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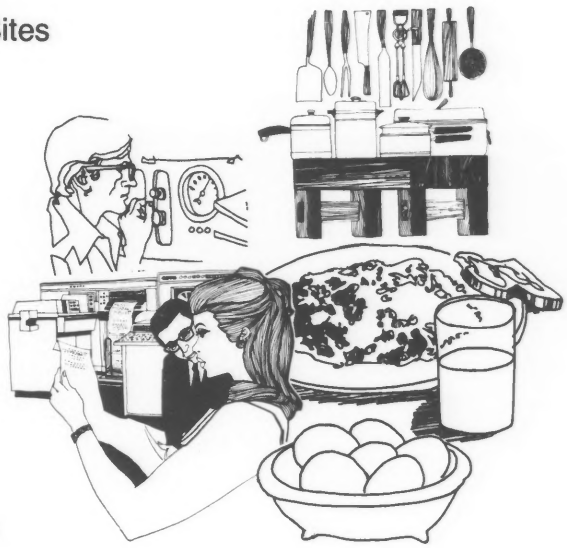

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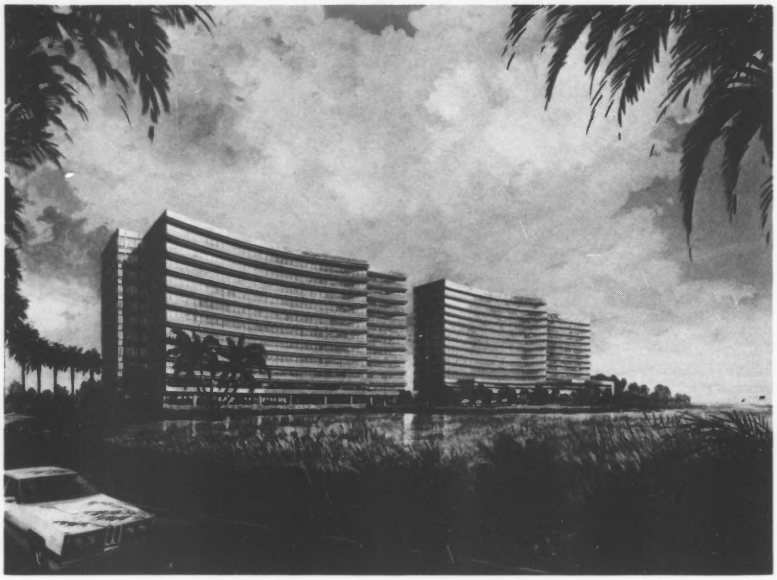

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# Dairy and Food Sanitation

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## ARTICLES:

*Dairy and Food Sanitation, Vol. 8, No. 3, Pages 112-118 (March 1988)*


# A Perspective on Food Safety Concerns

**Written and Edited by**
**Lois D. McBean, M.S. R.D.**
*(A reprint from the January-February 1987 Dairy Council Digest)*

The United States food supply not only is safer than it ever has been, but it also is the safest worldwide (1-3). The improved nutritional status and increased lifespan of Americans may be attributed in part to the safety of our food supply, in addition to its abundance, variety, availability, and wholesomeness. Significant advances made in protecting our food supply, along with the United States' stringent and high food safety standards, are evidenced by the safety record of milk and fluid milk products, for example. Today, these foods are associated with less than 1% of all disease outbreaks due to infected foods and contaminated water as compared with 25% of such reported outbreaks in 1938 (4).

Despite this progress, incidences of rare, but often highly publicized food-related illnesses do occur (1-3). Recent contamination of milk, cheese, watermelons, and other foods has heightened our awareness of food safety issues (5). In addition, technological advances in food processing with increased use of chemicals and food additives have led some consumers to question the safety of our food supply (6). The increased health consciousness of the U.S. population, and scientists' ability to detect contaminants at extremely low levels, often in parts per billion, have contributed to recent concerns about food safety (1,7). Controversy about food safety, while certainly not new, also stems from misconceptions about safety and food safety issues (1,7-11a). Safety means absence of risk or hazard (7,9). Because risk cannot be totally absent, food safety can never be absolute (7,9,11a). Consumers may delude themselves by seeking absolute food safety when such is impossible (10, 11a). While food safety cannot be guaranteed, much can and has been done to achieve a realistically high degree of relative safety of our food supply (10).

Not only consumers, but food producers and processors, food technologists, regulatory agencies, and health professionals are concerned about food safety. Consumers, however, differ from most other groups in their perceptions of major food safety issues (8,12,13). Research studies reveal that consumers identify the use of chemicals in producing, processing, and preserving food as a major concern (6,12-14). In contrast, food safety authorities rank microbiological contamination at the top of the list of food-related hazards (3,8,11b,13,15). In fact, the Food and Drug Administration (FDA) has shifted its major focus away from relatively low risk chemical additives to disease-causing microbes in food (16). Nearly all food-related chemicals tested by the FDA to date have a margin of safety of 1,000 or more (16). On the other hand, isolated incidences of microbiological contamination of food recently have led to considerable illness and even death (8,16).

This *Digest* reviews food safety concerns, specifically microbiological contamination and to a lesser extent the presence of intentional (e.g., food colors) and unintentional (e.g., mycotoxins, pesticide residues) additives in food. While microbiological contamination is the most frequent cause of food-related illnesses, these generally are mild and unreported. Moreover, almost all food poisoning incidents can be prevented by properly handling food in the home or at foodservice establishments (17). As succinctly stated by Hall (7), "all that really matters in food safety can be reduced to three words -variety, sanitation, and moderation." By consuming a nutritionally balanced diet made up of a variety of foods in moderation that have been prepared and stored following established sanitation practices and under proper temperatures, the risk of foodborne illness can be greatly minimized (7,18).

## MICROBIOLOGICAL CONTAMINATION OF FOODS

Much of the recent attention focused on foodborne microbial diseases can be attributed to the improved means of detecting bacteria, the complexity of the food supply, and the greater concentration of the food industry (10). The latter makes it possible for one small mishap in a food plant to affect millions of people.

Certainly not all bacteria are harmful. Consider, for example, the important role of microorganisms both within the body and in the production of foods such as cheese

and yogurt. Pathogenic bacteria, however, are responsible for the majority of food-related outbreaks in the United States (19). The adverse effects of bacteria can result from their presence in food (e.g., *Salmonella* infection) or through the release of preformed toxins (e.g., staphylococcal food poisoning or botulism) (11b,11c). Opportunity for microbial contamination exists not only during the processing, transporting, and marketing of food, but most often during the preparation and handling of food in the home or at foodservice establishments (10,11c). A wide variety of foods, in particular foods of animal origin (e.g., meats, fish and shellfish, poultry), are implicated in foodborne microbial incidences (3). Furthermore, the symptoms of foodborne disease may range from temporary discomfort with prompt recovery (e.g., *Clostridium perfringens* poisoning) to more severe and even fatal conditions (e.g., botulism) (11b,11c,17). Individuals most susceptible to the ill effects of microbial contamination of food include the very young, the elderly, and the chronically ill (11b). In genetically predisposed individuals, chronic diseases such as arthritis may be triggered by foodborne bacteria (20).

The incidence of foodborne microbial disease in the United States is unknown (10,11c,17,21). However, from 400 reported cases/year to as many as five million outbreaks/year are cited (3,10,22,23). Diarrhea of foodborne origin is even more prevalent, accounting for as many as 81 million cases/year (24). The economic impact also is staggering with costs ranging from one to 10 billion dollars annually due to medical care and lost earnings (3,10).

### Specific Pathogenic Bacteria

A number of different types of microorganisms may cause foodborne illness. Those responsible for most reported outbreaks in the United States include *Staphylococcus aureus, Salmonella* species, *Clostridium perfingens* and *Clostridium botulinum* (21,25). Furthermore, as a result of advances in detection methods, several newly emerging foodborne pathogens have received attention such as *Campylobacter jejuni, Yersinia enterocolitica, Listeria monocytogenes,* and pathogenic strains of *Escherichia coli* (11c, 21,26,27).

*Staphylococcus aureus,* a ubiquitous organism often found on the skin and in nasal passages of most people, is responsible for 20 to 40% of reported foodborne illness/year (11c,25). The illness is caused not by the bacterium itself, but by one of several enterotoxins that are produced when this pathogen is allowed to multiply in foods (11c). Foods of animal origin such as meats and dairy products most often are involved in staphylococcal outbreaks (11c,20,25). Symptoms of nausea, vomiting, diarrhea, and abdominal cramping may occur suddenly within one to six hours (average two to three hours) after consuming a food containing staphylococcal enterotoxin (11c,20,25). Recovery, however, is rapid (one to two days) and *Staphylococcus*-related illnesses rarely are fatal (11c,25). Although the bacteria can be destroyed by a sufficiently high temperature, this is not true for its toxins. It is important therefore to avoid contamination with this bacteria by maintaining personal cleanliness and adhering to recognized sanitation procedures in the handling of foods (25). Keeping foods at the proper temperature [i.e., <4.4°C (40°F) or>60°C (140°F) inhibits growth or destroys this bacterium (25). In contrast, leaving susceptible foods at room temperature encourages this bacterium to multiply and to produce toxins (25).

Another leading cause of foodborne illness in the United States is *Salmonella* (11c,26,28). This microorganism, of which there are more than 2,000 different serotypes, is found in most animals (20,25,26). Raw meat and poultry are the most important source of *Salmonella,* although other foods such as eggs, raw milk, and fish and shellfish also have been implicated in recorded outbreaks (20,28). The most common serotype associated with salmonellosis, the disease caused by *Salmonella* bacteria, is *Salmonella typhimurium* (20). In general, the symptoms of salmonellosis include diarrhea, abdominal cramps, vomiting, and fever usually within 24 hours after consuming the contaminated food (20,25,26). The illness tends to be of short duration with a low mortality rate (26). Symptoms, however, may be more severe for the very young, the elderly, and those already weakened by disease (11c, 25). Also, serious chronic diseases such as rheumatoid disorders may occur as a sequelae of *Salmonella* infection (20,26).

Within the past few years, some isolated outbreaks associated with drug-resistant strains of *Salmonella* have made newspaper headlines and created considerable concern (27-31). In 1985, a particular strain of *S. typhimurium* which displays rare resistance to certain antibiotics and a plasmid profile not seen before 1984 was associated with the largest reported food-related outbreak of salmonellosis in U.S. history (20,25,27-31). Over 16,000 culture-confirmed cases of salmonellosis in six states were recorded, all involving persons who had consumed two brands of 2% lowfat milk processed at a single dairy in Chicago, Illinois (25,27-31). This "Great Salmonella Outbreak" triggered an intensive investigation involving federal, state, and local regulatory authorities as well as dairy industry officials (25,31). Postpasteurization contamination of milk was suspected in this case (27). Because *Salmonella* is very heat sensitive, it usually is readily destroyed by normal cooking of food and proper pasteurization of milk (11c, 26). In fact, most outbreaks of salmonellosis can be traced to mistakes in food handling, either in foodservice establishments or in the home (11c).

*Clostridium perfringens* often is called the "cafeteria germ" because most foodborne outbreaks caused by this organism are associated with the foodservice industry (e.g., restaurants, institutions) or situations in which large quantities of food are prepared and served (11c,19,25). This organism is a common cause of foodborne microbial

illness with relatively mild symptoms such as diarrhea, abdominal cramps, shivering, and headache (11c,19). Both onset of symptoms (8 to 24 hours) and recovery (12 to 24 hours) are rapid (11c,25). Because *Clostridium perfringens* is widely distributed in nature, it can contaminate a large variety of foods under the right conditions. Foods of animal origin (e.g., meat, poultry) when improperly cooked or stored, as well as dried mixes when rehydrated and stored at inadequate temperatures, are most commonly involved in outbreaks of *C. perfringens* poisoning (11c,19,25).

In contrast to illness associated with *C. perfringens* which, in general, are common but mild, *Clostridium botulinum* can produce a neurotoxin that causes botulism, a very serious, even fatal disease (11c,19). Botulism traditionally has been associated with contaminated canned foods (11c,19,26). Recently, however, other foods such as potato salad, sauteed onions, and chopped garlic have been implicated in botulinum food poisoning (26,27). Symptoms of botulism appear within 12 to 36 hours after consuming the contaminated food and generally involve the nervous system. Dizziness, blurred vision, respiratory failure, and other neurological disorders may occur, followed by death if a suitable antitoxin is not administered (11c,25,26). Heating canned foods at a temperature high enough to kill *C. botulinum* spores or keeping foods under refrigeration helps prevent botulism (25).

In adults, botulism typically results from intake of the preformed toxin in contaminated food. However, in the mid-1970's, a condition called infant botulism was described in which the neurotoxin was produced in infants' intestinal tract following multiplication of *C. botulinum* (26). Now infant botulism in an adult has been verified (32,33). In this case, the toxin was produced *in vivo* rather than consumed per se (32,33). The presumed agent of infant botulism is a food source that contains *C. botulinum* spores but lacks the preformed toxin (32). Individuals with gastric achlorhydria or an altered intestinal flora may be particularly susceptible to this type of botulism (32). The discovery of infant botulism has led to concern that the spectrum of botulism may be expanding (33).

Although *Campylobacter jejuni* was isolated from animals over 80 years ago, only within the last decade has this pathogen been recognized as a cause of foodborne disease in humans (19,21,27). Nearly all outbreaks of *Campylobacter* illness, in particular acute gastroenteritis, are associated with raw or inadequately cooked foods of animal origin (19,21). Raw milk, for example, recently has been identified as the vehicle for *Campylobacter* outbreaks in over 250 persons in Kansas (34), as well as 39% of 38 individuals who attended a banquet in Wisconsin (35), and 88% of 25 college students at a weekend retreat in Oregon (36). In addition to raw milk, other foods such as undercooked chicken, processed turkey, raw clams, and raw hamburger, as well as unchlorinated water have been implicated in outbreaks of *Campylobacter* enteritis (10,19,21). In general, the symptoms of *Campylobacter* infection resemble those of other foodborne illnesses and include nausea, malaise, abdominal cramps, headache, diarrhea, and sometimes fever (10,21). Other common symptoms of this foodborne disease include urinary tract infections and reactive arthritis (10). Because *Campylobacter jejuni* is a slow growing bacterium, the onset of symptoms is delayed, occurring generally three to five days after intake of the contaminated food (27). Most patients recover in less than one week and death is rare (10,21). Although this organism is associated with many foods of animal origin, thorough cooking of foods, especially meat and poultry, pasteurization of milk, and proper handling of food are practical means of eliminating the possibility of contamination with this bacterium (21).

Another new bacteria in the news is *Yersinia enterocolitica* (11c,21). Although recognized as a human pathogen since 1939, it was not until 1976 when isolated outbreaks of yeriniosis, the disease caused by *Yersinia enterocolitica,* increased our awareness of this organism (21). Foods implicated in recent incidences of foodborne illness caused by *Yersinia enterocolitica* include chocolate milk, reconstituted dry milk, pasteurized milk and tofu (11c,26). The usual explanation for these outbreaks is postprocessing (e.g., postpasteurization of milk) contamination with *Yersinia enterocolitica* (26,27,37). Symptoms of infection from this organism include diarrhea, fever, headache, and severe abdominal pain which mimics acute appendicitis (21). Unfortunately, the appendicitis-like symptoms have led to some unnecessary appendectomies (21,27). Infection with *Yersinia enterocolitica* also can trigger arthritis, myocarditis, and other disorders (21,27). *Yersinia enterocolitica* has been isolated from a wide variety of animals, foods, and water sources (26,37). Moreover, it is one of only a few species of foodborne bacteria that grow under refrigeration (11c,21,27,37). This means that cold storage, a traditional means of preventing the growth of many food poisoning bacteria, is ineffective in controlling the growth of *Yersinia enterocolitica* in foods (21,37). Therefore, other measures such as sufficient heat treatment (e.g., proper pasteurization of milk) must be taken to inactivate this pathogen (21). The good news is that the strains of *Yersinia enterocolitica* primarily associated with human illness are not prevalent in foods (21). This helps explain why there are relatively few human outbreaks of yersiniosis in the United States (21,26).

Recent food-related outbreaks associated with *Listeria monocytogenes* have brought this pathogen to the attention of both health professionals and the public, although the microorganism has been recognized for over 50 years (21,27,38,39). The first documented report of foodborne illness caused by *Listeria monocytogenes* in North America occurred in 1981 in the maritime provinces of Canada and was linked to commerically prepared coleslaw (21,37-39). In 1983, a specific brand of pasteurized whole or 2% milk was implicated in an outbreak of listeriosis (i.e., a non-contagious infection caused by the

bacterium, *Listeria monocytogenes)* in Massachusetts that involved 42 adults and 7 infants (40-42). This was followed in 1985 by contamination of a soft Mexican-type cheese in California that caused several hundred recorded cases of listeriosis, mostly among Hispanics (27,38,39,42). More recently, *Listeria monocytogenes* has been isolated from other varieties of domestic and imported soft cheeses such as Brie (27). These sporadic outbreaks, however, are rare, especially in relation to the widespread distribution of *Listeria monocytogenes* in the environment (21,27,41). But this does not mean that listeriosis is not cause for concern.

Most healthy people can overcome infection by *Listeria monocytogenes* by virtue of cell-mediated immunity (41). For these individuals, transient, mild flu-like symptoms such as fever, headache, or vomiting may occur (41). In contrast, newborns, pregnant women, and individuals with compromised immune systems (e.g., patients undergoing chemotherapy for cancer treatment) are particularly susceptible to listeriosis (21,38,39,41,42). In these persons, the manifestations of listeriosis may be severe and include meningitis, abortion, and perinatal septicemia (i.e., the infant is born alive but dies shortly after birth) (21,26). The onset of symptoms may occur four days to three weeks after consuming the contaminated food (39). The mortality rate in susceptible individuals with listeriosis is 30 to 40% (21,38-40,42). *Listeria monocytogenes* grows and multiplies under refrigeration (37,39). Optimal growth occurs at 30-37°C, although the organism can grow at temperatures as low as 3°C to as high as 45°C (39). Also, this organism tends to grow best under neutral or alkaline conditions. *Listeria monocytogenes,* however, is heat sensitive (26). While there is some academic debate about whether this organism can survive pasteurization (39), recent studies (43,44) have found that under normal operating conditions pasteurization of milk in compliance with the Grade A Pasteurized Milk Ordinance (4) (i.e., 72°C or 161°F for 15 seconds) is sufficient to destroy *Listeria monocytogenes*. In the recent isolated incidences involving *Listeria*-contaminated milk and cheese products, current evidence suggests that the pasteurization process itself was adequate, but that contamination occurred following pasteurization (27,38-40). Industry and government agencies are working to prevent postpasteurization contamination of milk and to learn more about *Listeria monocytogenes,* including the minimum amount of *Listeria monocytogenes* which must be consumed to elicit illness in humans, the incidence rate of listeriosis, and whether or not different strains of this bacterium vary in their virulence (39).

*Escherichia coli* is a common inhabitant of the intestinal tract of humans and animals (26). While this microorganism long has been considered harmless, certain strains of *E. coli* now are being recognized as pathogenic. Moreover, food has been identified as a vehicle for transmission of these organisms (21,26,45). Since 1982, a few sporadic food-associated outbreaks of gastroenteritis linked to *E. coli* 0157:H7 have occurred (21). Consumption of a ground beef sandwich prepared at restaurants belonging to the same chain was associated epidemiologically with two outbreaks of gastroenteritis in Oregon and Michigan in 1982 (21). In these outbreaks, *E. coli* 0157:H7 was linked with a clinically distinctive disorder characterized by severe abdominal cramps and bloody diarrhea (21,26). *E. coli* 0157:H7 also has been associated with hemolytic uremic syndrome, a leading cause of acute renal failure in children (21). Because of the severity of illnesses associated with *E. coli* 0157:H7, appropriate measures need to be taken to prevent contamination of foods with this organism (21). Unfortunately, little is known about the source and prevalence of *E. coli* 0157:H7. However, thoroughly cooking meat and avoiding recontamination should protect against illnesses caused by pathogenic strains of *E. coli* (26).

## Control and Prevention of Foodborne Bacterial Illnesses

Of the foodborne microbial disease outbreaks reported to the Centers for Disease Control over a five-year period, 77% were traced to foodservice establishments, 20% to homes, and 3% to food processing plants (26). That is, 97% of all reported foodborne bacterial illness results from mishandling food in either foodservice establishments or homes (26). To lower the incidence of foodborne disease, it is important therefore to educate food handlers and consumers about proper handling of food, sanitation procedures, and personal hygiene (3,11c,26).

A number of government agencies at the federal, state and local level are involved in maintaining the safety of our food supply (19,46). Meat, for example, is regulated by the Food Safety and Inspection Service, a United States Department of Agriculture (USDA) agency that inspects all meat and poultry slaughtered in the United States (23). Microbiological monitoring and surveillance of plants and products are a primary concern of this agency. The FDA, on the other hand, is responsible for protecting the safety, sanitation, and nutritional quality of all other foods in interstate commerce (46,47). This agency accomplishes its mission through inspections and surveillance of various segments of the food industry, sample analyses of food, and when necessary enforcement actions such as seizures or plant recalls and prosecutions (11c). The FDA has established regulations and voluntary guidelines for protecting the safety of the food supply. This agency works cooperatively with state and local authorities and provides the general public with information and educational programs to reduce exposure to foodborne microbial contamination (46,47). The general public in turn has a role in reporting an illness suspected to be food-related to public health authorities (11c). Regulatory agencies then can investigate suspected outbreaks, interpret the findings, and disseminate the information to prevent further occurrences (3,48).

Of all the food industries, the dairy industry is considered to be the most regulated (19). The FDA has the

responsibility under the Food, Drug and Cosmetic Act and the Public Health Service Act to assure the public that the nation's milk supply is uniformly safe and wholesome. Milk sanitation laws and regulations followed by most state and local authorities are based almost exclusively on the Public Health Service/FDA's Grade A Pasteurized Milk Ordinance (4,23). Microbiological criteria for most dairy foods are specified in this document (4,23).

To ensure the microbiological safety of dairy foods, three measures are necessary: (i) pasteurization or more severe heat treatment, (ii) prevention of postpasteurization contamination, and (iii) end-product testing for microorganisms and toxins in certain products (23). Proper pasteurization of milk is the primary factor responsible for milk safety (6,49). About 1% of all milk consumed in the United States is unpasteurized or raw, and yet raw milkaccounts for about 95% of all outbreaks of milkborne illness reported over the past 30 years (31,49). As mentioned above, a number of foodborne diseases are associated with raw milk consumption, notably salmonellosis and campylobacteriosis (34-36). Despite the claims of raw milk advocates, there is no scientific evidence that raw milk is nutritionally superior to pasteurized milk or that it has unique health benefits (49). The recent outbreak of a newly recognized chronic diarrhea syndrome associated with raw milk intake emphasizes the hazards posed by this food (50,51).

Increased attention now is being given to protecting milk and other dairy foods after pasteurization (52,53). As a result of the recent sporadic outbreaks associated with pasteurized milk and milk products, the FDA, in cooperation with state public health and regulatory agencies and the dairy industry, has intensified its inspection and micro-biological surveillance of various types of dairy processing plants, other dairy operations and products (52,53). These actions are intended to minimize the risk of postpasteurization contamination of milk associated with equipment failure or operator error (53). In most of the recent foodborne incidents involving pasteurized milk and other dairy foods, postpasteurization contamination of milk is suspected because the pasteurization process itself was effective in killing most microbial pathogens (27,38-40,53). The FDA also has initiated more intensive training programs for federal and state dairy inspectors as well as educational programs for dairy industry personnel (52,53). The FDA recognizes that pasteurized milk is one of the safest foods consumed in the United States (52). However, this government agency, as well as the dairy industry is concerned about the recent sporadic milk-related disease outbreaks and is taking steps to minimize the likelihood of future occurrences (52,53).

## OTHER FOOD SAFETY CONCERNS

In contrast to the established data on food safety which reveal micro-biological contamination to be the greatest threat, the general public perceives intentional and unintentional additives in food as major food safety issues (2,8).

### Intentional Additives

Approximately 2,800 food additives are used to maintain or increase foods nutritional value, preserve freshness (e.g., antioxidants, antimicrobial agents), make food taste (e.g., sugar, salt) or look (e.g., colors) better, and aid in its processing and/or preparation (2,5,6,54). Without food additives, it would be impossible for food to be safely produced in massive quantities and transported nationwide or worldwide as is done in the 20th century (6,54). Despite consumers' concerns about the safety of food additives, food additives are extensively studied and regulated (1,2,6,11d). Moreover, most food additives have a large margin of safety (16).

The FDA regulates food additives through the Federal Food, Drug and Cosmetic Act. Passage of the Food Additives Amendment in 1958 and the Color Additives Amendment in 1960 makes it necessary for the food industry to demonstrate the safety of a new food additive before approval by the FDA (54). This means that the manufacturer bears the responsibility for conducting scientific tests to establish the safety of a new food additive. Before 1958, it was the FDA's task to prove that an additive was either safe or dangerous. The hundreds of additives used in foods before the 1958 amendment were placed on the FDA's GRAS (generally recognized as safe) list (54). Many of these additives subsequently have been reviewed by the FDA and either have been approved for continued use, recommended for further study, or banned (6). As part of the 1958 Food Additives Amendment, the Delaney Clause prohibits the use of any additive that causes cancer in man or animals, regardless of the amount required to cause the disease. Because of advances in technology, liberalization of the "zero risk" standard of the Delaney Clause has been proposed so that the health benefits of an additive may be weighed against its risk (6,55,56). In addition to the debate about updating the Delaney Clause, questions are being raised regarding whether specific additives should be banned if proven harmful for only a few people, and whether food manufacturers can produce acceptable products using smaller quantities of additives (6). Although the majority of food additives pose no significant hazard with usual use, the safety of approved food additives is reviewed periodically (11d).

### Unintentional Additives

Unintentional additives or unavoidable contaminants in food that are of concern include mycotoxins, antibiotic residues, and chemical contaminants such as pesticide residues.

Mycotoxins, which are toxic substances produced by molds under certain environmental conditions, have threatened human health for centuries (1,57,58). Many, but not all, molds that form on foods can produce myco-

toxins. Although there are many mycotoxins, aflatoxins are the best known and of greatest concern because of their toxicity and potential carcinogenicity (57). Foods most susceptible to aflatoxin contamination in the United States are peanuts, corn, and cottonseed after they are harvested and stored (57). Although aflatoxins are of natural origin, the FDA considers them added, although unavoidable, contaminants (57). There is no direct evidence of mycotoxin involvement in foodborne disease in humans, but there is considerable indirect evidence (57,58). The FDA therefore has set practical limits or action levels for aflatoxins in foods and animal feed (57). Moreover, most U.S. food processors are even stricter than the FDA in monitoring aflatoxins in food ingredients and finished products (*57*). To protect against mycotoxin contamination consumers should prevent the growth of mold on foods by properly storing and using foods within a reasonable length of time (*57*). If mold does develop, it is best to remove it before contamination is minimal, especially in relation to other environmental hazards. However, the amounts and kinds of mycotoxins in our food supply continue to be evaluated (*57,58*).

Antibiotic residues per se in animal foods generally are of little concern (6). In fact, the law requires producers to wait a specified time after administering antibiotics to animals to treat disease before animals are slaughtered or before eggs or milk are used as food (19). To ensure compliance with this law, the USDA, as part of its national residue program, routinely monitors animal foods for antibiotic residues (15,19,59,60). The use of low levels of antibiotics in animal feed, however, theoretically could promote the development of antibiotic-resistant bacteria which might cause disease in humans (6,28-30,50-67). Since the early 1950s, many livestock and poultry producers have added subtherapeutic doses of antibiotics such as penicillin and tetracycline to animal feed to increase growth rates, control the spread of disease, and produce meat at lower prices (6,60,64,66). The concern is that following prolonged exposure to these antibiotics, traditional bacteria in animals will be suppressed at the expense of new resistant strains that eventually will contribute to serious diseases especially in individuals already taking antibiotics for these illnesses (28,61,66). Recently, researchers from the Centers for Disease Control have implicated hamburger meat as the source of antibiotic resistant *Salmonella newport* in two separate incidences of Salmonella infections (61,67). In both cases *Salmonella newport* was traced to farm animals receiving subtherapeutic levels of antibiotics (61,67). It is noteworthy that many of the individuals who developed salmonellosis had been taking antibiotics for other medical problems (61,67).

While some scientists and consumers have called for a ban on the use of subtherapeutic levels of antibiotics in animal feed, others disagree (59,60,64-66). Opponents claim that the evidence is insufficient to quantify the risk to humans and that discontinuing subclinical antibiotic use in animals would have a negative economic impact (60). The health consequences of subtherapeutic levels of antibiotics in animal feed continue to be debated among public health officials, the scientific community and the media.

Modern technology with its use of pest control substances, particularly halogenated hydrocarbon pesticides, and other industrial chemicals is responsible for the abundance and variety of our food supply. Yet, this same technology is blamed for adding unwanted chemicals to our environment, and in particular, to our food (1). Although chemical contaminants can be added inadvertently to the food supply, regulatory controls in terms of permitted levels in foods minimize human exposure (6,11e). The Environmental Protection Agency (EPA), for example, must approve all pesticides before they are sold in the United States. Also, tolerance levels are established for allowable pesticide residues in food (6,11e). In general, these are 100 times below the level considered to be harmful (6,11e). The FDA, under its pesticide monitoring program, collects and samples food nationwide for pesticide residues and other chemical contaminants, if the maximum allowable levels are exceeded, regulatory action is taken and the food is removed from the marketplace. Food and agricultural industries work closely with federal, state, and local regulatory agencies to minimize and/or eliminate chemical contamination of food. Nevertheless, irresponsible or accidental use of chemicals has led to some isolated incidents (11e,68,69). Although the general public regards chemicals as a major cause of food-related illnesses, our Nation's food supply is very safe, particularly from a chemical standpoint (4). It is obvious, however, that the benefits of modern technology are not without some degree of risk (1).


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# *A Comparison of Ground Water Monitoring Data From CERCLA and RCRA Sites*

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## Background

The number of hazardous waste disposal sites in this country has been estimated to be as high as 50,000 (Everett, et al. 1982). The responsibility for investigating and/or monitoring the potential impact of these sites on the ground water resource has been vested in two major governmental programs. The Resource Conservation and Recovery Act (RCRA) Program (U.S. EPA 1985a) has been developed to monitor the approximately 800 active hazardous waste disposal facilities (Vincent 1986). The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Program (U.S. EPA 1985b) has been developed to investigate and remediate potential problems as inactive hazardous waste disposal sites.

The technical approaches that have been specified for monitoring ground water conditions in the vicinity of hazardous waste disposal sites are quite different for these two programs. The RCRA program established a minimum requirement of a four-well monitoring network (one upgradient well and three downgradient wells) to be installed and sampled by the owner/operator of a hazardous waste disposal facility. The required level of sample characterization is based on the regulatory status of the RCRA facility and generally increases as the site progresses from interim status (detection monitoring) to assessment monitoring to permitted (U.S. EPA 1985c). Sites initially classified as interim status must undertake a uniform analytical program consisting of four indicator parameters (pH, specific conductance, total organic carbon, and total organic halogen), 11 metals, seven organic compounds, four anions, three radioactive measurements, and one biological parameter (U.S. EPA 1985c). When a significant indicator parameter increase in detected and confirmed in a downgradient location, the facility is reclassified into the assessment monitoring program. The recently released RCRA Ground Water Monitoring Technical Enforcement Guidance Document (U.S. EPA 1986) requires these sites to install additional wells as necessary to characterize the rate and extent of contaminant migration and to analyze samples for 359 Appendix VIII constituents. By comparison, the CERCLA program has no minimum sampling network, no required sampling frequency, and no mandatory analytical program. CERCLA monitoring programs are established by government personnel on a site-by-site basis.

The preceding information is presented to contrast the level of specific monitoring guidance provided by the two programs responsible for investigating/monitoring the impact of hazardous waste disposal sites on ground water. The reader is referred to program descriptions and implementation guidance documents for a more detailed discussion of the objectives and approaches of the two programs (U.S. EPA 1985a, U.S. EPA 1985b, U.S. EPA 1985c, U.S. EPA 1985d, U.S. EPA 1986, Geotrans 1983).

A project had been initiated to evaluate the capability of the RCRA indicator parameters to monitor changing ground water conditions (Plumb and Nacht 1984, Plumb and Fitzsimmons 1984). The approach taken to achieve this objective was to compile existing ground water data that had been generated during the investigation and/or monitoring of hazardous waste disposal sites. Because the compiled data were obtained from both RCRA and CERCLA programs, the resultant data base offers a unique mechanism to contrast the two programs. The remainder of this paper will discuss distinct difference that have been identified between the data sets from each monitoring program and implications of these differences on the development of a ground water monitoring strategy.

## Data Compilation

Ground water data generated through the required monitoring of RCRA hazardous waste disposal facilities and the investigation of uncontrolled hazardous waste disposal sites (CERCLA sites) were obtained with the cooperation and assistance of personnel in the EPA offices of Solid Waste and Emergency and Remedial Response, EPA regional offices. This effort resulted in the accumulation of ground water quality data from more than 5000 wells at 334 hazardous waste disposal sites (178 CERCLA sites and 156 RCRA sites) in all 10 EPA regions and 42 states. The present data base consists of analytical records

for 958 chemical species for which analyses have been attempted, including 794 organic compounds and 164 inorganic species (dissolved and total concentrations for the same inorganic species were treated separately). These results are based on site investigations that occurred between 1981 and 1984. Additional information on the data base has been presented elsewhere (Plumb 1985, Plumb 1986, Plumb and Pitchford 1985).

## Comparison of Monitoring Programs

The composited data provided a basis to compare the two regulatory strategies being used to monitor ground water in the vicinity of hazardous waste disposal sites. The program elements that were evaluated included the size of the monitoring well network, the frequency of sampling, and the analytical results for monitoring.

### Monitoring Networks

One important factor in characterizing ground water conditions during a site investigation is the size of the monitoring well network. The number of wells utilized at 123 RCRA sites and 178 CERCLA sites are summarized in the histograms presented in Figure 1. Based on this information, 72 percent of the RCRA networks consisted of 10 or fewer wells, the most frequently encountered well network size of RCRA sites was four wells, and 6 percent of the RCRA sites utilized a well network smaller than the regulatory minimum of four wells (U.S. EPA 1985a, U.S. EPA 1985c). By comparison, only 54 percent of the CERCLA networks consisted of 10 or fewer wells, yet the most frequently encountered well network size at CERCLA sites was three wells, and 30 percent of the CERCLA investigations used three wells or less. The shaded areas of Figure 1 represent monitoring programs that would not satisfy the minimum specified RCRA guidelines.

An inspection of the RCRA site information revealed that 94 percent of the sites utilized a monitoring well network that equaled or exceeded the minimum specified network of four wells. However, one observation that is potentially more important than the small percentage of sites not in compliance with the minimum RCRA regulatory program is the relatively high percentage of sites at which the monitoring well locations were not completely identified. Fifteen percent of the RCRA sites in the data base had no designated downgradient wells and 23 percent of the RCRA sites had no designated upgradient wells. The practice of incomplete or inaccurate labeling of monitoring well locations will reduce the effectiveness of the RCRA program because the strategy relies on the detection of significant indicator parameter increases in downgradient wells to identify sites from which contaminants may be migrating and for which more extensive assessment monitoring is necessary (U.S. EPA 1985c).

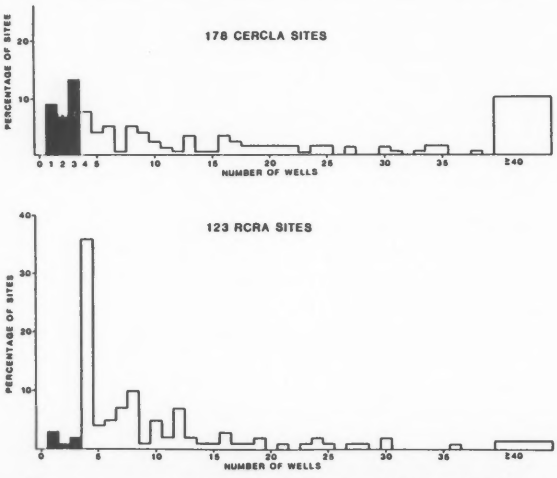


**Figure 1. Comparison of number of wells at RCRA and CERCLA sites**

It is not possible to make a similar assessment of the CERCLA program because there is no specified minimum CERCLA monitoring network. It should be noted, however, that 30 percent of the CERCLA site investigations have utilized a monitoring network of three wells or less. Small networks such as this are not sufficient to define the ground water gradient or the direction of ground water flow. Also, to the extent that a minimum four-well network (as specified in the RCRA requirements) is necessary, a large percentage of the CERCLA investigations cannot be producing sufficient data to adequately characterize the occurrence and distribution of ground water contaminants in the vicinity of these sites. One additional disadvantage of a small monitoring network is the fact that the failure to detect contaminants is not a reliable indication that a particular site is not affecting ground water quality.

### Sampling Frequency

A second important factor in ground water monitoring programs is the frequency of sampling events. In order to compare the sampling frequency in each regulatory program, the reported number of sampling events per year for each site was tabulated over a period of record. This information was then presented as a histogram, shown in Figure 2. The most frequently implemented sampling frequency at RCRA sites was fur events per year (47 percent), which corresponds with the interim status detection monitoring requirements (U.S. EPA 1985c). However, the information in Figure 2 demonstrates that a substantial number of site monitoring requirements. By comparison, the most frequently utilized sampling frequency at CERCLA sites was one event per year (50 percent). Although there are no formal CERCLA monitoring requirements, the low sampling networks suggests that efforts to characterize ground water contamination at CERCLA sites may be inadequate.

### Sample Characterization

The composite data base also provides a mechanism to compare the two regulatory programs based on the number of contaminants that have been detected in found

water (Table 1). CERCLA monitoring at 178 sites resulted in the detection of 480 constituents in the vicinity of one or more sites. In addition,another 220 organic compounds were tentatively identified as being present but at concentrations too low to quantitate (Plumb 1985, Plumb 1986). The number of contaminants detected as a result of routine RCRA monitoring at 156 sites is only 100. Thus, the RCRA monitoring programs generated data on only 21 percent of the contaminants that might be expected to occur in ground water at hazardous waste disposal sites based on the composite CERCLA data (Table 1).

The composite RCRA data were also divided into appropriate subsets (i.e. Texas Sites, Louisiana sites, and miscellaneous sites) for evaluation. Although the analytical results for each of the RCRA subsets equaled or exceeded the minimum monitoring requirements, the number of detected compounds dropped as low as 6 percent of the CERCLA compounds at the miscellaneous sites (Table 1). There are several factors that can contribute to this situation. First, many of the CERCLA sites may be abandoned or may have no effective management plan to control off-site migration of waste materials disposed of at the site. This would result in a larger number of contaminants reaching ground water. Second, CERCLA investigators have more latitude to create site-specific monitoring programs. The flexibility to perform analyses for a larger number of contaminants is likely to result in a larger number of contaminants being detected. Third, the composite data base suggests that the required RCRA analytical program does not effectively target the expected occurrence of contaminants. Specifically, GC/MS analyses have not even been attempted at the Texas

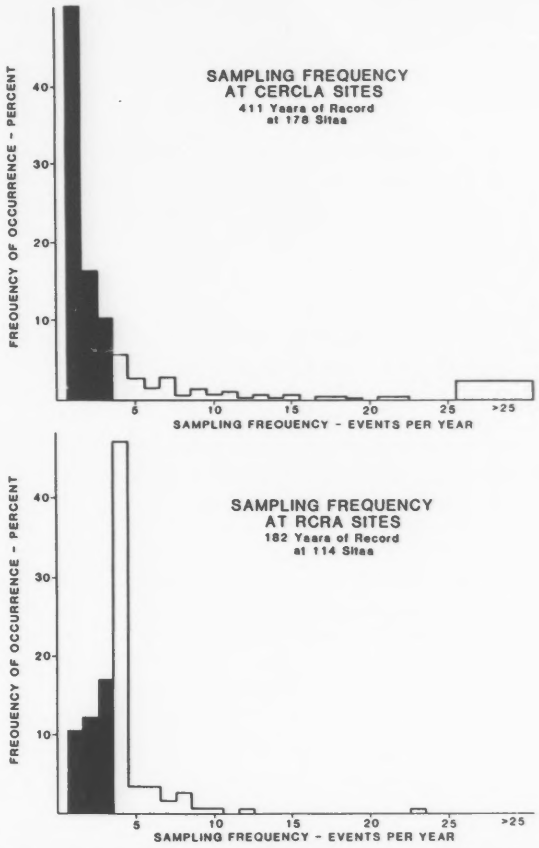


**Figure 2. Frequency of sampling events at CERCLA and RCRA sites**

## TABLE 1
## Classification and Number of Chemical Contaminants Detected in Ground Water

| | CERCLA Sites | Texas RCRA Sites | Louisiana RCRA Sites | Miscellaneous RCRA Sites | Combined RCRA Sites |
|---|---|---|---|---|---|
| Number of Sites | 178 | 117 | 17 | 20 | 156 |
| Inorganic Constituents | | | | | |
| Cations | 70 | 19 | 25 | 11 | 26 |
| Anions | 32 | 6 | 7 | 4 | 7 |
| Radioactive Constituents | 6 | 3 | 3 | 3 | 3 |
| Physical Constituents | 34 | 6 | 10 | 5 | 10 |
| Organic Priority Pollutants | | | | | |
| Volatiles | 31 | 0 | 16 | 0 | 16 |
| Base/Neutrals | 44 | 1 | 10 | 0 | 11 |
| Acid Extractables | 11 | 1 | 2 | 1 | 2 |
| Pesticides | 25 | 7 | 10 | 3 | 12 |
| Non-Standard Priority Pollutants | 15 | 0 | 0 | 0 | 0 |
| Miscellaneous Organic Constituents | 212 | 4 | 12 | 3 | 13 |
| Totals | 480 | 47 | 95 | 30 | 100 |
| Percentage of CERCLA Compounds, % | 100 | 9.8 | 19.8 | 6.2 | 20.8 |

and "miscellaneous" RCRA sites, which could explain the low occurrence of organic priority pollutants, non-standard priority pollutants, and miscellaneous organic constituents relative to those observed at the CERCLA sites.

Frequency of detection data for the general classes of contaminants that have been reported in ground water during hazardous waste site investigations are summarized in Table 2. An inspection of this information reveals that the frequency of detection of classes of contaminants in CERCLA site ground water decreased in the following order: indicators, inorganics, miscellaneous organics, volatile compounds,acid extractable compounds, base/neutral compounds, and pesticides. The composite data from RCRA sites followed an identical progression. In fact, the calculated frequency of detection for inorganics, base/neutral compounds, acid extractable compounds, pesticides, and indicators was similar in the composite data from both regulatory programs (Table 2).

Because of the observed similarity of monitoring results for classes of contaminants, the frequency of detection of the required RCRA analytes (except pesticides) in both sets is compared in Figure 3. The fact the most of these comparisons center around the 45° diagonal indicates that the similarity observed between CERCLA and RCRA data for the general class of inorganic constituents (Table 2) also appears to be valid for most individual inorganic constituents. It should also be noted that the required RCRA inorganic analytes cover the broad range of conditions that can be expected (Mg, Ca, Na, and Mn are detectable 80 to 100 percent of the time; Pb, Ni, and Ba are detectable 35 to 70 percent of the time; and Sb, Ag, and Hg are detectable 0 to 20 percent of the time).

The observed frequency of detection of the seven RCRA organic analytes in ground water during hazardous waste disposal site investigations is summarized in Table 3. Each of the six pesticides had a similar frequency of occurrence in ground water at RCRA sites and CERCLA sites. The largest difference noted in Table 3 occurs with phenol data and is probably due to the use of different analaytical methods. The CERCLA detection frequency of 13.6 percent is based on a GC/MS analaytical method for acid extractable compounds that is specific for phenol while the RCRA detection frequency of 40.6 percent is based on a conventional distillation-colorimetric analytical method for phenol. The colorimetric method will test positive for non-priority pollutant and naturally occurring phenolic compounds, as well as phenol. (The reported frequency of detection of phenol in ground water at CERCLA sites when the wet chemical method is used is 33.4 percent.)

All of the organic contaminants detected during CERCLA site monitoring were rank-ordered based on the frequency of detection of each compound. The data in Table 3 were compared to the rank-ordered list to determine the relative importance of the designated RCRA

**TABLE 2**
**Frequency of Detection of Classes of Ground Water Contaminants Based on the Program Classification of the Site**

| Class of Compounds | CERCLA Data | | | RCRA Data | | |
|---|---|---|---|---|---|---|
| | Detectable Events Reported | Total Analyses Reported | Detection Frequency (%) | Detectable Events Reported | Total Analyses Reported | Detection Frequency (%) |
| Inorganics | 41,003 | 71,752 | 57 | 33,106 | 61,369 | 54 |
| Volatiles | 16,141 | 139,371 | 12 | 100 | 2640 | 4 |
| Base/Neutrals | 680 | 66,347 | 1 | 21 | 1736 | 1 |
| Acid Extractables | 401 | 16,229 | 2 | 20 | 464 | 4 |
| Pesticides | 514 | 42,670 | 1 | 228 | 16,864 | 1 |
| Non-Standard Priority Pollutants | 359 | 11,570 | 3 | 0 | 0 | – |
| Miscellaneous Organics | 1854 | 12,523 | 15* | 49 | 103 | 48* |
| Indicators | 12,967 | 13,572 | 96 | 30,550 | 33,684 | 91 |

*Detection frequency for miscellaneous organic compound is biased high due to the method of reporting results.

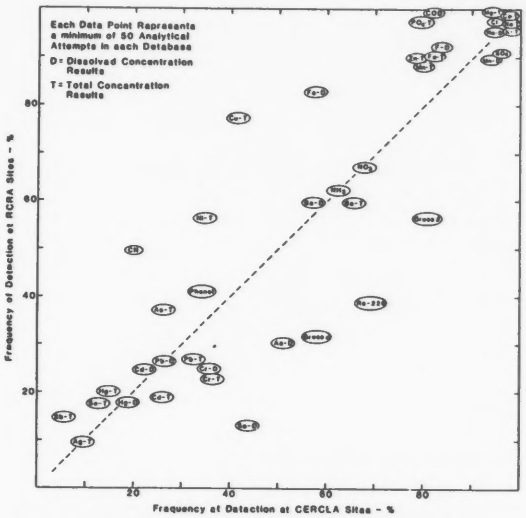


**Figure 3. Frequency of occurrence of selected ground water contaminants at RCRA and CERCLA sites**

**TABLE 3**
**Comparison of Frequency of Detection Data for Required RCRA Organic Analytes in CERCLA and RCRA Data Bases**

| Required RCRA Analyte | CERCLA Detection Frequency (%) | CERCLA Rank | RCRA Detection Frequency (%) | RCRA Rank |
|---|---|---|---|---|
| Phenol | 13.6 | 10 | 40.6 | 2 |
| 2,4-D | 7.7* | 17 | 2.3 | 35 |
| Lindane | 4.8 | 22 | 1.8 | 39 |
| Silvex | 2.4* | 33 | 1.4 | 44 |
| Endrin | 0.9 | 58 | 1.3 | 47 |
| Methoxychlor | 0.7* | 66 | 0.8 | 64 |
| Toxaphene | 0.2 | 97 | 1.1 | 53 |

*Based on less than 500 analyses. All other detection frequencies based on more than 1500 analyses.

analytes. The only RCRA analyte included in the 15 most frequently detected organic compounds is phenol, which was ranked 10th with CERCLA data or second with RCRA data. Three of the RCRA analytes (endrin, methoxychlor, and toxaphene) were ranked 58th or lower. When the ground water contaminants were rank-ordered based on average concentration, maximum concentration, or the number of sites at which a contaminant has been detected in the ground water, the same result was obtained (i.e. the only RCRA analyte included in the top 15 contaminants was phenol) (Plumb and Pitchford 1985).

A review of the information in Table 3 reinforces the earlier statement that the RCRA analytical program is not adequate to detect the organic contaminants that are likely to be present during the investigation and/or monitoring of a waste disposal site. However, it is suggested that the effectiveness of the RCRA monitoring strategy can be significantly improved by modifying the program to include routine analysis for volatile organic compounds. This change would provide for direct monitoring of the nine most frequently detected organic contaminants and 13 of the 15 most frequently detected organic contaminants in the CERCLA data base (Table 4). In addition, the approach would target 38 of the 50 compounds that compose the two most frequently detected classes of organic contaminants in ground water (volatile organic compounds and non-standard organic priority pollutants)(Table 2).

One final observation is the similarity of monitoring results from CERCLA and RCRA sites for a broad spectrum of ground water contaminants. This situation suggests the possibility of developing a common technical monitoring program for use at both types of hazardous waste disposal sites. For example, a basic monitoring approach that relies on a select list of inorganic constituents (as specified in the RCRA detection monitoring program) and volatile organic compounds would provide direct monitoring for approximately 90 percent of the reported ground water contamination at both CERCLA and RCRA sites (based on the detectable events listed in Table 2 for all classes of compounds except indicators). Such an approach would provide reasonable confidence that a contaminant plume migrating off-site could be detected and the results could then be used to develop a detailed, site-specific monitoring program. Other benefits to be derived from the development and use of a common monitoring program at CERCLA and RCRA waste disposal sites included: 1) direct monitoring of the heavily manufactured and generally more mobile (volatile) organic solvents, and 2) more effective monitoring of organic contamination than provided by the RCRA detection monitoring program.

## Summary

Ground water monitoring data obtained during the investigation of 156 RCRA sites and 178 CERCLA sites were compiled to contrast the two regulatory monitoring programs. This comparison demonstrates that the RCRA site monitoring programs generally use larger sampling networks that are sampled more frequently than those used during CERCLA investigations but the RCRA samples are not analyzed as extensively as the CERCLA samples. The most frequently utilized network at RCRA sites was equivalent to the minimum regulatory requirement of four wells sampled four times a year. By comparison, the most frequently used monitoring network at CERCLA sites consisted of three wells sampled once a year. While there are no formal CERCLA requirements, the fact that a high percentage of these sites would not

**TABLE 4**
**Ranking of Organic Ground Water Contaminants Based on Frequency of Detection in the CERCLA Database***

| Rank Order | Contaminant | Class of Compound | Detection Frequency (%) |
|---|---|---|---|
| 1. | Trichloroethene | Volatile | 51.3 |
| 2. | Tetrachloroethene | Volatile | 36.0 |
| 3. | 1,2-trans-Dichloroethene | Volatile | 29.1 |
| 4. | Chloroform | Volatile | 28.4 |
| 5. | 1,1-Dichloroethene | Volatile | 25.2 |
| 6. | Methylene Chloride | Volatile | 19.2 |
| 7. | 1,1,1-Trichloroethane | Volatile | 18.9 |
| 8. | 1,1-Dichloroethane | Volatile | 17.9 |
| 9. | 1,2-Dichloroethane | Volatile | 14.2 |
| 10. | Phenol | Acid Extractable | 13.6 |
| 11. | Acetone | Volatile (non-standard) | 12.4 |
| 12. | Toluene | Volatile | 11.6 |
| 13. | bis-(2-ethylhexyl)-phthalate | Base/Neutral Extractable | 11.5 |
| 14. | Benzene | Volatile | 11.2 |
| 15. | Vinyl Chloride | Volatile | 8.7 |

*Composite data from 178 sites.

be considered to be in compliance with the RCRA program requirements suggests that many CERCLA investigations are not producing sufficient data to adequately characterize ground water conditions near these sites.

Samples collected during CERCLA investigations are subjected to more extensive chemical analysis than RCRA samples. Composite CERCLA data from 178 sites indicate that at least 102 inorganic chemical constituents and 378 organic compounds have been detected in the ground water and an additional 220 organic compounds have been tentatively identified as being present. A similar review of composite RCRA monitoring data from 156 sites suggests that only 33 inorganic substances and 54 organic compounds are present. This discrepancy is a result of the limited organic monitoring requirements of the RCRA program and the fact that the specific RCRA analytes are not representative of the most frequently detected organic ground water contaminants. A modification of the RCRA detection monitoring requirements, to include routine analysis for volatile organic compounds, would improve the effectiveness of the program by providing direct monitoring of the most frequently detected class of contaminants and 13 of the 15 most frequently detected individual organic contaminants.

A comparison of composite monitoring results from CERCLA and RCRA sites demonstrated that pesticides, base/neutral compounds, acid extractable compounds, and inorganic constituents were present at the same frequency of detection in both data bases. Because waste disposal is the principal activity at both types of sites, and the monitoring results are very similar, this situation favors the development of a basic monitoring program for use at both types of sites. It has been suggested that an analytical program consisting of volatile organic compounds and a select list of inorganic constituents would be suitable for this purpose. Such an approach would target the two most frequently detected classes of ground water contaminants in the composite data base (inorganic constituents and volatile organic compounds). In addition, the approach would standardize monitoring at CERCLA sites, improve organic monitoring RCRA sites, and possibly reduce analytical costs by limiting the analysis for infrequently detected ground water contaminants.

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personnel in both Las Vegas and Washington, it does not necessarily reflect the view of the EPA and no official endorsement should be inferred.

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*Dairy and Food Sanitation, Vol. 8, No. 3, Page 126 (March 1988)*


## *The Scientists Tell Me . . .*

# *Goat Meat and Milk Production in Kenya Evaluated Using Computer Simulations*

**by Marilyn Brown**

*(TAES Science Writer, Department of Agricultural Communications, Texas A&M University, College Station, TX 77843)*

The image of how goats can benefit humans has changed over the years. Previously, goats were commonly, and incorrectly, blamed for environmental degradation. Recent studies indicate that the animals tend to be the most robust of livestock species, being able to survive in poor as well as good environments, and are simply remnants left on abused pastures or grazing lands.

Goats are vitally important to the people of western Kenya, where they provide meat and milk and subsist on vegetation that is otherwise left unused. To fulfill the dual purpose of milk and meat production, feed for goats must be sufficient to provide growth, reproduction, and milk production.

Texas Agricultural Experiment Station animal scientist Tom Cartwright, with F. Ruvuna of Kenya and others, used computer simulations to evaluate the breeding, managements systems, and other production requirements for successful dual-purpose goat utilization in Kenya.

The genetic potential of present breeds is low, Cartwright says, and the feed resource base and problems with diseases and parasites also limit productivity.

Community interest in dual-purpose goats with one-half dairy breeding is high, Cartwright says. Important dairy breeds do not produce and survive well in Kenya under typical smallholder farm conditions because of the lack of adaptability to the stressful environments.

The focus of the computerized breeding project, then, was to develop a new breed of goats with the capability to live, grow, reproduce, and produce milk within an environment that feasibly could be provided by Kenyan farmers.

Animals that are half-native and half-dairy were found to be the optimal combination. The use of four breeds - two native and two European - provided advantages for selection potential and for retaining hybrid vigor.

One of the advantages of conducting analyses by computer simulation, Cartwright says, is that various options can be examined in a short time. The researcher used simulation models to discover optimal flock sizes (four to six mature does); two native breeds' genetic potential for milk production compared to that of the crossbred; and two diets, one including storage forage.

Cartwright found that only six-doe flocks on the base diet plus forage provided a satisfactory stability of dairy milk supply.

Successful production also is dependent upon forage, which varies in quantity and quality throughout the year.

"Flocks must be managed so that fluctuating nutrients demands that vary with the growth, pregnancy, and lactation status of each individual tend to coincide best with the seasonal forage variation of the basal diet," Cartwright says.

Simulations showed that the stability required short-term storage of feedstuffs for use during the critically deficient periods and the development of additional feed resources, the researcher says.

When the animals were not lactating, the protein and energy requirements of the does were met by the available diet, but when the animals were lactating, energy was the most limiting nutrient.

A major management consideration is the optimal amount of dairy milk to extract without hindering kid performance, the researcher says. The research found that allowing the kids to consume about half the milk, when does were supplemented, resulted in intermediate weaning weights and adequate dairy milk yield.

Already, Kenya is putting the results of the research to use. The breeding herd has been established and does of the new breed were first mated in January f this year. F-1 crosses have been released to farmers, and their feedback on the performance of the crosses and their progeny will be valuable, Cartwright says.

*Dairy and Food Sanitation, Vol. 8, No. 3, Pages 127-130 (March 1988)*


# A Progress Report On AIDS Research

**by Marian Segal**

*(A member of FDA's public affairs staff, reprinted from FDA Consumer/October 1987)*

The scientist is hunched over his test tube, intent on the cloudy contents. Suddenly he jumps up, arms raised in exultation, and shouts, "Eureka! I've found it!"

Isn't that how it's supposed to happen? Maybe so, but that's what movies - not science - are made of. It's clear that discovery of a vaccine or cure for AIDS will not be signaled by one triumphant eureka. Rather, success will be the culmination of many small, often tedious, steps in medical research. Given the ravages of this disease and its relentless spread, the rate of progress may seem painfully slow.

But in fact there has been an amazing amount of research - and progress - on acquired immune deficiency syndrome. According to Dr. Anthony S. Fauci, director of the National Institute of Allergy and Infectious Diseases (NIAID) and coordinator for AIDS research at the National Institutes of Health (NIH), scientists have learned "more about the nature of the AIDS virus, its component structures and their functions, and its mechanisms of pathogenesis [disease development in a shorter period of time than...any other infectious agent." Still, this tiny virus, which barely qualifies as a life form, remains undefeated in the war it has waged with man.

The AIDS virus (HIV, or human immunodeficiency virus) belongs to a family of recently recognized "retroviruses." Its outer shell, or envelope, surrounds a protein core that protects its genetic material, RNA (ribonucleic acid). To infect a cell, the virus attaches to a receptor on the cell's surface, enters the cell, sheds its outer coat, and releases its RNA. Then, using an enzyme it makes called reverse transcriptase, the virus converts its RNA into DNA (deoxyribonucleic acid). The viral DNA becomes integrated into the cell DNA. When the cell divides, the altered DNA produces viral messenger RNA (mRNA) that codes for new viral proteins. In essence, the infected cell becomes a virus factory, and the new viruses go on to infect other cells. This may not happen as soon as a cell is infected; the virus may remain latent for months or years without causing detectable harm.

The prime targets of the AIDS virus are T4 lymphocytes, white blood cells that orchestrate the body's immune response to invading germs. This presents an enormous problem because, as Fauci explains, "the first thing that the virus attacks is the very cell that's supposed to protect the body against it. So, you're essentially wiping out the defense system of the body on the first day of the war." The virus can also infect brain cells, causing memory loss, loss of coordination, partial paralysis, or mental disorders.

A cure for AIDS will likely require two types of drugs used together: an anti-viral agent to kill the virus and an immune enhancer to help rebuild the damaged immune system. An intense search is on around the globe for those elusive compounds and for a vaccine that will prevent new infections. Last June, more than 7,000 people from approximately 70 countries gathered in Washington, D.C., to exchange information at the Third International Conference on AIDS, described in a *Washington Post* article as the "largest international scientific gathering ever devoted to one disease." Some of the reports, presented on drug and vaccine research were hopeful, some discouraging, and other controversial. Undisputed, however, was the extraordinary energy being expended on coming to grips with all aspects of the disease.

In this country, the U.S. Public Health Service leads the federal effort. From 1984 through 1986, PHS spent close to $93 million on AIDS drug and vaccine research. In 1987, nearly $145 million will be spent, and President Reagan's 1988 budget request for these activities is just over $185 million.

NIH has been conducting research on AIDS at its Bethesda, MD, campus near Washington, D.C., since the disease was first recognized in 1981. Besides its "intramural" work by NIH scientists, the agency supports studies in medical institutions around the country. NIAID has established 19 AIDS treatment evaluation units engaged in human (clinical) testing of experimental drugs. AIDS clinical study groups will soon be set up so that doctors outside large cities can participate in drug development and testing. In 1986, NIAID established National Cooperative Drug Discovery Groups in five medical centers. The groups comprise scientists from various

disciplines who work together to find new approaches to drug development. More than 10 new groups will be funded by the end of 1987, and similar National Cooperative Vaccine Development Groups will be set up in 1988.

Most of the AIDS anti-viral drugs target the virus at the point where RNA is converted to DNA by blocking the action of reverse transcriptase. Among these drugs are zidovudine (also known as AZT) - the only drug currently approved by FDA for treating AIDS - and dideoxycytidine (DDC), now in clinical trials.

Researchers are also looking at antivirals that work at other stages of the infection cycle - for example, to keep the virus from entering the cell or to inhibit assembly of new virus particles. It may be that using two or more antivirals together will work best. Severe side effects would be less likely if each of the drugs could be used in lower doses. Also, this approach might deter the virus from developing resistance, since it would have to adapt to several chemicals at once.

Drugs to revitalize the immune system such as interleukin-02, are also being tested in patients. Others, including alpha-interferon and Ampligen, a synthetic drug that induces the body to produce interferon, are being evaluated for both antivirals and immune-fortifying properties.

The media regularly report progress on new AIDS drugs, but problems abound, and enthusiasm over preliminary reports of experimental drugs must be tempered with caution. Premature optimism over any experimental drug - whether for AIDS, arthritis, cancer, or any other disease - can lead to disappointment. A case in point is suramin, a drug used to treat African sleeping sickness. It seemed to be a promising candidate against AIDS because test tube experiments showed it could inhibit reverse transcriptase. But in clinical studies, the drug proved excessively toxic, and patients showed no improvement.

Many other roadblocks have been encountered in the laboratory or at the bedside. Any therapy that uses combinations of drugs must be carefully devised, since one drug may cancel the effect of another. Also, because these drugs may have to be taken for years, they must be harmless enough for patients to tolerate over long periods.

The search for AIDS drugs is further complicated by the virus's ability to directly infect the brain. Drugs will have to be developed that can penetrate the "blood brain barrier," which, for reasons scientists don't fully understand, prevents some substances from reaching the brain.

That drug development is, of necessity, a time-consuming process should come as no surprise. The vast majority of new drugs are developed by drug companies working with medical researchers. Once a substance is identified as a possible therapy, it must be tested first in animals and then in humans to find out how it works in the body, what unwanted side effects it can cause, and if it is effective against the illness. Animal testing may take one or two years. If the drug still shows promise after animal testing, the company or investigator developing the drug can apply to the Food and Drug Administration for investigational new drug approval to begin testing the substance in humans. FDA sets the standards for clinical drug testing and must give prior approval for each of three carefully controlled study phases before the research can proceed.

The first phase usually lasts several weeks to a year. A small number of people are given the substance to see how it works in the body and if it can be tolerated. In Phase II, the drug is given to a somewhat larger number of patients with the targeted disease ( or stage of disease) to get more information on safety and to evaluate effectiveness. This evaluation generally lasts several months to two years. Phase III involves testing the drug in a much larger number of patients - usually at least 1,000 - for more definitive evidence of effectiveness. This phase may take several years to complete. At each stage of testing, more is learned about how the drug works, proper dosage levels and toxicity, and benefits of therapy.

When testing is complete, the manufacturer or investigator can submit a new drug application to FDA, supplying the agency with all the information collected on the drug, including clinical test data, how the drug is made, quality control procedures, chemistry, pharmacology, and toxicology. In some cases, a panel of outside experts appointed by FDA is asked to review the material and make a recommendation to the agency. The agency then approves or disapproves the drug for marketing based on its own review and the advisory panel's recommendation. The review process for new drug applications averages a little over two years.

FDA has taken several steps to speed development of AIDS drug. The agency initiated conferences with American and European drug companies that expressed interest in submitting investigational new drug (IND) applications for AIDS drugs. These meetings are held to explain the standards and procedures for clinical testing, hoping to eliminate time lost to misunderstandings about the requirements.

Efforts in the last two years to hasten all reviews of new drug applications are paying off. Backlogs in some areas have been cut more than 30 percent. All potential AIDS drugs are given the highest review priorities. Because of this, AZT was reviewed and approved for certain AIDS patients less than four months after the new drug application was filed. This is one of the shortest approval actions on record.

FDA recently issued a new rule (published in the May 22 *Federal Register*) allowing wider access of experimental drugs to people with AIDS and other life-threatening diseases. According to FDA Commissioner Frank E. Young, M.D., "AIDS has focused public attention on this issue [compassionate use of experimental drugs as never before. The new procedures will make experimental drugs available - usually at the end of Phase II con-

trolled clinical trials - for patients with life-threatening diseases who are willing to agree to accept a greater risk than would be normally expected." (See "Experimental Drugs for the Desperately Ill" in the June 1987 *FDA Consumer*.). The rule includes safeguards to protect both the patient's welfare and the drug research and development process.

While a cure for AIDS is imperative, the hope for the future is to find that "ounce of prevention" - a vaccine that will prevent new infections and eventually eradicate the disease. Last August, FDA approved the first clinical study of an AIDS vaccine in this country. The test vaccine is manufactured by MicroGeneSys, Inc., in West Haven, Conn., and the study will be conducted by NAID at NIH's Clinical Center. Dr. Gerald V. Quinnan Jr., director of the Division of Virology at FDA's Center for Drugs and Biologics, says the researchers will first study the vaccine in 60 healthy homosexual men who have no evidence of infection with the AIDS virus and who practice "low-risk" sexual behavior. Three persons with no history of risk behaviors will also receive the vaccine, and a group of 18 control subjects, including three people with no history of risk behavior, will receive a placebo.

The principle of vaccination is to stimulate cells to produce antibodies (disease-fighting substances) against a specific virus, bacterium, or other invader. Unfortunately, developing vaccines against viruses - and particularly retroviruses - is complex and fraught with obstacles. To name a few:

- The traditional strategies of vaccine preparation - use of a while killed or weakened virus - are not being pursued because of potential risks with this deadly virus.
- The AIDS virus mutates easily, producing many slightly different strains A vaccine developed to stimulate antibodies against one strain may not be effective against another.
- The virus may enter the body already encapsulated in a cell, so that antibodies don't have a chance to detect and, therefore, defeat it. And, since antibodies do not permeate cells, an antibody response probably would not help people already infected. In these cases, a vaccine would have to be designed with a different approach - perhaps not to prevent infection, but to keep the virus from doing harm.
- Two AIDS viruses have been identified - HIV-1 and HIV-2. Although HIV-1 overwhelmingly predominates worldwide, HIV-2 has been seen primarily among West Africans, and variants of each of these viruses exist. This multiplicity of viral forms complicates the problem of vaccine development. The common cold, for example, defies attempts to produce a vaccine against it because there are so many types of cold viruses. Devising a rabies vaccine, on the other hand, was a much easier task because there is only one rabies virus.

Another obstacle to rapid vaccine development is the lack of a good animal model in which to test candidate vaccines for effectiveness before they are tried in humans. Right now, chimpanzees are the only animals that the AIDS virus can infect, and these animals are expensive and in short supply. Further, no infected chimp has yet developed the disease, and none may ever do so. Studies with chimps can provide information on how the immune system responds to a test vaccine and perhaps indicate its potential value, but the results of animal tests do not guarantee like results in humans. According to Fauci, "The development of a good animal model for AIDS is very important," he says, "but the chimpanzee model is not strictly analogous to human infection. If a vaccine protects the chimpanzee, it doesn't tell you what will happen in humans. And if it *doesn't* protect, it still doesn't tell you what will happen." Even so, chimps remain the best model so far. NIH has organized breeding facilities for the animals and will, through its own research and support of others, try to refine the chimpanzee model and develop an alternative animal model.

Researchers are approaching the challenge of vaccine development from various angles. Most test vaccines for AIDS use pieces, or sub-units, of the virus to stimulate antibody production. Leading questions that must be answered are: Which part or parts will stimulate an adequate antibody response, and will the antibodies be effective against different virus strains.

Proteins from the virus's outer shell, or envelope, are used most often for AIDS vaccine preparations. It's thought that one of these would be most likely to elicit a good antibody response, since this is the part of the virus the immune system recognizes.

Scientists are also looking at the virus's core proteins. A British study of 48 HIV-infected men, reported in the Jan. 17, 1987, issue of *Lancet*, showed that all the men produced antibodies to proteins of the virus envelope, but those who also had high levels of antibody to core proteins were free of symptoms during the entire four years of the study. This could have important implications for vaccine development.

Researchers at NIH and other centers are trying a variety of techniques to prepare the candidate vaccines. Some isolate and purify natural protein particles while others make synthetic protein segments. The MicroGeneSys vaccine consists of purified protein from the virus. Fauci stresses that "no one can get AIDS from the vaccine, and we expect no adverse effects beyond those that sometimes occur from other immunizations, such as some redness and soreness at the site of injection."

Another method of vaccine preparation uses substances made of fat and protein that can be chemically manipulated to include other proteins, such as the pieces of the AIDS virus envelope. The idea of ISCOMS (immune stimulating complexes), as they are called, is to assemble viral proteins into particles that mimic the natural virus, but are noninfectious.

Most investigators are using genetic engineering techniques to produce a vaccine. In one strategy, the AIDS virus gene that codes for its envelope proteins is inserted into the vaccinia virus (which is used in the smallpox

vaccine). A French physician, Dr. Daniel Zagury, has inoculated himself and a number of other volunteers with one such vaccine. At the June 1987 AIDS conference, Zagury reported that the vaccine stimulated limited antibody production and some other immune responses. So far, there have been no ill effects. It is impossible to know, though, whether the antibodies will prevent infection if challenged with the real virus.

Another new approach to an AIDS vaccine is based on "anti-idiotype" antibodies. With this technique, the vaccine recipient would never have to be exposed to any viral component. In the first step of preparation, animals are induced to make antibodies to the virus. These antibodies are inoculated into other animals, which then produce a second antibody. The hope is that this second antibody, which looks like the protein from the original virus but contains none of it, will elicit a protective immune response.

Experimental vaccines face the same rigorous testing procedures as do experimental drug treatments. Quinnan says that the initial Phase I studies will look at toxicity and evaluate the immune response. Phase II trials, with larger numbers of people, will give more information on safety and the ability of the vaccine to induce immune responses. And, to an even greater extent than with investigational new drugs. Phase III testing will involve very large numbers of volunteers at numerous medical centers.

Despite all this research, scientists caution that a cure or vaccine for AIDS is far from just around the corner. In testimony before the Senate Labor and Human Resources Committee in January 1987, Fauci states that, "given the nature of the AIDS epidemic, even if the [vaccine preparations now under investigation prove to be safe and effective, it is likely that it will take a number of years until a vaccine is available for widespread use."

In the meantime, better drugs are being sought to combat the infections and cancers to which people with AIDS fall prey - and from which they ultimately die. At the International AIDS Conference, NIH's Dr. Carmen Allegra reported encouraging responses to trimetrexate, which is similar to the anti-cancer drug methotrexate, in patients with *Pneumocystis carinii* pneumonia, a parasitic lung infection. NIH is also studying the effectiveness of foscarnet and 9-(1,3-dihydroxy-2-propoxymethyl) guanine, or DHPG, in treating various infections caused by cytomegalovirus, which is a type of herpes virus. Doxyrubicin, and anti-cancer agent, is being studied as a treatment for Kaposi's sarcoma, a type of skin cancer.

Research at NIH also focuses on gaining more insight into the workings of the AIDS virus and the immune system's response to it - information critical for devising rational new approaches to treatment. Some of the many questions that remain unanswered are:

• What is the role of macrophages - another type of white blood cell important in immune function - in AIDS? These cells, too, have the receptor molecule for the AIDS virus and can be infected, but, unlike T-cells, they are not destroyed. Could this suggest that the T-cell needs something besides this molecule for infection to be lethal to the cell?

• what makes some people more susceptible to infection than others? Is there a genetic predisposition? Does the health of the person's immune system at the time of exposure play a role in infection? Does stress influence disease development or progression?

• What triggers the transition from latent infection to active infection? Could a new infection stimulate cell activity? Do environmental or genetic "co-factors" influence disease progression?

In this age of high technology, Americans increasingly look to wonder drugs to treat all their ills. The short history of AIDS in the United States has seen a steady growth of knowledge about the disease, the virus, and how it is transmitted. What still eludes us, however, are those magic bullets that will prevent or cure AIDS.

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# *Hazard Analysis and Critical Control Point Identification in Ice Cream Plants*[1]

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*[1]Presented in part at the New York State Association of Milk and Food Sanitarians 64th Annual Conference, Syracuse, New York, September 23, 1987.* *[2]Asst. Prof., Dept of Food Science, University of Guelph, Guelph, Ontario, Canada N1G 2W1*

Frozen dairy products such as ice cream, ice milk, sherbets, and others, are an important segment of the dairy industry. Of the 145 billion pounds of milk produced in the United States in 1986, 15 billion pounds was utilized in frozen dessert manufacture (7). With an annual production of 1.5 billion gallons of ice cream representing over $4 Billion, the per capita consumption is approximately 25 quarters per annum of ice cream and related products (1). Ice cream has become one of the most popular desserts in this country. The consumer demands a certain quality from the manufacturer, but more importantly they demand a product which is unquestionably safe.

In light of the number of recent food borne illness outbreaks associated with milk products, the interest in plant hygiene and product safety is of critical importance to the dairy manufacturer. The ice cream industry needs to be especially concerned about product safety due to the susceptibility to contamination from post pasteurization handling. A considerable amount of processing and ingredient addition is done after pasteurization and the only control of bacterial contamination post pasteurization is through sanitation and hygiene.

Several pathogenic organisms can survive in ice cream after contamination, including *Salmonella sp., Listeria monocytogenes, Campylobacter sp.,* and *Yersinia sp.* Of these, the *Listeria* organism is of particular interest because of the fact that it will grow at low temperatures and can be lethal to certain segments of the population (3,6).

It should be strongly emphasized that proper pasteurization will adequately destroy all pathogenic bacteria (6,9) However, because of the frequency with which they are found in raw milk, all raw milk must be considered as potentially containing pathogens. It must also be assumed that these pathogens are present in your plant. Therefore, post pasteurization contamination could potentially be very destructive and great care must be taken to eliminate all possibilities of post pasteurization contamination from any source.

The Hazard Analysis and Critical Control Point (HACCP) program is designed as a total system of product safety and quality assurance. HACCP programs have successfully been implemented in many of the large food processing companies and should be considered as an integrated system. This review will identify many hazards and their respective controls in an ice cream plant and will outline many areas to consider in assuring product safety and freedom from post pasteurization contamination. The design of any HACCP program will be unique to each given plant.

## A/ Identifying Hazards and Critical Control Points

### 1. Process variables:

### Plant flow diagram

An up-to-date plant flow diagram and piping blueprint is the first step in developing a HACCP program and is a valuable tool in discovering unnecessary or unwanted piping, cross- connections or unauthorized changes made to initial installations which could be a source of problems. Once the diagram is complete, a thorough inspection of the plant should be made with blueprint in hand to be sure that the actual product flow system matches the desired system. In addition, the identification and elimination of any dead ends can be made and any dented or pitted pipes or fittings should be replaced. The use of plastic caps over exposed fittings is recommended but caps should not move from raw to pasteurized fittings or be left laying on the floor when not in use.

A very generic flow diagram outlining the basic unit operations of an ice cream plant is shown in Figure 1 and could be used as a model for developing flow diagrams unique for each operation. To be useful, flow diagrams need to be as detailed as possible.

### Raw Receiving

It should be assumed that all incoming raw milk prod-

ucts are contaminated with pathogens. This assumption, although hopefully incorrect, will ensure that safety procedures are adequate. Ideally, the raw receiving area should be completely isolated from the rest of the plant operation and all movement of plant personnel and equipment from the raw area to the finished product area should be minimized or eliminated.

## Ingredients

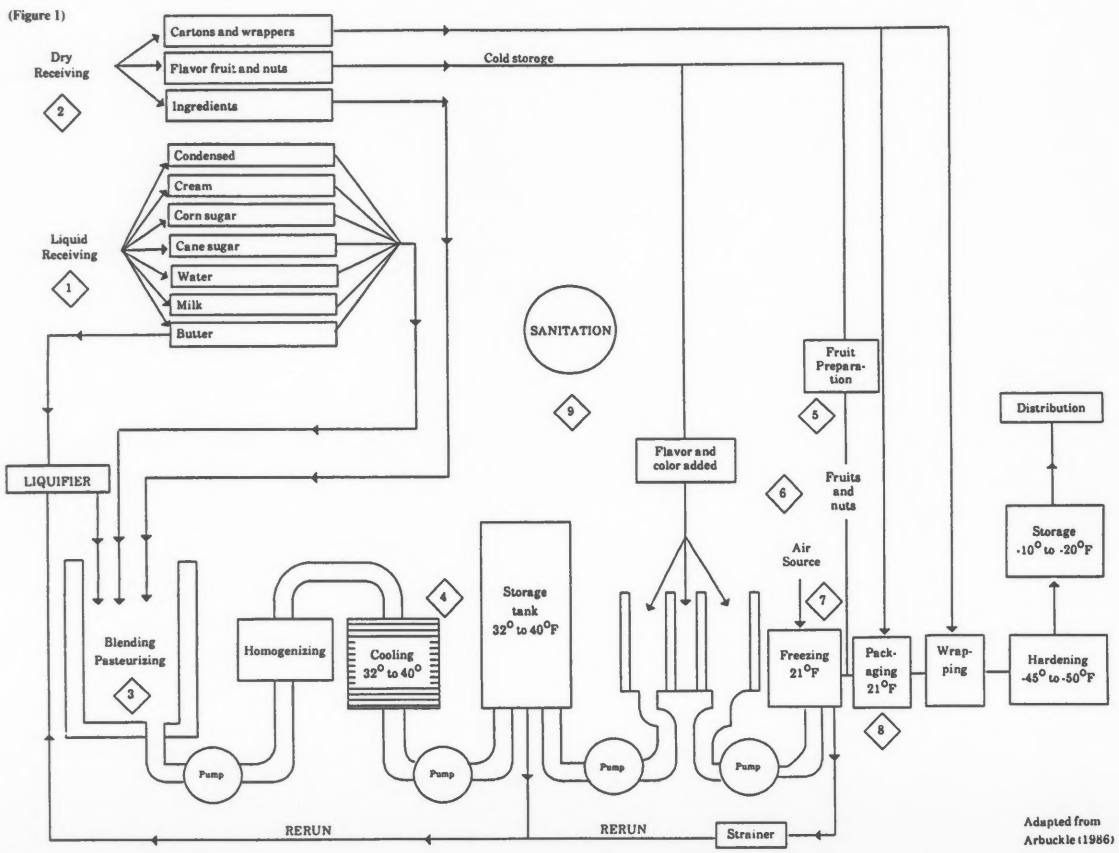
Specifications for and routine monitoring of all incoming ingredients should be developed. Dairy product ingredients must meet established standards and be fresh and of high quality. Certification by the supplier of suspect ingredients such as egg products is one way of maintaining quality. Powdered colors used in ice cream manufacture should be prepared in the laboratory using sterilized water and should be kept reasonably fresh. Liquid flavors and fruit preparations should be monitored for coliform contamination as necessary. Although bacteria cannot grow in low water activity foods, many can survive if contaminated at the point of preparation. All suppliers should be reliable and should have the confidence of the manufacturer but not his blind faith. Inspections of suppliers facilities are often warranted and welcomed.

## Pasteurization

Pasteurization is the only biological control point in the system. All pathogens are destroyed by adequate pasteurization (6,9). It is imperative that the pasteurizer be maintained and operated properly. Minimum pasteurization standards for frozen dessert mixes are shown in Table 1 (4). Pasteurization beyond the minimum standard is recommended to allow for a safety margin.

In batch pasteurization equipment, the proper operating condition of leak detector outlet valves and the operation and cleaning of vapor space heaters are areas of concern for potential product contaminations. The maintenance of the holding time can be assured with a time/temperature

Figure 1. Flow diagram from a typical ice cream plant showing the major areas of post pasteurization and critical control points. (1) Raw dairy product safety assessment and quality monitoring, (2) Ingredient safety assessment and quality monitoring, (3) Pasteurization standards, (4) Pasteurization equipment maintainence and inspection, (5) Fruit preparation/straining, (6) Ingredient exposure at feeder, (7) Air quality at barrel freezer, (8) Contamination during filling/packaging, (9) Adequate sanitation and hygiene throughout the plant (Diagram adapted from Ref. 2).



sensor which will not allow product to be pumped until the timing is complete.

In addition to the regulatory requirements for HTST pasteurization equipment, it is recommended, whenever possible, that a positive pressure differential be maintained between the product and the heating medium and between the product and the cooling medium. Sweetwater quality should be routinely monitored. During routine inspections of the plates, a dye test for pinhole leaks through the plates is recommended.

**Freezing**

Product exposure and ingredient addition at this step make the freezing and filling operations critical in terms of product hygiene. Although most organisms cannot grow at temperatures less than 0°C, many can survive at less temperatures and, in the case of *Listeria,* the infectious dose for illness to occur has not been determined and thus a zero tolorance must be maintained. The barrel freezers must be properly sanitized after assembly and immediately before operation. The hand assembly of the many intricate parts makes this operation a likely source of contamination.

The air source to the barrel freezer should be assessed for quality. If air is drawn from the plant floor through a needle valve, then the surrounding environment must be kept clean and sanitary. If the air source to the freezer is through the compressed air line, then the quality of the compressed air lines must be assessed. Although the heat of compression is very high, the air lines could cause a recontamination of the air. These lines should be equipped with adequate dryers and filters. Drain ports at the lowest points in the compressed air system should be in place and monitored regularly. Bacterial filters are available for placement in the compressed air lines as it enters the freezer and bacterial filters with very small pressure drops are also available for barrel freezers which draw air from the floor by vacuum.

The ingredient feeder is probably the greatest source of contaminants in ice cream. Fruit preparation and straining procedures should be monitored for coliform contamination. All pails, boxes, or other containers from which ingredients are dumped into the ingredient feeder should be cleaned and sanitized. Ingredient exposure at the ingredient feeder should be kept to a minimum with the feeder being covered at all times.

Table 1. Pasteurization standards for frozen dessert mixes as defined in the Code of Federal Regulations (4).

PASTEURIZATION OF FROZEN DESSERT MIXES

Every particle of milk prduct is heated in properly designed and operated equipment to *at least* the following temperature and held for *at least* the following time:

| | | |
|---|---|---|
| 155°F | (690 C) | 30 Minutes |
| 175°F | (800 C) | 25 Seconds |
| 180°F | (830 C) | 15 Seconds |

The handling of product rerun developed at the freezer needs to be assessed at each plant. It is recommended that no rerun be added back to the flavor tank at any time. The addition of rerun to the flavor tank greatly increases the chance for contamination. All rerun which can be reclaimed through filtration and blending should be repasteurized and blended with fresh mix. Any rerun which cannot be reclaimed must be clearly segregated from the reclaimable material with no chance for confusion. The handling of waste material should not provide the opportunity for product contamination from outside sources such as pails or barrels. Any product which has left the plant in packaged form is not reclaimable if returned for any reason. Recent ammendments to New York Standards read "Returned packaged milk and milk products, frozen desserts or melloream shall not be repasteurized for Grade A, frozen desserts, or melloream use".

**Packaging**

In addition to the freezing operation, the filling operation also offers great chance for product contamination. Container storage and make-up facilities must be adequate. Empty containers should not be exposed to contamination prior to filling. The filler heads must be kept clean and sanitary throughout the operation. Employees handling product at this stage such as in manual capping operations must exercise great care to prevent problems. They should never lose sight of the fact that every package will be consumed by somebody.

Another area of concern is product tampering in the marketplace. Tamper evident packaging is becoming increasingly available. Many product lines now shrink wrap individual packages to avoid marketplace tampering. Although not the focus of this review, tamper proof packaging should be considered for all new packaging introductions and as an eventual replacement for conventional ice cream packaging.

**2. Environmental variables:**

**Plant environment**

In addition to equipment sanitation and hygiene, the plant environment is also critical to product safety in that many organisms can be transmitted through air borne contamination. Several aspects of the plant environment will be considered here.

The heating, ventilating, and air conditioning (HVAC) system needs attention as an agent for transmission of air borne contamination. The system ducts and piping should be free of excessive dirt and dust and filters maintained in clean condition. The production and filling area should be maintained under positive pressure with air flow moving from finished to raw product areas. The location of outside air intakes should be such that outside contamination of the air system is minimal. In addition, air lines on the compressed air system should be free of

moisture, oil, and debris and should be cleaned and inspected regularly.

Drains are another area of potential environmental contamination. They should be maintained in good condition with suitable debris baskets, screens, and traps. Drain location should be away from major areas of product exposure such as filling machines to avoid air borne contamination. Floors should be sloped to allow for good drainage and prevention of water pooling on floors. When possible, spills should be immediately rinsed to the drain.

Air borne contamination can also be carried through the formation of moisture aerosols from high pressure hoses or centrifugal pump spray. Operation of hoses or other aerosol formation during times of product exposure should be avoided. Condensation from equipment or frozen pipes forms readily in ice cream plants, especially in hot weather. Exposed product should be protected from the possibility of condensation drip.

Any items which enter the production areas such as pallets, fork trucks, milk cases, maintenance equipment, etc., are suspect and should be thoroughly cleaned and in sanitary condition. If pallets are brought onto the production floor, have they come in to the plant from an outside source? Where have they been?

Traffic flow in production areas should be assessed. Employee movement from raw to finished areas should be minimal. Farm tank truck drivers or other unauthorized persons **should not** be allowed access to production areas. Viewing areas behind glass are a great way to allow visitor access to the plant without allowing product access.

There are many other environmental concerns such as garbage handling and pest control which should be assessed in each plant situation.

### Sanitation and Cleaning

Beyond pasteurization, the only control of product safety or bacterial quality is through sanitation and hygiene, both equipment and environment. Most of the ice cream plant is CIP cleanable and recommendations of the chemical suppliers should be followed. However, many items such as homogenizer screens, ingredient feeders, variagating pumps, filler heads and freezer barrels need to be taken down to be adequately cleaned. This equipment must be thoroughly stripped and scrubbed. CIP lines should be self draining or self evacuating and removal of cross connections between raw and finished lines is often necessary.

Absortent items such as rags or sponges should be avoided as they often become microbial zoo's. Disposable towels for wiping spills during filling can be used in their place. If sponges are to be used, they should be continually dipped in a sanitizer solution of adequate strength and replaced frequently. Brushes used for cleaning should be segregated and labeled for interior versus exterior cleaning of equipment and for raw versus finished product usage Wooden handles should be avoided.

The common sanitizers have been shown to be effective against pathogenic organisms and recent recommendations are shown in Table 2 (5). However, the quaternary amonium sanitizers are not effective against *Pseudomonas* and are not recommended for product contact surfaces.

### Personnel

All plant functions including pasteurization, sanitation, and product handling are done by the hourly employees. Their awareness of and training in sanitation and hygiene principles is critical to product safety and quality. The development of standard operating procedures for every job in the plant will assure that each employee is aware of his/her responsibilities. Adequate training of new employees and retraining or continuing education of experienced employees is difficult but necessary. A continual effort to upgrade employee knowledge of plant procedures and concerns must be made.

Employee cleanliness and hygiene must be stressed. Hair and beard nets, clean plant clothes, and suitable footwear should be provided and helps to instill a general feeling of sanitation which will carry through to plant surroundings as well. Street clothes should not be permitted in the plant, nor should plant clothes be allowed to leave the plant with employee. Proper clothes laundering should be provided by the company. Locker rooms, changing areas, and break/lunch rooms should be situated so as to minimize traffic through production areas. Visitor protection must also be provided and none should be permitted access to the production rooms without proper attire.

### B/ Critical Control Point Monitoring

The only biological time/temperature control in the ice cream plant is pasteurization. There is a considerable amount of processing done post pasteurization and this necessitates the need for adequate sanitation and hygiene of both equipment and environment. The preceding section has identified a number of potential areas of contamination and actions which can be taken to control these factors. They should be considered in addition to the good manufacturing practices as outlined in the Pasteurized Milk Ordinance or state regulations. Other agencies such as the Northeast Dairy Practices Council also outline areas of concern in post pasteurization contamination. (8)

Table 2. Sanitizer recommendations for control of *Listeria sp.* and *Salmonella sp.* (5).

| | |
|---|---|
| Chlorine Based Sanitizers | 100 PPM |
| Idophors | 25 PPM |
| Quaternary Ammonium Sanitizers | 200 PPM |
| Acid Anionics | 200 PPM |

In developing a program of monitoring these areas of concern, it is important to distinguish between the hazardous versus the objectionable; biological versus physical hazards. For example, shell fragments in ice cream from nuts are objectionable but unlikely to cause illness. Biological safety must remain the first concern. With the aid of plant flow diagrams and piping blueprints, the hazards and controls unique to each plant can be outlined by following through all the basic unit operations.

It is worth mentioning that coliform testing is still the best monitoring tool of post pasteurization contamination. The presence of any coliform bacteria indicates a contamination which should not be present The source of a persistent coliform contamination should be identified and eliminated promptly. Coliform bacteria are indicator organisms. Their presence could indicate pathogenic contamination. However, their absence does not guarantee freedom from pathogens. Pathogen testing should be performed by well trained personnel at a lab removed from the production areas. In-house pathogen testing is not recommended.

### C/ Product Retrieval/Recall

A good recall program, adequately tested, is an essential part of the HACCP program. The importance of product coding to a recall situation will be emphasized here. The effects of a product recall can be minimized through ingredient tracking and product coding. All incoming ingredients should be coded and recorded by number, date, lot size, etc. This is a necessary part of inventory control and stock rotation as well. The ingredients used for each batch lot of ice cream made should then be recorded. This is the "what goes where" aspect of the program. Finished product should be coded with records available as to exactly what went into each batch. Finally, some monitoring of delivery of coded product must get done. This is the "who get what" aspect. With this kind of ingredient tracking program, if a supplier were to call and advise that he had shipped a bad batch of ingredient, some knowledge as to where that ingredient was would be available. Conversely, returned product with some defect would be identifiable so that others of the same batch could be retrieved.

## SUMMARY AND CONCLUSIONS

This review has attempted to identify some of the hazards associated with post pasteurization contamination in an ice cream plant along with some of their respective controls. **Pathogenic bacteria will not survive pasteurization.** The only entry mechanism is through recontamination. With adequate sanitation and hygiene, recontamination can be avoided. The ice cream industry is very healthy with tremendous consumer support and growth potential. To maintain the positive position enjoyed now, industry personnel must not allow themselves to become complacent in issues of product safety. With proper care and attention given to plant hygiene, the ice cream industry will remain strong and healthy for many years to come.

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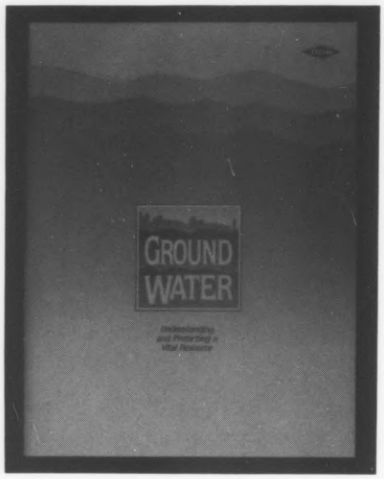
# News and Events




## New Booklet Describes Groundwater Protection

A new booklet, "Understanding and Protecting a Vital Resource," takes a comprehensive look at groundwater. Available from The Dow Chemical Company, the booklet is a useful reference for definitions, issues and technologies surrounding groundwater and groundwater contamination.

Groundwater is subsurface water that occurs in fully saturated soils and geological units called aquifers. It accounts for more than half of all U.S. drinking supplies and, in rural areas is virtually the only source of potable water. Industrial and residential reliance on this vital resource has nearly tripled since 1950.

Dow is committed to protecting groundwater quality during the development, manufacture, distribution and use of Dow products. The company supports the collection of data, scientific study of groundwater and dissemination of information related to groundwater quality.

For a copy of "Understanding and Protecting a Vital Resource," contact The Dow Chemical Company, 2020 Willard H. Dow Center, Midland, MI 48674. Telephone: 800-258-CHEM, ext. 12.

## 1988 Center for Dairy Research Conference

The 1988 Center for Dairy Research Conference will focus on "Milkfat: Trends and Utilization." Presentations by UW-Madison faculty and scientists, by faculty from other universities, and by scientists and technical management personnel from industry will cover the economic, chemical, nutritional and technological aspects of the use of milkfat in various food products. A poster session on UW-Madison dairy research projects will also be featured. The keynote address at the banquet on the evening of April 20, "What Can We Say About Milkfat and Health?", will be presented by Dr. Robert E. Olson, School of Medicine at the State University of New York at Stony Brook.

For more information, call Lee Jensen, Associate Researcher, Center for Dairy Research, University of Wisconsin-Madison, 1605 Linden Dr., Madison, WI 53705. Telphone: 608-262-2264.

## International Workshop in Rapid Methods and Automation in Microbiology - Graduate Fellowship Grant

The purpose is to provide educational opportunities for highly qualified and motivated graduate students to be trained in the newest applied microbiological techniques. The fellows must participate from July 6 - 16, 1988, inclusive to help with set-up and clean-up of laboratories before, during, and after the workshop. Fellows must provide own transportation to and from Kansas State University and have the appropriate personal insurance. The applicant must be a degree-seeking full time graduate student in an approved graduate school. The applicant must be interested in and competent in microbiological procedures especially in the area in diagnostic microbiology and biomass estimation by modern methodologies. The applicant must submit a statement of interests, a current vitae, an official graduate school transcript, and a letter from a major professor indicating that the applicant is a full time student and the student's competence in applied microbiology.

1987 Fellows were: Marilyn Hattier (L.S.U.) and Kathy Richter (Univ. of Nebraska).

For more information, contact: Dr. Daniel Y.C. Fung, Ph.D., Fellow Amer. Academy of Microbiol., Director, Rapid Methods and Automation in Microbiology, Call Hall, Kansas State University, Manhattan, KS 66506.

## *Scientists Work to Solve the Calcium-Cholesterol Dilemma*

Dairy products are caught in a conundrum these days, alternately praised and condemned.

Susan K. Harlander, a food scientist who does research for the University of Minnesota's Agricultural Experiment Station, describes the dilemma: "Dairy products are one of the few sources in the American diet for calcium. And yet, when people go on a diet, or if they are diagnosed to have high cholesterol levels or coronary disease, they will invariably avoid butter and cheese and whole milk, primarily because these products are perceived to be high in fat and cholesterol."

If you want to be good to both your bones and your heart, what's a person to do? Harlander has set her sights on one potential answer: eliminating the cholesterol from dairy products.

Research has recently demonstrated people can affect their serum cholesterol level by decreasing the cholesterol in their diet.

"The issue of whether or not dietary cholesterol affects serum cholesterol has been a controversy for a long time," Harlander says, "because your body makes its own cholesterol. It makes as much and sometimes more than it needs because cholesterol is an integral part of all your membranes and performs other essential functions in your body. But recent studies demonstrate that you can reduce serum cholesterol levels by reducing the amount you eat, and even a relatively small reduction appears to be beneficial."

Previous bioengineering research in cooperation with experiment station food scientist Larry McKay, led Harlander to look for a solution to the dairy dilemma in the genes of microorgamisms. McKay pioneered genetic modification to improve the starter cultures that are used to produce fermented dairy products such as cheese and yogurt. Harlander decided to look for microorganisms that would degrade cholesterol without causing harm to the food or to humans. Adding these organisms to dairy fermentations could create products that are low in cholesterol or free of cholesterol.

Harlander assumed there must be such microorganisms. "After all," she says, "there are microorganisms that break down almost any product in nature. We figured there had to be a microorganism that could break down cholesterol and actually detoxify it in terms of what would happen in the body."

A class of bacteria called eubacteria, which live in nature and are also found in the human gut, degrade cholesterol to a harmless compound called coprostanol. Pure cultures of the bacterium reduce cholesterol to coprostanol with over 90 percent efficiency. Coprostanol isn't absorbed very readily, and if it is absorbed, it's broken down by normal pathways in the digestive system and doesn't contribute to the formation of plaque in arteries as excess cholesterol does.

There is no indication that the process of changing cholesterol to coprostanol would affect the flavor of dairy products. Harlander's research focus, therefore, is to isolate the fragment of DNA which codes for the cholesterol-reducing genes and, using genetic engineering techniques, to clone that DNA fragment into dairy Streptococci which are used in the production of cheese, yogurt, and buttermilk. Harlander sees a time when all dairy starter cultures could be capable of reducing cholesterol in dairy products.

"But successful cloning of the cholesterol-reducing genes opens the possibility of alternative uses for the enzymes," she adds. It could be used, for example, not just in cultured dairy products, but to pretreat milk. Someday, you may find the milk in your grocer's refrigerator case has been "filtered" during processing to remove the cholesterol.

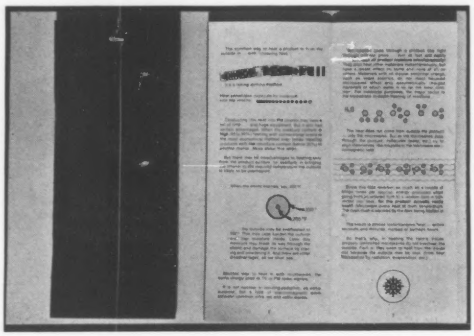
Harlander also sees potential for inoculating dairy products with engineered organisms that would not only reduce or eliminate the cholesterol in them, but would be capable of implanting in the human gut, where they would be able to assimilate at least part of the cholesterol ingested in the diet.

To help evaluate this potential, she has set up a cooperative study with the University of Texas Health Sciences Center. The reduced-cholesterol products would be tested with baboons, the animal model system for coronary heart disease studies.

So far, Harlander has developed techniques for measuring the conversion of cholesterol to coprostanol, and has shown that certain strains of eubacterium will reduce cholesterol to coprostanol in a model milk system. She says, "We have identified a very good strain and are not isolating the enzymes and the fragment of DNA which codes for cholesterol-reducing ability. This will then be subcloned into cheesemaking strains of lactic Streptococci and evaluated for cholesterol-reducing ability during fermentation."

It's a complex process, involving the manipulation of pieces of naturally occurring organisms to take advantage of their ability to degrade cholesterol. Other recent research has found that drugs can do the same thing. However, Harlander believes that while these may help people facing severe coronary health problems, the "natural" solution is better for the normal person concerned about his or her health.

For more information, contact: Susan K. Harlander, Educational Development Systems, Minnesota Extension Service, 433 Coffey Hall, University of Minnesota, St Paul, MN 55108. Telephone: 612-624-5335.



## What You Should Know About Industrial Microwave Processing

An 1987 updated and expanded version of "WHAT YOU SHOULD KNOW ABOUT INDUSTRIAL MICROWAVE PROCESSING" is now available free. *Not a sales booklet,* it cites advantages, disadvantages and limitations of this neglected technique.

The booklet shows how a firm can determine whether microwave processing might or might not benefit them, pitfalls in testing, whether present conventional heating equipment can be used with microwaves to increase production and lower costs, answers on safety, cost figuring formulas, bibliography of other pertinent readings, etc.

Microwave processing has been used successfully on: pasta, chemicals, snacks, heating liquids in tanks, vegetables, FRIT, coconut, fabrics, nuts, ceramics, bacon, sausage, chicken, beef, veneers, color pigments, egg tempering, meat tempering, moving web, fibre structural curing, medical treatment, drugs and medicines, forming and curing insulation, casting molds for engine blocks and in the manufacture of other automobile components, semi-conducter manufacturing, rubber vulcanization and devulcanization, glue curing, toxic waste disposal, oil well heating, drying the tile for space shuttle heat shield, 100% recycling of asphalt roads in-place, research in almost every area imaginable, and many other uses often kept secret because of the great advantages microwaves can give (one reason why one hears more of failures than of the many on-going successes).

Where applicable microwave processing has been reported to use 20% - 30% less energy and sometimes well over 50% less, to increase throughput up to 20 times and save up to 80% of floor space. Microwaves can cut infestation as much as 99.99%, give longer shelf-life to foods, process below nitrosamine-forming heat levels, and more.

For a free copy of this guidebook write to Svenson & Associates, 45 Webb Road, Watsonville, CA 95076-9736. Telephone: 408-722-4621.

## AIB Offers Updated Dietary Fiber Seminar

An updated seminar, titled DIETARY FIBER has been scheduled by the American Institute of Baking in Manhattan, Kansas from July 11-13, 1988.

AIB's first technical seminar on dietary fiber was presented in July of 1986. Since then, there have been several advancements in ingredient technology, product development and understanding the role fiber plays in health and disease. The 1988 seminar has been developed around these new advances.

In particular, the seminar will emphasize areas of immediate interest to food manufacturers, ingredient suppliers and ultimately, the consumer. Several high-fiber baked and other food products, prepared at AIB's facilities, will be displayed and individually discussed. A table top display of ingredients and products where fiber is a significant component is planned as well. Time will also be devoted to updating health and regulatory aspects of fiber and fiber-containing foods along with their marketing strategies.

Brochures for DIETARY FIBER will be mailed in early 1988 so participants can plan well in advance to attend. Additional information, a copy of the seminar brochure and registration can be obtained from AIB's Registrar's Office. Write to the Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502. Telephone: 800-633-5137.

## DFISA Changes Site for Food & Dairy EXPO '89

Dairy & Food Industries Supply Association has announced a change in location and dates for Food & Dairy EXPO '89. The show will be held from November 11 through 15, 1989 at Chicago's McCormick Place.

"The decision to return to Chicago instead of Anaheim, is based on Anaheim's construction schedule delay in expanding their facilities to meet EXPO's growing needs," said John Martin, DFISA's executive vice president.

"Chicago is an international city offering the industry a centralized location with first class facilities. We are excited about the opportunity to return to Chicago and build on the success of Food & Dairy EXPO '87." Martin added.

EXPO '87 attracted 26,241 attendees, and 531 exhibitors utililzed 297,000 net sq. ft. (27,608 $M^2$) of space. The show has surpassed Germany's DLG-

FoodTec and France's SIEL, to become the world's largest exhibition for dairy and pumpable food products. For information on exhibiting or attending Food & Dairy EXPO '89, contact Dairy and Food Industries Supply Association, Inc. (DFISA), 6245 Executive Boulevard, Rockville, MD 20852-3938. Telephone: 301-984-1444.

## *Natural Compound Could Aid Food Safety Efforts*

Researchers have discovered that lysozyme, a natural compound found in tears, kills bacteria that cause food spoilage and two kinds of food poisoning.

The finding, by University of Wisconsin-Madison scientists, has attracted interest by the food industry because it could provide another tool to promote food safety. Eric Johnson and Virginia Hughey, food microbiologists at the UW's Food Research Institute, published their results in the September issue of Applied and Environmental Microbiology.

"Lysozyme occurs naturally in foods of animal origin, such as eggs and milk, and prevents bacterial growth in such foods," Johnson says. "It's attractive as a food preservative because it specifically attacks bacterial cell walls and is harmless to people."

The researchers found that lysozyme from egg whites was active against the bacteria responsible for listeriosis and certain types of botulism. Botulism is caused by a lethal toxin produced by the bacterium Clostridium botulinum. Although botulism is uncommon, it remains one of the most deadly types of food poisoning.

Listeriosis is a recently recognized cause of miscarriages and deaths among newborns and people with suppressed immune function. "The bacterium Listeria monocytogenes is a serious concern as an emerging pathogen in a variety of food products," says Johnson. "It has been associated with listeriosis outbreaks linked to vegetables, Mexican-style cheeses and milk products." An outbreak of 31 deaths and miscarriages over a four-year period was recently linked to Listeria-contaminated soft cheese in Switzerland, according to press reports.

The UW-Madison researchers found that lysozyme was not effective against seven other bacteria that cause salmonella and similar types of food poisoning.

Johnson and Hughey found that lysozyme controls several spoilage bacteria that attack canned foods, reducing their useful life. Johnson says adding lysozyme might reduce the heat treatments food processors need to apply when canning some foods. The enzyme is unusual in that it retains its potency from refrigeration temperatures to boiling.

Johnson believes that natural enzyme could replace sulfite as a preservative to prevent browning and spoilage of lettuce, potatoes and similar foods in restaurants. The U.S. Food and Drug Administration withdrew sulfite as a food preservative in 1987 because some people have strong allergic reactions to it. The agency is currently evaluating the use of lysozyme.

Chemists in Italy have developed industrial methods to recover lysozyme from egg whites. The material has been approved for use in Europe, where cheesemakers add lysozyme to certain hard cheeses to prevent gas formation and cracking of the cheese wheels.

Johnson and Hughey are now testing the ability of lysozyme to control the growth of Listeria in cabbage, sausage and soft cheese. Johnson says the initial results have been very encouraging.

Funds for the research were provided in part by Societa Prodotti Antibiotici and Miles Laboratories, Inc., two companies that produce lysozyme.

For more information, contact Eric Johnson, Dept. of Agricultural Journalism, 440 Henry Mall, Madison, WI 53706. Telephone: 608-262-1461.

## *NYA Welcomes FDA Proposal Allowing Labeling of Health Claims*

In comments submitted to the Food and Drug Administration (FDA), the National Yogurt Association (NYA) told the agency that it welcomes a recent proposal that would allow the use of health claims on food labels.

NYA is the national trade association representing companies engaged in the business of manufacturing and marketing of live culture yogurt and their suppliers.

On Aug. 4, 1987, FDA issued a proposal for making the health claims. The criteria FDA has proposed include:

- Any health claim could trigger full nutrition labeling.
- Labeling information must be truthful, and also not overemphasize or distort the role of a particular food in promoting health.
- Health claims must be based on and consistent with valid, reliable, scientific evidence that is publicly available prior to any health claims
- The labeling should describe the role of the specific food or ingredient in terms that are consistent with generally recognized medical and nutritional principles.

The proposal would also create a Public Health Service (PHS) Committee, which would create sample health-related messages.

"The basic principles on which FDA has based its criteria are eminently reasonable. While such a large population of products can legally be termed 'yogurt' in the USA, there are inevitably conflicting results in the scientific literature. The need to have conducted definitive studies, using clearly identified test products and preferably to have submitted the results to peer review, are all pertinent to the elucidation of what health claims may be made for products such as live active culture yogurt. The methodology used should be in accordance with recognized practice and the research results made available to FDA when requested, but these need not necessarily be in the public domain. Proprietary information, disclosed on a confidential basis, should also be accepted."

"Experimental studies which use in vitro, animal and/or human trials as appropriate, possibly supplemented with epidemiological surveys and proprietary data and on which a consensus of authoritative opinion has emerged, are clearly indicated as justification of health claims," Anderson told FDA.

"NYA sees a need for FDA (and the FTC on advertising) to devote substantial resources to enforcement. The credibility of the food industry and of the two agencies hinges on the public perception that nutrition/health messages are truthful, valid and helpful. The very substantial advertising expenditure of NYA members is wasted unless this credibility is maintained by the entire food industry. This is a far more important activity than the proposal to form a PHS committee, which NYA recommends FDA not proceed with. Such a committee is no substitute for implementation and enforcement, and is more likely to inhibit than to assist in the development of meaningful language in which to communicate on the food label. It is difficult to see how such a committee would be able to produce useful advertising messages in a timely fashion." Anderson concluded, "This proposal is likely to enable the live active culture yogurt industry to more definitively present the health attributes of this highly nutritious product to a consuming public which is steadily becoming more health-conscious and seeking a prudent diet."

For more information, contact Scott Ramminger, The National Yogurt Associaton, 1764 Old Meadow Lane, Suite 350, McLean, VA 22102. Telephone: 703-821-0770

## New, Dairy Products Analysis Manual

A new 91 page *Dairy Products Analysis Manual* is now available. The manual includes complete sample preparation and measurement procedures for Total Kjeldahl Nitrogen determination, using the compact Digesdahl Digestion Apparatus and an improved nesslerization technique. Complete procedures for other low-level elemental determinations (Ca, Mg, P, K, and salt) that can be performed on the same sample digest also are detailed.

This manual describes the reliable Hach One pH system, standarized coliform tests and a streamlined *E. coli* detection procedures using MUG-containing culture media. Also included is information about Carle gas chromatograph systems configured specifically for rapid packaging headspace analysis.

Additional manuals available cover meat and poultry; cereals and pasta; and beverages. Each contains step-by-step procedures and information about the equipment and reagents needed to perform a test.

For more information, write to Hach Company, PO Box 389, Loveland, CO 80539. Ask for literature number 3112. Telephone: 303-669-3050.

## Hydrotex

A full line of food grade lubricants meeting U.S.D.A. requirements has been introduced by Hydrotex. Designated "Ultra-Kleen", each lubricant is classified H-1 by the U.S.D.A. for incidental food contact.

For additional purity, the new products also are blended with USP-rated base oils, rather than conventional technical grade base oils.

"Because food processing equipment typically operates under harsh conditions involving moisture, heat and corrosion, our Ultra-Kleen lubricants have been specially designed to provide optimum protection", said Pat DeLarios, Hydrotex Director of Product Research and Control. "At the same time, they fully meet U.S.D.A. regulations for federally inspected meat and poultry plants," DeLarios added.

These lubricants produce no odors or toxic fumes, the company reports, making them ideal for baking, broiling, forming and packaging equipment.

Among the six new products are a food machinery grease, food machinery oils (in three viscosity grades) and food grade gear lubricants (in two viscosities).

"Virtually all food and beverage manufacturers or processors may find applications for the Ultra-Kleen lubricants", DeLarios explained.

For more information, contact: Hydrotex, Inc., PO Box 560707, Dallas, TX 75356-0707. Telephone: 1-800-527-9439.

# Preventive Pest Control

*by George T. Okumura*

*George T. Okumura*

## Warehouse Beetle

**Q. In the January issue you talked about the Warehouse Beetle causing illness to humans when the larvae are ingested. Do you know of animals becoming ill from them?**

A. I have a record of dogs only becoming ill. However, I believe other animals can also become ill.

**Q. Based on what you mentioned about the Warehouse Beetle being omnipresent and omnivorous with food preference of high protein; such as powdered milk, powdered eggs, etc., how often do you receive complaints of this insect relative to infestation of packages, package damage, and litigation?**

A. Frequently. I would place this insect immediately behind the Indian-Meal Moth as the number two pest. At this time I have five litigations running concurrently. Two of these cases are concerning Warehouse Beetles causing illness.

**Q. Tell us about the Warehouse Beetle sex pheromone - its function and application.**

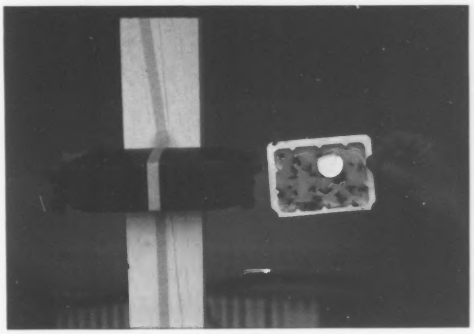
A. In nature the female releases her sex pheromone to attract the males. The components of this pheromone have been now synthesized. The synthetic pheromone, located in the membrane of a dispenser (size is little larger than a quarter) is slowly released for three months or more. The lure is placed on the sticky board which is in turn placed into a box to prevent food dust from accumulating on the lure. Many of these trap boxes are set inside throughout the building against the walls and pillars at eye level or higher. The trap is supported by wrapping masking tape around the box and onto the structure. Initially set the traps about 75 feet apart and then record the catches. Remove the inactive traps therefore decreasing the numbers. Some companies make and record daily counts to establish a Warehouse Beetle population profile. The primary function of the lure is to detect the presence of the Warehouse Beetle.

**Q. Should the traps also be set outside?**

A. Yes, these beetles are actively flying outdoors during warm days. I have set about 50 traps around the perimeter of a food plant and have caught as many as 5,000 beetles during one summer week. The traps were set about 100 feet away from the plant. The outside catches had significantly reduced the population inside by catching some of the beetles before they flew into the plant.

**Q. Are there other pheromones for other insects; such as Indian Meal Moth, Red Flour Beetles, etc.?**

A. Yes. One can write or call Consept, 213 Southwest Columbia, Bend, Oregon 97708. (1-800-367-8727), for types of lures that are available.

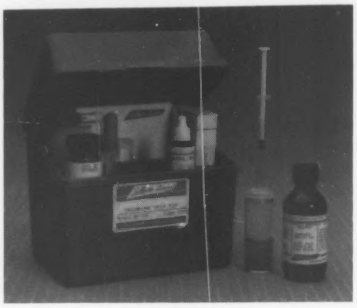


*Sex pheromone lure on a sticky board.*

*(Address questions concerning this column to: IAMFES, Preventive Pest Control P.O. Box 701, Ames, IA 50010)*

# New Product News

*The products included herein are not necessarily endorsed by Dairy and Food Sanitation.*



## EPA Accepted Chlorine Test Kit

• LaMotte Chemical Products announces a first to the compliance monitoring specialists with their Model DT-DR Chlorine test kit. The Model DT-DR kit is accepted by the United States EPA for both National Interim Primary Drinking Water Regulations (NIPDWR) and National Pollution Discharge Elimination Systems (NPDES) programs. A DPD-FAS titration method is used to measure chlorine residuals from 0 to 10 ppm to a sensitivity of 0.2 ppm. The test kit offers 50 tests for both Free and Total Chlorine. Components are packaged in a compact foam-lined carrying case.

Additional information can be obtained from: LaMotte Chemical Products Co., PO Box 329, Chestertown, MD 21620. Telephone: 800-344-3100.

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## Laminating Adhesive Protects Stand-up Pouch From Hot Liquids

• Special laminating adhesives retain their bonding strength when subjected to pasteurization temperatures in hot-fill, stand-up pouch packaging applications. The adhesives bond layers of PET to aluminum foil to linear low density polyethylene to form the lamination used to make the pouches.

In addition to resisting heat that could cause delamination of the inner ply, the adhesive also has to resist the acidic content of the fruit drinks.

Complete information on Tycel® laminating adhesives for hot-fill applications is available from Lord Corporation, Attn: Bruce Whitehair, 2000 West Grandview Blvd., Erie, PA 16514-0038. Telephone: 814-868-3611.

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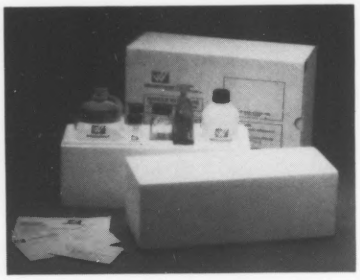

## Organon Teknika Corporation Announces New System for Dectection of Listeria

• Organon Teknika Corporation, Durham, North Carolina, announces the availability of monoclonal antibody based ELISA test system for the detection of Listeria in food and dairy products. The monoclonal antibodies, produced by Bionetics Research, Inc., an affiliate of Organon Teknika, Rockville, Maryland, detect all species and serotypes of *Listeria,* and show no cross-reactivity with other organisms.

The format of the assay is a 96-well microtitration plate (8 x 12 well strips) coated with a monoclonal antibody. Another enzyme-labeled monoclonal antibody is used to form a one step ELISA test system. The procedure is very easy to perform and requires no radioactive components, special permits or assigned work areas to perform this Listeria assay.

The test procedure can be performed with the same instrumentation utilized in the Salmonella Test System currently offered by Organon Teknika. AOAC collaborative studies comparing the ELISA Listeria test system with USDA and FDA recommended culture procedures are underway.

For more information, contact: Clem Darrow, Product Manager, Organon Teknika, 800 Capitola Drive, Durham, NC 27713. Telephone: 919-361-1995.

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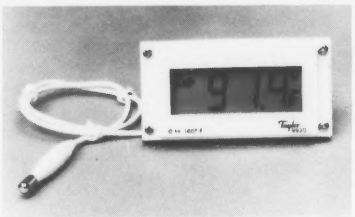

## New Micro-Circuit Board Adds Spoilage Alarms, HI-LO Memory, Expanded Readings to Foodservice Remote-Reading Storage Thermometers

• Newly upgraded Taylor compact foodservice thermometers for storage cabinets and rooms now feature a new micro-circuit board that allows high-low spoilage alarms, high-low temperature memory, Fahrenheit or Celsius readings and 15-second reading updates.

Each board is linked to a remote sensor with 39" cable that allows temperature monitoring without opening doors to refrigeration, holding, warming and heating equipment. The digital thermometers are designed for easy installation on existing mobile and stationary units. Instruction sheets are available for technicians to make board adjustments.

To cover all foodservice storage needs, TCA also has introduced two Taylor models for warming and heating units.

The new circuit board allows high and low temperature alarms to be connected to user audio and visual alert systems. Built-in memory will retain temperatures above or below a preset limit to warn of possible food spoilage.

The factory-set 15-second update mode may be changed internally to 1-second and the factory-set Fahrenheit readings may be changed to Celsius.

Flange-mount models offer two advantages over panel-mount models: (1) greater resistance to accidental impact, (2) a hole of only 9/32" is needed for the thermometer's remote sensor. Flange diameter is 3-3/4" and requires three screw holes in the cabinet.

TCA points out these battery-operated digital models eliminate the danger of food contamination by liquid from broken thermometer tubes. Polystyrene components of the digitals are rust-proof.

These foodservice thermometers with settable circuit boards are available from foodservice suppliers or by writing Earl Vaught, TCA Promotion Services, 95 Glenn Bridge Road, Arden, NC 28704. Telephone: 704-684-5178.

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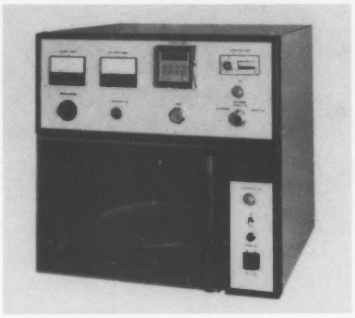

## New Laboratory Microwave Oven Aids Food Companies in Recipe Development Package Design

• Cober Electronics of Stamford, CT announces the introduction of its new Model LBM 1.2 Laboratory Microwave Oven.

Developed specifically to respond to the needs of the food scientist for a research tool, the LBM 1.2 can be used for:

- development of special "microwave oriented" packaging and containers for consumer products
- recipe and compound development of foods and products to be heated in home microwave ovens

The LBM 1.2 has the flexibility to simulate the features and cooking ability of the many different home and commercial microwave ovens that are on the market by:

- applying microwave power in ten distinct settings over a 1200 watt range
- applying convection hot air as an adjunct to the microwave for browning and cooking

The benchtop system is unique in the marketplace due to its full array of instrumentation and features which include:

- ability to vary microwave power levels to find optimum cooking or heating selection
- ability to measure reflected microwave power for recipe evaluation and enhancement
- the capability to study the affects of heating with or without a turntable
- the measurement of the contribution of convection hot air
- the capability to measure product temperature

For more information, contact: Cober Electronics, Inc., 102 Hamilton Ave., Stamford, CT 06902. Telephone: 203-327-0003.

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## New On-Line Moisture and Process Control Analyzer from Auburn International, Inc.

• The MAGNEFLOW Line of products produced by Auburn International's Industrial Magnetic Resonance (IMR) Division are the first to provide on-line monitoring of product moisture and fat content. This immediate feedback capability is superior to other conventional laboratory moisture analyzers, which require several hours to collect and report findings.

The first application of Auburn's IMR technology has been for moisture measurement and feedback control for grain milling and for a number of similar food processing applications.

According to Dr. Robert Pearson, inventor of the IMR technolgoy and Vice President of Auburn's IMR Research and Development Division, "This data is critical in such applications as wheat milling where one wheat miller calculated that in controlling wheat moisture content by .2 percent in the combined output of 10 mills he would be able to save $500,000 a year."

Auburn's MAGNEFLOW is being further developed to measure the amount of fat and moisture in processed meats, baked goods and animal feed; to determine the physical to bound water ratio in solids; pore size distribution in solids; surface area of catalyst supports; coordinated to bound water ratios in clays; the hydrogen content in fuels.

All IMR marketing and manufacturing is located at Auburn International, Inc.'s corporate headquarter at Eight Electronics Ave., Danvers Industrial Park, Danvers, MA 01923. Telephone: 800-255-5008.

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## Multi-Ranger

• Milltronics introduces Multi-Ranger. As a function selectable ultrasonic level monitoring device, multi-ranger will measure level, flow, and act as a dual pump controller. These functions are selectable via a removeable programmer/controller. One controller may be implemented to operate many multi-ranger devices. Multi-ranger utilizes ultrason transducers to monitor ranges from 12 inches to a maximum of 45 ft. Multi-ranger is factory programmed for instantaneous start-up, and is available from stock. Volume conversions and vapor compensation are two additional features providing extended versatility to multi-ranger customers. Write or telephone Milltronics, Inc., 709 Stadium Dr. East, Arlington, TX 76011. Telephone: 817-277-3543.

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## 511 LP Pressure-Meter

• A new Digital Meter from Solomat Instrumentation measures differential pressure with 1/1000th inch of water resolution and will display air velocity (200 to 20000 ft/min) when used with a pitot tube. Pressure units are switchable between inches $H_2O$, Pa and PSID with a range +60 inches of water. Air velocity is temperature compensated and is switchable between ft/min and m/s.

This handheld meter also features minimum, maximum and average recall; a hold function and a simultaneous display of pressure and temperature. The instrument is designed for industrial balancing and can be expanded for %RH, dewpoint and RPM measurement for a complete H.V.A.C. Measuring package.

For more information, contact: Bernie Edwards, Applications Manager, Solomat Instrumentation, 652 Glenbrook Rd., Stamford, CT 06906. Telephone: 203-348-9700.

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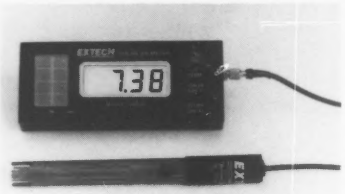


## *Solar Powered pH Meter - Fits in your pocket*

• A compact Solar Powered pH Meter Kit has been introduced by EXTECH Instruments. This pocket sized meter features a large 1/2" LCD display and a replaceable electrode with a 39" cable that makes it easy to immerse in any solution. The electrode is terminated with a miniature BNC connector. It also features calibration, slope and temperature adjustment screws to maximize accuracy to 0.02 pH and resolution to 0.01 pH. The Solar pH meter is powered by average laboratory or outdoor light conditions eliminating the inconveniences of buying or replacing batteries. Complete Kit includes the Solar pH Meter, a rugged polymer bodied combination pH/Reference electrode, and foam padded pouch carrying case with belt strap. For more information, contact: EXTECH Instruments Corp., 150 Bear Hill Rd, Waltham, MA 02154. Telephone: 617-890-7440.

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## *New Ethylene Oxide Leak Detector Introduced by CEA Instruments ... Unit Detects Less Than 1 ppm*

Toxic gas detection of less than 1 ppm is now possible with the introduction of the Ethylene Oxide Leak Detector from CEA Instruments, Inc., Emerson, NJ.

The unit is a low cost, continuous, dedicated gas detector utilizing a unique patented sensor that is unaffected by moisture, temperature change or poisons.

The sensor is highly specific, provides rapid response, explosion-proof and contains audio-visual alarms. It is UL approved, solid-state diffusion type with no pump or sample lines to maintain.

The main applications for the EtO Detector are in the areas where ethylene oxide is widely used such as hospitals, for instrument sterilization; as a fumigant in food and textile plants; and as a fungicide in the agricultural industry. In chemical processing industries EtO is used to produce ethylene glycol, acrylonitrite and nonionic surfactants.

The CEA EtO Leak Detector is a part of the company's Series-U line of single gas, lightweight, electro chemical instruments available in portable, wall-mount, or multi-point configuration.

Electrical classification is explosion-proof under Class 1, Division 1, Groups A, B, C and D hazardous atmospheric areas. Standard features include meter readout of 0-10 ppm or 0-50 ppm or 0-100 ppm. Optional 0-1 VDC or 4-20 mA recorder output is available.

For more information, contact: Robert K. Berner Associates, 50 Mount Prospect Ave., PO Box 1438, Clifton, NJ 07015. Telephone: 201-777-6070.

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## *Ice Cream Profit Zone Thermometer Now Teflon Coated*

• The Brooklyn Profit Zone Thermometer has been improved and protected. The PZT has been for years the standard instrument to measure accurately to a tenth degree Fahrenheit the temperature of ice cream as it is drawn from the freezer. Too cold can cause crumbling, too warm can sacrifice quality and volume. Stay within the profit zone with this 6" long mercury in glass thermometer scaled 15 to 32°F in 1/10°F divisions.

Now the PZT is available encapsulated in teflon. This improves its resistance to breakage and if it should break the glass and mercury are kept within the see-thru teflon coating. The PZT user can have the accuracy of a mercury thermometer without the danger.

To order specify #6E430. To see the complete line of thermometers, request free 44 page Catalog 80.

For additional informational, contact: Roy E. Teichert, Brooklyn Thermometer Company, Inc., 90 Verdi St., Farmingdale, NY 11735. Telephone: 516-694-7610.

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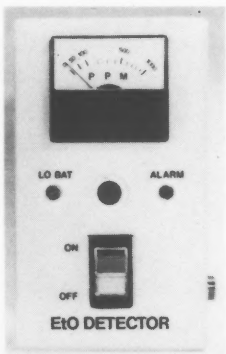
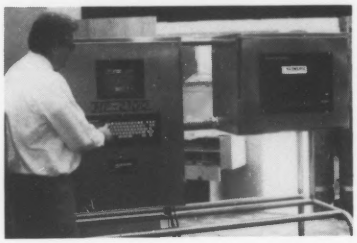


## *MP-2100 CIP Controller Geared for Easy Operation, Future Capabilities*

• Cleaning and sanitation in dairy, beverage and food processing plants have become easier and more efficient with the introduction of the MP-2100 microprocessor CIP controller from Klenzade, Division of Ecolab Inc.

The MP-2100, the most modern dedicated CIP controller, has a wide variety of management reporting capabilities to make operation supervision and record-keeping easier. Along with being "user friendly", the system also contains remote input/output capabilities -- controlled through a five-wire cable -- resulting in a "communication driven" system that can communicate with host computers.

Geared for the future, the system can easily be modified to expand as a facility grows. The MP-2100 also has a large program capacity and can store more than 200 cleaning programs.

Hard Copy Readouts

Reporting capabilities of the MP-2100 include hard copy readouts that help simplify reporting demanded of sanitation operations in many industries. The system can report chemical use inventories, giving a summary of CIP programs and providing a full documentation of user programs.

Off-Site Programmable Disk

The MP-2100 program is stored on a 3-1/2 inch diskete, which can be programmed off-site and mailed to the plant. This quick access feature helps keep production on target and helps prevent sanitation problems in their early stages.

Once the modem feature is available, operators will be able to monitor or troubleshoot while the unit is in operation -- all from a remote location.

For maximum security, the MP-2100 locks in programs with a function key and a secret password.

For more information on the MP-2100 microprocessor CIP controller and plant sanitation products, equipment and services, contact Klenzade, Division of Ecolab, Inc., PO Box 1018, Beloit, WI 53511, or call 815-389-3441.

**Please circle No. 254**
**on your Reader Service Card**

# Food and Environmental Hazards to Health

## Epidemic of Gastrointestinal Illness Probably Caused By Campylobacter in Water-Quebec

On 2 April 1985, the De Lanaudiere Community Health Department was notified regarding a large number of primary school children who had become ill with gastrointestinal symptoms following the consumption of a meal on 29 March. This meal, which was served at noon that day in a local restaurant, was similar to that served at Sugar Bushes during the maple syrup season. On 29 and 30 March, 3 other groups of adults and children had supper at the same restaurant and experienced the same gastrointestinal symptoms. Moreover, several other persons who had eaten at this establishment during the same time period presented with similar symptoms.

The investigation which followed involved a thorough inspection of the restaurant facilities including obtaining water and food samples for bacteriological analysis and water samples from the two neighboring houses and two artisian wells which constitute the primary source of water in the immediate area. A telephone questionnaire was conducted of the 626 persons at risk (433 adults and 187 children) to obtain age, sex, date and time meal was consumed, time of onset of illness, symptoms, and duration of illness. Finally, 23 people who had experienced more severe symptoms were requested to submit three separate stool specimens for culturing for *Escherichia coli, Campylobacter,* and parasite identification.

The standard of hygiene, and food preparation and storage techinques at the restaurant were considered satisfactory. Bacteriological analysis of samples taken in the restaurant indicated the following: very slight contamination of tap water in the dishwashing section; heavy contamination of the tap water in the kitchen; and food items, highly satisfactory. The quality of the municipal water was good. Inspection of the wells and septic tank facilities revealed that they did not conform to the law regarding standards for such installations. All three wells were highly polluted.

The epidemic curve indicates a common source of infection with sudden onset of illness, limited in time. The total of 344 persons were ill (137 children and 207 adults), giving an attack rate of 55.5%. The mean incubation period was 29.7 hours, median 32, suggesting a pathogen with a relatively short incubation period, or heavy contamination, or heavy consumption. There also appeared to be a bimodal distribution of cases in relation to incubation period, particularly among the adults, suggesting two agents, one with a very short incubation period of 12-16 hours and the other with a longer period of 36-40. The duration of illness did not exceed 7 days (mean 1.83 days, median 3.5); the illness lasted less than 3 days in 92.5% of the cases. The majority of cases experienced milk symptoms including abdominal cramps (91.9%), nausea (87.8%), vomiting (68.6%), headache (54.4%), chills (42.2%), dizziness (34.9%), and fever (26.5%). In general, the adults seemed to experience more diarrhea and the children more vomiting. Only 5.8% consulted a physician. Despite the impreciseness of the questionnaire, it was believed that approximately 51% of the cases, particularly the children, may have transmitted the infection to one or more family members.

Food-specific attack rate analysis strongly suggested that water was the source of infection. *Campylobacter* was isolated from the stool of 3 of the 23 cases who submitted specimens, and 2 of these strains were the same serotype and biotype. Reporting delays as well as technical difficulties in preserving and transporting the samples could possibly explain the low number of positive results.

The problems with water and sewage in this area have been known since 1982 but there are several factors involving local and provincial groups which have to be resolved before a solution can be reached.

Can. Dis. Weekly Report 4-11-87

## Nationwide Dissemination of Multiply Resistant Shigella sonnei Following a Common-Source Outbreak

In early July 1987, an outbreak of multiply resistant Shigella sonnei gastroenteritis occurred among persons who attend the annual Rainbow Family gathering in North Carolina. Since that time, four clusters of gastroenteritis due to multiply resistant S. sonnei have been reported among persons who had no apparent contact with gathering attendees.

Preliminary results from a survey of gathering attendees showed that 157 (58%) of the 270 respondents experienced acute diarrheal illness. This finding is consistent with previous estimates of a 50% or greater attack rate of acute gastroenteritis among the 12,000 attendees. Seventy-five attendees from 26 states and 14 contacts of these persons who had not attended the gathering have had culture-confirmed infection. The S. Sonnei isolates from these patients are resistant to ampicillin, tetracycline, and trimethoprim-sulfamethoxazole - the antibiotics usually used to treat shigellosis.

In July, August, and September, clusters of multiply resistant S. sonnei infection occurred in Missouri and Pennsylvania. Isolates from these cases showed an antimicrobial resistance pattern similar to that of the strain involved in the North Carolina outbreak. Two small clusters were reported from Missouri. A third cluster occurred among patrons and employees of a Pennsylvania restaurant. In a fourth cluster, which has been epidemiologically linked to the third, residents and staff of a nursing home in the same Pennsylvania town became ill.

**Editorial Note:** In a national survey of Shigella isolates conducted in 1985 and 1986, approximately 4% of isolates from S. sonnei infections acquired in the United States were resistant to trimethoprim-sulfamethoxazole. None had the same antimicrobial resistance pattern as the North Carolina outbreak strain. The occurrence of these four clusters of infection with multiply resistant S. sonnei underscores the need for sensitivity testing to guide in selecting appropriate antimicrobial therapy. Such testing also permits early identification and prompt reporting of multiply resistant strains to public health authorities so further transmission can be prevented.

Further spread of this resistant strain will likely limit the effectiveness of the usual antimicrobial agents for treating shigellosis. Infections that are caused by this multiply resistant Shigella and that require antimicrobial therapy can be treated with nalidixic acid or norfloxacin. Although studies in other countries suggest that both nalidixic acid and norfloxacin are effective for the treatment of shigellosis, it is important to note that neither nalidixic acid nor norfloxacin has been approved by the Food and Drug Administration (FDA) for treatment of bacterial gastroenteritis. Both nalidicix acid and norfloxacin are quinolones, and care should be exercised in prescribing either one for children because of experimental evidence that quinolones can cause arthropathy in young animals. No such lesions have been reported to the FDA in association with nalidixic acid therapy in humans. Life-threatening infections are rare with S. sonnei but could be treated with gentamicin or chloramphenicol, to which the outbreak strain is sensitive.

Basic hygiene and sanitary precautions remain the cornerstones of control measures for shigellosis outbreaks, including those due to multiply resistant strains. Vigorous emphasis on handwashing with soap after defecation and before eating has been shown to reduce secondary transmission of shigellosis.

MMWR 10-2-87

## Listeria Monocytogenes Meningoencephalitis-British Columbia

On 12 May 1987, a 59-year-old male from Port Alberni developed malaise, headache, nausea, and vomiting. His condition worsened during the next 2 days, with delirium, and a decreased level of consciousness, and he was seen by his physician and transferred to Victoria. On examination he was febrile with meningismus; the white cell count was $18.1 \times 10^9$/L with 11% staff cells and toxic vacuolation of neutrophils noted. The CSF was pale yellow and cloudy with 83 RBCs x $10^6$/L, with a differential count of neutrophils 64%, lymphocytes 26% and monocytes 10%. Glucose was 3.3 mmol/L and protein 1.g/L. Some pulmonary vascular congestion was noted on the chest X-ray and a CT scan was normal with no evidence of subarachnoid hemorrhage. By 16 May, both blood and CSF cultures grew *Listeria monocytogenes*. Immunoglobulin profile was normal.

This patient had been relatively healthy up to this illness. He had asthma and was being treated with Reclovent® Ventolin® inhalers and Choledy1®. He was not on systemic steroids. He was a "borderline" employed as a road foreman and did not have contact with livestock at home or work, except for the removal of a dead deer killed by a vehicle two months before admission. He drinks twelve bottles of beer and less than five ounces of spirits per week. Water supply was chlorinated municipal water. Dietary history revealed an allergy to dairy products so he voids milk products except for small amounts of cheddar cheese. His meat consumption is varied and generally cooked well. He eats no fruits but a wide variety of vegetables.

He was treated with penicillin (6 million units IV q6h) and gradually improved. He was discharged on 5 June, 21 days after admission, with bilateral leg weakness which was improving.

Canada Dis Weekly report 10-3-87

## Fatalities Resulting From Sulfuryl Fluoride Exposure After Home Fumigation - Virginia

On September 25, 1986, an elderly Virginia couple had their home fumigated by a local pest extermination company for the control of woodboring insects. Two hundred and fifty pounds of sulfuryl fluoride (SF), a colorless, odorless fumigant gas commonly used for this purpose, was applied in the approximately 80,000-cubic-foot home that day. Before fumigation, the house was vacated, tightly sealed, and externally covered with a tarpaulin to maintain high levels of the gas inside. During fumigation, electric fans were used to circulate the pesticide. Entry into the house was prohibited until approved by the exterminators, and a security guard watched the house from 2 p.m. on September 25 until 7 a.m. on September 26.

At 9 a.m. on September 26, the exterminators removed the tarpaulin and opened the doors and windows to ventilate the house. Afterward, they ran electric fans for 2 1/2 hours to facilitate air circulation. Reentry was approved at 2 p.m., and reports suggest that the couple returned home between that time and 5 p.m., approximately 5 to 8 hours after ventilation procedures began. The couple left their home to attend a football game at 7 p.m. and returned for the night at approximately 10 or 11 p.m.

On September 27, within 24 hours of their return, the wife experienced weakness, nausea, and repeated vomiting, and her husband complained of dyspnea and restlessness. By the morning of September 28, the husband had developed severe dyspnea and cough. At 7:15 a.m., he experienced a generalized seizure followed by cardiopulmonary arrest. He was transported to a local emergency room, but resuscitative measures were unsuccessul. Death was presumed to be caused by an acute myocardial infarction, and inhalation of a toxic agent was not suspected.

On October 1, the widow, who was complaining of severe weakness, dyspnea, intermittent chills, and anorexia, consulted her family physician. She had not left her home in 3 days and was unable to walk into the physician's office. She was admitted to the hospital, where a chest X-ray revealed severe hypoxemia and diffuse pulmonary infiltrates. On October 2, ventricular fibrillation occurred, and she died at approximately 11 p.m. Because both deaths occurred within a short period of time and the wife's illness was compatible with toxic gas inhalation, these deaths were then thought to be related to the recent home fumigation.

Autopsy reports reported by the Office of the Chief Medical Examiner revealed that both decedents died of acute pulmonary edema from exposure to a toxic agent. Toxicologic analysis of blood and other tissues could not be performed on the husband, but analysis of serum obtained from the wife on October 1 (6 days after fumigation) revealed a plasma fluoride level of 0.5 mg/l. No fluoride was detected (at the 1.0 mg/kg concentration) in other tissues, including those from the kidneys, liver, and lungs. No other toxic agents were detected. Although the couple became ill at similar times, the differences in time from exposure till death suggest that their levels of exposure to SF may have differed. Unfortunately, the details of their activities upon reoccupying their home are not known.

On October 6, the district manager of the extermination company notified the Virginia Department of Agriculture and Consumers Services of the deaths. Investigation verified that the cylinders of pesticide contained SF and had been manufactured prior to June 18, 1986. The amount used (250 pounds) was determined to be appropriate, based on the cubic footage of the house, the air temperature, and the relative humidity.

Although the exterminators removed the tarpaulin, opened the windows and doors, and used fans to aerate the home, they failed to measure the air concentration of SF inside the home. This step is necessary to determine the appropriate time for reoccupancy. Air samples taken during the investigation by state officials on October 8 revealed no detectable levels of SF, but levels of this gas would have been expected to have dissipated by that time.

Neither of the two workers who removed the tarpaulin and ventilated the house was licensed, but their supervisor, who had extensive experience with SF, was certified. The presence of a certified applicator was not required by the product label on the cylinders used during this fumigation, and none was on had at the time.

**Editorial Note:** SF (chemical formula $F_2O_2S$) was first introduced in 1957 as an insecticide and has been widely used to exterminate wood-boring insects in buildings. It is applied by fumigation techniques that require the building to be tightly sealed to allow a high concentration to penetrate the wood. In 1986, approximately 200 to 500 homes, in Virginia were fumigated with SF (Dow Chemical Company, unpublished data. It is, however, more widely used in other areas of the United States, such as Florida and California.

Background plasma fluoride levels for humans have been reported to approximately 0.01 mg/l. While peak concentrations of 0.06 to 0.4 mg/l have been noted to decrease to 0.2 mg/l within 2-9 hours. Thus, the concentration of 0.5 mg/l found in serum obtained from the wife 6 days after fumigation suggests that she had experienced acute exposure to an elevated concentration of fluoride.

In short-term toxicologic experiments, inhalation of 1,000 parts per million (ppm) of SF for 3 hours or 15,000 pm for 6 minutes was fatal to less than 5% of experimental animals. However, these studies also indicate that higher concentrations of SF cause respiratory irritation and central nervous system depression, which may be followed by excitation, convulsions, and respiratory arrest. Animals exposed to low but unspecified doses of SF first had parasympathetic stimulation with vomiting, diarrhea, lacrimation, salivation and abdominal colic. This stage was followed by cardiovascular collapse and pulmonary edema. Similar observations were noted in the two cases reported here.

The scientific literature reports at least four deaths from exposure to SF since its wide usage began 10 to 15 years ago. However, these two fatalities in Virginia are the first in which the residents had not reentered the structure under unusual or prohibited circumstances. In this situation, there had not been appropriate air monitoring during aeration and before clearance for reoccupancy was given. These precautions are clearly required by the product label.

The product labels on all cylinders manufactured since June 28, require that two persons trained in the use of SF be present at all times during fumigant introduction, testing, and aeration procedures. After fumigation, the house is to be aerated until the level of SF is $<5$ ppm, as measured by a Miran* gas analyzer. Measurements should be taken before reoccupancy because the kinetics of SF dissipation depends on many variables including the amount of fumigant applied, the quality of the tarpaulin, the ambient temperature, and the wind speed. No one should enter the house without a self-contained breathing apparatus if the level of SF is $>5$ ppm. The Occupational Safety and Health Administration's current permissible exposure limit and the American Conference of Governmental Industrial Hygienist' (ACGIH) threshold limit value for SF are 5 ppm. The ACGIH short-term exposure limit is 10 ppm. The level considered immediately dangerous to life and health is 1,000 ppm, and persons exposed at this level must use a supplied-air respirator with a full facepiece, helmet, or hood.

The difference in time of death for the couple was striking, but data are not sufficient for interpretation. The only known host factor that may account for this difference is age, since neither the husband nor wife had a prior history of cardiopulmonary disease. The husband was 8 years older than the wife, but it is doubtful that this small age difference could account for the large time

**N.M.C.**

**NATIONAL MASTITIS COUNCIL**

Treatment needed when prevention fails

Even in the best managed herds there will be occasional cases of clinical mastitis that require treatment. Before beginning treatment, realize first that a clinical case represents a failure of mastitis control and that treatment is a costly process that will not have much effect on the level of mastitis in the herd. Ask yourself why that cow has clinical mastitis and how future cases can be prevented.

Mastitis control programs, especially treatment routines, are best developed in consultation with a veterinarian skilled in mastitis control. Treatments selected will be based on knowledge of the kinds of organisms most likely to be causing clinical mastitis in the herd. This knowledge is best obtained by culture of all clinical cases over a period of several months; in some herds, culture of all clinical cases is a routine practice. The best time to culture clinical cases is as soon as the condition is discovered and before any treatment is given. Usually, treatment should be given before culture results are available. If results indicate that the treatment given was inappropriate, it can be changed.

Subacute mastitis, with abnormal milk but little or no swelling of the udder and no systemic signs, is best treated, at least initially, by intramammary infusion of a commercial mastitis product. Label directions as to treatment intervals, number of treatments and milk withholding time should be followed.

Acute mastitis, with a hard swollen quarter and often with fever and loss of appetite, should be treated by or under the supervision of a veterinarian. In such cases, antibiotics usually are given intravenously or intramuscularly and also in the mammary gland. Supportive treatment including electrolytes and antiinflammatory drugs may be require in severe cases. In the early acute stages, frequent milking out of the affected quarter may be helpful.

After treatment, clinical cows should be marked with ankle bands, tail tags or other methods to ensure that their milk is not added to the herd milk. Milking affected cows separately, as in the hospital string of a large herd or last in the milking order of a smaller herd, will reduce the possibility both of transmitting the disease to normal cows and of contaminating herd milk.

Clinical cases that do not return to normal after treatment or that appear to clear up but then recur after days or weeks should be reevaluated. In these cases, culture and determination of antibiotic sensitivity may suggest a more effective treatment. Cows with infections that have resisted several courses of treatment of that culture indicates are unlikely to be cured should be considered for culling.

1840 Wilson Blvd.
Arlington, VA 22201
703-243-8268

difference between their deaths.

Persons who develop illness that may be related to SF exposure require consultation by a physician. Health-care workers should be aware that exposure to highly toxic substances such as SF may occur without warning or detection and may involve persons other than the individual patient. The initial symptoms of illness from SF exposure can be nonspecific and may resemble other common illnesses, even when the dose has been in the lethal range. Early clinical recognition of illness, timely investigation of the source, and appropriate environmental intervention may help prevent fatalities from this type of exposure.

Preventing life-threatening exposure to SF depends on the proper use of this pesticide. According to package labelling, this restricted-use pesticide is "for sale to use only by certified applicators or persons under their direct supervision." The label also states that the product is only for those uses for which the applicator is certified. Certified applicators are cautioned to use SF in accordance with the label instructions, and consumers are alerted to be aware of the precautions that should be taken when their homes are exterminated.

MMWR 9-18-87

# IAMFES

## MEETING REGISTRATION FORM
**75th IAMFES Annual Conference**
**July 31 - August 4, 1988**
**Hyatt Regency Westshore**
**Tampa, Florida**

QUESTIONS: Call 800-525-5223 or 515-232-6699

**NOTE: PRICES LISTED ARE FOR *MAIL REGISTRATION POSTMARKED BY JUNE 15, 1988.***

***REGISTRATION AND FUNCTIONS AFTER JUNE 15 ARE $5.00 HIGHER FOR EACH REGISTRATION AND EACH FUNCTION***

NAME _____ COMPANY NAME _____

ADDRESS _____ CITY _____ STATE/PROVINCE _____

COUNTRY _____ ZIP _____ JOB TITLE _____

OFFICE PHONE # _____ IF STUDENT, COLLEGE OR UNIV. _____

COMPANIONS (spouse/children) _____ _____

_____ _____

**PLEASE CHECK where applicable**

**IAMFES MEMBER** _____
**NON-MEMBER** _____
**AFFILIATE MEMBER *ONLY*** _____

**STUDENT** _____
**30 or 50 Year Member** _____
**AFFILIATE DELEGATE** _____

**EXECUTIVE BOARD** _____
**PAST PRESIDENT** _____
**SPEAKER** _____

**PRICES GOOD WHEN POSTMARKED BY JUNE 15, 1988**
**Prices after June 15 are $5.00 higher for each registration and each function. Registrations postmarked after June 15 must include higher prices.**

**SECTION 1**

| | IAMFES MEMBER | SPOUSE/GUEST (not company representative) | STUDENT | NON-MEMBER | *Registration & IAMFES Membership for 1989 | BEST BUY |
|---|---|---|---|---|---|---|
| Registration | ☐$45 | ☐$15 | ☐$10 | ☐$75 | ☐$83 | |
| Early Bird Reception | ☐FREE | ☐FREE | ☐FREE | ☐FREE | ☐FREE | |
| Gasparilla Celebration | ☐$29 | ☐$29 | ☐$29 | ☐$29 | ☐$29 | Children 12 & under No.____ ☐$13.50 each |
| Banquet & Reception | ☐$23 | ☐$23 | ☐$23 | ☐$23 | ☐$23 | Children 12 & under No.____ ☐$11.50 each |

*Includes Dairy and Food Sanitation

**SECTION 2**

**— SPECIAL EVENTS —**

**Choose the events you wish to attend and include with your registration form above - see next page**

| | DAY/DATE | ADULTS | CHILDREN | How Many |
|---|---|---|---|---|
| Tampa by the Bay Tour | Mon. 8-1 | $25.00 | $12.50 (12 and under) | ____Children ____Adult |
| Adventure at Busch Gardens | Wed. 8-3 | $25.00 | $ 4.00 (2 and under) | ____Children ____Adult |
| Disney World Package | Thurs. 8-4 Fri. 8-5 | ☐ PLEASE CHECK IF INTERESTED AND YOU'LL BE CONTACTED. | | |

Make Checks Payable to:
IAMFES 1988 Meeting Fund
**U.S. FUNDS ONLY**

**Mail by June 15, 1988 to:**
**James L. Strange**
**FL Dept. of Agr. & Cons. Serv.**
**3125 Conner Blvd.**
**Tallahassee, FL 32399-1650**
**Phone:904-487-1480**

**Total of Section 1 $** _____
**Total of Section 2 $** _____
**Overall Total $** _____

# IAMFES

## Special Events Program

### TAMPA BY THE BAY TOUR
***August 1, Monday***
***9:30 a.m. - 3:30 p.m.***

A guided bus tour of historical Tampa, FL. Visit the University of Tampa campus including the lovely H. B. Plant Museum which was once the lavish Tampa Bay Hotel built in 1890. Shop at Hyde Park in the restored area, drive along Bayshore Blvd. where some of Tampa's finest old mansions are located. Lunch at the Colannade Restaurant over-looking the water. Browse the marketplace at Harbour Island and finally visit Ybor City, Tampa's famous Latin quarter. Here you visit historic Ybor Square located in a cigar factory built in 1886. There will be ample time for shopping in the quaint shops and you will view cigars being handrolled. Cost: Adults $25.00; Children (12 and under) $12.50.

### A DAY OF ADVENTURE AT BUSCH GARDENS
***August 3, Wednesday***
***9:30 a.m. - 4:30 p.m.***

Spend the day at Busch Gardens, The Dark Continent. Visit the fourth largest zoo in the United States, the amusement park, nature shows, and all Busch Gardens has to offer. Including Lunch at the park. Cost: Adults $25.00; Children (2 and under) $4.00.

### DISNEY WORLD PACKAGES
***August 4 & 5, Thursday and Friday***

For those interested, 2 or 3 day post-meeting Disney World packages will be arranged by Around the Town Travel Agency, Tampa, FL. Typical packages will include transportation, park admission, and lodging at special rates. Arrangements must be confirmed no later than June 30, 1988.

### SOCIAL EVENTS THROUGHOUT THE MEETING

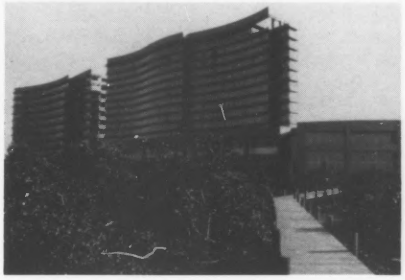
Cheese & Wine Reception with Exhibits, Sunday Evening
Gasparilla Festival, Monday Evening
Awards Banquet & Reception, Wednesday Evening

**Make Your Reservations Early!**

# Hotel Reservations

# IAMFES

## *75th Annual Meeting*
## *July 31 - August 4, 1988*
## *Hyatt Regency Westshore*
## *6200 Courtney Campbell Causeway*
## *Tampa, FL 33607*



The Florida Association of Milk, Food and Environmental Sanitarians (FAMFES) will be hosting the 75th IAMFES Meeting, July 31 - August 4, 1988. They cordially invite you to participate in the educational sessions as well as in social functions and special events with old or new colleagues and friends, view the table top exhibits, and enjoy Florida hospitality at the Hyatt Regency Westshore, uniquely located in a 35 acre nature preserve on beautiful Tampa Bay.

**MAIL THIS FORM DIRECTLY TO:**

**HYATT REGENCY WESTSHORE**
**IAMFES MEETING**
**6200 Courtney Campbell Causeway**
**Tampa, FL 33607**

**QUESTIONS? CALL THE HYATT REGENCY WESTSHORE AT: 813-874-1234**

NAME(s) _____

_____

ADDRESS _____

_____ CITY _____

STATE/PROVINCE _____ COUNTRY _____ ZIP _____

OFFICE PHONE NUMBER _____

SHARING ROOM WITH _____ NUMBER OF PERSONS _____

ARRIVAL _____ DEPARTURE _____

SPECIAL REQUESTS _____

Accomodations will be confirmed only with a check for the first night's deposit, or use your credit card to guarantee your reservations. You will be charged for the first night if your reservation is not cancelled prior to 6 p.m.

CREDIT CARD # _____ CREDIT CARD _____

EXPIRATION DATE _____

CARD HOLDERS SIGNATURE _____

**SPECIAL ROOM RATES** for this convention are $65 plus tax . . . up to 4 persons in a room.

Clearwater Travel Park
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*just across the CCC bridge

# Affiliate Newsletter

## *FDA Interpretations Committee*

Last year five new IAMFES Committees were formed to enhance and enlarge the already existing IAMFES Committees. The committees are:

1) Food Service Sanitation Committee
   Chairperson: Dr. Bennett Armstrong

2) Education and Training Committee
   Co-Chairpersons: Joel Simpson and Ulfert Esen

3) Water Quality and Waste Disposal Committee
   Chairperson: Dr. Robert Zall

4) Retail Foods Committee
   Chairperson: Tom Schwartz

5) FDA Interpretations Committee is in need of a chairperson. If you are interested or would like more information on this committee or any of the above contact IAMFES Committees Chairperson Ron Case, Kraft Inc., Kraft Court - OP/5, Glenview, IL 60025, 312-998-2056.

## Affiliate Calendar

**1988**

**April 6-8, MISSOURI MILK, FOOD AND ENVIRONMENTAL HEALTH CONFERENCE** will be held at the Holiday Inn Executive Center, Columbia, Missouri. For more information, contact: Grace Steinke, 9713 Fall Ridge Trail, Sunset Hills, MO 63127-1508.

**April 14-15, THE FIRST ORGANIZATIONAL ANNUAL MEETING OF THE PROPOSED NEBRASKA AFFILIATE** will be held in Lincoln, Nebraska. Sessions will begin at noon on the 14th and end at noon on the 15th. For more information, contact: Nancy Bremer, State Dept. of Agric., 3703 So. 14th St., Lincoln, NE 68502. Telephone: 402-471-2176.

**April 20, INDIANA ENVIRONMENTAL HEALTH ASSOCIATION, INC.** annual spring meeting to be held at the Holiday Inn at the Airport in Indianapolis, IN. For more information, contact: Larry Beddow, Vigo Co. Air Pollution Control, 201 Cherry St., Terre Haute, IN 47807. Telephone: 812-238-8429.

**May 16-18, THE PA DAIRY SANTARIANS & LABORATORY DIRECTORS ANNUAL MEETING,** to be held at Penn State University. For more information, contact: Sidney Barnard, Food Science Extension Specialist-Dairy, 8 Borland Laboratory, Penn State Univ., University Park, PA 16801. Telephone: 814-863-3915.

**June 6-8, TEXAS ASSOCIATION OF MILK, FOOD & ENVIRONMENTAL SANITARIANS ANNUAL MEETING** will be held at the Howard Johnson Plaza-South, Austin, TX. For more information, contact: Janie Park, TAMFES, PO Box 2363, Cedar Park, TX 78613-2363. Telephone: 512-458-7281.

**September 26-28, INDIANA ENVIRONMENTAL HEALTH ASSOCIATION, INC.,** annual fall meeting will be held at the Hilton in Fort Wayne, IN. The contact person is Rosemarie Hansell, Marion Co. Health Dept., 222 East Ohio St., Indianapolis, IN 46204. Telephone: 317-633-9682.

**September 27-29, NEW YORK STATE ASSOCIATION OF MILK AND FOOD SANTARIANS** annual meeting will be held at Sheraton Inn-Binghamton at Sarbro Square, One Sarbro Square, Binghamton, NY. For more information, contact: Paul Dersam, 27 Sullivan Rd, Alden, NY 14004. Telephone: 716-937-3432.

**September 29-30, SOUTH DAKOTA STATE DAIRY ASSOCIATION** will hold it annual convention at the Holiday Inn, Brookings, SD. For additional information, contact: Shirley W. Seas, Dairy Science Dept., SD State University, Brookings, SD 57007. Telephone: 605-688-5480.

## Book Reviewers Wanted!

**Free books to members who read and write book reviews for Dairy and Food Sanitation. For an updated list of books write: Associate Editor, Dairy and Food Sanitation, P.O. Box 701, Ames, IA 50010.**

# IAMFES Audio Visuals Library

## A Free IAMFES Members Benefit

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

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

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

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

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

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

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

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

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

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

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

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

Other food and environmental audio-visuals should be available soon.

Sidney E. Barnard
Chairman Audio Visual Library
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If you are interested in checking out any of our audio-visuals contact: Margie Marble, P.O. Box 701, Ames, IA 50010, 800-525-5223 (outside Iowa), 515-232-6699. IAMFES Members Only.

# Dairy and Food Sanitation Instructions for Authors

## Nature of the Magazine

*Dairy and Food Sanitation* is a monthly publication of the International Association of Milk, Food and Environmental Sanitarians, Inc. (IAMFES). It is targeted for persons working in industry, regulatory agencies, or teaching in milk, food and environmental protection.

The major emphases include: 1) practical articles in milk, food and environmental protection, 2) new product information, 3) news of activities and individuals in the field, 4) news of IAMFES affiliate groups and their members, 5) 3-A and E-3-A Sanitary Standards, amendments, and lists of symbol holders, 6) excerpts of articles and information from other publications of interest to the readership.

Anyone with questions about the suitability of material for publication should contact the editor.

## Submitting Articles

All manuscripts and letters should be submitted to the Editor, Kathy R. Hathaway, IAMFES, P.O. Box 701, Ames, Iowa 50010.

Articles are reviewed by two members of the editorial board. After review, the article is generally returned to the author for revision in accordance with reviewer's suggestions. Authors can hasten publication of their articles by revising and returning them promptly. With authors' cooperation articles are usually published within three to six months after they are received and may appear sooner.

Membership in IAMFES is not a prerequisite for acceptance of an article.

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## Reprints

Reprints of an article may be ordered by the author. An order form for reprints will be sent to you. Reprints may be ordered with or without covers, in multiples of 100. Reprint costs vary according to the number of printed pages in the article. Reprints cannot be provided free of charge.

## Types of Articles

*Dairy and Food Sanitation* readers include persons working as sanitarians, fieldmen or quality control persons for industry, regulatory agencies, or in education. *Dairy and Food Sanitation* serves this readership by publishing a variety of papers of interest and usefulness to these persons. The following types of articles and information are acceptable for publication in *Dairy and Food Sanitation*.

### General Interest

*Dairy and Food Sanitation* regularly publishes nontechnical articles as a service to those readers who are not involved in the technical aspects of milk, food and environmental protection. These articles deal with such topics as the organization and application of a milk or food control program or quality control program, ways of solving a particular problem in the field, organization and application of an educational program, management skills, use of visual aids, and similar subjects. Often talks and presentations given at meetings of affiliate groups and other gatherings can be modified sufficiently to make them appropriate for publication. Authors planning to prepare general interest nontechnical articles are invited to correspond with the editor if they have questions about the suitability of their material.

### Book Reviews

Authors and publishers of books in the fields covered by *Dairy and Food Sanitation* are invited to submit their books to the editor. Books will then be reviewed and published in an issue of *Dairy and Food Sanitation*.

## Preparation of Articles

All manuscripts should be typed, double-spaced, on 8½ by 11 inch paper. Side margins should be one inch wide.

The title of the article should appear at the top of the first page. It should be as brief as possible and contain no abbreviations.

Names of authors and their professions should follow under the title. If an author has changed location since the article was completed, his new address should be given in a footnote.

*con't. p. 158*

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## D.F.S. Instruction for Authors, *con't. from p. 154*

### Illustrations, Photographs, Figures

Wherever possible, submission of photos, graphics, or drawings to illustrate the article will help the article. The nature of *Dairy and Food Sanitation* allows liberal use of such illustrations, and interesting photographs or drawings often increase the number of persons who are attracted to and read the article.

Photographs which are submitted should have sharp images, with good contrast.

### Examples of Proper Bibliographic Citations

Paper in a journal

Alderman, G. G. and E. H. Marth. 1974. Experimental production of aflatoxin in citrus juice and peel. J. Milk Food Technol. 37:308-313.

Paper in a book

Marth E. H. 1974. Fermentations. pp. 771-882. In B. H. Webb, A. H. Johnson, and J. A. Alford (eds.) Fundamentals of dairy chemistry (2nd ed.), AVI Publishing Co., Westport, CT.

Book

Fennema, O. R., W. D. Powrie, and E. H. Marth. 1973. Low-temperature preservation of foods and living matter. Marcel Dekker, Inc., New York. 598 p.

Patent

Hussong, R. V., E. H. Marth, and D. G. Vakaleris. 1964. Manufacture of cottage cheese. U.S. Pat. 3,117,870. Jan. 14.

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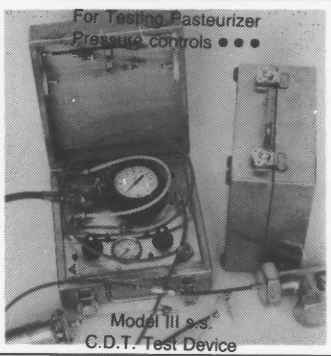


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# JFP Abstracts

*Abstracts of papers in the March* Journal of Food Protection

***To receive the* Journal of Food Protection *in its entirety each month call 1-800-525-5223, ext. A or 515-232-6699, ext. A in Iowa.***

**Survival of *Listeria monocytogenes* in Simulated Milk Cooling Systems,** R. Petran and E. A. Zottola, Department of Food Science and Nutrition, University of Minnesota, 1334 Eckles Avenue, St. Paul, Minnesota 55108

*J. Food Prot.* 51:172-175

Survival of *Listeria monocytogenes* under conditions that might be found in milk cooling systems was studied. Sterile solutions of 0.1 and 0.01% peptone, 0.1 and 0.01% nonfat dry milk (NFDM), 30% propylene glycol, and 30% propylene glycol with 0.01% NFDM were inoculated with 6000 *L. monocytogenes* Scott A/ml and were incubated at 4°C. The temperature was increased to 7°C when little growth was observed. At 7°C, populations approached $10^9$ organisms/ml in NFDM and peptone. Growth was greater in the higher concentrations of each, and there was limited survival in the glycol media. Growth in minimal media, 0.01% peptone, 0.01% NFDM, 30% propylene glycol with 0.01% NFDM, and 1% tryptic soy broth (TSB), was studied. These media were inoculated with 3500 *L. monocytogenes* Jalisco cheese/ml. At 4°C, more growth was observed in the NFDM than in the peptone, no survival was seen in the glycol media, and the most growth was observed in the TSB. Growth in sterile 10, 20, and 30% propylene glycol solutions (with 0.1% NFDM) was studied by inoculation with 8800 *L. monocytogenes* Jalisco cheese/ml and incubation at 4°C. Growth in the 10% solution was observed. However, there was survival in the 20 and 30% solutions with no increase in numbers apparent over the time studied. Presence of *L. monocytogenes* in milk cooling systems may pose a hazard, especially in sweet water systems that might contain a small amount of milk.

**Nature and Number of Ground-Beef Microorganisms Capable of Growth at 25°C but Not at 32°C,** E. G. Steinbuegge and R. Burt Maxcy, Department of Food Science and Technology, University of Nebraska-Lincoln, Lincoln, Nebraska 68583-0919

*J. Food Prot.* 51:176-180

The nature and relative population density of microorganisms capable of growth at 25°C but not at 32°C was determined on enumerations from ground beef. Only approximately 60% as many bacteria were recovered when incubation was at the higher temperature. One-third of the randomly selected isolates from the 25°C plates were unable to grow at 32°C. Some of these isolates were strikingly similar to pathogens. Incubation of plates at 25°C for 48 h is recommended to improve recovery of bacteria of significance in ground beef.

**Comparative Study on Injury and Recovery of *Staphylococcus aureus* using Microwaves and Conventional Heating,** H. Khalil and R. Villota, University of Illinois, Department of Food Science, 382D Agr. Eng. Sci. Bldg., 1304 W. Pennsylvania Avenue, Urbana, Illinois 61801

*J. Food Prot.* 51:181-186

Cells of *Staphylococcus aureus* FRI-100 were exposed to a sublethal temperature of 50°C for 30 min in 0.1*M* phosphate buffer using either microwave energy or a conventional heating source. Following thermal stress, cells were allowed to recover. Injury was monitored as the difference between cell counts when an inoculum from the recovering cells was plated on TSA and TSAS. Total viable population following either heat treatment was $10^6$ cells/ml as indicated by TSA counts. When the same suspensions were plated on TSAS, a viable count of $1.7 \times 10^3$ cells/ml resulted from conventional heating compared with $5.6 \times 10^2$ cells/ml following microwave irradiation. Greater membrane damage was sustained by the microwave-heated cells judging by the release of 260-nm absorbing intracellular substances. In addition, the microwave-heated cells regained their enterotoxin synthesis ability at a slower rate following recovery as judged by equal counts on TSA and TSAS. Microwave heating also exerted less injurious effects on *S. aureus* when carried out anaerobically.

**Recovery of *Clostridium perfringens* from Food Samples Using an Oxygen-Reducing Membrane Fraction,** C. B. Hoskins and P. M. Davidson, Department of Food Technology and Science, University of Tennessee, P.O. Box 1071, Knoxville, Tennessee 37901

*J. Food Prot.* 51:187-191

Three strains of *Clostridium perfringens* were inoculated into different food products and their recovery rates on tryptose sulfite cycloserine (TSC) agar, with and without an oxygen-reducing membrane fraction (ORMF), were compared. Organisms were generally recovered in greater numbers using TSC+ORMF and aerobic incubation than with TSC and anaerobic incubation. Organisms inoculated into beef stew were subjected to heat and cold stress for various periods. In all instances, presence of ORMF in TSC and aerobic incubation resulted in greater recovery of viable *C. perfringens* than did TSC and anaerobic incubation. Of 35 uninoculated raw meat samples evaluated, *C. perfringens* was recovered from 22 using TSC+ORMF compared to 18 using TSC alone.

**Production of Enterotoxin by *Vibrio vulnificus* Isolates,** Gerard N. Stelma, Jr., Procter L. Spaulding, Antolin L. Reyes, and Clifford H. Johnson, Division of Microbiology, Food and Drug Administration, Cincinnati, Ohio 45226

*J. Food Prot.* 51:192-196

Weakly virulent isolates of *Vibrio vulnificus* that were lethal only to simultaneously iron-overloaded and immunosuppressed mice were tested for ability to cause fluid accumulation in the permanently ligated rabbit ileal loop. Unlike the highly virulent isolates, which caused septicemia and death in rabbits, these isolates caused significant fluid accumulation in the rabbit loops. Fluid accumulation was also observed when culture filtrates were tested, indicating the existence of an enterotoxin. Enterotoxin activity did not correlate with the hemolysin or protease activities. Only one of three enterotoxigenic isolates caused diarrhea when administered to temporarily ligated rabbit ileal loops, suggesting involvement of some other pathogenic determinant(s) such as colonization.

**Microbiological Changes in Smoked and Charred Baltic Herrings during Storage,** Hannu J. Korkeala and Pekka K. Pakkala, College of Veterinary Medicine, Department of Food and Environmental Hygiene, P.O. Box 6, SF-00551 Helsinki, Finland and National Board of Health, Siltasaarenkatu 18, SF-00530 Helsinki, Finland

*J. Food Prot.* 51:197-200

The microbiological quality of smoked and charred Baltic herrings from two different processing plants was studied after preparation and after storage for 24, 48 and 96 h at 4 and 20°C. One of the processing plants used traditional processing methods and the other a modern processing technology. No significant increase in aerobic plate counts (APCs) was observed during storage of smoked herrings at 4°C; after 96 h the mean APC was $1.7 \times 10^2$ CFU/g. The mean APC of charred herrings increased markedly at 4°C within 48 h, and after 96 h was $2.4 \times 10^4$ CFU/g. At 20°C the mean APCs of smoked and charred herrings increased markedly within 24 h, and after 96 h were $1.0 \times 10^8$ and $1.7 \times 10^9$ CFU/g, respectively. At 20°C, high coliforms and fecal streptococci counts were found in some samples and high *Staphylococcus aureus* counts in 2 samples. The microbiological quality of smoked herrings was better than that of charred herrings both after processing and during storage. Bacterial numbers of smoked herrings prepared in a modern steel oven were lower than those of herrings prepared in a traditional tiled oven. The mean APC of charred herrings was, however, higher when the modern continuous-operating line was used compared to the traditional method. On the continuous-operating line, heavy bacterial contamination occurred during the salting stage. The salting procedure was therefore changed by cooling the brine. When chilled brine was used, the mean APC of charred herrings was lower than the corresponding mean for the traditional method.

**Production of Sensitive Monoclonal Antibodies to Aflatoxin $B_1$ and Aflatoxin $M_1$ and Their Application to ELISA of Naturally Contaminated Foods,** D. E. Dixon-Holland, J. J. Pestka, B. A. Bidigare, W. L. Casale, R. L. Warner, B. P. Ram and L. P. Hart, Department of Food Science and Human Nutrition, and Department of Botany and Plant Pathology, Michigan State University, East Lansing, Michigan 48824 and Neogen Corporation, Lansing, Michigan 48912

*J. Food Prot.* 51:201-204

Two new hybridoma cell lines capable of secreting sensitive monoclonal antibodies for aflatoxin $B_1$ ($AFB_1$) and aflatoxin $M_1$ ($AFM_1$), were produced by fusing NS-1 myeloma cells with spleen cells of BALB/c female mice immunized with $AFB_1$- and $AFM_1$-carboxymethyloxime bovine serum albumin conjugates, respectively. Detection limits for these antibodies in the direct enzyme-linked immunosorbent assay (ELISA) were 0.5 ng/ml for $AFB_1$ and 0.25 ng/ml for $AFM_1$. Concentrations of $AFB_1$ analogs (ng/ml) required to inhibit 50% binding of $AFB_1$-perioxidase conjugate to $AFB_1$ monoclonal antibody solid phase in direct ELISA were: $AFB_1$, 2.6; $AFB_2$, 13; $AFG_1$, 8; $AFB_2$, 15; $AFM_1$, 23. Analog concentrations (ng/ml) required to inhibit 50% binding of $AFB_1$-perioxidase conjugate to $AFM_1$ monoclonal antibody solid phase were: $AFM_1$, 0.8; $AFM_2$, 700; $AFB_1$, 0.5; $AFB_2$, 35; $AFB_{2a}$, >10,000; $AFG_1$, 12; $AFG_{2a}$, 12; $AFP_1$, 16; and $AFQ_1$, 9.2. These new monoclonal antibodies were applicable to both the ELISA detection $AFB_1$ in com, cottonseed, cottonseed meal, and mixed feed following a simple extraction in 55% methanol as well as the direct detection of $AFM_1$ in milk.

**Mercury Content in Different Species of Mushrooms Grown in Spain,** G. Zurera-Cosano, F. Rincon-Leon, R. Moreno-Rojas, J. Salmeron-Egea and R. Pozo-Lora, Department of Food Hygiene and Technology, Faculty of Veterinary Medicine, University of Cordoba, 14005 Cordoba, Spain

*J.Food Prot.* 51:205-207

The mercury content of 117 mushroom samples corresponding to 8 different species collected in the Sierra of Cordoba (Spain) was determined by cold vapor atomic absorption spectrophotometry. The results obtained showed that the mercury content differed according to the species and to the anatomical group examined. Samples of *Psalliota xanthoderma* showed maximum levels (0.669 - 0.210 mg/kg, fresh weight) and the ratio cap/stem obtained is 1.32. The concentration levels were compared to literature data and the contribution of mushrooms to the daily intake of mercury in Spain was evaluated.

**Microbiological Conditions and Keeping Quality of Veal Tongues as Affected by Lactic Acid Decontamination and Vacuum Packaging,** Ingrid J. R. Visser, Peter A. Koolmees and Peter G. H. Bijker, Department of the Science of Food of Animal Origin, Faculty of Veterinary Medicine, The University of Utrecht, P.O. Box 80.175, 3508 TD Utrecht, The Netherlands

*J. Food Prot.* 51:208-213

The effect of a lactic acid decontamination treatment on the microbiological condition and keeping quality of veal calf tongues was assessed. Thirty tongues were collected 45 min post mortem. Ten were washed with tap water in a centrifuge, 10 were treated with 2.0% (v/v) L-lactic acid instead of water, and 10 tongues received no treatment and served as control samples. Immediately following these treatments all tongues were vacuum-packaged, chilled 2 h in ice-water and stored at 3±1°C and 85±5% ERH. At 0, 14, and 28 d post mortem samples were taken for bacteriological, histobacterioscopic and sensory examination. The histobacterioscopic examination showed that the initial microflora appeared to be predominantly located under and between the papillae of the tongue surface. Centrifugation with water only did not significantly affect the bacteriological condition of tongues, although the overall appearance improved. Decontamination with lactic acid decreased mesophilic aerobic colony counts from 5.6 to 2.7 $\log_{10}$ CFU/cm$^2$. After 14 d of storage the so-called "delayed" effect of lactic acid was still observed. At that time aerobic colony counts and *Enterobacteriaceae* counts of controls were 6.5 and 2.8 $\log_{10}$ CFU/cm$^2$, while these counts of the lactic acid treated group were 4.0 and <1.3, respectively. Results of the bacteriological examinations were substantiated by the histobacterioscopic findings. Centrifugation with lactic acid detached superficial cells from the stratified squamous epithelium. Decontamination of tongues by centrifugation with lactic acid before vacuum packaging will increase storage life and safeguard public health.

**Significance of Samples Taken for Bacterial Counts from Reduced Areas of Bovine Carcasses,** Jorge Lasta and Reinaldo Fonrouge, Meat Technology Department, Veterinary Science Research Center (Centro de Investigaciones en Ciencias Veterinarias), CC 77, Morón 1708, Argentin and School of Veterinary Science, La Plata National University, Calle 60 y 118, 1900 La Plata, Argentina

*J. Food Prot.* 51:214-217

The purpose of this study was to investigate if small sampling areas (10 and 100 cm$^2$) from bovine carcasses allowed obtaining bacterial counts that were characteristic of the hygiene level in abattoirs during the slaughtering process and, as a consequence, to know the hygiene level of the carcasses. Two abattoirs were classified according to the infrastructure and the operations as Good (G) and Fair (F). At these abattoirs, samples were taken from two sites (brisket and round), from two sampling areas (10 and 100 cm$^2$ for each site), corresponding to nine carcasses per visit. Each abattoir was visited five times. The count of total viable microorganisms at 20°C was taken as an indicator of the microorganisms present. The differences between abattoirs, considering the sites, were not statistically significant. On the other hand, the differences between areas sampled (10 and 100 cm$^2$) were significant and showed that the count will depend on the size of the area sampled. The conclusion is that small sampling areas are not adequate to evaluate the hygiene of bovine carcasses.

**Microbial Purification of Shellfish: A Review of Depuration and Relaying,** Gary P. Richards, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Charleston Laboratory, P.O. Box 12607, Charleston, South Carolina 29412

*J. Food Prot.* 51:218-251

A review of the literature on shellfish depuration and relaying revealed wide diversity in microbial uptake and elimination among shellfish species and for different microorganisms. Information on relaying of five commercial shellfish species and on controlled purification (depuration) of 11 species indicates that such processes are effective in reducing the levels of bioconcentrated bacteria and viruses from shellfish. The degree of bacterial and viral bioconcentration varies with shellfish species; however, the primary sites of bioconcentration are the hepatopancreas and digestive diverticula. Low levels of enteric viruses and coliphage may be sequestered in shellfish hemolymph and tissues, thus protecting them from elimination through depurative processes. *Vibrio* spp. appear to proliferate when closely associated with intestinal cells of shellfish. Shellfish relaying techniques offer effective microbial depletion provided water quality is acceptable and shellfish remain physiologically active. The current body of literature on controlled purification demonstrates a broad spectrum of conditions under which shellfish are depurated. Optimal times, temperatures and salinities for effective depuration vary among shellfish species. Proper design and operation of depuration plants is crucial to insure process integrity. Recirculating and flow-through purification systems are effective in reducing the levels of pathogenic and indicator microorganisms from shellfish, but the extent to which they reduce viruses from shellfish is uncertain. Studies are needed to validate the effectiveness of depuration processes in eliminating pathogenic viruses and to address the adequacy of indicator bacteria as measures of enteric virus contamination.

# Calendar

## 1988

**March 21-24, INDUSTRIAL REFRIGERATION SHORT COURSE** is designed for engineers and supervisors employed by food processors or for contractors, design firms and equipment manufacturers. The 4 day course will be held on the U.C. Davis campus. The fee is $630. For more information on refrigeration, contact: James Lapsley, University Extension, U.C. Davis 95616. Telephone: 916-752-4395.

**March 21-23, PRINCIPLES OF QUALITY ASSURANCE** is sponsored by the American Institute of Baking. For more information, contact: The American Institute of Baking, Registrar's Office, 1213 Bakers Way, Manhattan, KS 66502. Telephone: 800-633-5137.

**March 21-25, DEPARTMENT OF FOOD SCIENCE & NUTRITION, MID-WEST WORKSHOP IN MILK & FOOD SANITATION,** to be held at Fawcett Center for Tomorrow, Ohio State University, Columbus, OH. For more information, contact: David Dzurez, 2121 Fyffe Road, Columbus, OH 43210-1097.

**March 27-30, DAIRY AND FOOD INDUSTRIES SUPPLY ASSOCIATION 1988 ANNUAL CONFERENCE** to be held at Marriott's Rancho Las Palmas in Rancho Mirage, CA. For more information call DFICA offices at: 301-984-1444.

**APRIL 6-8, MISSOURI MILK, FOOD AND ENVIRONMENTAL HEALTH CONFERENCE,** to be held at the Holiday Inn Executive Center, Columbia, Missouri. For more information, contact: Grace Steinke, 9713 Fall Ridge Trail, Sunset Hills, MO 63127-1508.

**April 6-8, MECHANICAL MAINTENANCE FOR WATER & WASTEWATER PERSONNEL** will be held at the University of Florida, Gainesville. For more information, contact: Dr. Barbara Mitchell. Telephone: 904-392-9570.

**April 10-13, MILK INDUSTRY FOUNDATION, INTERNATIONAL ICE CREAM ASSOCIATION, MARKETING & TRAINING INSTITUTE SPRING BOARD MEETING,** to be held at The Ritz Carlton, Laguna Niguel, CA. For more information, contact: John F. Speer, Jr., 888 16th Street, NW, Washington, DC 20006.

**April 11-13, MECHANICAL MAINENANCE FOR WATER & WASTEWATER PERSONNEL** will be held in West Palm Beach, FL. For more information, contact: Dr. Barbara Mitchell. Telephone: 904-932-9570.

**April 13, 38th ANNUAL UNIVERSITY OF MARYLAND ICE CREAM CONFERENCE,** for more information, contact: Dr. James T. Marshall, Department of Animal Sciences, University of Maryland, College Park, MD 20742. 301-454-7843.

**April 13-14, CHEESE RESEARCH CONFERENCE,** to be held at the Sheraton Inn, Dane Co. Expo Ctr., Madison, WI. For more information, contact: Agricultural Conference Office, Jorns Hall, 650 Babcock Drive, Madison, WI 53706. Telephone: 608-263-1672.

**April 13-14, ULTRAFILTRATION TECHNOLOGY** to be the subject of San Diego seminar. The seminar will be directed to ultrafiltration techniques and their industrial product applications. Further information is available from the seminar's sponsor: Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604. Telephone: 717-291-5609.

**April 13-15, BASIC ELECTRICAL MAINTENANCE FOR WATER & WASTEWATER PERSONNEL** will be held at the University of Florida, Gainesville. For more information, contact: Dr. Barbara Mitchell. Telephone: 904-392-9570.

**April 18-20, BASIC ELECTRICAL MAINTENANCE FOR WATER & WASTEWATER PERSONNEL** will be held in West Palm Beach, FL. For more information, contact: Dr. Barbara Mitchell. Telephone: 904-392-9570.

**April 18-21, AMERICAN DAIRY PRODUCTS INSTITUTE ANNUAL MEETING & TECHNICAL CONFERENCE,** to be held at Chicago O'Hare Marriott Hotel, Chicago, IL. For more information, contact: Warren S. Clark, Jr. 130 N. Franklin Street, Chicago, IL 60606.

**April 20, INDIANA ENVIRONMENTAL HEALTH ASSOCIATION, INC.** Annual Spring Meeting to be held at the Holiday Inn at the Airport in Indianapolis, IN. The person to contact for information is: Larry Beddow, Vigo Co. Air Pollution Control, 201 Cherry Street, Terre Haute, IN 47807. Telephone: 812-238-8429.

**April 20-21, 1988 CENTER FOR DAIRY RESEARCH CONFERENCE (MILKFAT: TRENDS AND UTILIZATION),** alternates with Cheese Research and Technology Conference, to be held at the Holiday Inn Southeast, Madison, WI. For more information, contact: Nina Albanese-Kotar, Center for Dairy Research, University of Wisconsin-Madison, 1605 Linden Drive, Madison, WI 53706. 608-262-5970.

**May 9-12, PURDUE ASEPTIC PROCESSING AND PACKAGING WORKSHOP,** sponsored by the Food Science Department at Purdue University. For more information, contact: James V. Chambers, Food Science Dept., Smith Hall, Purdue University, West Lafayette, IN 47907. Telephone: 317-494-8279.

**May 16, EPA ORGANIC LABORATORY DATA QA/QC VALIDATION** will be held in Pittsburgh. This is is conjunction with Analytical & Environmental Training Courses. For more information, contact: Barbara, Professional Analytical & Consulting Services, Inc., 409 Meade Dr., Coraopolis, PA 15108. Telephone: 412-262-4222.

**May 16-18, THE PA DAIRY SANITARIANS & LABORATORY DIRECTORS ANNUAL MEETING,** to be held at Penn State University. For more information, contact: Sidney Barnard, Food Science Extension Specialist-Dairy, 8 Borland Laboratory, Penn State Univ., University Park, PA 16802. Telephone: 814-863-3915.

**May 17-18, BASICS OF LABORATORY QA/QC (70),** will be held in Pittsburgh. Course provided by Professional Analytical & Consulting Services, Inc. For more information, contact: Barbara, Professional Analytical & Consulting Services, Inc., 409 Meade Dr., Coraopolis, PA 15108. Telephone: 412-262-4222.

**May 19, EPA INORGANIC LABORATORY DATA QA/QC VALIDATION (80),** will be held in Pittsburgh, PA. For more information, contact: Barbara, Professional Analytical & Consulting Services, Inc. Telephone: 412-262-4222.

**May 19-20, ANALYTICAL & ENVIRONMENTAL TRAINING COURSES** will be held in Pittsburgh, PA. The course title is Mass Spectrometry for Managers (05). For more information, contact: Barbara at Professional Analytical and Consulting Services, Inc., 409 Meade Drive, Coraopolis, PA 15108. Telephone: 412-262-4222.

**May 22-24, GEORGIA DAIRY PRODUCTS ASSOCIATION ANNUAL CONVENTION,** to be held at Callaway Gardens, Pine Mountain, GA. For more information, contact: Pat Hamlin, P.O. Box 801, Macon, GA 31208.

**May 29-June 2. INTERNATIONAL CONFERENCE ON MASTITIS** will be held in St. Georgen/Langsee, Carinthia, Austria. For information, contact: Prof. Dr. E. Glawischnig, International Conference on Mastitis, II. Medizinische Universitatsklinik for Klauentiere, der Veterinarmedizinischen Universitat in Wien, Linke Bahngasse 11, A-1030 Vienne, Austria. Telephone: 0222 / 73 55 81 ext. 500, 501.

**June 1, BASICS OF TOXICOLOGY,** will be held in Pittsburgh, PA. Offered by the Professional Analytical & Consulting Services, Inc. For more information, contact: Barbara, Professional Analytical & Consulting Services, Inc., 409 Meade Dr., Coraopolis, PA 15108. Telephone: 412-262-4222.

**June 2-3, BASICS OF INFRARED SPECTROMETRY & SPECTRAL INTERPRETATION** will be conducted by the Professioal Analytical & Consulting Services in Pittsburgh. For more information, contact: Barbara, Professional Analytical and Consulting Services, Inc., 409 Meade Dr., Coraopolis, PA 15108. Telephone: 412-262-4222.

**June 6-8, TEXAS ASSOCIATION OF MILK, FOOD & ENVIRONMENTAL SANITARIANS ANNUAL MEETING** to be held at the Howard Johnson Plaza-South, Austin, TX. For more information, contact: Janie Park, TAMFES, PO Box 2363, Cedar Park, TX 78613-2363. Telephone: 512-458-7281.

**June 6-9, EPA ENVIRONMENTAL ANALYTICAL CHEMISTRY (130),** will be offered by the Professional Analytical & Consulting Services, Inc., in Pittsburgh, PA. For more information, contact: Barbara, Professional Analytical & Consulting Services, Inc., 409 Meade Dr., Coraopolis, PA 15108. Telephone: 412-262-4222.

**July 8-15, RAPID METHODS AND AUTOMATION IN MICROBIOLOGY** will be held at Kansas State University. The workshop is certified by American Society for Microbiology for Continuing Education Credits. Contact Dr. Daniel Y.C. Fung, Call Hall, Kansas State University, Manhattan, KS 66506. Telephone: 913-532-5654.

**July 11-13, AMERICAN INSTITUTE OF BAKING IN MANHATTAN** has scheduled an updated seminar entitled "Dietary Fiber" in Manhattan, Kansas. For more information write to the Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502. Telephone: 800-633-5137

**July 31-August 4, IAMFES 75th ANNUAL MEETING,** to be held at the Hyatt Regency Westshore, Tampa, FL. For more information, contact Kathy R. Hathaway, IAMFES, Inc., PO Box 701, Ames, IA 50010. 800-525-5223, in Iowa 515-232-6699.

**August 7-12, 1988 ANNUAL MEETING OF THE SOCIETY FOR INDUSTRIAL MICROBIOLOGY,** to be held at the Hyatt Regency, Chicago, IL. For more information, contact: Mrs. Ann Kulback, SIM, PO Box 12534, Arlington, VA 22209-8534.

**September 11-13, NATIONAL DAIRY COUNCIL OF CANADA ANNUAL CONVENTION,** to be held at the Winnipeg Convention Centre, Winnipeg, Manitoba. For more information, contact: Pat MacKenzie, 141 Laurier Avenue West, Ottawa, Ontario, Canada K1P-5J3.

**September 11-14, SOUTHERN ASSOCIATION OF DAIRY FOOD MANUFACTURERS, INC. 74TH ANNUAL CONVENTION,** to be held at the Boca Raton Hotel & Club, Boca Raton, FL. For more information, contact: John E. Johnson, P.O. Box 1050, Raleigh, NC 27605.

**September 21-22, UNITED DAIRY INDUSTRY ASSOCIATION ANNUAL MEETING,** to be held at the Hyatt Regency Minneapolis, Minneapolis, MN. For more information, contact: Edward A. Peterson, 6300 N. River Road, Rosemont, IL 60018.

**September 26-28, INDIANA ENVIRONMENTAL HEALTH ASSOCIATION, INC.** Annual Fall Meeting to be held at the Hilton Inn in Fort Wayne, IN. For information, contact: Rosemarie Hansell, Marion Co. Health Dept., 222 East Ohio St., Indianapolis, IN 46204. Telephone: 317-633-9682.

**September 27-29, NEW YORK STATE ASSOCIATION OF MILK AND FOOD SANITARIANS,** to hold annual meeting at the Sheraton Inn-Binghamton, Sarbro Square, One Sarbro Square, Binghamton, NY 13901. For more information, contact: Paul Dersam, 27 Sullivan Rd, Alden, NY 14004. Telephone: 716-937-3432.

**September 29-30, SOUTH DAKOTA STATE DAIRY ASSOCIATION,** will hold it's annual convention at the Holiday Inn, Brookings, SD. For more information, contact: Shirley W. Seas, Dairy Science Dept., SD State Univ., Brookings, SD 57007. Telephone: 605-688-5480.

**October 9-13, AACC ANNUAL MEETING,** to be held at the Hotel InterContinental San Diego, in San Diego, California. For more information, contact: Raymond J. Tarleton, American Assoc. of Cereal Chemists, 3340 Pilot Knob Road, St. Paul, MN 55121. 612-454-7250.

**October 15-19, MILK INDUSTRY FOUNDATION & INTERNATIONAL ICE CREAM ASSOCIATION ANNUAL CONVENTION & SHOW,** to be held at Marriott's Orlando World Center, Orlando, FL. For more information, contact: John F. Speer, Jr., 888 16th Street, NW, Washington, DC 20006.

**November 28-December 1, NATIONAL MILK PRODUCERS FEDERATION ANNUAL MEETING,** to be held at the Hilton, Anaheim, CA. For more information, contact: James C. Barr, 1840 Wilson Blvd., Arlington, VA 22201.

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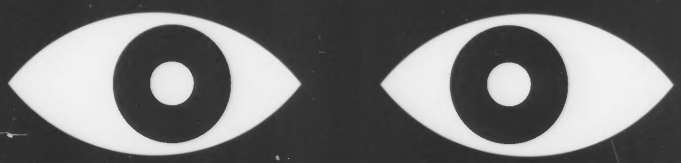

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