mat is another step toward complete clean room contamination control. The Super Kleen Tacky Mat is designed to pick up more foot-borne contaminants and last longer than conventional hard-surface mats. Made with a special poly foam cushion it has unique contouring and resilient qualities. Each sheet is made of 1/16 foam that is treated with a special non-allergenic, bio-static, non-aging adhesive. The mat provides total conformity to a shoe under normal pressure.

The Super Kleen Tacky Mat consists of 10 disposable sheets, packed 12 mats to a case, which are simply removed after soiled to expose a fresh clean sheet.

The Super Kleen Tacky Mat Model 6000M meets all NASA, government, Federal, American Association of Control Standards and GMP's.

Liberty Industries - East Berlin, CT

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Bacteria-Free Sanitary Sight Gauges Permit Safe, Clear View of Product During Processing

Sani-Tech PS sight gauges, formed from Amoco Performance Product's durable Udel polysulfone, permit a safe, clear view of product during a variety of sanitary processing operations.

Sani-Tech PS sight gauges are available with 316 sanitary Tri-Clamp, I-line and 150 ANSI flange fittings in lengths up to 10 feet, ranging from 1/2" to 4" I.D.

Sani-Tech - Andover, NJ

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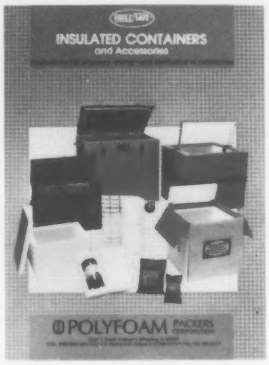

New Freez/Safe® catalog offers expanded line of stock, foam insulated containers and accessories

The all new catalog of Freez/Safe Insulated Containers -- *free* from Polyfoam Packers Corporation -- features approximately 120 stock items, ready for immediate delivery. It describes the industry's largest selection of reusable foam plastic insulated shippers, mailers, transporters and accessories.

Expanded or reorganized, the new catalog illustrates the wide range of available sizes, shapes and styles in seamless, molded containers. These containers are used most often for safe shipping of samples, transporting and demonstrating refrigerated or frozen product, and conducting quality control and quality assurance programs involving temperature-sensitive items. Among the new models included are lightweight transporters with tough, washable nylon shells for sales presentations and vending.

Also shown for the first time are protective bottle shippers in capacities from 1 gallon to 4 ounces for transporting liquid samples; and Insul-Ice™, the new food-safe refrigerant cubes/wrap that is more convenient and efficient than ice, and is reusable.

Polyfoam Packers Corp. - Wheeling, IL

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A wide range of Sani-Tech PS sight gauges permit a safe, clear view of product during sanitary processing operations.

New Literature Release DCI, Inc. Dual Agitated Mix Tanks

DCI, Inc. fabricatores of stainless steel vessels for the dairy, food, beverage and pharmaceutical industries, announces the release of a new bulletin: Dual Agitated Mix Tanks.

The bulletin discusses the standard specifications for the dual agitated tanks available in 200 to 3000 gallon sizes. It also illustrates dome tops, outlines design benefits and discusses available options.

DCI, Inc. - St. Cloud, MN

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Eliminate Odors Forever with Odor-Sof®

A new, non-toxic deodorant guaranteed to eliminate odors permanently by neutralizing the problem causing molecules is now available. Odor-Sol destroys, not simply masks, odors by chemically bonding with the odor-causing compounds. Safe, sanitary and biodegradable Odor-Sol works immediately upon contact and leaves no "replacement odor." Proven effective Odor-Sol comes with a money back guarantee. Odor-Sol is non-staining and can be applied directly to surfaces, or used as an air freshener. The strength of the concentrate can be altered, depending upon the severity of the odor. Odor-Sol concentrate has unlimited shelf life and is available in 32 and 128 oz. sizes, as well as in a ready-to-use quart sprayer.

Multi-purpose Odor-Sol is for commercial, industrial and home use, and for virtually any odor causing application.

Circle K Industries - Mundelein, IL

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Sani-Care: A Responsive Sanitation Program for Food Handling and Processing Areas

There's simply no room for compromise in sanitation programs for food handling and processing facilities. Whether it's the meat department of a supermarket or a major industrial food processing operation, any business can fortify it's sanitation program with an ICL Sani-Care Clean Team.

Designed for simplicity, accountability and performance, ICL matches technology, products and people to provide a complete sanitation program.

ICL has been serving the needs of business and industry for 65 years throughout the United States. A leader in sanitation and maintenance products since 1924.

ICL - Omaha, NE

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Zero Bacteria Walls/Ceilings

Structoglas fiberglass reinforced (FRP) wall and ceiling panels comply with USDA and MID specifications for incidental food contact surfaces. The resin-rich, textured surface will not support mold, mildew or other bacterial growth; cannot be permeated by cooking fumes or grease; cleans easily with common household detergents; and installs as easily as ordinary wall board.

Structoglas panels are manufactured by Sequentia Incorporated, world's largest producer of fiberglass reinforced panels and proprietary composite products for agricultural, industrial, chemical, commercial and residential building and transportation applications.

Sequentia, Inc. - Strongsville, OH

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New Flying Insect Control System

Pro-Tech Livestock Corporation announces the availability of its Model 55 "PRO-TECH-TOR" flying insect control system, for use in equine, dairy, beef, swine, poultry and kennel operations. The system includes the powerful Pro-Tech insecticide along with an advanced technology mechanical system which automatically delivers the insecticide in a fine, fog-like mist.

The mechanical part of Model 55 is a spray delivery system that is manufactured to the highest commercial standards, including all brass pumps and pressure components, heavy-duty nylon tubing and spray nozzles, poly insecticide reservoir and an electronic timer control head. The low odor insecticide, which is formulated by Pro-Tech, is deadly to flying insects, but has been approved for use around warm-blooded animals and is accepted by the Environmental Protection Agency.

Pro-Tech Livestock Corp. - Tomball, TX

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Exhaust Biological Safety Cabinet

The Baker Company, Inc. announces their 100% exhaust biological safety cabinet, SterilchemGARD, that exceeds the minimum standards for Class II, Type B2 cabinets, as defined by National Sanitation Foundation Standard #49.

Designed to protect product, personnel and environment, SterilchemGARD aids in the control of airborne particulate contaminants, including micro-organisms and chemicals determined to be potentially harmful. Both the downflow and intake air in the SterilchemGARD are totally exhausted from the cabinet. Because this 100% exhaust feature permits no recirculation, the cabinet may be useful for some work which generates small amounts of chemical vapors and gases, thus broadening its range of applications.

Each Baker cabinet is subjected to extensive physical testing include HEPA filter integrity, evaluations of the airflow patterns, precision of the intake and exhaust air velocities. A permanent record of each cabinet's test results are kept on file at the company's headquarters and a copy is shipped with the cabinet.

The Baker Company - Sanford, ME

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ProTek Environmental Introduces Vapor Extractor Service for Cleanup and Resource Recovery

ProTek Environmental, Inc. announced its advanced vapor extraction and soil treatment service for the in situ remediation of petroleum hydrocarbon-contaminated soil. Using its Vapor Extraction System (VES), ProTek not only thoroughly cleans the soil, but also extracts and actually recovers the hydrocarbon product for recycle. This on-site, in situ solution can save customers up to 80% of the cost of alternate cleanup methods and results in a liability-free site.

ProTek's VES program is particularly effective for the remediation of those sites where the contamination has migrated under buildings, structures or roads and cannot be excavated or remediated by conventional methods.

ProTek Environmental - Huntington Beach, CA

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New Product: High Efficiency, Sanitary Cyclone

Fluidizer, Inc. is introducing the CENTRI-CLONE, TYPE-S, High Efficiency, Easy Clean, Sanitary Cyclone. The CENTRI-CLONE is designed specifically for applications in the food and pharmaceutical industries.

The CENTRI-CLONE is designed with a smooth spiraling flow path around the shell. The vapor outlet extends deep into the cyclone. This isolates the outlet from the inlet gases and prevents "short circuiting" of uncleaned gases. Efficiency is further improved by the smooth, 4B finish on the interior walls; that prevents particles from bouncing off the walls and re-entering the systems.

The CENTRI-CLONE has been designed with ease of cleaning and disassembly in mind. The unit is assembled with standard sanitary clamps and gaskets to hook into your system. CENTRI-CLONE is available in eight different models and sizes.

Fluidizer, Inc. - Hopkins, MN

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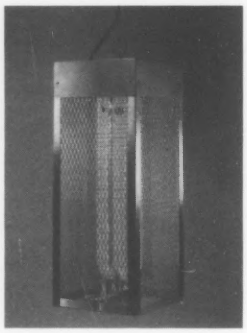


Indoor-Outdoor Vertical Insect Electrocutor

Vandermolen Corporation has added a vertical hanging fly and bug killer to its line of insect electrocutors for commercial and farm use.

The new Model V484 is made of stainless steel and other noncorrosive materials. It is suitable for both indoor and outdoor use. Outdoor coverage area is up to 1 1/2 acres.

When used indoors, or on loading docks, an optional insect catch tray (not shown) is available to hold electrocuted flies and bugs. The unit is 31" tall and uses 80 watts of UV light to attract the insects to the electrically charged killing grids.

Vandermolen Corp. - Livingston, NJ

Please circle No. 252 on your Reader Service Card

Integrated BioSolutions, Inc. Introduces Desk-Top Incubator

The Cultura Incubator, for use in industrial quality assurance microbiology laboratories, is manufactured to demanding quality standards in Switzerland for IBS and is made from high impact, acid proof, plastic for sturdiness as well as ease of cleaning. It is engineered to provide even temperature distribution throughout the chamber, coupled with compactness and portability. All that is required for operation is an electrical outlet.

The Cultura, which comes with a two year warranty, has been designed specifically for IBS's Q.A. MicroKit. Using the well proven technique of gellified plate agar, in a format needed by today's fast moving laboratories, Q.A. MicroKit is a plastic slide coated on both sides with carefully modified media. Convenient, easy-to-use, and in expensive, Q.A. MicroKit is the "microbiology lab in a tube."

IBS is also the exclusive North American marketer of Lumac ATP instruments and reagents, as well as the MicroSys MIMS Software for industrial microbiology laboratories.

Integrated BioSolutions, Inc. - Princeton, NJ

Please circle No. 253 on your Reader Service Card

Water Treatment for Cooker Operations

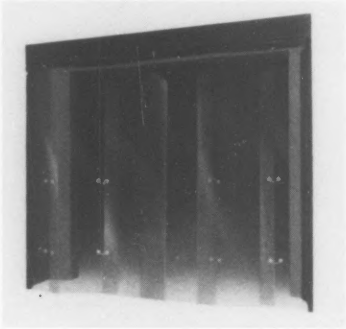
ChemTreat, Inc. has invested a tremendous amount of time and money to develop a solution to the common problems associated with all types of cooker operations. The result is a product line containing a large number of USDA approved products. They comprise a group within ChemTreat's product line known as *Hydro-Treat*.

Free Plant Review - Highly qualified ChemTreat representatives will conduct a free survey of your facility. Included in the survey are:

Plant diagrams; Laboratory analysis of all critical water systems; Equipment inspections; Review of system operations; Metals balance studies; Biological studies; and Equipment efficiency studies.

ChemTreat, Inc. - Ashland, VA

Please circle No. 254 on your Reader Service Card



Enviro to Introduce High Speed Bi-Folding Door Food & Dairy Expo '89

The HYDRAFOLD door is designed to combine the features of strip curtains with the time saving, energy saving advantages of high-speed operation.

The power feature of the HYDRAFOLD door enables door speeds of up to nine feet per second to clear a ten foot wide doorway in just a second. Vehicles can pass through the doorway without contacting door panels. Panels remain transparent and traffic can move efficiently. For that same ten foot wide doorway, the doors can also close in just one second. Energy loss, and the escape of dust, chemical fumes and other pollutants are minimized.

ENVIRO offers the HYDRAFOLD doors in six panel models. Standard door sizes are up to 12' x 14' - larger sizes are available. The door is designed to conform to USDA regulations.

ENVIRO - Milwaukee, WI

Please circle No. 255 on your Reader Service Card

RE-FREEZ-R-BRIX Refrigerant Packs

RE-FREEZ-R-BRIX is a block of rigid open cell foam refrigerant impregnated with a specially formulated non-toxic aqueous solution and hermetically sealed in a heavy duty plastic pouch.

•**Prevents Thawing** - Keeps frozen products, that are packaged to minimize air space properly, chilled for an extended time period without the use of an expensive refrigerated environment.

•**Safeguards Against Freezing** - When packed in properly insulated containers, warmed **RE-FREEZ-R-BRIX** releases heat keeping perishables from freezing.

•**Protects Against Warming** - Keeps perishables requiring a temperature range between 32°F to 60°F at a safe, uniform cooling temperature for up to 6 days.

Ideal for: Produce; Dairy Products; Pharmaceuticals; Blood Products; Meat & Poultry; Prepared Foods; Lab Samples; Sea Food Products; Bio Products.

Polar Tech Industries, Inc. - Elgin, IL

Please circle No. 256 on your Reader Service Card

Tri-Plas Designs and Manufactures Injection Molded Products Using Fortilene(R) Polypropylene

Tri-Plas, Inc., with manufacturing plants in three states, produces containers, lids and promotional drinkware made from FORTILENE 1803 polypropylene resin supplied by Soltex Polymer Corporation. These injection molded products are universally accepted for their long shelf life, content protection and aesthetic merchandising values.

FORTILENE 1803 is a controlled rheology homopolymer that utilizes unique catalyst technology. It is designed for injection molding applications that require improved impact and meets FDA 21CFR 117.1520 requirements.

In addition to FORTILENE polypropylene, Soltex Polymer Corporation's products include FORTIFLEX(R) polyethylene and SOLEF(R) PVDF.

Soltex Polymer Corp. - Houston, TX

Please circle No. 257 on your Reader Service Card

B-Safe™ Products for Radiation Safety

The new Schleicher & Schuell B-Safe radiation protection products afford maximum protection for lab personnel. This new group of products includes easy-access benchtop waste containers, shields and vial storage containers. Also available is a novel personal shield system which combines a labtop personal shield with a shielded tube rack and integral ice bath. This provides radiation protection during labtop sample cooling, handling and storage.

One of the unique aspects of B-Safe products is that the storage containers incorporate B-Safe activated carbon paper, which absorbs harmful volatile breakdown products of ^{35}S compounds.

Schleicher & Schuell, Inc. - Keene, NH

Please circle No. 258
on your Reader Service Card

New Head Space Oxygen Analyzer

Illinois Instruments, Inc. is pleased to announce the introduction of the new Model ZR891/HS Head Space Oxygen Analyzer.

The Model ZR891/HS is ruggedly constructed, simple to calibrate, and requires no special operator skills. The instrument may be used to monitor head-space oxygen levels from 10 ppm up to 100%. The various sampling systems make the instrument ideally suited for both flexible and rigid packaging.

No periodic maintenance is required, and an optional recorder output is available.

Illinois Instruments, Inc. - McHenry, IL

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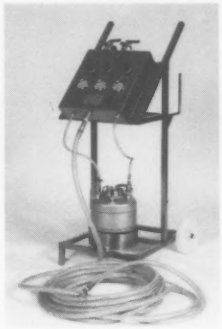
on your Reader Service Card



Eliminate Chemical Waste with the "ELMO" Foamer

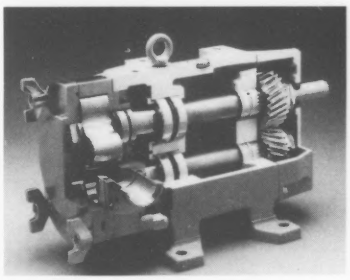
Astro Products, Inc. announces the immediate availability of a foamer that works with as little as 30 lbs. water pressure.

Designed for more positive use of cleaning chemicals, the "ELMO" Foamer mixes air and water with chemicals automatically. A broad range of chemical to water ratios can be selected by simply adjusting pressure regulators.

The "ELMO" Foamer is presently in use in food processing plants in the Midwest and Southeast.

Astro Products, Inc. - Fitzgerald, GA

Please circle No. 260
on your Reader Service Card



Pumps and Metering Controls Featured by Gelber Industries at Food & Dairy Expo '89

A variety of sanitary pumps, and controls were exhibited by Gelber Industries during the Food & Dairy Expo '89, November 11-15 in Chicago's McCormick Place.

Highlighting sanitary pumps that comply with FDA requirements, Gelber's display included positive rotary, centrifugal, metering, and drum pump designs.

Gelber presented a sanitary magnetic-drive gear pump that features a sealless design that eliminates the possibility of product leakage and contamination. The pump is designed for automatic fluid sampling and low-flow metering applications.

Gelber Industries - Lincolnwood, IL

Please circle No. 261
on your Reader Service Card

Positrac^R Conveyor Belt Tracking Pulleys and Self-Aligning Hub-Locs

Positrac^R conveyor pulleys were specifically designed to lower the cost of operating powered belt conveyors. The dual helix pulleys self-center the conveyor belt, out-drive rubber lagged pulleys, plus continuously clean the inner face of the belt.

These pulleys, available from Dynaloc Corporation, are manufactured in food approved finishes: Electro-Zinc plating, Hard-Coat stainless steel coating or all stainless steel construction.

The price of Positrac^R pulleys includes either compression type hubs and bushings, or straight bore hubs with key ways and set screws at each end. Special bores, bearings and Dynaloc's own Hub-Locs^R are also available.

Dynaloc Corporation - San Mateo, CA

Please circle No. 262
on your Reader Service Card

Tenney Introduces New Portable Temperature-Vibration Test Chamber

Tenney Engineering, Inc., of Union, New Jersey, the largest and most experienced manufacturer of high technology environmental test equipment, is pleased to introduce a portable cart-mounted temperature vibration test system designated Model BMAG, BENCHMASTER AGREE System.

The unit is offered as a full turnkey system which includes a complete vibration system or as a stand-alone chamber with a customized interface including an adjustable height support system for existing vibration machines. The thermal system is an enhanced version of the popular Tenney Benchmaster Series environmental test chambers offering 5 cubic feet of workspace. Temperature ranges from -73°C to +200°C and temperature rates of change to 20°C/minute are available.

Vibration capabilities, 350 force pounds sine and 135 force pounds random are offered with a 9" x 10" mounting surface.

The units can be configured for MIL-STD-781 AGREE specification requirements or environmental stress screening programs.

Tenney Engineering, Inc. - Union, NJ

Please circle No. 263
on your Reader Service Card

New Electronic Liquid Level Sensor

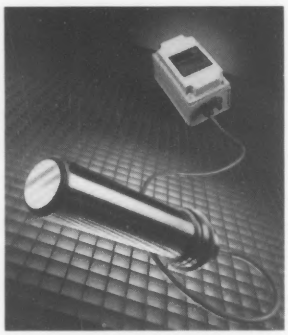
The new King-Gage(R) electronic liquid level sensor/transmitter is designed to meet sanitary requirements, including clean-in-place, for storage and processing tanks.

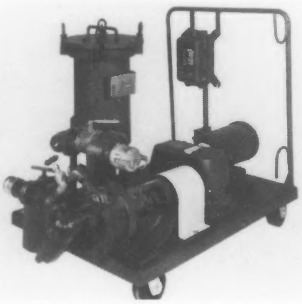
The sensor transmits a direct 4-20mA signal proportional to liquid level. Sensor output is suited for process control or remote level indication -- ideal for food, dairy, pharmaceutical, cosmetic and many other applications. Temperature compensation assures a high degree of repeatability and long-term stability.

The sensors are offered in a variety of tank mountings that include sanitary clamp-type fittings and flush-weld tank shells. King Engineering Corp. offers a choice of electronic or pneumatic sensors, designed with 50 years of experience in engineering and manufacturing gauging components and complete systems.

King Engineering Corp. - Ann Arbor, MI

Please circle No. 264
on your Reader Service Card





Uniquax Pump-Filter Systems Announced

The Quackenbush Company has announced the UNIQUAX line of portable pump-filter units. The self-contained units solve many batch filtration and fluid movement needs. The system features the flexibility of operating as either a pump-filter or a pump only. UNIQUAX saves money by replacing multiple permanent systems with one portable pump-filter.

UNIQUAX systems are available in six capacities ranging from laboratory size batches to production batches of 10,000 gallons. Both bag and cartridge-type filter canisters are offered, and the units can be ordered with optional dual filters and series/parallel filtering capabilities.

Only heavy-duty components are used in the manufacturing. Pumps are strainer protected, casters are of the ball bearing type, explosion-proof motors are standard, gauges are diaphragm protected, and the cart is high-strength formed steel.

Quackenbush Company - Lake Zurich, IL

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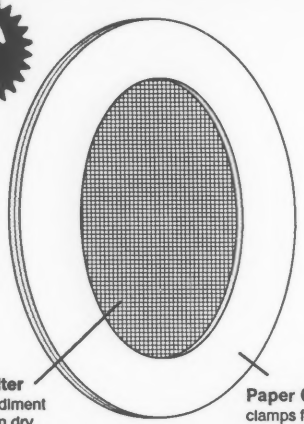
SaniChek™

PIPELINE FILTER DISK

NEW



- Preferred construction of paper & cloth.
- Monitors sediment in *all* incoming milk.
  - farm bulk tank pick up
  - receiving bay at plant
- Augments laboratory sediment testing.
- Protects pumps & downstream equipment.

Call for a free sample. 800-826-8302

NELSON JAMESON INC

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Phone 715/387-1151 ▪ FAX 715/387-8746

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Food and Environmental Hazards To Health

Radon Exposure Assessment - Connecticut

In 1985, indoor air radon (radon-222) levels were found to be elevated in households in Pennsylvania. Following this discovery, the Connecticut Department of Health Services (CDHS) received inquiries from citizens who requested that their household air be tested for the presence of radon. Because information regarding radon exposures in Connecticut did not exist, CDHS initiated a series of surveys/projects to characterize this potential problem.

In the first survey (Connecticut Radon Survey), carried out from 1985 through 1987, indoor radon sampling was done in 202 homes in 44 towns in areas with suspected high potential for radon. Indoor air radon levels in the homes were sampled using alpha-track devices (one per home) placed in the lowest lived-in area of each home for 3 months. Because radon levels are typically highest during the winter, all homes were sampled for radon in December, January, and February. Radon levels ranged from 0.1 picocuries per liter (pCi/L) to 24.6 pCi/L (geometric mean: 1.3 pCi/L). Eleven percent exceeded the Environmental Protection Agency (EPA) maximum exposure guideline of 4 pCi/L.

In the second survey (EPA-Connecticut Survey), EPA provided support for a survey of basement radon levels in Connecticut homes. From December 1986 through early March 1987, charcoal-testing devices were distributed to 1157 houses for placement in the basement or lowest livable area of each house for 2 days. In 168 towns, homes were selected in the order in which homeowners had requested an energy audit from an energy conservation organization. Housing characteristics, air infiltration rate, smoking habits of occupants, and house location were recorded when the devices were placed.

Of the basements tested, 19% exceeded the EPA guideline of 4 pCi/L. The percentage of homes with levels >4 pCi/L varied between regions (boundaries defined by the estimated geologic potential for radon presence). The age of the house was the strongest predictor of indoor radon levels, with mean radon concentration levels increasing with the average age of the homes. Based on the results of the EPA-Connecticut survey, CDHS issued an advisory in August 1987 that all Connecticut homeowners should have their houses tested for radon.

In December 1987, CDHS initiated the Household Testing Program (HTP). HTP provided free radon-testing devices and placement instructions to residents living in areas suspected of having high radon levels, measured radon concentrations in selected Connecticut municipalities, and examined the association between basement and living area radon concentrations.

Based on results of the previous two radon surveys and information on terrestrial radiation and bedrock geology, 53 municipalities were initially identified for the HTP. Of these, 38 were selected to participate in the HTP based on the ability of local health departments or other agencies to distribute testing devices. Each municipality was provided with 200 charcoal-testing devices for use in 100 volunteer households. For each home, one charcoal-testing device was placed in the basement or other lowest livable area, and the second device placed in the lowest lived-in area. The measurements detected a consistent 3:2 ratio between basement and living area radon concentrations. In addition, basement radon levels were strongly predictive of levels in lived-in areas (R^2=0.48, $p<0.00001$).

Each of the three surveys detected higher radon levels in areas with granitic bedrock and lower radon levels in areas with sedimentary rock. Of all housing characteristics, only two (cinder-block foundation and house age) had statistically significant positive associations with radon levels. Energy-efficient homes did not have higher radon levels.

Alpha-track devices for follow-up long-term testing have been distributed to 340 households with lowest lived-in area radon concentrations >4 pCi/L and/or basement radon concentrations >20 pCi/L.

Editorial Note: CDHS has collected data on indoor air radon levels in 5036 households. The data from the three Connecticut studies closely agree about both average radon levels detected and the percentage exceeding 4 pCi/L. Based on the risk model from the Biological Effects of Ionizing Radiations IV report, results from the EPA-Connecticut Survey indicate that, in Connecticut, radon exposure may account for 280 excess cases of lung cancer per year.

The CDHS studies helped to quantify the magnitude of radon exposure in Connecticut, assisted in establishment of a radon program, and guided subsequent research and public education on radon health risks, screening, and mitigation techniques.

Until 1984, radon was considered a health hazard primarily for uranium and underground mining workers and for persons living in homes built on uranium mill tailing deposits or land reclaimed from phosphate mining. Based on EPA surveys of 1986-1989, however, exposure to radon and its short-lived decay products are estimated to exceed the EPA guideline (4 pCi/L) in >8 million homes located in 25 states and Native American lands (EPA, unpublished data, 1989).

In the United States, 5,000-20,000 deaths from radon exposure may be occurring yearly. For persons who are exposed at the EPA guidance level of 4 pCi/L over a lifetime, overall risk for lung cancer is approximately 1%-3%. Risk for lung cancer from radon exposure is greatest among smokers, although risks for nonsmokers are also substantial (approximately 15 per 1000 exposed). Smoking appears to interact synergistically with radon in causing lung cancer. Consequently, cessation of smoking represents a crucial prevention measure for reducing lung cancer risk, particularly among radon-exposed populations.

MMWR 10/27/89

PS Forum For Professional Sanitarians

Sanitarians are widely recognized as experts when it comes to questions about food and health. When the public wants to know about the health aspects of *Salmonella, Clostridium, Listeria* and other food safety issues they turn the Yellow Pages to County Health Department and are referred to a Sanitarian.

But what happens when the caller is asking about the health aspects of salt and sugar, or zinc, iodine, and other trace minerals in food? Where does the public turn when asking about high-density lipoprotein (HDL) or low-density lipoprotein (LDL)? If your department is fortunate, a nutritionist will be available to deal with these questions.

Cholesterol is a major topic of current public interest related to food and health. There is growing concern that some "health" advice now being provided on this subject may not be based on adequate scientific information and may be confusing the public. During a meeting at the National Academy of Sciences last September, former Surgeon General C. Everett Koop stated he found "insufficient justification for some advocacy efforts" related to cholesterol (e.g. the National Cholesterol Education Program).

Food labeling related to nutrition is an emerging issue that will certainly result in numerous questions from the public and the food industry. The American Heart Association's recent fee based "Heartguide" endorsement of certain food products will also generate questions concerning food and health. As food and health experts, Sanitarians should be able to address some of these questions. We certainly don't need to be nutrition experts but we should be knowledgeable about the health aspects related to these food issues.

Sanitarians can expect to be asked increasing questions concerning the nutritional aspects of food. As more food service facilities add "health" foods to their menus and as new food labeling requirements are proposed and discussed Sanitarians will have an opportunity to keep the public informed.

OFF THE CLIPBOARD:

- EPA has established a hotline for information and guidance on federal regulations concerning PCBs and asbestos. The hotline can also provide assistance on other Toxic Substance Control Act (TSCA) issues. The hotline number (202)554-1404 is staffed from 8:30 a.m. to 5:00 p.m. EST.

- Contaminated knives used in food service operations haven't been indicated as a major source of foodborne illness, however, it is interesting to note where and how you will find some knives stored. How many times have you found a cook's "personal" knife stored in a home-made cardboard holder, hidden behind the griddle or in a hip pocket? Cross-contamination of foods is very likely, not to mention what could happen if a cook were to fall. On your next inspection check out the knives.

- Response to the reader FDA Interpretations survey last fall were overwhelming. Requests for copies of interpretations exceeded our capacity to keep up with the mail. To be able to respond to IAMFES members in a timely manner arrangements are being made that will enable the Ames office to provide FDA interpretations on a request basis.

- By the time this issue is published you should be able to obtain copies of the translated FDA Key Code Requirements from the IAMFES Ames office. Use the 1-800-369-MFES number to obtain details. Wouldn't it be great to have interpretations and other FDA information available on a computer data base? Now that we're in the computer age it may be possible.

- Have you tried the IAMFES audio visual lending library? The lending library is a valuable resource that can turn "just another training session" into a multi-media event that students will remember. All you have to do is call the Ames office and coordinate scheduling.

- 1989 could easily be called the year of disasters, just ask the residents of the Carolinas and California. Hurricanes and earthquakes can create critical public health problems. Planning is the key word in minimizing the problems before they occur. California isn't the only state that needs to plan. At least 39 states are subject to major or moderated seismic risk. Request a free subscription to "Natural Hazards Observer," Campus Box 482, University of Colorado, Boulder, CO 80309, to obtain more information about the potential hazards in your state.

- We appreciate the comments and remarks about the new format. It you have a program or concern that you would like to share with other Sanitarians in the field send us a note at PS, Box 1832, Frederick, MD 21701.

Homer C. Emery, RS
Chair, FDA Interpretations Committee

April Field Inspection Quiz

1. During a nursing home inspection a resident asks about the type of fat in foods that leads to high blood cholesterol levels. Which type of fat would likely raise blood cholesterol levels?
   A. Polyunsaturated fatty acids
   B. Monounsaturated fatty acids
   C. Fatty acids from olive oil
   D. Saturated fatty acids

2. Health departments in which of the following major urban population centers need to establish active planning to prepare for public health problems resulting from earthquakes?
   A. Los Angeles, CA
   B. St. Louis, MO
   C. Buffalo, NY
   D. Memphis, TN
   E. Charleston, SC
   F. All the above since they have been identified at risk by the Federal Emergency Management Agency (FEMA).

3. Of the following spore forming bacteria which one is capable of multiplying the fastest?
   A. Clostridium botulinum
   B. Clostridium perfringens
   C. Bacillus cereus

4. A Sanitarian-in-training has asked about the pH of foods noted during a recent inspection. Of the following foods which one would most likely have the lowest pH?
   A. ground beef
   B. butter
   C. milk
   D. commercial mayonnaise

5. You receive a request for information concerning federal laws about the "Superfund." You should refer the caller to:
   A. Resource Conservation and Recovery Act (RCRA)
   B. Comprehensive Environmental Responsibility, Compensation and Liability Act (CERCLA)
   C. Hazardous and Solid Waste Amendments (HSWA)
   D. Toxic Substances Control Act (TSCA)

Answers to March FIQ: 1. (A); 2. (A); 3. (A); 4. (A); 5. (A).

Letters to the Editor

The following letters were sent to IAMFES President, Ron Case, in response to his petition for comments regarding the proposed IAMFES name change.

Dear Ron:

I hear by the grapevine that a change of the name from International Association of Milk, Food and Environmental Sanitarians is underway. I have been asked to forward my comments to your attention.

In Edmonton, Canada a few years ago, I stood at the microphone ready to give my reactions to the name change and the subject was quickly tabled. I was going to say that an association that receives 80% of the membership voting in favor of a name change has no right to ignore it. When asked after the meeting what I intended to say, I was informed that the dairy lobby contains such power that the name change would not be possible. Additionally, I was informed that it would mess up the names of the affiliates. Subsequently, I examined the names of the various affiliates and noticed that they varied quite a bit all over the country. I was therefore unable to determine why the name change would be a problem, except where local dairy lobbies are in control of the affiliates.

A name such as Association for Food Protection would be more timely. It turns out to be quite an event whenever I attempt to try and describe to anybody what IAMFES stands for. After carefully defining International Association of Milk, Food and Environmental Sanitarians a broad smile invariably comes across the face of the listener. Then questions start coming; "Why is milk highlighted in the title? Isn't it a food?" Listeners have most fun with the last word; "Are sanitarians street sweepers or those that guard the water quality of the sewage system?" My best clarification technique has been to say the organization publishes the Journal of Food Protection. That seems to clear the air. It is really in the business of providing a safe food supply, irrespective of what the complex association name might envision.

I threatened to withdraw my membership after the last go around on this topic. However, I do enjoy my opportunity to review journal articles and associate with a great membership. I am therefore glad that I did not withdraw membership at that time. However, I do still feel strongly about the need for change of the association name. If it is seriously being considered again please add my name to the list of those who would like to see it reflect the 90's and not the tenacity of a stodgy minority lobby.

Sincerely,
Gary H. Richardson
Professor Emeritus/Department of Nutrition and Food Science,
Utah State University

Dear Mr. Case:

This is in regard to the frequently raised proposal that the name of the International Association of Milk, Food and Environmental Sanitarians (IAMFES) be changed.

I support a change in names almost to the extent that almost any other name would be preferable to the present one. In a more serious vein, the present name of the organization is very cumbersome, and in a very real sense it is quite misleading. Why must milk and food be separated. Is not milk a food? Is there value to such redundancy. I think not.

The inclusion of "environmental" is curious. Are we concerned with environmental effects on foods or on how foods affect the environment. The meaning of the term is not clear, and whatever is meant, I think the word is not necessary in the name of the organization.

If the organization is "international", then the word sanitarian is likewise curious. In most of the industrialized world, the words "sanitation" and "sanitarian" are not used, have no status. The words hygiene and hygienist are used. This would matter very little, were it not for the fact that the association claims to be international.

The objective of virtually all members of IAMFES is food protection. Why not the name International Association for Food Protection? I know this has been suggested and an "old guard" has effectively opposed any change. This is nothing short of silly. If the Society of Bacteriology could change its name and that of its journals to keep up with the times, the IAMFES should do the same.

Sincerely,
John H. Silliker
Silliker Laboratories, Inc.

Dear Ron:

I recently heard that IAMFES will again be considering a name change. My purpose for writing to you is to let you know that I strongly favor a name change.

There are several reasons that a name change is appropriate. First, the present name inaccurately reflects the many fields in which IAMFES members are employed. As you know, our membership includes regulatory personnel, industry scientists and executives, college professors (both research and teaching), government research scientists, and private consultants. In fact, there are very few of our members that would (or could) classify themselves as sanitarians.

Secondly, our present name does not fully reflect the strengths of the organization nor it's contribution to public health. Virtually all my professional colleagues are familiar with and routinely read the *Journal of Food Protection.* Many even consider it the primary journal for publishing their own research. Yet some do not even realize that IAMFES is the organization behind that respected journal. Our organizations' name should reflect our scientific base and mission.

Finally, both the present name and its' acronym are awkward and unflattering to use in conversation. I routinely have new potential members laugh and then make some teasing remark the first time they hear our name. It is not the organization that they find amusing but the name. In addition, I know of one individual (a member) who wished to attend the Annual meeting. However, her supervisor denied the travel request because IAMFES sounded too "lightweight" to be of value. Our present name is apparently not communicating the dignity and strength of our association, especially to non-members.

Our present name has a proud heritage and has served us well over the years. However, the time has come for us to adopt a name that better identifies both the membership and the issues of the next decade and century. I respectfully ask that you and the Executive Board give serious consideration to a name change.

Sincerely,
Robert E. Brackett
Associate Professor
President, Georgia Association of Food
and Environmental Sanitarians

Affiliate News

Georgia Association of Food and Environmental Sanitarians Meet

On Febraury 16, 1990, 46 people braved tornadoes, clogged highways and torrential downpours to gather at the Airport Holiday Inn in Atlanta for the 4th Annual Meeting of GAFES. They were treated to an educational program that was as broad as it was deep.

Dr. Jerry Stober from the Environmental Protection Agency presented findings of a study done on toxin levels in fish from Georgia streams. His findings were useful in pinpointing the sources of various toxins and suggested ways of minimizing their uptake in fish.

In a presentation as timely as today's newspaper, Dr. George Morris of Pathogen Control Associates traced the history of *Legionella* back as far as the 1950's. After describing the many outbreaks and methods of diagnosing the disease, he related the latest state of the knowledge. He then went on to outline how various sources of atomized water can be handled to reduce the threat of Legionnaires disease.

Biofilm and Surface Sanitation in the Food Industry was presented by Dr. Mel Czechowski of Diversey-Wyandotte. He outlined his research into the ways biofilms come into being on various surfaces and upon efforts to sanitize these surfaces.

Dr. Roy Blankenship spoke on research being done by the USDA-ARS to control *Salmonella* in poultry. Their efforts are centered on finding suitable, competitive bacteria that can be induced into the chicken's gastro-intestinal tract. Early results indicate that *Salmonella* doesn't compete all that well and that if other, more competitive bacteria are present before *Salmonella* is introduced, that the *Salmonella* can't get started.

Flavorich's on-going efforts and commitment to quality control were reported by Ruth Fuqua. She documented the results of this commitment and identified the steps Flavorich has taken to achieve the level of quality control it enjoys.

The last speaker of the day was Susan Gallatin who updated the group on the efforts to legislate the registration of sanitarians in Georgia. Since the legislation seems to be going nowhere at the present time, the group is considering voluntary registration.

At the Business meeting, the group heard from Steve Halstead, Executive Manager of IAMFES and elected the following officers for 1990-91:

President.....Joe Frank
Vice President.....Al Fain
Secretary.....Mark Harrison
Treasurer.....Jim Camp

Outgoing President Bob Brackett was presented with a plaque recognizing his service to GAFES.

Upcoming IAMFES Affiliate Meetings

MAY

•**7-9, 1990 Pennsylvania Association of Dairy Sanitarians & Dairy Laboratory Analysts Annual Meeting** at the Keller Conference Center, Penn State University, University Park, PA. For more information, contact Sid Barnard, 8 Borland Lab, University Park, PA 16802, 814-863-3915.

•**16, Ontario Food Protection Association** will hold a Spring Workshop entitled "Effective Employee Education in the Food Industry: Training a Trainer" at the Toronto Airport Hilton hotel. For more information contact programme co-ordinators, Bob Tiffin, 519-885-8284 or FAX 519-885-8210 or Ann Roberts, 519-822-5530 or FAX 519-822-5530.

•**23-25, South Dakota Environmental Health & South Dakota Rural Health**, Ramkota Inn, Pierre, SD. For information contact Dave Micklos, SD State Dept of Health, 523 E. Capital, Pierre, SD 57501, 605-773-3141.

JUNE

•**5-6, Texas Association of Milk, Food & Environmental Protection Annual Meeting**, held at the Howard Johnson-South Plaza, Austin, Texas. For more information contact Janie Park, Secretary, P.O. Box 2363, Cedar Park, TX 78613-2363, 512-458-7281.

•**14, Alabama Association of Milk, Food and Environmental Sanitarians 1st Annual Spring Meeting** will be held in Montgomery, AL at the Hotel Monticello on South Monticello Drive. For further information and agenda, write or call T.A. McCaskey, Dept. Animal & Dairy Sciences, Auburn University, Auburn, AL 36849-5415, 205-844-1518.

SEPTEMBER

•**18-20, New York State Association of Milk and Food Sanitarians Annual Meeting**, at the Sheraton Inn-Syracuse, Liverpool, NY. For more information contact Paul Dersam, 27 Sullivan Rd., Alden, NY 14004, 716-937-3432.

•**19-20, Wisconsin Association of Milk and Food Sanitarians Annual Meeting**, Pioneer Inn, Oshkosh, WI. For more information contact Neil Vassau (608)267-3504.

•**26-28, Kansas Association of Sanitarians Annual Meeting**, Red Coach Inn, Salina, KS. For more information contact John Davis, 1900 East 19th, Wichita, KS 67214, 316-268-8351.

Tim McCann, Oregon Affiliate.

Bud Pancoast, President of the Connecticut Association of Dairy & Food Sanitatians.

The Annual Oregon Dairy Industries Conference was Held at the Eugene Hilton on February 13 & 14

This conference was orchestrated by Floyd Bodyfelt. Floyd has been an active member of IAMFES for many years and was instrumental in forming the Oregon Affiliate of IAMFES.

Many members of IAMFES attended this meeting and were rewarded with speakers on timely subjects such as "New Packaging Technologies: Applications for Dairy Foods" and "America's Overflowing Trash Cans!" (Food Packaging and It's Impact on the Solid Waste Crisis), presented by Dr. Joseph Hotchkiss, Cornell University. The Film, "Big Fears, Little Risk," with Dr. Bruce Ames addressed the Dioxin issue.

Dee Buske, IAMFES Affiliate Liaison, spoke at the ODI Business Meeting. She also met individually with many IAMFES members from Oregon to generate interest and support in revitalizing the Oregon Affiliate.

Tim McCann, (IAMFES Member) was elected President of ODI, replacing Les Todd.

The Connecticut Association of Dairy & Food Sanitarians Inc. Held their Annual Meeting Wednesday, January 24, 1990 at Septembers Restaurant in New Haven

Mary Jane Mattina, PhD, Analytical Chemist with CT Agricultural Experiment Station spoke on "Analysis of Food Chemicals." The "BST" controversy was presented by William Graves, PhD, Milk Specialist, University of Massachusetts. "Risk Assessment - Telling It Like It Is" and Dealing with the Media was the topic of Bela T. Matyas, MD, Chief, Office of Environmental Health and Risk Assessment, RI State Department of Health, Providence, RI.

This meeting was presided over by Bud Pancoast, President and Rod Banks, Vice-President.

The Central office of IAMFES was represented by Dee Buske, Affiliate Liaison. She met individually with several members and potential members. Thanks to Don Shields and Susan Davis for their extra considerations.

United Airlines Named Official Airline for 1990 IAMFES Annual Meeting

United Airlines is pleased to offer the attendees of the International Association of Milk, Food and Environmental Sanitarians' 77th Annual Meeting a 40 percent discount off unrestricted coach fares or 5 percent discount off lowest applicable fares, including first class. This special offer, available only to attendees of this meeting, applies to travel on domestic segments of all United Airlines and United Express flights. These fares are available through United's Meeting Plus Desk with all fare rules applying.

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77th IAMFES Annual Meeting Registrat

Woodfield Hilton and Towers - Arlington Heights, Illinois - Augu
(Use photocopies for extra registrations)

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Spouse/Companion (Name): _____
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*Student Membership (verification req
❑ *Journal of Food Protection* or
❑ *Dairy, Food and Environmental Sa*

Other Fees: (Per Person)

Cheese & Wine Reception (Sun., 8/5)
"Taste of Chicago" (Mon., 8/6)

Art Institute, Lunch, Sears Tower (Mo
Long Grove Shopping, Lunch (Mon.,
Water Tower Place, Lunch, Shopping
Haeger Pottery Tour, Lunch, Shopping
Morton Arboretum, Lunch, Shopping
Kraft Cooking Demo (Hotel) (Wed., 8
IAMFES Awards Banquet (Wed., 8/8)

Charge Card Payments: Please Circle: VISA/MASTERCARD/AMERICAN EX

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Registration Information

Send payment with registration to IAMFES, 502 E. Lincoln Way, Ames, IA 50010-6666. Make checks payable to IAMFES. Pre-registration must be post-marked by July 30, 1990. The pre-registration deadline will be strictly observed. For additional information contact Julie Heim at 1-800-369-6337.

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The IAMFES policy on meeting
"Registration fees, minus a $15.00
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less than two (2) weeks prior to the
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stration Form

- August 5-8, 1990

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Home Work)

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

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neeting cancellation/refunds is as follows: $15.00 processing fee, will be refunded for marked at least two (2) weeks prior to the funds will be made for cancellations made or to the start of the meeting, however, the red with written notification to a colleague.

Exhibitor Information

An exhibition of products and consultant services will be at the Woodfield Hilton and Towers. For more information on exhibiting at the conference, please contact Scott Wells at 1-800-369-6337.

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77th Annual Meeting
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Woodfield Hilton and Towers
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Synopsis of Papers

Abstracts of papers to be presented at the 77th Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians, Inc. to be held in Arlington Heights, IL., August 5-8, 1990.

Temperature Shift Effects on Injury and Death in *Listeria monocytogenes*, *James L. Smith*, Eastern Regional Research Center, USDA, ARS, 600 E. Mermaid Lane, Philadelphia, PA 19118.

The extent of death and injury in *Listeria monocytogenes* (Scott A strain) is dependent on growth temperature, i.e., the cells become increasingly less heat resistant as the growth temperature decreases. When *L. monocytogenes* is grown at 37°C, heating cells at 52°C for one h is only slightly lethal whereas cells grown at 28, 19, or 10°C are more heat sensitive. Shifting cells grown at lower temperatures to 37°C for 2.5 to 5 h led to cells that had increased heat resistance, i.e., the cells grown at lower temperatures behaved more like 37°C grown cells. Addition of 50 to 100 µg/ml chloramphenicol prevented the shift-up effect whereas 50 to 100 µg/ml ampicillin had little effect. The antibiotics results suggested that protein synthesis may be necessary for the shift-up increase in heat resistance. However, cells grown for 12 h at 37°C and then shifted to 19°C for 12 h did not show decreased heat resistance. The results indicate that *L. monocytogenes* present in foods at low temperatures (and growing) will become more heat resistant if the food is temperature abused.

The Hazard Communication Standard - Implications for the Food Service Industry, *Homer C. Emery*, Ph.D., U.S. Army, P.O. Box 1832, Frederick, MD 21701.

The Hazard Communication Standard implemented by the Occupational Safety and Health Administration (OSHA) in 1983 was initially focused on large scale industrial producers and users of hazardous chemicals. On 17 March 1989 OSHA expanded this standard to included the foodservice industry. The Hazard Communication Standard requires workers to be provided with hazard communication (HAZCOM) training on the use of chemical substances used in the workplace. Sanitarians in the foodservice industry and state and local health departments may be called upon to assist foodservice managers in developing HAZCOM programs. Requirements for HAZCOM training in the foodservice industry and resources that sanitarians can use in program implementation are identified.

Current Studies on *Listeria monocytogenes*, *Irene V. Wesley*, USDA-ARS, National Animal Disease Center, Ames, IA 50010.

Our presentation will summarize our research on the (a) role of *L. monocytogenes* in the dairy cows and (b) characterization of *L. monocytogenes* by restriction enzyme analysis.

Epidemics of *L. monocytogenes* have been linked to the consumption of contaminated dairy products. We wished to examine the effect of dexamethasone a synthetic glucocorticoid, which mimics the immunosuppression associated with stress, on milk titers of *L. monocytogenes* and chronic infections established. Following dexamethasone treatment, the number of pathogens shed in the milk increased nearly 100-fold. This suggests that stress of adverse weather, lactation and pregnancy may increase titers of *L. monocytogenes* in the milk and thus pose a significant public health problem.

Because each of the 4 major food-borne listeriosis epidemics in North America involved the 4b serovar, we evaluated alternative methods of differentiating isolates. In this study restriction enzyme analysis with the enzyme Hha I was used to characterize isolates recovered from the 1981 Canadian (n=29), the 1983 Massachusetts (n=9) and the 1985 Southern California (n=54) outbreaks. Isolates from each of the epidemics exhibited a distinguishing pattern. Thus, the ease with which REA can be applied to all serotypes of *L. monocytogenes* argues for its use as a powerful epidemiological tool in evaluating listeriosis outbreaks or suspect cases of cross-infection.

Growth of *Aeromonas hydrophila* and *Plesiomonas shigelloides* on cooked crayfish tails stored under modified atmosphere, vacuum and air, *Steven C. Ingham*, Dept. of Applied Microbiology & Food Science, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 0W0

Growth of *A. hydrophila* and *P. shigelloides* on sterile cooked crayfish tails was monitored for 6d storage under an 80% CO_2/0% 0_2 modified atmosphere (MA), vacuum and air. Storage temperatures were 2 and 8°C for *A. hydrophila*, and 8, 11 and 14°C for *P. shigelloides*. MA was strongly inhibitory to *A. hydrophila* at 2°C and less inhibitory at 8°C. *A. hydrophila* grew slowly under vacuum at 2°C, and at 8°C grew at a rate similar to that under MA at 8°C. At 2 and 8°C, growth of *A. hydrophila* was least inhibited under air. *P. shigelloides* did not grow under any storage treatment at 8°C. MA effectively prevented *P. shigelloides* growth at 11°C, and slowed growth slightly at 14°C. Vacuum storage was less inhibitory than MA at 11°C and did not deter growth at 14°C. Growth of *P. shigelloides* was most rapid at 11 and 14°C under air.

A Rapid New 24 Hour Method for Detection and Confirmation of Total Coliforms and *E. coli* in Foods, *Gil Dichter*, Access Analytical Systems, Inc., 21 Business Park Drive, Branford, CT 06405.

Total coliform and *E. coli*: densities were determined in 11 different foods within 24 hours using Colilert, a new defined substrate test. Colilert incorporated ONPG and MUG as specific primary nutrient indicators to simultaneously detect and confirm total coliforms and *E. coli* in a food sample. Development of yellow color confirms total coliforms, yellow plus blue fluorescence confirms *E. coli*. Approximately 80% of the food samples were naturally contaminated, the remainder were seeded either with *K. pneumoniae* or *E. coli*. Colilert MPN results were compared to AOAC/BAM reference methods. (Multiple Tube Fermentation for total coliforms, E.C. broth for fecals at 44.5°C).

Results of this preliminary feasibility study indicates excellent agreement between Colilert and reference methods for total coliforms and *E. coli*. Indices of agreement generated by comparing Colilert to presumptive LTB and confirmed BGLB results were 0.958 and 0.875 respectively. Index of agreement between Colilert *E. coli* and E.C. fecal coliform was 0.977.

Colilert was easy to perform and read, requiring no subculturing or confirmation steps, with results available within 24 hours of inoculation, reducing costs and turn around time associated with the comparative methods.

PRELIMINARY PROGRAM 77TH
INTERNATIONAL ASSOCIATION OF MILK, FO

In Cooperation with the Associated Illinois M
and Wisconsin Association of

Woodfield Hilton and Towers **August 5-8,**

REGISTRATION TIMES

Saturday, August 4 ..... Noon - 4:00 P.M.
Sunday, August 5 ..... 9:30 A.M. - 4:30 P.M.
Monday, August 6 ..... 8:00 A.M. - 4:00 P.M.
Tuesday, August 7 ..... 8:00 A.M. - 4:00 P.M.
Wednesday, August 8 ..... 7:30 - 10:00 A.M.

EXHIBITOR HOURS

Sunday, August 5 ..... 8:15 - 10:00 P.M.
(Following the Opening Session)
Monday, August 6 ..... 9:30 A.M. - 3:30 P.M.
Tuesday, August 7 ..... 9:30 A.M. - 3:30 P.M.

FRIDAY, AUGUST 3

8:00 - 5:00 IAMFES Board Meeting

SATURDAY MORNING, AUGUST 4

8:00 - 12:00 IAMFES Board Meeting

Members are invited to submit Agenda items by July 15 to President Ron Case. Board Meetings are open to all members.

SUNDAY, AUGUS

COMMITTEE M

9:00 - 1:00	NMPF/IMS
9:30 - 10:30	Dairy Quality &
10:00 - 11:00	Baking Industry
10:00 - 11:00	DFES Manager
10:00 - 12:00	Constitution &
10:00 - 5:00	Communicable
10:30 - 11:30	Dairy Quality &
11:00 - 12:00	JFP Manageme
11:00 - 12:00	Food Service S
11:00 - 12:00	Nominating
1:00 - 3:00	IAMFES Name
1:30 - 2:30	Food Equipmer
1:30 - 2:30	Audio Visual L
1:30 - 3:30	Applied Labora
2:00 - 4:00	Affiliate Counc
2:30 - 3:30	Retail Foods
2:30 - 3:30	Water Quality
3:00 - 4:00	Foundation Fur
3:30 - 5:00	FDA Food Ser
4:00 - 5:00	Past Presidents

77TH ANNUAL MEETING OF THE
K, FOOD AND ENVIRONMENTAL SANITARIANS

llinois Milk, Food & Environmental Sanitarians
ation of Milk & Food Sanitarians

ust 5-8, 1990 **Arlington Heights, IL**

AUGUST 5

TTEE MEETINGS

IMS
Quality & Safety (Farm Section)
Industry Sanitary Standards
Management
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Quality & Safety (Plant Section)
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Visual Library
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SUNDAY EVENING, AUGUST 5

OPENING SESSION
Presiding R. Case and R. Sanders

7:00 WELCOME TO THE 77TH ANNUAL MEETING

7:20 *Ivan Parkin Lectureship - G. Burditt, Burditt, Bowles & Radzius, Chartered Law Offices, Chicago, IL

*This lecture is sponsored by the IAMFES Foundation Fund supported by Sustaining Memberships

8:15 Cheese and Wine Reception (in the Exhibit Hall)

SYMPOSIUM: LISTERIA

Convener: D. MARCUM

1:30 **Temperature Shift Effects on Injury and Death in *Listeria monocytogenes*** -J. SMITH and B. Marmer, USDA, Philadelphia, PA

1:45 **Effective Control of *Listeria monocytogenes* in a Dairy Processing and Packaging Plant by Isothiazolone Microbicide** - J. HSU, Rohm and Haas Co., Springhouse. PA

2:00 **Virulence of *Listeria monocytogenes* in a Pregnant Animal Model** - A. LAMMERDING, K. Glass, A. Gendron-Fitzpatrick and M. Doyle, Univ. of Wisconsin, Madison, WI

2:15 **Virulence of *Listeria monocytogenes* Hemolysins** - P. PETERKIN, E. Idziak and A. Sharpe, Health and Welfare Canada, Ottawa, Ontario, Canada

2:30 **Behavior of *Listeria monocytogenes* in the Presence of Lactic Acid Bacteria in a Medium with Internal pH Control Requiring Agitation (IPCM-2)** - J. WENZEL and E. Marth, Univ. of Wisconsin, Madison, WI

2:45 **Factors Contributing to Growth Inhibition of *Listeria monocytogenes* in Raw Egg Albumen** - C. WANG and L. Shelef, Wayne State Univ., Detroit, MI

3:00 **Growth Suppression of *Listeria monocytogenes* by Sodium or Potassium Lactate in Cooked Chicken or Beef** - L. SHELEF and Q. Yang, Wayne State Univ., Detroit, MI

3:35 **Survival of *Listeria* Egg Washwater** - F. R. McKellar, Food Ontario, Canada

3:50 **Use of a Bacteriocin *acidilactici* to Inhib Associated With Fre** Dickson and J. Cro NE

4:05 **Persistence and *monocytogenes* in N a Food Processing P** E. Zottola, Univ. of

4:20 **Inhibition of *Listeria* Milk** - A. LUND Minnesota, St. Paul,

4:35 **The Potential for Bacteriostatic Agen** SKOOG and S. Tati Paul, MN

4:50 **Behavior of *Lister* Presence of Gluc Preparation of Cot Gluconic Acid** - M Marth, National Re Food Dept, Dokki, C

SYMPOSIUM: HAZ CRITICAL CON

Convener: D

1:30 **Evolution of HACC** J. SILLIKER, Sillik Inc., Carson, CA

TERNOON, AUGUST 6

Listeria monocytogenes in Synthetic
ater - F. BARTLETT, J. Laird and
, Food Research Centre, Ottawa,
nada

cteriocin Produced by *Pedicoccus*
o Inhibit *Listeria monocytogenes*
With Fresh Meat - J. NIELSEN, J.
J. Crouse, USDA, Clay Center,

and Control of *Listeria*
es in Non-Food Contact Areas in
essing Plant - A. SPURLOCK and
Univ. of Minnesota, St. Paul, MN

Listeria Species by *Bacillus* in Raw
LUND and E. Zottola, Univ. of
St. Paul, MN

ial for Use of Diacetyl as a
ic Agent in Food Systems - J.
S. Tatini, Univ. of Minnesota, St.

Listeria monocytogenes in the
f Gluconic Acid and During
of Cottage Cheese Curd Using
cid - M.A.El-SHENAWY and E.
onal Research Center, Dairy and
Dokki, Cairo, Egypt

: HAZARD ANALYSIS
CONTROL POINT
vener: D. GABIS

HACCP: What It Is and Isn't? -
R, Silliker Laboratories,
, CA

2:20 Quantitative Aspects of Hazard Analysis - T. ROBERTS, AFRC - Institute of Food Research, Shinfield, Reading, UK

3:30 Teaching HACCP to Food Processors, Regulatory Officials - F. BRYAN, Food Safety Consultation and Training, Lithonia, GA

SYMPOSIUM: BIOTECHNOLOGY AND THE DAIRY FOOD INDUSTRY

Convener: J. BRUHN

1:30 Biotechnology - How it has Helped the Food Industry - (Speaker to be announced)

2:00 Chymosin - A New Product from Biotechnology - R. SELLMAN, Pfizer, Inc. Milwaukee, WI

2:30 Phage-Resistant Starter Cultures from Biotechnology - M. SANDERS, Consultant to Miles Marschall Labs, Littleton, CO

3:30 Bovine Somatatropin (BST) - A Review of Its Actions (AHI representative)

4:00 BST- Effects on Milk and Milk Composition - D. BARBANO, Cornell University, Ithaca, NY

4:30 Regulatory Perspective on Biotechnology - A Case Study - N. KIRSCHBAUM, Wisconsin Dairy Products Association, Madison, WI

TUESDAY MORNI

SYMPOSIUM: DAIRY
Convener: B. COLEMAN

8:30 **Bacterial Quality of Vanilla Ice Cream Purchased at Stores in Pennsylvania** - R. SMELTZ and S. Barnard, Penn State Univ., University Park, PA

8:45 **Sanitary Procedures Committee Report** - D. WHITEHEAD, Brandon, MS

9:00 **A Survey of Fluid Milk Processing Plants for Airborne Contamination Using Various Sampling Methods** - T. REN and J. Frank, Univ. of Georgia, Athens, GA

9:15 **Potential for Cold-Pasteurization of Milk Using Microfiltration** - K. ECKNER and E. Zottola, Univ. of Minnesota, St. Paul, MN

9:30 **3-A Symbol Council Report** - W. LAUN, Cedar Rapids, IA

9:45 **Dairy Quality and Safety Committee Report** - S. SIMS, Washington, DC

10:00 **Development of a Nisin-producing Starter Culture Suitable for Cheddar Cheese Manufacture** - R. ROBERTS, E. Zottola and L. McKay, Univ. of Minnesota, St. Paul, MN

I0:35 **Mode of Antimicrobial Activity of Lactobacilli and Yogurt** - D. WATSON, C. Fernandes and K. Shahani, Univ. of Nebraska, Lincoln, NE

I0:50 **Applied Laboratory Methods Committee Report** - R. BISHOP, Blacksburg, VA

11:05 **Audio Visual Co** HAVERLAND, Cinc

11:20 **Water Quality Wa** Report - R. CARA Raleigh, NC

11:45 **Dairy Industry Ec** Pennsylvania - S. BA University Park, PA

SYMPOSIUM: FOOD
Conveners: A. LA and N. C

8:30 **Welcome and** LAMMERDING, Un WI

8:40 **Current Studies on** I. WESLEY, USDA,

9:10 **Behavior and Serc** Staphylococcal Ent Mushrooms - R. BEN DC

10:00 ***Salmonella enteritidis*** for Human Healt American Agricultu APHIS, Harrisburg,

10:30 **Update on Research** Bacterial Enteropat COX, USDA, ARS,

ORNING, AUGUST 7

ıal Committee Report - H. ND, Cincinnati, OH

lity Waste Disposal Committee . CARAWAN, NC State Univ.,

stry Educational Programs in n - S. BARNARD, Penn State Univ., ark, PA

FOOD MICROBIOLOGY
: A. LAMMERDING and N. COX

and Introduction - A. ING, Univ. of Wisconsin, Madison,

dies on *Listeria monocytogenes* - USDA, ARS, Ames, IA

nd Serological Identification of al Enterotoxin A in Canned - R. BENNETT, FDA, Washington,

nteritidis and Eggs: - A Small Issue Health: A Large Issue for griculture - L. SHIPMAN, USDA, risburg, PA

esearch Efforts to Control Human nteropathogens in Poultry - N. , ARS, Athens, GA

11:00 **Implications of Microbial Infections in Immunocompromised Populations - R. BROWN, Univ. of Wisconsin, Madison, WI**

11:30 **General Discussion - Panel**

SYMPOSIUM: CHEMICAL RESIDUES
Convener: R. RICHARDSON

(Subject and speakers to be announced at a later date)

GENERAL SESSION
CHALLENGE OF THE 90'S
Convener: B. GRAVANI

1:25 Door Prize

1:30 The Impact of Changing Life Styles on Food Safety - D. FARR, Food Marketing Institute, Washington, DC

1:50 The Importance of Risk Assessment In Food Safety - (Speaker to be announced)

2:15 Coping Strategies in Fulfiling Consumer Expectation - G. PRINCE, The Kroger Company, Cincinnati, OH

2:35 Role of the Food Protection Professional in Meeting the Challenges of the 90's - D. CLINGMAN, General Mills, Orlando, FL

2:50 Break

3:15 D

3:20 W

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4:00 B

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OON , AUGUST 7

ANNUAL IAMFES BUSINESS MEETING

3:15 Door Prize

3:20 Welcome and Introduction - R. SANDERS

3:40 Presidential Address - R. CASE

4:00 Business Meeting - R. CASE, Presiding

- Moment of Silence for Departed Assoc. Members
- Minutes of last business meeting - M. DOYLE
- Report of Executive Manager - S. HALSTEAD
- Report of Affiliate Council - W. COLEMAN
- Foundation Fund Report - H. HAVERLAND
- Dairy, Food and Environmental Sanitation Management Committee Report - H. BENGSCH
- Journal of Food Protection Management Committee Report - R. MARSHALL
- Program Advisory Committee Report - G. PRINCE
- Old Business
- New Business
- Resolutions - R. GRAVANI

WEDNESDAY MORN

SYMPOSIUM: GLOBAL ASPECTS OF FOODBORNE DISEASE SURVEILLANCE

Convener: E. TODD

8:30 **Introduction and Canadian Foodborne Disease Surveillance - E. TODD, Health Protection Branch, Ottawa, Ontario**

9:00 **Surveillance Systems in New York State and Malaysia - J. GUZEWICH, New York State Department of Health, Albany, NY**

9:30 **Foodborne Disease Surveillance in Europe - K. Gerigk, Robert von Ostertag Institute, Berlin, Germany**

10:20 **Committee on Communicable Disease Report - F. BRYAN, Food Safety Consultant, Lithonia, GA**

10:40 **Foodborne Disease Surveillance in South and Central America - F. QUEVEDO, Pan American Health Organization, Bethesda, MD**

11:10 **Foodborne Disease Surveillance from a WHO Perspective - (Speaker to be announced)**

SYMPOSIUM: SHELF LIFE AND SAFETY OF MINIMALLY PROCESSED REFRIGERATED FOODS

Conveners: E. KOENIG and F. DRAUGHON

8:30 **Introduction - F. DRAUGHON, Univ. of Tennessee, Knoxville,TN**

8:40 **Sous Vide and Minimally Processed Refrigerated Foods: Looking Back and Moving Forward - A. BRODY, Schotland Business Research, Inc., Princeton, NJ**

9:10 **Modified Atmospher Safety - C. HACKNE**

9:40 **FDA's Position on Re C. OTTO, FDA, Was**

10:25 **Microbiological Cri Aspects of Minimall Foods - J. KVENBE DC**

11:05 **Application of Existin Safety of Raw and M Stored Under Modi SMITH, USDA Easter Philadelphia, PA**

11:35 **Retail Guidelines fo Reduced Oxygen Atmospheres - S. BO Health, Springfield, I**

SYMPOSIUM WASTE DIS

Convener: C.

8:30 **The Trashing of Ame Solid Waste Problem of Commerce of the**

8:50 **The NIMBY Syndron Disposal (Speaker to**

9:10 **Food Packaging and N. SHERMAN, Foo Institute, Washingto**

9:30 **Recycling: Prospects to be announced)**

MORNING, AUGUST 8

mosphere Packaging and Food
IACKNEY, VPI, Blacksburg, VA

on on Retail Vacuum Packaging -
DA, Washington, DC

cal Criteria and Regulatory
Minimally Processed Refrigerated
KVENBERG, FDA, Washington,

f Existing Technology to Improve
v and Minimally Processed Foods
r Modified Atmospheres - J.
A Eastern Regional Research Lab,
PA

lines for Refrigerated Foods in
xygen Packaged In Modified
- S. BOHM, Illinois Dept. Public
gfield, IL

SIUM: SOLID
E DISPOSAL
ener: C. FELIX

of America -An Overview of the
Problem - H. ALTER, Chamber
of the U.S.A.

Syndrome - The Politics of Waste
aker to be announced)

ing and Waste - The Tradeoffs -
AN, Food Service & Packaging
shington, DC

rospects and Limitations (Speaker
ced)

10:10 **Solutions - Technology Vs. Lifestyle Changes - T. RATTRAY, Procter & Gamble Company**

10:50 **Panel Discussion - Solutions and Actions - Biodegradability - Composting - Incineration - Reuse - Source - Reduction - Landfilling - Recycling**

DAIRY FIELDMEN SYMPOSIUM

Convener: R. DAGGS

8:25 **Welcome Address - R. DAGGS, Wisconsin Dept. Health, Madison, WI**

REGULATORY PERSPECTIVES

8:30 **The BGH Dilemma: Implications for Industry - N. KIRSCHBAUM, Wisconsin Dairy Products Assn., Madison, WI**

9:00 **NCIMS and The Dairy Fieldman - J. KENNEDY, Missouri State Dairy Board, Jefferson City, MO**

9:30 **Anatomy of a Regulation: The Drug Debit - B. McCARTHY, Michigan Dept. Ag, Lansing, MI**

TECHNICAL PERSPECTIVES

10:30 **Application and Use of Veterinary Prescription Drugs - D. BOSMAN, Wisconsin Dept. Agriculture, Madison, WI**

11:00 **Present and Future Tests for Milk Quality - P. HERMSEN, AMPI, Shawano, WI**

11:30 **Membrane Fractionation on the Farm: Potentials and Pitfalls - C. HONER, IL**

SYMPOSIUM: METHODOLOGY

Convener: R. BISHOP

1:30 **Rapid Salmonella Detection by a New Conductance Method** - D. COUSINS and P. Coombs, Radiometer America Inc., Westlake, OH

1:45 **Tactics for Combining the Coliform and Indole Tests: Simple Media for Both Total Coliforms and *Escherichia coli*** - G. CHANG and R. Lum, Univ. of California, Berkeley, CA

2:00 **A One-Step Device for Evaluating On- Site Microbial Contamination** - J. BUZONIK and K. Rossmore, BioSan Lab Inc, Ferndale, MI

2:15 **A Rapid New 24-Hour Method for Detection and Confirmation of Total Coliforms and *E. coli* in Foods** - G. DICHTER, S. Mongillo, L. Gaidish, S. Edberg and S. Wardlaw, Access Analytical Systems, Inc., Branford, CT

2:30 **Fluorescence Screening Test for Pyruvate Kinase Activity in Canned Cured Ham** - C. DAVIS and W. Townsend, USDA, Athens, GA

3:05 **Performance of a Colorimetric DNA Hybridization Method in the Detection of *Salmonella* in Dried Pasteurized Egg Products** - G. RILEY and M. Mozola, Henningsen Foods, Inc., Omaha, NE

3:20 **Rapid Identification of Antibiotic Residues by High Performance Liquid Chromatography Coupled With the Microbial Receptor Assays - HPLC Receptorgrams** - E. ZOMER and S. Charm, Penicillin Assays, Inc., Malden, MA

3:35 **Detection of *Brucella sp.* in Mexican White Soft Cheese Proceeding from Cd. Obregon, Mexico** - M. DIAZ DE AGUAYO and E. Acedo F., Hermosillo, Sonora, Mexico

SYMPOSIUM: CO
FOOD SAFETY

Convener: C

1:30 **Consumer Concern about, why are they they done about it** - California, Davis, C

1:45 **The scientific facts communicate them** Food Technologists.

2:05 **Food Industry Resp Healthy Product a About it** - (Speaker

3:00 **The Supermarket Food Safety and Q** to be announced)

3:30 **The Regulatory Ro enhance consumer** (Speaker to be ann

4:00 **Effective Communi Techniques we can** announced).

SYMPOSIUM: BAKI

Conveners: P. B. PURS

1:30 **Computerized Sanit** to be announced)

2:00 **B.I.S.S.C. Standard** (Speaker to be ann

FTERNOON , AUGUST 8

M: COMMUNICATING AFETY CONCERNS

ener: C. BRUHN

Concern, What are people worried are they concerned, and what have bout it - C. BRUHN, University of Davis, CA.

ic facts on food safety and how to te them - C. WIXOM, Institute of ologists.

try Response, Assuring a oduct and Telling the Consumer Speaker to be announced).

market Response: Responding to and Quality Concerns - (Speaker nced)

tory Role, What Can be done to nsumer perception of food safety - be announced).

ommunication Strategies: Tips and we can all use - (Speaker to be

BAKERY SANITATION

eners: P. FISHER - B. PURSLEY

ed Sanitation Scheduling - (Speaker nced)

Standards for Bakery Equipment - be announced)

2:30 **B.I.S.S.C. Committee** - M. RONGE

3:55 **In-House Video Training Progams** - (Speaker to be announced)

4:20 **Pollution Prevention and Waste Reduction** - (Speaker to be announced)

4:45 **Sanitation Education** - (Speaker to be announced)

DAIRY FIELDMEN SYMPOSIUM CONTINUED

VIEW FROM THE FIELD

1:30 **Environmental Mastitis** - L. SMITH, Ohio Ag. Research and Development Center, Wooster, OH

2:00 **Contagious Mastitis** - L. TIMMS - IA State Univ., Ames, IA

2:30 **Man, Machine and Mentality** - K. KIRBY, A & I Labs, Edgerton, WI

PUTTING IT ALL TOGETHER

3:30 **Essentials of a Quality Milk Program** - D. BERG, Land O' Lakes, Minneapolis, MN

4:00 **Now is the Time for Action** - A. BRINGE, Univ. of Wisconsin, Madison, WI

4:30 **Questions/Adjourn**

SPECIAL EVENTS PROGRAM

Monday, August 6

LONG GROVE VILLAGE/HOBSON HOUSE RESTAURANT

9:30 a.m. - 3:30 p.m. - Cost: $20.00 (Includes Lunch)

Turn your watch back to yesteryear and explore the treasures at a crossroads in our country's past! We'll be taking you to Long Grove, a 19th Century village featuring antiques, boutiques and over 100 charming and unique specialty shops. Relax and enjoy lunch at Hobson House Restaurant, featuring a homemade, buffet-style lunch served in garden surroundings. Your afternoon is free to continue shopping, sampling fresh apple cider and homemade fudge or simply visit with friends in a charming atmosphere untouched by progress. **(Tour limited to 46 people).**

ART INSTITUTE TOUR

9:00 a.m. - 4:00 p.m. - Cost: $25.00 (Includes Lunch)

One of the world's leading art museums is located in Chicago. This tour will show it to you. You will be picked up at the hotel and driven to the Art Institute. The price of admission is included and Monet's Series Paintings will be on exhibit during the time of your visit. Lunch is provided in the garden level restaurant of the Institute. After lunch you will be taken to the Sears Tower. Here on the 103rd floor of the world's tallest building, you will look down upon the East, West, North and South beauty of Chicago. Admission to the Tower is included. **(Tour limited to 46 people).**

Tuesday, August 7

HAEGER POTTERY/MILK PAIL VILLAGE

9:00 a.m. - 3:30 p.m. - Cost: $20.00 (Includes Lunch)

The world's largest art pottery awaits you on this guided walking tour of Haeger Potteries. Watch the old world master potter spin works of art on his potter's wheel. You will browse through the factory outlet salesroom and select your favorite art pottery pieces. We've planned a quaint lunch at the Milk Pail Restaurant, nestled in the beautiful woods and fields of Milk Pail Village and famous for its country fare. Following a delicious meal, shop leisurely through over 20 shops of country ware, paintings. clothing, crafts and one-of-a-kind treasures. **(Tour limited to 46 people).**

"MAGNIFICENT MILE" - WATER TOWER PLACE TOUR

9:00 a.m. - 4:00 p.m. - Cost: $25.00 (Includes Lunch)

Experience the Crown Jewel of Chicago's Magnificent Mile. You will be taken from the hotel, driven along beautiful Michigan Avenue and dropped off at Water Tower Place. Glass-enclosed elevators, fountains and beautiful greenery are just a part of this tremendous shopping and architectural marvel. Lunch is provided at "the 95th" - an elite Chicago dining experience. Situated on the 95th floor of the John Hancock building, this restaurant offers an unparalleled view of Chicago. **(Tour limited to 45 people).**

Wednesday, August 8

MORTON ARBORETUM TOUR
9:00 a.m. - 4:00 p.m. - Cost: $20.00 (Includes Lunch)

The Morton Arboretum is a 1,500 acre preserve consisting of native Illinois prairie and forest land and beautiful cultivated gardens. Tour participants will be taken from the hotel to the Arboretum. Once there, an arboretum Naturalist will come on board the bus to narrate a tour of the grounds. Lunch is included and will be served in picturesque "Ginkgo Restaurant" overlooking Crabapple Lake. After lunch, ample time will be given for browsing in the gift shop, strolling among the flower gardens or viewing a slide show provided by the Arboretum. **(Tour limited to 45 people).**

KRAFT GENERAL FOODS COOKING DEMONSTRATION (WOODFIELD HILTON)
Free

Kraft Cooking Demo will be held at the Woodfield Hilton and Towers. Details on this event will be published at a later date.

EVENTS BY INVITATION

Monday Morning, August 6

7:00 IAMFES Committee Chairperson Breakfast Meeting

Tuesday Evening, August 7

5:30-6:30 Presidential Reception
7:00 Past President's Dinner

SPOUSE/COMPANION ACTIVITIES

Sunday, August 5

8:15-10:00 Early Bird Reception - Cheese & Wine

Monday Evening, August 6

7:00 "Taste of Chicago"

Wednesday Evening, August 8

6:00-7:00 Reception
7:00 Annual Awards Banquet

EXHIBITORS
(as of March, 1990)

Advanced Instruments, Inc.....Needham, MA
American Type Culture Collection.....Rockville, MD
Becton Dickenson Microbiology Systems.....
Cockeysville, MD
Capitol Vial, Inc.....Fultonville, NY
Charles Felix Associates.....Leesburg, VA
Copesan Services, Inc.....Brookfield, WI
Educational Testing Service.....Princeton, NJ
Foss Food Technology Corp.....Eden Prairie, MN
Go-Jo Industries, Inc.....Akron, OH
Henkel Corporation.....Plymouth Meeting, PA
IDEXX Corporation.....Portland, ME
Klenzade Div., Ecolab, Inc.....St. Paul, MN
Michelson Laboratories, Inc.....Los Angeles, CA
Nasco.....Fort Atkinson, WI
Organon Teknika Corporation.....Durham, NC
Oxoid U.S.A., Inc.....Columbia, MD
Radiometer America, Inc.....Westlake, OH
Silikal North America, Inc.....Stratford, CT
Silliker Laboratories.....Chicago Heights, IL
Smithkline AHP.....West Chester, PA
Sparta Brush Co., Inc.....Sparta, WI
Spiral Systems Instruments.....Bethesda, MD
Taylor Company.....Rockton, IL
3-A Symbol Council.....Waukesha, WI
3M Microbiology Products.....St. Paul, MN
Walker Stainless Equipment.....New Lisbon, WI
Wescor, Inc.....Logan, UT
Whitmire Research Laboratories, Inc.....St. Louis, MO

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Charlie Price

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Wednesday Awards Banquet.....
Sunday Wine & Cheese Recepti
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Door Prizes.....
Program.....
Meeting Rooms, Exhibits, Audi
& Speakers' Hospitality.....
Photography.....
Past Presidents' Dinner.....

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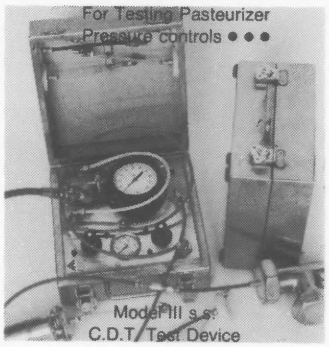

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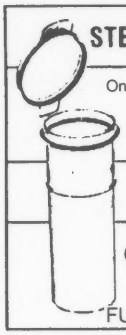

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Coming Events

1990

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•**1-2, Harrisburg Restaurant Food & Equipment Show**, sponsored by the Pennsylvania Restaurant Association. Held at the Farm Show Complex, Harrisburg. Call 1-800-346-PROS or (717)697-4199 for details, FAX (717)790-9441.

•**7-9, 1990 Pennsylvania Association of Dairy Sanitarians & Dairy Laboratory Analysts Annual Meeting** at the Keller Conference Center, Penn State University, University Park, PA. For more information, contact Sid Barnard, 8 Borland Lab, University Park, PA 16802, (814)863-3

•**7-11, Electrical Troubleshooting**. American Institute of Baking, Manhattan, KS. Contact: Melinda Enns at (913)537-4750.

•**8-10, Introduction to Food Chemistry**, to be held in Chicago, Illinois. For more information or registration materials, contact the American Association of Cereal Chemists, 3340 Pilot Knob Road, St. Paul, MN 55121, (612)454-7250 FAX (612)454-0766.

•**14-17, Introduction to Cereal Chemistry and Technology** to be held in Minneapolis, Minnesota. For more information or registration materials, contact the American Association of Cereal Chemists, 3340 Pilot Knob Road, St. Paul, MN 55121, (612)454-7250 FAX (612)454-0766.

•**14-17, Purdue Aseptic Processing and Packaging Workshop**, sponsored by the Food Science Department at Purdue University. For information contact James V. Chambers, Food Science Department, Smith Hall, Purdue University, West Lafayette, IN 47907, (317)494-8279.

•**14-18, Recognition of Animal Hairs in Food Seminar**, Okumura Biological Institute, Clarion Hotel, Sacramento, CA. For more information contact George Okumura, 6669 14th Street, Sacramento, CA 95831 (916)421-8963.

•**14-18, Applications and Troubleshooting Microprocessor Control Circuits Seminar**, presented by The American Institute of Baking. To register, write to American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502, (913)537-4750 or (800)633-5137 or FAX (913)537-1493.

•**16, Ontario Food Protection Association**, will be holding a Spring Workshop at the Toronto Hilton Hotel. The title of this theme is: "Effective Employee Education in the Food Industry: Training a Trainer." for more information contact programme co-ordinators, Bob Tiffin (519)885-8284, FAX (519)822-8210 or Ann Roberts (519)822-5530 or FAX (519)822-5530.

•**19-23, The 71st Annual National Restaurant Association Restaurant, Hotel-Motel Show**, held at McCormick Place, Chicago, IL. For more information contact National Restaurant Association, 150 N. Michigan Ave, Ste. 2000, Chicago, IL 60601, (312)853-2525, FAX (312)853-2548.

•**22-24, Adding Fiber to Food: How and Why** to be held in Chicago, Illinois. For more information or registration materials, contact the American Association of Cereal Chemists, 3340 Pilot Knob Road, St. Paul, MN 55121, (612)454-7250 FAX (612)454-0766.

•**23-25, South Dakota Environmental Health & South Dakota Rural Health,** Ramkota Inn, Pierre, SD. For information contact Dave Micklos, SD State Dept of Health, 523 E. Capital, Pierre, SD 57501, (605)773-3141.

JUNE

•**4, Pesticide Applicator Certification Seminar,** Okumura Biological Institute, Clarion Hotel, Sacramento, CA. For more information contact George Okumura, 6669 14th Street, Sacramento, CA 95831 (916)421-8963.

•**4-5, HACCP** to be held in Chicago, Illinois. For more information or registration materials, contact the American Association of Cereal Chemists, 3340 Pilot Knob Road, St. Paul, MN 55121, (612)454-7250 FAX (612)454-0766.

•**4-5, Starch: Structure, Properties, and Food Uses** to be held in Chorleywood, United Kingdom. For more information or registration materials, contact the American Association of Cereal Chemists, 3340 Pilot Knob Road, St. Paul, MN 55121, (612)454-7250 FAX (612)454-0766.

•**5, Worker Safety Compliance Seminar 1990, Chemical, Pesticides and Fumigants in the Workplace,** Okumura Biological Institute, Clarion Hotel, Sacramento, CA. For more information contact George Okumura, 6669 14th Street, Sacramento, CA 95831 (916)421-8963.

•**5-6, Texas Association of Milk, Food & Environmental Protection Annual Meeting**, held at the Howard Johnson-South Plaza, Austin, Texas. For more information contact Janie Park, Secretary, P.O. Box 2362, Cedar Park, TX 78613-2363, (512)458-7281.

•**18-19, Dough Rheology and Baked Products Texture** to be held in Short Hills, New Jersey. For more information or registration materials, contact the American Association of Cereal Chemists, 3340 Pilot Knob Road, St. Paul, MN 55121, (612)454-7250 FAX (612)454-0766.

•**24-27, ADSA Annual Meeting** to be held at North Carolina State University, Raleigh, North Carolina. For more information contact Mr. Carl Johnson, 309 W. Clark Street, Champaign, IL 61820.

JULY

•**6-7, International Symposium on Rapid Methods and Automation in Microbiology: Ten Years of Excellence**. Contact Dr. Daniel Y.C. Fung, Director, 207 Call Hall, Kansas State University, Manhattan, KS 66506, (913)532-5654, FAX (913)532-7059.

•**6-13, International Workshop on Rapid Methods and Automation in Microbiology: Ten Years of Excellence**. Contact Dr. Daniel Y.C. Fung, Director, 207 Call Hall, Kansas State University, Manhattan, KS 66506. (913)532-5654, FAX (913)532-7059.

16-18, American School Food Service Association 44th

Annual Conference to be held at the New Orleans Convention Center, New Orleans, Louisiana. For more information call (703)739-3900 or (800)877-8822.

AUGUST

•**5-9, IAMFES 77th Annual Meeting**, Woodfield Hilton Towers, Arlington Heights, IL. For more infor-mation, contact Steven K. Halstead, IAMFES, Inc., 502 E. Lincoln Way, Ames, IA 50010 (800)369-6337.

•**6-7, Pesticide Applicator Certification Seminar**, Okumura Biological Institute, Holiday Inn, Elk Grove Village, IL. Contact George Okumura, 6669 14th Street, Sacramento, CA 95831 (916)421-8963.

•**7-8, Dietary Managers Association** to be held at the Hyatt Orlando, Orlando, Florida. For more informa- tion call (708)932-1444 or (800)323-1908.

•**8-9, Advance Pesticide Technology for the Food Industry Seminar**, Okumura Biological Institute, Holiday Inn, Elk Grove Village, IL. For more information contact George Okumura, 6669 14th Street, Sacramento, CA 95831 (916)421-8963.

•**15-18, FOOD PACIFIC, 1990** will be held at Vancouver's domed stadium, B.C. Place. Those wishing to attend may obtain further information by contacting: B.C. Food Exhibitions Ltd., 190-10651 Shellbridge Way, Richmond, B.C., Canada V6X 2W8 (604)660-2288.

•**26-31, Eighth International Biodeterioration and Biodegradation Symposium.** University of Windsor, Ontario, Canada. For more information contact Mary M. Hawkins, Corresponding Secretary, 10657 Galaxie, Ferndale, MI 48220-2133, (313)544-0042.

•**27, Pesticide Applicator Certification Seminar**, Okumura Biological Institute, Clarion Hotel, Sacramento, CA. For more information contact George Okumura, 6669 14th Street, Sacramento, CA 95831 (916)421-8963.

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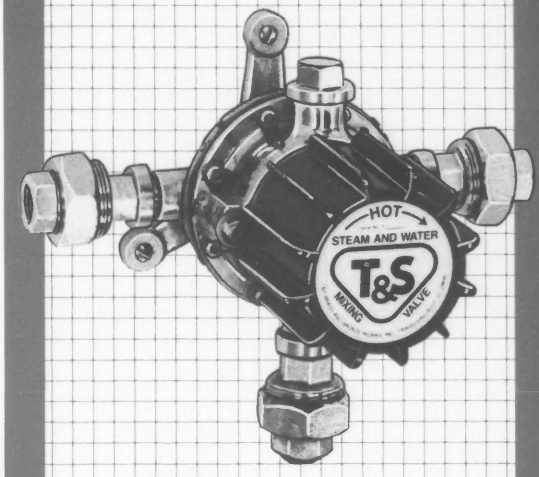

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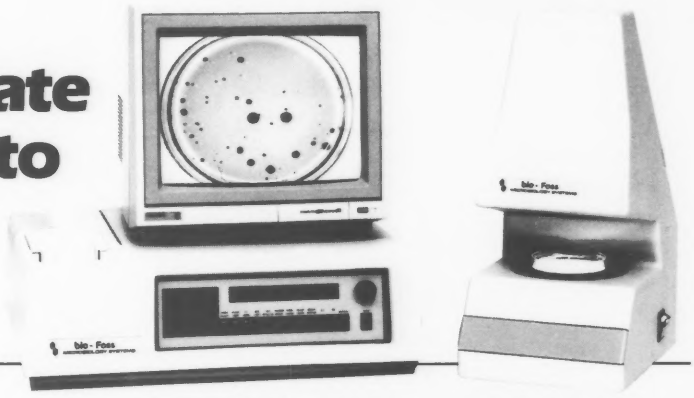

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From the Ames Office . . .

By
Steven K. Halstead
IAMFES
Executive Manager

One of the first things I had Dee Buske, our Affiliate Liaison, do was a needs survey of the affiliates. Several pages long, the survey contained the usual stuff - names and addresses of officers, annual meeting date, number of members, etc., but also many questions getting at "What can the Ames office do to help you?"

We learned a lot from the survey. The first thing we learned was that our list of contacts was very much out-of-date. We learned that many contacts didn't know they were our contacts. We learned that many contacts did not feel that they could speak for their affiliate.

After eight years of association work at the state level, I knew what I wanted from the national office. I wanted it to hold my hand when I was hurting. I wanted it to encourage me when I was blue. I wanted it to pat me on the back when "I did good." Those were the important wants.

I also looked to it to educate me in the ways of association management - how to work with volunteers; how to plan and manage meetings; how to run a meeting; how to train officers; how to protect the association's tax status. The list goes on and on.

We had expected that with the information gained from the survey, we would put together a two day meeting to meet the identified needs. Plenty of time would be set aside for the participants to network and interact with the IAMFES staff and officers. We went so far as to solicit preferred days of the week and month.

The contacts who responded informed us that if they were coming to a meeting, they wanted to learn about Salmonella, Listeria, etc., etc., etc. In other words, they simply did not see themselves as association managers.

I have a dream that someday every one of our affiliates will have paid staff. They may not all be multi-person, full-time staff, but paid staff, just the same. Several are ready for that now.

For my dream to become reality, substantial membership growth will have to occur. This can happen, but it is going to take capable, trained managers.

I invite all our affiliates to share in my dream.

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

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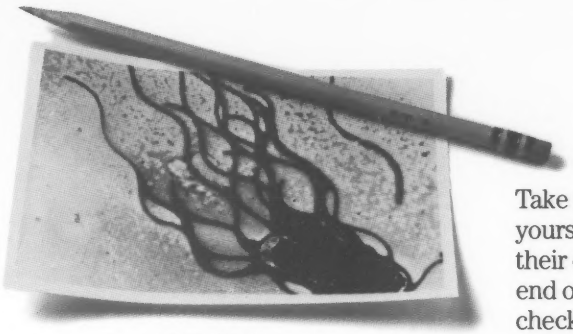

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  - (benethamine)
  - (calcium)
- ● ◆ ■ Penicillin O
- ● ◆ ■ Penicillin S
- ● ◆ ■ Penicillin N
- ● ◆ ■ Methicillin
- ● ◆ ■ Nafcillin
- ● ◆ ■ Ticarcillin
- ● ◆ ■ Penicillin V.
  - (benzathine)
  - (hydrabamine)
  - (potassium)
- ● ◆ ■ Oxacillin
- ● ◆ ■ Cloxacillin
  - (benzathine)
- ● ◆ ■ Dicloxacillin
- ● ◆ ■ Flucloxacillin
- ● ◆ ■ Ampicillin
  - (trihydrate)
- ● ◆ ■ Amoxicillin
  - (trihydrate)
- ● ◆ ■ Piperacillin
- ● ◆ ■ Hetacillin
- ● ◆ ■ Carbenicillin
- ● ◆ ■ Cephalothin
  - (Cephaloglycin)
- ● ◆ ■ Cephapirin
- ● ◆ ■ Cephapirin Benzathine
- ● ◆ ■ Cephradine
- ● ◆ ■ Cephacetrile
- ● ◆ ■ Cephalexin
- ● ◆ ■ Cephaloridine
- ● ◆ ■ Cefazolin
- ● ◆ ■ Cefoxitin
- ● ◆ ■ Cefaclor

CHARM TEST I ◆

- ● ◆ ■ Cefadroxil
- ● ◆ ■ Cefamandole
- ● ◆ ■ Cefatrizine
- ● ◆ ■ Cefazedone
- ● ◆ ■ Cefmenoxime
- ● ◆ ■ Cefmetazole
- ● ◆ ■ Cefonicid
- ● ◆ ■ Cefoperazone
- ● ◆ ■ Ceforanide
- ● ◆ ■ Cefotaxime
- ● ◆ ■ Cefotetan
- ● ◆ ■ Cefotiam
- ● ◆ ■ Cefroxadine
- ● ◆ ■ Cefsulodin
- ● ◆ ■ Ceftazidime
- ● ◆ ■ Ceftezole
- ● ◆ ■ Ceftizoxime
- ● ◆ ■ Ceftriaxone
- ● ◆ ■ Cephalosporin C
- ● ◆ ■ Cephamycin A
- ● ◆ ■ Cephamycin B
- ● ◆ ■ Cephamycin C
- ● ◆ ■ Cephapirin Sodium
- ● ◆ ■ Cephradine

TETRACYCLINES (T)

- ■ Tetracycline
- ■ Chlortetracycline
- ■ Oxytetracycline
- ■ Demeclocycline
- ■ Methacycline
- ■ Doxycycline
- ■ Minocycline

AMINOGLYCOSIDES (ST)

- ■ Dihydrostreptomycin
- ■ Streptomycin sulfate
- ■ Neomycin
- ■ Kanamycin
- ■ Amikacin
- ■ Gentamicin
- ■ Tobramycin

CHARM TEST II ■

MACROLIDES (E)

- ■ Troleandomycin
- ■ Erythromycin
  - Erythromycin Stearate
  - Erythromycin Estolate
  - Erythromycin Gluceptate
  - Erythromycin Lactobionate
  - Erythromycin Phosphate
- ◆ ■ Spiramycin
  - Erythromycin Thiocynate
- ◆ ■ Oleandomycin
- ◆ ■ Tylosin
- ◆ ■ Lincomycin
- ◆ ■ Clindamycin

MYCOTOXINS (MY)

- ■ Aflatoxin M_1, M_2
- ■ Aflatoxin B_1, B_2, G_1, G_2

SULFONAMIDES (SM)

- ● ◆ ■ Sulfamethazine
- ● ◆ ■ Sulfadimethoxine
- ● ◆ ■ Sulfabromomethazine
- ● ◆ ■ Sulfamerazine
- ● ◆ ■ Sulfamethoxypyridazine
- ● ◆ ■ Sulfasoxazole
- ● ◆ ■ Sulfadiazine
- ● ◆ ■ Sulfapyridine
- ● ◆ ■ Sulfacetamide
- ● ◆ ■ Sulfamethizole
- ● ◆ ■ Sulfanilamide
- ● ◆ ■ Sulfaguanidine
- ● ◆ ■ Dapsone
- ● ◆ ■ Sulfamethoxazole
- ● ◆ ■ Sulfachloropyridazine
- ● ◆ ■ Sulfanitran
- ● ◆ ■ Sulfaquinoxaline
- ● ◆ ■ Sulfathiazole

■ NOVABIOCIN (N)

◆ ■ CHLORAMPHENICOL (C)

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