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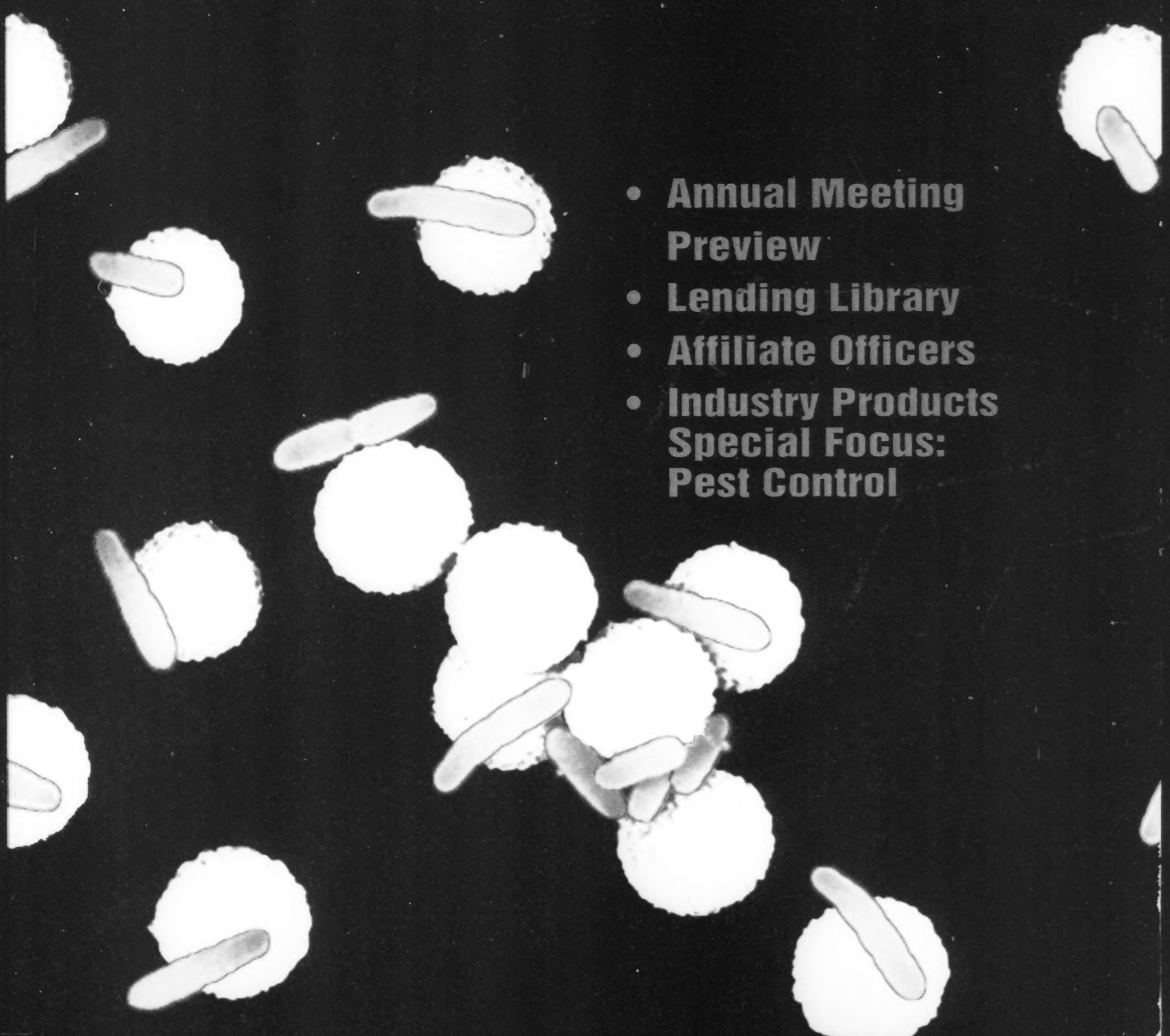
DAIRY, FOOD AND ENVIRONMENTAL

Sanitation

A PUBLICATION OF THE INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC. MARCH 1995



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ABOUT THE COVER. . .
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A PUBLICATION OF THE INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC.

ARTICLES

Editor's Note:

The following is a correction from the article "Extending the Keeping Quality of Fluid Milk to 21 Days" on page 13 in the January issue of *Dairy, Food and Environmental Sanitation*:

Recommended Procedures and Practices

6. Provide a separate area and facilities where milk haulers and receiving personnel can loaf while waiting. This will help keep them out of pasteurizing and packaging rooms. This means coffee, restrooms, refrigerated cases for samples, ice, drinking fountain, table, and comfortable chairs.

We apologize for the error.

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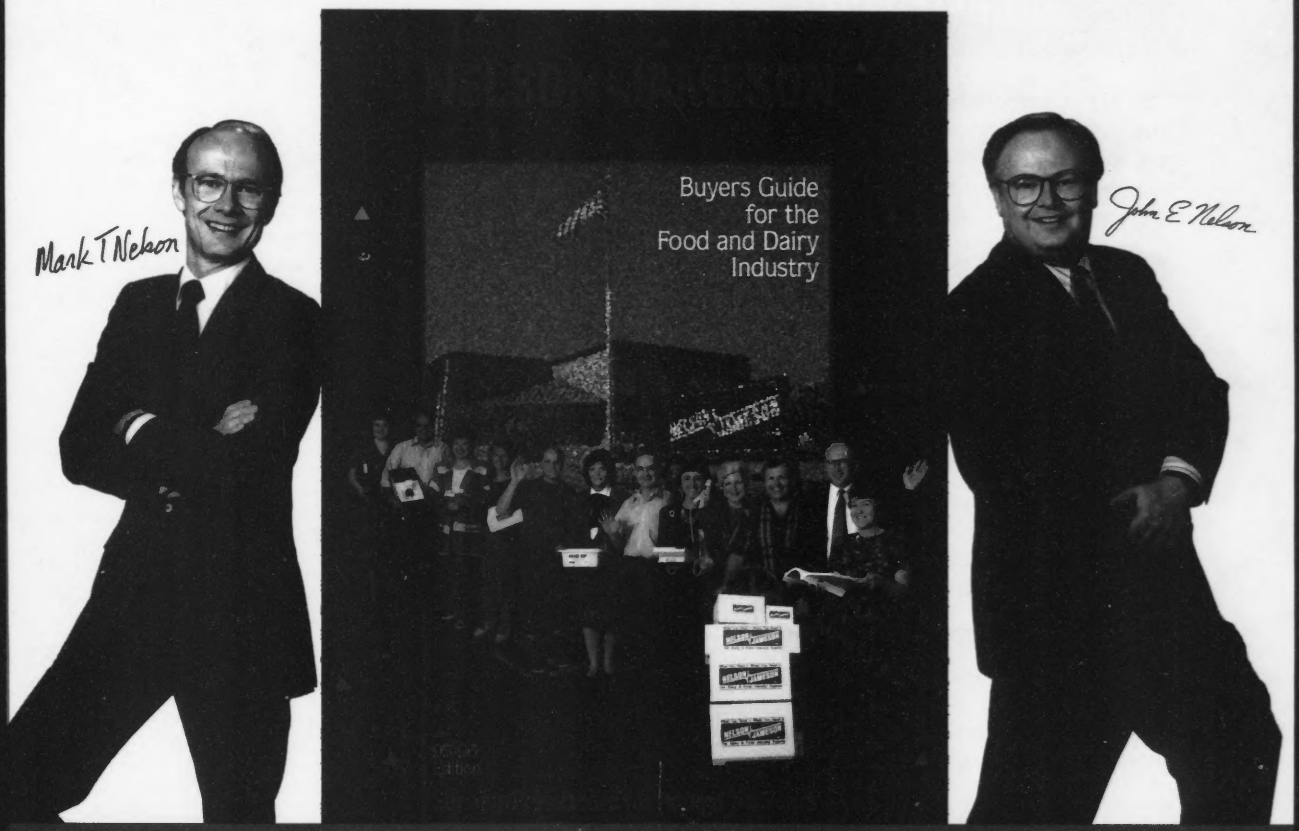

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2. *Listeria monocytogenes*

Identification of marker(s) that singly or in combination reliably differentiate disease-causing from non-disease-causing strains of *Listeria monocytogenes*.

3. Enterohemorrhagic *Escherichia coli*

Definition of features that singly or in combination reliably differentiate strains of SLTEC (VTEC) which are pathogenic for humans from those which are not.

4. *Cryptosporidium*

Methods development for the isolation and enumeration of *Cryptosporidium* in foods.

Frequency of occurrence and survival of *Cryptosporidium* in ready-to-drink beverages.

The deadline for submission of preproposals is **May 31, 1995.**

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Washington, DC 20036

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"Instructians ta Cantributars" can be obtained from the editor.

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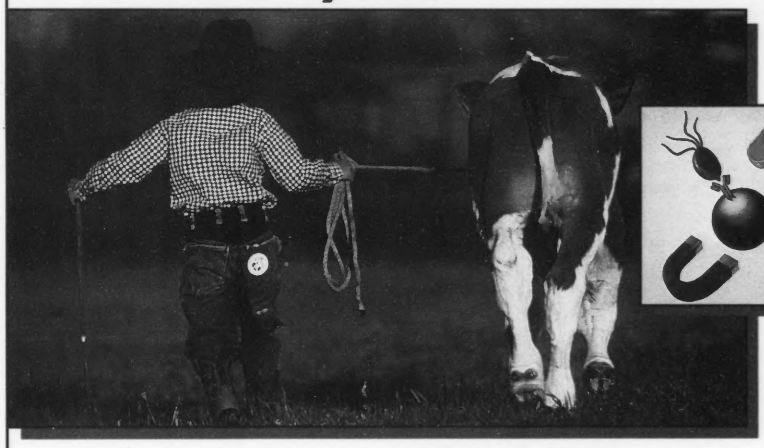

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THOUGHTS

FROM THE PRESIDENT

By C. DEE CLINGMAN,
IAMFES President

"Who are you?"

As all IAMFES members are generally aware our membership consists of three primary disciplines or professional backgrounds. We have members working in government or regulatory agencies, members associated with universities or research, and members engaged in business or industry. But there is some information you might not realize and may jar your grandmother's preserves.

An analysis of 1993 membership indicated that of our 3,037 members, 2,202 have been members for five years or less. This means almost 3/4 of our membership is new, within the past 5 years. Almost half of these new members came from governmental/regulatory, microbiologist/scientist and quality control/assurance job areas. Unfortunately, the same three groups accounted for 178 dropped memberships or half of the total loss of members in 1993. Further analysis indicated that over half of the dropped members had been members only since 1991. Why are we losing the groups we most attract?

A point of significance, and an upcoming concern, is that IAMFES loses approximately 300 members a year. Over the past five years this has resulted in an 8% net reduction of members. Or simply stated, we are losing more members each year than we are gaining. From a financial perspective this places more cost burdens on existing members since less membership revenue is collected and costs generally go up with inflation, staff salary increases, etc.

New membership trends are impressive. IAMFES has shown an average of an 18% gain of new members each year. This clearly illustrates that IAMFES is able to attract an adequate number of new members even without a formal recruitment plan in place. But due to the high loss of members, the membership does not grow in size even with impressive gains.

While some may think lost memberships come from retired members, in 1993 only 2 dropped memberships came from that category. Interestingly, eight new memberships came from staff at other Associations.

What we do not know: Are members leaving for a specific reason; how can IAMFES address or change to meet these unfulfilled needs; and are the reasons for the attrition rate beyond IAMFES' control?

During the upcoming months Carol Mouchka, Marketing Director at IAMFES headquarters, will be developing a survey document for members who drop. This analysis will help us develop and implement a retention and recruitment plan for IAMFES. Any reduction in membership loss rate will improve IAMFES' growth potential.

I would like to thank Carol Mouchka for her analysis, which made this column possible. The overall success, however, for membership growth and retention lies in each member as we market our Association to our peers and colleagues and encourage their continued support and participation.

I know I'm glad to have you as an IAMFES member!

On My MIND...

By STEVEN K. HALSTEAD, CAE
IAMFES Executive Manager

"Forget old, dirty and dingy. Think new, clean and sparkling. Think Pittsburgh."

...is Pittsburgh.

One of the distinct pleasures of being your Executive Manager is I get to spend quite a bit of time in the cities that host our Annual Meetings. Pittsburgh joins a growing list of cities that I have come to love and really look forward to visiting. It seems that every time I visit, I discover something new and the love affair deepens. Our March Executive Board meeting in Pittsburgh proved to be no exception.

I took the last flight out of Des Moines on Sunday knowing that I would not get to Pittsburgh until after 11 p.m. By the time I got my luggage, a seat on the shuttle bus, and made the trip from the airport to downtown, it was nearly midnight. I hadn't planned it this way, but was rewarded with a spectacular view of Pittsburgh at night.

From the airport, you go through the Mt. Washington Tunnel and cross the Fort Pitt Bridge into downtown Pittsburgh. As you come out of the tunnel, the city spreads out before you at the confluence of the three rivers and their surrounding hills. It is a breathtaking view. If only traffic would allow one to stop and savor it!

Our headquarters hotel is the Hilton Hotel and Towers in downtown Pittsburgh. The Hilton's front yard is Point State Park. When you see it you will understand why General Pitt built a fort there. Cannon fire could easily control river traffic on the three rivers. (Really, there are three rivers in name only. The Monongahela and the Allegheny rivers come together to form the Ohio river. One can only speculate there was a terrific argument as to what to call the river formed when the Mon and the Allegheny joined. Should it be the Mon or the Allegheny. A compromise was reached and they called it the Ohio!)

The "Point," as it is called, has gone through many changes over the years. There are the remains of bridge abutments on the other side of the rivers indicating at one time the point served as a bridge terminus. In the early fifties, the bridges were removed and the outline of Fort Pitt was identified. The land was cleared, built up (to prevent flooding), a marvelous fountain built, and the area made into a beautiful park.

The Point now serves as a focal point for a number of art fairs, weddings, the annual Regatta, numerous festivals and events. On nice days, people from the surrounding office buildings take their bag lunch to the park. Or, they buy something from the multitude of vendors who seemingly appear out of the clear blue sky. It is a wonderful sight to see.

If you are into architecture, you will love Pittsburgh. Many of the older, majestic buildings have been restored. Although many of the newer buildings are "boxes," their exteriors make them interesting boxes. Be sure to take the time to visit the PPG complex and the U.S. Steel complex. They are outstanding!

Don't miss the Three Rivers Stadium – IF the Pirates are playing ball this summer, they are scheduled to be in town during our meeting. Maybe we can arrange something as the stadium is just a short walk away. Then there is the new science museum, the Aviary, the zoo, University of Pittsburgh, Carnegie Mellon University, and Mr. Roger's Neighborhood. All worth seeing and enjoying.

Forget old, dirty and dingy. Think new, clean and sparkling. Think Pittsburgh.

The International Association of Milk, Food and Environmental Sanitarians

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Campylobacter jejuni/coli

The National Advisory Committee on Microbiological Criteria for Foods

EXECUTIVE SUMMARY

Introduction

The National Advisory Committee on Microbiological Criteria for Foods (the Committee) addressed the issue of food-borne campylobacteriosis in view of the relatively recent recognition of *Campylobacter jejuni/coli* organisms as a cause of human illness, the increased isolation rate from cases and outbreaks, and the association of campylobacteriosis with foods of animal origin, especially poultry and raw milk. (Note: In this document, "*Campylobacter*" and "campylobacters" will refer to both *C. jejuni* and *C. coli*, unless otherwise noted.)

CURRENT STATUS

Ecology

Campylobacter jejuni and *C. coli*, gram-negative, spirally shaped microaerophilic bacteria, formerly classified as *Vibrio fetus*, were first associated with infertility and abortion in cattle and sheep in 1913. It was not until 1973, when newly developed selective culture techniques made the isolation possible, that the organisms were linked to diarrheal disease in humans.

Campylobacters are commensal microflora of the intestinal tracts of birds, cattle, sheep, goats, and swine. Poultry have been cited as a major source of sporadic human illness due to infection by *C. jejuni*. A poultry flock may become infected from environmental sources, such as water, rodents and flies, and cross-contamination of poultry carcasses may occur during slaughter. Studies in the United States have shown that the majority of broiler carcasses and parts sold at retail are contaminated with *C. jejuni*.

Although healthy cattle may excrete *C. jejuni* in their feces, human disease is more commonly associated with *Campylobacter*-contaminated milk than with beef carcasses contaminated with the organisms. Unpasteurized milk is a known food vehicle for outbreaks of campylobacteriosis.

Domestic dogs and cats, wild birds, primates and rodents may harbor *Campylobacter* spp. However, the organisms are rarely isolated from cold-blooded animals. *C. jejuni* has been isolated from fresh water, seawater and from shellfish, and both water and shellfish have been implicated as vehicles in human cases of campylobacteriosis.

Campylobacters grow optimally in an atmosphere containing 5% oxygen and have an optimum growth temperature between 30 and 45°C. They survive storage at refrigerated temperatures better than at room temperature. The organisms are rapidly inactivated in milk at pasteurization temperatures and in meat at 47 to 60°C. The cells are sensitive to freezing, drying and to salt concentrations above 1% sodium chloride (NaCl). Ascorbic acid and several spices inhibit growth of *C. jejuni*, but sodium hypophosphite is ineffective against the species. Campylobacters are sensitive to standard concentrations of common disinfectants. Modified atmospheres have little inhibitory effect on survival of campylobacters, however, *C. jejuni* are sensitive to other treatments such as ultraviolet and gamma irradiation.

Campylobacters, like some other gram-negative bacteria, have been reported to exist in a viable but non-culturable state following stress such as nutrient deprivation, heat shock, or cold shock. Both viable, non-culturable cells and attached, culturable cells are more resistant to disinfectants than are culturable cells in solution. These two states may need to be considered when designing control strategies for *Campylobacter* spp.

Epidemiology

The National *Campylobacter* Surveillance System has been used to determine the incidence of reported cases of campylobacteriosis in the United States since 1982. The isolation rate is approximately 5 to 6 cases per 100,000 population, which is close to that of *Shigella* spp. (7 to 8 cases per 100,000), but less than that of *Salmonella* spp. (18 to 20 cases per 100,000). However, based on isolation rates in three studies, the incidence of *Campylobacter* infections is estimated to be approximately 10 times the nationally reported isolation rate, or 50 cases per 100,000. By estimating the number of milder, unreported infections, it is believed that the true incidence is approximately 200 times the nationally reported rate, or 10 cases per 1,000 (1%).

Outbreaks of *Campylobacter enteritis* peak in May and October. Most outbreaks of campylobacteriosis are food-borne (raw milk) with the remainder being waterborne.

Campylobacter infections also occur as sporadic cases not associated with large recognized outbreaks. Sporadic cases peak in the summer. Studies have identified improper handling of raw chicken meat, poor kitchen hygiene, and eating raw and undercooked chicken as risk factors for sporadic cases of food-borne campylobacteriosis. There are also non-food sources of human infection by *Campylobacter*.

Pathogenesis

Campylobacter enteritis is usually characterized in humans by watery diarrhea accompanied by malaise, fever and abdominal pain. Onset of diarrhea occurs within a week after exposure and usually lasts approximately 1 week. Complications of infection by *C. jejuni* may include abdominal pain resulting in unnecessary appendectomies, reactive arthritis, Reiter's syndrome or Guillain-Barré syndrome.

Several mechanisms have been proposed to describe the pathogenesis of *Campylobacter* spp. Campylobacters may penetrate and proliferate within the intestinal epithelium resulting in bloody diarrhea. Campylobacters may also penetrate the intestinal mucosa with proliferation in the lamina propria and mesenteric lymph nodes. Invasion in this manner causes symptoms which may result in unnecessary appendectomies. A third pathogenic mechanism is production of an enterotoxin similar to cholera toxin and the labile toxin of *Escherichia coli*, resulting in watery diarrhea. Cross-reactivity of a protein produced by the bacterium with peripheral nerve myelin proteins may be a factor in the pathogenesis of Guillain-Barré syndrome. In recent studies, 38% to 46% of Guillain-Barré syndrome patients had antecedent *C. jejuni* infections.

RECOMMENDED CONTROL STRATEGIES FOR *CAMPYLOBACTER*

The original intent of the Committee was to develop strategies for the control of important bacterial foodborne pathogens from production to consumption. Control strategies for *Campylobacter* spp. in specific areas are outlined in the following paragraphs. The Committee developed recommendations for minimizing infection of broiler chicks and contamination during processing, distribution and consumer handling. The Committee recommends that HACCP principles be applied in production, processing, distribution, food service and consumer handling.

Minimize presence/survival/multiplication of *Campylobacter*

Campylobacter control during broiler grow-out:

1. *Animal Control.* Exclude animals other than the chicks from the grow-out house. Construct grow-out houses so that rodents, wild birds and other domestic animals are denied access. Have in place a program of rodent control.
2. *Drinking Water.* Provide clean drinking water to chicks by using municipal or other tested and approved water source, on-site chlorination, if necessary, and a nipple drinker system to avoid fecal contamination of drinking water.
3. *Grow-Out House Sanitation.* Require a change in footwear before entering the grow-out house. Clean and disinfect chick placement pans or boxes before re-use and avoid contamination by these pans.

Campylobacter Control During Broiler Processing

Certain procedures can be used to minimize *Campylobacter* contamination during processing. These procedures may include:

1. Rinse/wash equipment to minimize or reduce cross-contamination.
2. Sanitary dressing procedures (including reconditioning steps).
3. Disinfection of carcasses and related contact surfaces with chlorine or other bacterial control treatments (20 ppm total chlorine for washing steps, and 1 to 5 ppm free chlorine in the chill tank overflow).
4. Approved methods for carcass decontamination.
5. Counterflow water systems for scalding.

Distribution System

The most critical factors for the control of campylobacters in food during distribution are the temperature of refrigerated or frozen storage and prevention of cross-contamination between raw animal products and ready-to-eat foods.

Campylobacters will not grow during refrigerated or frozen storage, so the number of these organisms present in a food is a function of the number present initially, the number added by cross-contamination, and the growth of these organisms during improper storage. Three factors are critical in control of *Campylobacter* in food distribution:

1. Prevention of cross-contamination;
2. Adequate temperature control; and,
3. Proper packaging.

Application of Hazard Analysis Critical Control Points (HACCP) principles is as important in distribution as in production and processing.

Consumers

There is a risk associated with consuming raw foods of animal origin. This risk can be avoided by only consuming pasteurized milk, thoroughly cooked red meat, poultry, seafood and water from approved sources. In addition, good food handling practices in the home reduce the risk of illness. Three important factors are:

1. Wash and sanitize hands, cutting boards, utensils and containers before and after contact with raw poultry and other raw foods of animal origin to prevent cross-contamination to ready-to-eat foods.
2. Keep raw and cooked foods separate.
3. Keep hot foods hot (above 140°F [60°C]) and cold foods cold (below 40°F [4.4°C]).

RESEARCH NEEDS

The Committee identified the following three major areas as current research needs for determining the source, public health significance, and control of *Campylobacter* spp. as a food-borne pathogen.

Microbiology and Food Science

1. *Campylobacter* spp. control strategies on the farm:
   a. Identify environmental sources of infection and methods of control.
   b. Perform competitive exclusion and competitive inhibition studies including the role of attachment in colonization.
   c. Perform commercial scale studies of promising technologies, such as use of vaccines for chickens.
   d. Determine the role of specific disease conditions in animals as they influence *Campylobacter* contamination of finished products.
2. Control in processing plants
   a. Expand research on the use of approved intervention strategies such as chlorination and trisodium phosphate.
   b. Continue research with ozone, silver compounds, organic acids, irradiation, etc., to reduce the incidence of the organism.
   c. Study the resistance of campylobacters in biofilms and on equipment surfaces.
   d. Determine the significance of modified atmosphere packaging on *Campylobacter* spp. survival and transmission.
   e. Perform plant scale trials on promising intervention strategies.

Epidemiologic and Clinical Research in Humans

1. Develop strategies to enhance case detection:
   a. Obtain more information on virulence determinants to allow for more rapid diagnostic systems, i.e. DNA probes, polymerase chain reaction technique.
   b. Develop better diagnostic methods.
   c. Develop enhanced surveillance systems.
2. Perform epidemiologic studies to:
   a. Identify reservoirs of infection.
   b. Define mechanisms and vehicles of transmission.
   c. Identify risk factors for infection.
   d. Define scope and impact of long-term complications from infection.
3. Develop better laboratory sub-typing methods to support epidemiologic studies.

Communication and Education Strategies

Research funds are critically needed for communication and education.

1. Determine how to assess consumer knowledge and understanding of food handling and pathogen control.
2. Determine how to develop and effectively deliver appropriate *Campylobacter* food safety messages to consumers, regulators, industry, and health professionals.
3. Evaluate the effectiveness of educational programs.

Ecology of the Campylobacters

Campylobacters, formerly classified as *Vibrio* spp., have been recognized by veterinarians as causes of vibrionic infertility and abortions in cattle and sheep (*79*), but no corresponding infection in humans had been noted until 1957 (*61*). The intestinal prevalence of campylobacters in animals was not generally recognized by veterinarians or other medical professionals, although intestinal carriage was reported in the 1930s and '40s (*31,51*). Intestinal infections remained undiagnosed because of the lack of selective culture methods for this relatively fastidious bacterium and the general difficulties associated with culturing from feces.

Although King first isolated campylobacters from human blood cultures in 1957 (*61*), broad recognition of their causal role in human intestinal infection came in 1973, when Butzler et al. (*19*) applied a selective technique developed for veterinary diagnosis of vibrionic abortion (*26*) to the stools of children suffering from diarrhea. Medical interest in campylobacteriosis increased following a later study of human fecal specimens using a simpler direct plating method (*112*). Since then, as culturing for these bacteria has become more common, recognition of the campylobacters as important agents of human diarrhea has grown.

Campylobacter jejuni and *C. coli* are members of the family Spirillaceae (*50,117*). The *Campylobacter* genus contains a number of species with clinical importance in humans, but the most frequently identified human pathogen in the genus is *C. jejuni*. A second species, *C. coli* is a much less common cause of human disease.

Campylobacter coli is closely related to *C. jejuni*, and infections by these two species appear to share many clinical and epidemiologic characteristics. Since they are identical in behavior and epidemiology, whenever *C. jejuni* is used in this section, *C. coli* should be considered implicated as well. *Campylobacter jejuni, C. coli* and a third species *Campylobacter lari* (*56,86*) have been associated with the avian intestinal tract and food-borne infection (*83*).

Two species of *Campylobacter* are of particular importance in human disease, *C. jejuni* and *C. coli* (*14,61,112*). *Campylobacter jejuni* is a common resident of the intestinal tract of cattle, sheep and birds, while *C. coli* is more frequently associated with pigs (*31*). In one study, isolation rates of *C. jejuni* from cattle, goats and sheep were reported as 5, 2, and 15%, respectively (*97*).

The ecology of the campylobacters centers mainly on animal reservoirs, where they generally reside in the intestinal tract as commensals (*14,34,35*). Other sources in the environment (inanimate reservoirs) most likely arise from contamination with animal feces. It is not surprising then,

that food derived from animals is a major source of human campylobacteriosis. It should be noted that most studies on the ecology of campylobacters were done over a decade ago. Methods have improved since these studies were conducted, and there is a need for systematic ecological studies using modern methodologies.

Poultry

Poultry have been cited as a major source of *C. jejuni* (reviewed in 14,35,40,115,118,130). Since the optimal growth temperature of *C. jejuni* is between 42 and 45°C (*58*), this association may be due, in part, to the high (42°C) body temperature of birds (*77*). The extent of infection cited in any single study must be viewed with caution and with a careful scrutiny of the culture method used. As culture methods and other detection techniques have improved, *Campylobacter* spp. are found more frequently.

Some flocks studied have appeared free or nearly free of contamination (*22*), while other studies suggest nearly universal contamination (*90*). Pearson et al., (*92*) reported that the chief source of *Campylobacter* infection on a farm was a contaminated water supply.

During slaughter, poultry carcasses become contaminated by the release of intestinal contents or transfer of campylobacters from surface flora contamination of the birds. The degree of carcass contamination is a reflection of the intestinal carriage rate of the particular flock (*22*). In the United States, the majority of broiler carcasses and parts sold at retail are contaminated with *C. jejuni* (*14,45,87,119,122*). Certain factors, such as freezing and storage, may decrease the contamination (*90,111*).

Cattle

Healthy cattle may excrete *C. jejuni* in their feces (*27*), with the incidence of positive stool rates higher in the summer and lower in winter months (*14*). Carcasses may become contaminated with *C. jejuni* at slaughter, but this is infrequent, and the numbers of contaminating organisms is low (*14*). As a result, beef may not be a major source of human *C. jejuni* infections.

Contamination of milk can occur from infected cows. Unpasteurized milk is a known cause of outbreaks of campylobacteriosis (*12,27,95,101,127*). Lander and others (*68,69,70*) experimentally induced *Campylobacter mastitis* and reported that *C. jejuni* can multiply in the bovine udder, resulting in *Campylobacter*-contaminated milk. Naturally occurring *C. mastitis* (*49,85*) and isolation of the *Campylobacter* from the milk of cows with mastitis have been reported (*46,48,88*). However, other researchers found that campylobacters could be isolated only rarely from the milk of clinically mastitic cows (*24,74,102*) and that animal fecal material, rather than udder infection was the source of milk contamination (*134*).

Swine

Swine are more frequently reservoirs for *C. coli* than for *C. jejuni* (*14*). Blaser et al. (*14*) also found that over 50% of commercially raised swine harbor *Campylobacter* spp. in their intestinal tracts. *Campylobacter* spp. are sometimes associated with enteric disease in swine (*15,32,36,37, 71,80,94,109,110,128*). Uncooked sausage may be contaminated as a result of using fresh, unsalted swine intestine for sausage casing (*124*). Contamination of swine carcasses has varied widely in studies performed in different countries, from 2.9% in Poland (*65*) to 16.9% (*67*) and 60.7% (*89*) in Canada. Swine carcass contamination is more common than contamination of either cattle or sheep carcasses (*35*).

Sheep

Campylobacter jejuni causes abortion in sheep flocks. *Campylobacter jejuni* is less frequently isolated from the intestines of sheep than from swine or cattle, but with greater variability. Sheep carcasses are less frequently contaminated than cattle or swine carcasses following slaughter (*14*).

Food Sources

Foods, particularly of animal origin, are a principal source of campylobacters. Furthermore, such foods can introduce campylobacters into the food handling environment. Other foods also can be easily cross-contaminated with campylobacters that are present in biofilms on surfaces of food handling and processing equipment. Foods are discussed in the *Epidemiology* section of this document and will not be discussed here.

Other Environmental Sources

Dogs and cats. Domestic dogs and cats frequently harbor *C. jejuni* and other *Campylobacter* spp. in their intestinal tracts (*14,34*). A higher incidence of intestinal carriage has been reported in puppies and kittens than in older dogs and cats (*10,17,113,114,125*). Higher isolation rates are frequently associated with housing dogs and cats in kennels (*17*). Puppies and kittens were more resistant to infection by *C. jejuni* in one experiment than were the researchers conducting the experiment (*96*). In epidemiological studies in Norway and in the United States, exposure to pets or diarrheic pets was reported to be responsible for an increased risk of *C. enteritis* disease (*59,107*).

Other Animal Reservoirs

Nearly all avian species may harbor *Campylobacter* spp. Migratory waterfowl, some of which are consumed by humans, are frequent sources of *Campylobacter* isolates (*76*). The droppings of various wild birds have been suggested as a means of *Campylobacter* being introduced to farm animals (*20*); some researchers believe it could be a principal source of farm animal infection (*116*). Avian species may be more prone than mammals to intestinal colonization with *Campylobacter* spp. because of the birds' somewhat higher body temperatures (*77*).

Campylobacter infections are common within colonies of primates, but infection rates of free-living primates and those in zoos are lower (*76,131*). Other zoo animals have a low isolation rate with the exception of birds (*76*). It is difficult to determine if animals with low carriage frequencies are true reservoirs, or whether they are sporadically and transiently infected through their environment.

Rodents, both wild and laboratory-raised, may excrete *Campylobacter* spp. in their feces (*14,34*). LeMoine, Vannier and Jestin (*74*) reported *C. jejuni* in rats and mice captured in the vicinity of a pig farm. Annan-Prah and Janc (*4*) isolated *C. jejuni/coli* from one of seven rats and two of nine mice trapped in broiler house. Pacha et al. (*91*) isolated *Campylobacter* from a very low number of fecal droppings of meadow mice. Unlike *Salmonella* spp., *Campylobacter* spp. are rarely, if ever, isolated from reptiles and other poikilotherms (cold-blooded animals), probably because campylobacters do not grow below 30°C (*14*).

Flies (*Musca domestica*) are known vectors by which fecal bacteria gain access to human food (*136*). Both *C. jejuni* and *C. coli* were isolated from flies captured on chicken farms (50.7% positive) and piggeries (43% positive), but not from cattle barns or turkey farms (*105*). *Campylobacter coli* was isolated far more frequently than *C. jejuni* (*105*). No attempt was made in this study to differentiate internal from external contamination of the flies. Annah-Prah and Janc (*4*) isolated *Campylobacter* from seven of ten flies captured in a broiler house.

Human Reservoirs

In developed countries, asymptomatic excretion of *Campylobacter* is rare (*11*). This is not always true in developing countries, where rates of asymptomatic carriage are high, consumption of untreated water is common, or where multiple non-food sources of infection are possible (*14*). Humans can mechanically transfer *Campylobacter* into animal production or food preparation areas through contaminated boots, gloves and utensils, or through inadequate personal hygiene (*132*).

Water and Shellfish

Campylobacter jejuni has been isolated from both fresh water and seawater (*130*) and from shellfish (*1*). *Campylobacter* spp. die-off after only a few days in seawater, but survive in fresh water (*64,129*) and shellfish meats (*1*). Oysters have been implicated as vehicles in human cases of *C. jejuni enteritis* (*2,100*). Contaminated surface water is a recognized source of *Campylobacter* infections of humans and animals (*14,132*). *Campylobacter* spp. found in water is likely to have come from the feces of wild or domestic animals or birds.

FACTORS INFLUENCING THE GROWTH OF THE ORGANISM

Growth Characteristics

Optimal growth of *C. jejuni* is obtained in a microaerophilic atmosphere (5% oxygen) (*60*). These moderately thermophilic organisms grow between 30 and 45°C, with optimal growth between 42 and 45°C (*28*). The optimal growth range is pH 6.5 to 7.5 and Campylobacters have been reported to be inhibited at less than pH 4.9 (*28*) or pH 5.1 (*39*).

Heat Sensitivity of Campylobacters

Campylobacters are sensitive to heat and are inactivated by exposure to pasteurization temperatures (*118*). In milk, D-values for *C. jejuni* at 48°C were 7.2 to 12.8 min and at 55°C were 0.74 to 1.0 min (*28*). Campylobacters were more heat sensitive than *E. coli* O157:H7 and were rapidly inactivated in milk during high temperature, short time pasteurization at 60.0 to 72.0°C (*23*). In meat, D-values for inactivation of the organism ranged from 5.9 to 6.3 min for heating at 50°C (*62*) and less than 1 min for heating at 60°C (*38,62*). D-values for *C. jejuni* in ground chicken heated at 49°C and 57°C were approximately 20 min and approximately 0.8 min, respectively (*9*).

Cold Tolerance of Campylobacters

Campylobacters survive in refrigerated food (*62,63*), but may be sublethally injured during refrigeration at 4°C or freezing at -20°C (*99*). The organisms survive better under refrigeration than at room temperature (*6,21*). After holding artificially contaminated chicken at 4°C for 17 days, there was a 1 to 2 $\log_{10}$ reduction in number, but when samples were held at 23°C, there was a 2.5 to 5 $10g_{10}$ decrease in number (*9*). Campylobacters are sensitive to freezing: isolation rates for *Campylobacter* spp. were five-fold lower from frozen meat and poultry than from refrigerated meat and poultry (*124*).

Sensitivity to NaCl

The optimal NaCl concentration for growth of *C. jejuni* is 0.5% (*119*). Campylobacters are sensitive to higher concentrations of NaCl. The presence of NaCl at a 1% concentration increases the death rate (*28*). A concentration of 2% NaCl in broth held at 30 or 35°C (*42*) or 42°C (*3*) is bactericidal. Campylobacters are also sensitive to drying, especially in an anhydrous environment at 25°C (*29*).

Sensitivity to Preservatives and Disinfectants

Concentrations of 0.05% of oregano, sage or cloves inhibit the growth of *C. jejuni* (*25*). Ascorbic acid, at a concentration of 0.05%, inhibits the growth of *C. jejuni* (*33*) and is bactericidal at a concentration of 0.09% (*55*). The inhibition by ascorbic acid is probably caused by oxidation products of L-ascorbic acid rather than the acid itself (*33,55*). Growth of *C. jejuni* is not effectively inhibited by sodium hypophosphite in concentrations tested for use as a food preservative (*100*).

Campylobacter jejuni is sensitive to standard concentrations of common disinfecting agents including sodium hypochlorite phenolic compounds, iodophors, quaternary ammonium compounds, 70% ethanol and glutaraldehyde (*134*). Blaser et al. (*13*) reported that *C. jejuni*, in a standard suspension assay, was more susceptible than *E. coli* to both chlorine and monochloramine. In another study, when *C. jejuni* were allowed to attach to chicken skin before treatment with chlorine, chlorine had a negligible effect (*139*). In a study simulating a poultry scalding process, a 50 to 100 ppm concentration of a cationic quaternary ammonium product rapidly inactivated *C. jejuni* when heated at 50°C (*47*).

Antibiotic Sensitivity

Campylobacters vary in their sensitivity to antibiotics. Most of the *C. jejuni* and *C. coli* isolates studied isolated from humans, cats, dogs, pigs and seagulls, were sensitive to nitrofurans, gentamicin and chloramphenicol. Some isolates were resistant to one or more of the following antibiotics: ampicillin, erythromycin, streptomycin, kanamycin, tetracycline, nalidixic acid and cephalothin (*15,44,57*). *Campylobacter coli* and *C. jejuni* strains isolated from swine have been shown to be singly or

multiply antibiotic resistant (*44*). Some tetracycline resistant strains contain a plasmid (*15*).

Survival in modified atmospheres and vacuum packaging. Modified atmospheres and vacuum packaging have little inhibitory effect on the survival of the microaerophilic *Campylobacter* spp. These organisms survived just as well on beef (*41*) or chicken packaged with oxygen permeable wrap or various modified atmospheres or with vacuum when stored at 4°C (*121,136*). In another study, campylobacters survived best in inoculated turkey rolls incubated at 4°C with 40 to 100% carbon dioxide (*94*). Stern, Greenberg and Kinsman (*121*) found higher recoveries of campylobacters from vacuum-packaged beef than from beef wrapped in oxygen-permeable film, and slight differences in ground beef packaged in modified atmospheres or vacuum-packaged.

Susceptibility to irradiation. Irradiation processing is a feasible technology for decreasing the numbers of campylobacters on meat and poultry but facilities are currently limited. Campylobacters are more sensitive to gamma irradiation than are salmonellae (*66,127*) and have a D-value of 32 krad (*136*). Tarjan (*127*) reported that *C. jejuni* in culture medium and in chicken paste survives an irradiation dose of 0.2 kGy, but not a 1 kGy dose. *Campylobacter jejuni* is more sensitive to ultraviolet (UV) irradiation at 254 nm than are *E. coli* and *Yersinia enterocolitica* (*18*).

Viable, non-culturable factors. A relatively new, and somewhat controversial aspect of the ecology of many gram-negative bacterial species is the phenomenon referred to as "viable but non-culturable" forms. Most work with viable, non-culturable bacteria involve the marine vibrios (*107,138*), but other genera, including *C. jejuni* (*104*), have been studied. The viable, non-culturable form in which a bacterium enters a state of semi-dormancy is presumably as a survival strategy in response to some stress, e.g., inadequate nutrient availability.

The stress condition most often studied, and most frequently used to experimentally induce the viable, non-culturable state is nutrient deprivation (*107*), but other stress conditions, such as heat shock, cold shock, and attachment to surfaces (which may reflect a response to stress) may lead to the same dormant state (*5*). There is some evidence that bacteria in the viable, non-culturable state may still be infectious to humans (*16*), and to animals (*105,122*).

Campylobacters have been reported to exist in a viable, but non-culturable state with a coccoid morphology (*52,53,54,92,104,105,122*). Passage through rat ileal loops can "resuscitate" viable, non-culturable cells resulting from freeze-thaw injury (*109*). In separate studies of chicks, which had been challenged just after hatching with a suspension of viable, non-culturable *C. jejuni*, Stern et al. (*122*) were able to culture *C. jejuni* from cecal contents after 7 days, whereas Medema et al. (*82*) could not culture the organism. Other researchers reported that coccoid cells of *C. jejuni* were non-viable (*84*) and that neither disease nor viable *C. jejuni* could be detected after animal (mice and rabbits) and human volunteer challenge studies (*8*).

Effects of attachment and the viable, non-culturable state on resistance. Attached campylobacters and campylobacters in biofilms have been studied. Rollins et al. (*105*) and Pearson et al. (*93*) found that *Campylobacter* cells could not be cultured from drinking water and other samples from a poultry farm, but could be detected in clumps in a biofilm using immunofluorescent antibody techniques. Studies with other organisms have demonstrated that attached bacteria are significantly more resistant than unattached cells to disinfectants such as chlorine and chloramine (*72,73*). In fact,enterobacteriaceae grown as biofilms on glass slides, metal coupons, or on granulated activated carbon particles were 150- to 3,000-times as resistant to hypochlorous acid as were their unattached counterparts (*73*). Other studies have shown that nutrient-deprived bacteria are more resistant to disinfecting agents (*7,43*). A genetic basis for the bacterial response to nutrient deprivation has been established (*79*).

Thus, there may be a basis for conflicting reports on the chlorine susceptibility of *C. jejuni*. *Campylobacter jejuni*, in suspension, was more susceptible than *E. coli* to chlorine (*13*), but if the organisms were allowed to attach to chicken skin before treatment with chlorine, chlorine had no significant effect (*139*). It is important to determine if there is a viable, non-culturable state, or equivalent, functioning in campylobacters in the environment and on human foods, and whether attachment is part of this phenomenon. Without more research in this area, the ecology of campylobacters will remain somewhat uncertain, as will strategies for controlling this pathogen.

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The Epidemiology of Food-borne *Campylobacter* Infections in the United States

Campylobacter is recognized as one of the most common causes of bacterial gastroenteritis in humans in the United States (*3*). *Campylobacter* contains a number of species, but the most frequently identified human pathogen in the genus is *C. jejuni*. A second species, *C. coli*, is a much less common cause of human disease. *Campylobacter coli* is closely related to *C. jejuni*, and their infections appear to share many clinical and epidemiologic characteristics. Campylobacters appear to be normal commensal inhabitants of the intestinal tract of food-producing animals and at times may cause illness in these animals (*33*). The *C. jejuni* colonization rate in cattle ranges between 3% to 24% (*8,13*) and the colonization rate in poultry was found to vary from 0 to 100 percent (*1,4,12,18,35,36*) and the presence of ≥ 1,000,000 organisms per gram of feces of these animals is not unusual. *Campylobacter coli* is most frequently isolated from pigs (*22,32,33*). *Campylobacter* spp. are often isolated from retail meat and poultry (Table 1). A recent outbreak of infection by *C. fetus* spp. *fetus* in compromised hosts was associated with cottage cheese; diagnosis of these infections is complicated by the inhibition of *C. fetus* by commonly used campylobacters media (*10*).

A large heterogenity of biotypes exists within the *C. jejuni/coli* group of organisms (*24,27,35*). It is possible that not all serotypes are pathogenic for humans. Rogel (*24*) isolated 27 serogroups from chicken meat and the environment; some of these serogroups have been isolated from human cases of diarrhea, while others are very rarely or never isolated from humans. The public health significance of the presence of *C. jejuni* in foods cannot be fully evaluated until it has been determined whether equivalent pathogenicity is characteristic of all *C. jejuni* serotypes or is limited to certain ones, or if pathogenicity can be predicted by serotype.

TABLE 1. Prevalence of naturally contaminating *C. jejuni* and *Campylobacter coli* in retail market meats in the United States.

No. of sampling yielding *Campylobacter* spp.	
Product	No. of samples analyzed (%)
Chicken	107/360 (29.7)
Pork chop	18/360 (5.0)
Pork sausage	15/360 (4.2)
Ground beef	13/360 (3.6)
Beef flank	17/360 (4.7)
Lamb stew	29/360 (8.1)

Stern et al., 1985.

While the minimum infectious dose of *Campylobacter* has not been defined, 500 to 800 organisms have been sufficient to cause illness in some volunteers (*2,23*). The incubation period between ingestion and onset of illness has been reported to extend from one and 1½ to 7 days, generally within a 2-5 day range (*9*). The spectrum of clinical response to infection also is broad (*3*). As a mild disease, symptoms may last 24 h and resemble those of

viral gastroenteritis. At the severe end of the spectrum, *C. jejuni* may cause relapsing colitis that mimics ulcerative colitis or Crohn's disease. In addition, post-infection complications, such as Guillain-Barré syndrome have been reported in patients with campylobacteriosis (*19,21,30*). Most typically, campylobacteriosis results in a week of diarrhea (sometimes bloody), abdominal pain, malaise, fever, nausea and vomiting. Although some patients suffer severe, prolonged, and/or relapsing illness, nearly all patients eventually recover; the Centers for Disease Control and Prevention (CDCP; *10*) estimates that 200 *Campylobacter* deaths occur each year in the United States (*34*).

In the first eight years of *Campylobacter* surveillance at CDC, the annual number of reported infections has increased, but the infection rate has remained approximately 5 to 6 cases/100,000 population. The increase in the reported infections can be attributed to the increase in the population under surveillance (Table 2). The reported isolation rates are close to that of *Shigella* (7 to 8 cases per 100,000), and considerably lower than that of *Salmonella* (18 to 20 cases per 100,000). These low reported rates of isolation reflect the limitations of this laboratory-based surveillance system. It should be noted that *Campylobacter* isolates are not reportable in all states.

TABLE 2. Reported isolates and isolation rates, National *Campylobacter* Surveillance System, United States, 1982-1989.

Year	No. of Isolates	Isolation Rate/100,000
1982	4027	7.2
1983	8630	4.9
1984	8770	5.0
1985	9753	5.7
1986	10063	5.9
1987	9552	5.5
1988	10024	5.8
1989	10179	5.9

Several causes exist for underreporting campylobacteriosis. Many people with diarrheal disease do not consult a physician; therefore, these persons cannot be reported to CDC since the initiating event for reporting is the submission of a clinical specimen from the patient by his/herphysician. A single study of an outbreak estimated that approximately 20 cases of campylobacteriosis occurred for every patient who sought medical care and was cultured (*25*). Another major source of underreporting is the failure of many laboratories to routinely culture for *Campylobacter* in diarrheal stool specimens. In 1980, CDC conducted a study at eight hospitals whose microbiology laboratories cultured *Campylobacter* routinely from diarrheal stool specimens, along with *Salmonella* and *Shigella* (*6*). When these laboratories looked for *Campylobacter*, it was isolated twice as frequently as *Salmonella* and four-and-a-half times more frequently than *Shigella*. Since the incidence of *Salmonella* is estimated to be at least 20 cases per 100,000 population,diagnosed *Campylobacter* infections may be 40 to 50 cases per 100,000, which is ten times the reported rate. The isolation rate was 71 cases per 100,000 at a health maintenance organization in Seattle, WA in the early 1980s (*17*). In a later survey of the same population, it was 50 cases per 100,000 (Table 3). Therefore, when laboratories routinely look for *Campylobacter*, the isolation rates are approximately 10 times the national reported isolation rate, or roughly 50 cases per 100,000. It is clear that the current rate of underreporting complicates analysis of trends.

TABLE 3. Isolation rate of bacteriol pathogens at a health maintenance organization in Washington State.

Isolates per 100,000 person-years Pathogen	1981-1983	1985
Campylobacter	71	50
Salmonella	15	21
Shigella	7	7
Escherichia coli O157:H7	NT	8

The estimated isolation rate of 50 cases per 100,000 population if all laboratories looked for *Campylobacter*, and an estimate based on the single study referenced above of 20 milder infections for every culture-proven case, suggest an annual extrapolated infection rate for the United States for *C. jejuni* infections of approximately 1,000 cases per 100,000 or 1% of the United States population per year (*34*). The estimated annual infection rate is close to the annual estimated incidence for *Campylobacter* in Great Britain of 1.1% (*20*)

In the industrialized countries of North America, Australia and Europe, *C. enteritis* affects people of all ages, but typically it has a bimodal distribution with peaks of incidence in children under the age of 4 years and young adults (*28,34*). Information on age and sex of patients is collected by the *Campylobacter* surveillance system at CDC also shows that the highest isolation rate is for infants (approximately 14 cases per 100,000 population). In contrast to salmonellosis, however, data on sporadic campylobacteriosis indicate a male predominance from infancy to 45 years of age, and a large proportion of cases occurring during young adulthood for both sexes.

The clinical source of most reported *C. jejuni* isolates is stool specimens (Table 4). While only 0.3% of reported isolates came from blood, the proportion of invasive disease rises abruptly above age 70 to 1.2%. As of 1989 there has been no increase in bacteremia in men aged 25 to 49, the group most affected by AIDS, suggesting that AIDS does not predispose patients with *Campylobacter* gastroenteritis to bacteremia (*34*). The influence of immune status on invasive disease needs additional research.

TABLE 4. Sources and etiologic fraction in case-control studies of *C. jejuni*, infections in humans.

Site and Year	Poultry	Foreign Surface Raw Milk	Pets	Travel	Water
Seattle, 1984	≥50%	5%	6%	9%	8%
Georgia, 1987	70%		30%		

Outbreaks

CDC collects reports of food-borne and waterborne outbreaks from state health departments, including those

caused by *Campylobacter*. This is a passive reporting system so there is underreporting; in addition, these data do not represent all outbreaks that occur. Between 1978 and 1986, 57 outbreaks of campylobacteriosis were reported, including 45 food-borne outbreaks, 11 waterborne outbreaks, and one outbreak in a tourist group travelling overseas. A vehicle was determined for 80% of the food-borne outbreaks; of these 70% were caused by raw milk and 8% were associated with poultry. The classic outbreak occurs after a school trip to a dairy farm, during which the school children get a glass of raw milk. These data suggest that consumption of only pasteurized milk and potable drinking water could prevent 90% of the outbreaks in the United States.

It is important to remember, however, that most *Campylobacter* infections occur as sporadic cases, e.g., individual cases that are not associated with a recognized outbreak. Outbreaks have a marked bimodal distribution, with peaks in May and October, and the low point during the summer. In contrast, sporadic cases peak in the summer. This difference suggests that the epidemiologic characteristics of these cases are different than the epidemiology of outbreak-associated cases.

Sporadic Illness

Large case-control studies of sporadic *C. jejuni* infections have examined a number of different possible sources of human infection. Studies in the states of Washington (*14*) and Georgia (*11*) (Table 5) identified consumption of improperly cooked chicken as the dominant source of human infection, as well as poor kitchen hygiene, such as not thoroughly washing the kitchen cutting-board with soap. Several studies (*7,15,16*) in Colorado found that human infection was specifically associated with improper handling of raw chicken meat and with eating undercooked chicken. The person who prepared the chicken in the kitchen was the one most likely to become infected.

TABLE 5. Reported isolates of *C. jejuni* by source of isolates, 1982-1989.

Source	Number of Isolates
Stool	45,634
Blood	154
Gallbladder	3
Abscess/wound	2
CSF	1
Sputum	1

A case control study conducted at the University of Georgia identified three ways in which poultry can cause *C. jejuni* infections: eating chicken raw, eating undercooked chicken, using a knife or cutting board for cutting up a raw chicken, and for food items that did not receive adequate heat treatment before consumption (e.g., salad) without washing the knife and cutting board first, (*11*). These studies (*11,14*) suggest that proper handling and cooking of poultry products could result in a substantial decrease in the occurrence of sporadic *Campylobacter* infections.

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Campylobacter Pathogenesis

Human infection with *C. jejuni/coli* can result in a range of clinical illness from transient asymptomatic colonization to severe dysentery. In addition, the occurrence of extraintestinal infections and a variety of post-infectious sequelae have led to a number of studies examining potential mechanisms by which campylobacters cause disease. These studies have looked for a number of microbial substances that promote cytotoxicity, enterotoxicity, invasion, and a variety of immunologic reactions. The usual manifestation of infection by *C. jejuni/coli* is acute enteritis (*31*). Stools are commonly watery and, after 1 to 2 days of diarrhea, often contain fresh blood (*3*). Many patients have at least 1 day with eight or more bowel movements (*2*). Diarrhea is the most common symptom, occurring in virtually all symptomatic cases, and is usually accompanied by malaise, fever and abdominal pain. Other commonly reported signs and symptoms include nausea and vomiting, tenesmus, bloody diarrhea and joint pain.

Onset of diarrhea generally occurs 2 to 5 days after oral exposure. Human volunteer studies indicate that low exposure doses—500 to 800 organisms—are sufficient to make some previously healthy young adults ill, but have not characterized the minimal infectious dose or a dose response curve (*1*). The diarrhea generally lasts 5 to 10 days, and resolution of other signs usually occurs by 2 weeks after onset. In a recent study in Norway (Kapperud; In press), patients missed an average of 3.5 work days due to their illness (median = 1.5 days); hospitalization, required for 13% of patients, lasted an average of 4 days. Even without therapy, symptomatically infected persons usually are stool culture negative in 2 to 3 weeks after onset of illness (*3*). Studies of normal healthy human populations in industrialized countries, such as the United States generally demonstrate asymptomatic carriage rates of less than 1% (*2*). Secondary spread from infected persons is uncommon except from infants to mothers and other infants (*2*).

Clinically, infections by campylobacters can cause a watery diarrhea, a dysentery-like syndrome mimicking inflammatory bowel disease, or an extra-intestinal infection (*35*). Although uncommon, extra-intestinal infection including meningitis, cholecystitis and urinary tract infections have been reported. The relative importance of host factors versus strain differences in the clinical expression of infection is uncertain.

Levine et al. (*19*) have categorized enteric pathogens into a number of groups on the basis of the mechanisms by which they produce disease. Campylobacters have been reported to produce illnesses characteristic of pathogens in three of these groups. As an example of one mechanism, *Shigella* spp. penetrate and proliferate within the intestinal epithelium. Cell damage and death create a superficial lesion, and mesenteric adenitis and bacteremia seldom occur. Intestinal epithelial invasion appears to occur in 20 to 30% of cases of campylobacteriosis as demonstrated by bloody diarrhea and mucus and cellular exudate in their stools (*5,34*). Infection most commonly involves the terminal ileum and colon.

A second pathogenic mechanism of enteric disease, described by Levine et al. (*19*) as mucosal translocation, is common to such pathogens as *Salmonella* and *Yersinia*. It is characterized by penetration of the intestinal mucosa with minimal surface damage, and proliferation in the lamina propria and mesenteric lymph nodes. Mesenteric adenitis has been reported in children and young adults with campylobacteriosis (*2*). When it occurs, the mesenteric adenitis may be associated with abdominal pain sufficiently severe to mimic appendicitis. This provides evidence that *C. jejuni* also can use mucosal translocation to produce clinical disease (*3*).

Thus, *C. jejuni* is clearly capable of being invasive. Overt colitis and mesenteric adenitis are common clinical presentations, and many patients have blood, mucus and leukocytes in their stools. Experimentally, *C. jejuni* also has been shown to invade the intestinal epithelium of infant chickens (*32*), infant mice (*27*), and hamsters (*12*). Although *Campylobacter* is Sereny test negative (*21*), invasion also has been demonstrated in tissue culture systems and chick embryos. Using chick embryos to measure invasiveness, Field et al. showed that no relationship exists between virulence to the embryos and plasmid content, and that motility plays little role in invasion (*7*).

A third pathogenic mechanism of enteric disease described by Levine et al. (*19*) is the enterotoxin-induced watery diarrhea typified by cholera. The profuse watery diarrhea that frequently results from *Campylobacter enteritis*, especially in children in developing nations, provides clinical evidence that this mechanism can be used by *C. jejuni* (*31*).

Some *C. jejuni* isolates recovered from patients with watery diarrhea have been reported to produce an enterotoxin that appears functionally and immunologically similar to cholera toxin and *E. coli* LT (*30*). This work has been difficult to reproduce, and there are conflicting reports on antibody production directed against cholera toxin or its subunits in patients recovering from campylobacteriosis (*9,13,16,23,26,30*). *Campylobacter* enterotoxin may induce fluid accumulation in rats (*6,30*),

mice (*3*) and rabbit ileal loops (*23*), and may cause elongation of CHO cells and rounding of Y-1 mouse adrenal cells (*23*). Although these studies suggest enterotoxin production by *C. jejuni*, strains isolated in India from asymptomatic carriers and patients with watery diarrhea did not differ in their ability to produce the toxin (*22*).

Isolates from patients with bloody diarrhea elaborate cytotoxin as measured by Vero and Hela cell assays (*10,16,35*). Lesions observed in the hamster model developed by Humphrey, Mantae and Pittman (*12*) to demonstrate invasiveness also suggest that *C. jejuni* elaborates a cytotoxin. Elongation, shortening and blebbing of microvilli and extrusion of apical cytoplasm are likely due to cytotoxin produced by *C. jejuni* within the intestinal lumen. Intestinal epithelial cells of experimentally infected hamsters also contain swollen endoplasmic reticulum and mitochondria similar to those seen in cells treated with cytotoxic chemicals like carbon tetrachloride. A new cytolethal toxin (CLDT) distinct from previously reported cytotoxins and cholera-like enterotoxins is produced by some *Campylobacter* isolates, and may account for the CHO cell response (*13*).

In other enteric pathogens, plasmids have been shown to specify such virulence determinants as adherence, invasiveness, toxin production, iron sequestration, resistance to the bactericidal effects of serum, and antimicrobial resistance. Although some *C. jejuni* isolates contain plasmids, thus far only antibiotic resistance has been shown to be plasmid encoded (*34*).

The spiral morphology, cork-screw motility and microaerophilism of *Campylobacter* are similar to other normal inhabitants of intestinal crypts. When colonizing a host, *C. jejuni* associates with intestinal mucus in both the mucus blanket and the mucus-filled crypts, and does not appear to adhere to mucosal epithelium (*18*). The mobility of *Campylobacter* is due to one or more flagella, and flagellar antigens are the major antigens in certain serogroups of the heat-labile serotyping system of Lior et al. (*20*). Motility directed by chemotactic stimuli can increase the effectiveness of mucosal colonization, and Hugdahl and Doyle (*11*) have demonstrated positive chemotactic response to L-fucose, an exposed carbohydrate constituent of mucin.

The flagella of *C. jejuni* also appear to contain adhesions for epithelial cells, as shown by *in vitro* adherence to HeLa and INT 407 cells and in porcine brush border preparations (*26*). Whether active or not, presence of a flagellum improves colonization in animal models (*18,25,26*) and non-flagellated variants are unable to colonize animals (*4*) or human volunteers (*1*).

Other surface structures of *C. jejuni* that could serve as adhesions to gut epithelium are outer membrane proteins, Lipopolysaccharide (LPS), and glycocalyx material (*34*). Variation among *C. jejuni* strains in cell and mucus adherence assays suggests variable presence of different adhesions, and could account for lineal expressions of invasive versus toxin-mediated disease. In contrast to the long O polysaccharide chains that produce antigenic diversity for *Salmonella*, the LPS of *C. jejuni* is a lipoligosaccharide more similar to those of *Neisseria*, *Haemophilus* and *Bordetella* spp. (*34*). Even so, the small number of sugars in *Campylobacter* LPS provide considerable heat-stable antigenic diversity (*28*).

One of the primary virulence attributes of *Salmonella typhi* is its ability to survive within macrophages while being dispersed throughout the host's mononuclear phagocytic system (*34*). Kiehlbauch et al. (*15*) demonstrated that *C. jejuni* survives within monocytes for as long as a week; however, bacteremia is rarely documented among cases of campylobacteriosis (*33*). Engulfed *C. jejuni* survived longer than free bacteria in the study by Kiehlbauch et al. (*15*) but not as long as the more typical intracellular pathogens such as *Listeria*.

Complications of infection by *C. jejuni* are uncommon (*31*). Abdominal pain mimicking appendicitis can lead to unnecessary appendectomy. A small minority, approximately 2% of patients suffer from reactive (aseptic) arthritis arising 7 to 10 days post onset, and this can persist for several weeks to months. Reactive arthritis is considered by some to be incomplete Reiter's syndrome. Reiter's syndrome also has been reported to follow acute campylobacteriosis.

Reiter's syndrome is the most frequent cause of inflammatory arthritis of young men in North America and Europe. The syndrome consists of variable presentation of a tetrad of signs that include reactive arthritis, conjunctivitis, urethritis and dermatitis. It can follow diarrhea caused by a number of bacterial enteric pathogens, such as *Salmonella*, *Shigella*, *Yersinia* and *Campylobacter*, and generally occurs 1 to 3 weeks after onset of diarrhea. Race, gender and genetic background all appear to influence susceptibility and presentation. The arthritis is similar to ankylosing spondylitis. It is asymmetrical and involves mainly large joints of the lower extremities. In 50% of cases, Reiter's syndrome occurs as a single episode. The remaining cases are divided among patients who have relapses separated by long quiescent periods and patients with chronic, progressive, unrelenting disease.

Guillain-Barré syndrome occurs after infections by campylobacters, but is less common than reactive arthritis. Guillain-Barré syndrome typically is an acute paralytic disease with an assumed autoimmune etiology (*8*). Approximately 3,000 patients with Guillain-Barré syndrome are documented in the United States each year, 65% of whom are reported to have had an antecedent viral syndrome 1 to 3 weeks before onset and 5% to 10% of whom have had preceding surgery. The first reported association between campylobacteriosis and Guillain-Barré syndrome was made in 1982 (*24*).

In a review of 106 patients with Guillain-Barré syndrome, 13 (12%) gave a history of antecedent diarrheal disease and four were culture positive for *C. jejuni* (*29*). However, in a retrospective sero-survey, Kaldor and Speed (*14*) found that 38% of Guillain-Barré syndrome patients had recent *C. jejuni* infection. In addition, a recent study in Japan documented *C. jejuni* infection by positive stool culture in nearly half (46%) of 26 Guillain-Barré syndrome patients, but rarely among healthy controls (*17*). Most of their isolates were Penner serotype 19. The frequency with which *Campylobacter enteritis* precedes Guillain-Barré syndrome and the clinical severity of Guillain-Barré syndrome when it follows infection by campylobacters remain unclear at present (*24*). Fujimoto et al. (17) have shown that a 46 kDal protein from *C. jejuni* of an unspecified serotype which was isolated from a patient with Guillain-Barré syndrome cross reacts with peripheral nerve myelin proteins. This cross-reactivity is presumed to be a factor in the immune mediation of the Guillain-Barré syndrome (*24*).

With good supportive care, the mortality from Guillain-Barré syndrome is less than 5%, and 85% of patients eventually recover completely or almost completely.

In summary, campylobacters can infect humans by the oral route and produce a spectrum of illness. While infection is rarely life-threatening, illness can be severe and *Campylobacter*-induced deaths occur. The infectious dose is quite low in some instances, on the order of a few hundred organisms, but adequate dose-response studies have not been done. In industrialized nations, clinically normal persons rarely carry campylobacters, and when they do, they appear to pose limited threat of transmitting their infection. The published literature suggests that the pathogenic mechanisms used by campylobacters could be varied but, at present, the data do not clearly define which of these mechanisms is important in disease causation.

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Campylobacter in Broiler Production and Processing

The epidemiology of *C. jejuni* in chickens and its ecology in farm practices have not been completely defined. There appear to be a plethora of sources of infection of chicken during production, but the relative importance of these sources is unknown. The reader should be aware that improvements in isolation techniques, better understanding of *Campylobacter* physiology, and knowledge of the "viable but non-culturable" state of *Campylobacter* may account for some of the contradictions in citations reviewed in this document. However, there is sufficient information to encourage action to lower the incidence of infected birds and flocks. This information can be best applied through a HACCP approach.

The source of *C. jejuni* infection at the broiler grow-out level is not clear but the incidence of infection generally increases with age (*22*). When *C. jejuni* carriage and prevalence in flocks is assessed, the organism is usually found in large numbers and in a high percentage of the birds (*14,39,40*). Substantial variability exists in the prevalence of *Campylobacter* in different flocks and at different ages of the birds. Some broiler flocks appear to remain free of the organism (*1,30*).

Vertical transmission of this infection in poultry is highly improbable. The egg shells from hens excreting the organism are rarely contaminated. *Campylobacter jejuni* does not easily penetrate the egg shell (*11*), but when it does, it does not survive for more than 6 h in egg contents (*30*). This may be due to a bacteriocidal effect of the albumen (*16*). Prophylactic antibiotics may also influence *Campylobacter* infection (*1,49*).

Annan-Prah and Janc (*1*) found chicks at hatch and at 11 days post hatch were negative even though parent stock hens from two groups were 60% and 80% infected. Other studies concur that isolation from chicks less than 5, 7 or 14 days of age can seldom, if ever be accomplished (*14,24,40,44*).

Smitherman, Genigeorgis and Greene (*40*) and Genigeorgis, Hassume and Collins (*14*) have reported that feed, litter and water samples become contaminated only after the isolation of *Campylobacter* from live birds. Pearson et al. (*34*) found evidence of *Campylobacter* throughout a contaminated water system on a farm and has suggested that water contaminated with the organism may be a prime source of infection of chicks. If litter is a source of continued contamination between flocks, the organism must remain viable between the removal from the house of older birds and the introduction of new chicks into this house.

Some researchers have suggested that although the feed, litter and water may be negative for *Campylobacter* prior to infection of live birds, contamination might spread from an infected flock of birds to succeeding flocks via litter (*14*). Since *C. jejuni* is sensitive to dehydration and to toxic forms of oxygen (peroxide, superoxide anions) and survive poorly in aerobic environments, chicken house conditions are not ideal for *C. jejuni* survivability. Indeed poor survivability in an aerobic environment has been demonstrated, with greatest survivability of six days at 8°C (*9,18*).

Early studies indicated that *C. jejuni* is very sensitive to drying the studies (*12,31*) show that *Campylobacter* could not be isolated past 24 h when dried in the presence of turkey feces. Thus it is difficult to consider litter as the primary source of continued infection given the organism's poor survivability and the intervals between removal of birds and introduction of new birds to most houses. *Campylobacter* does not appear to spread rapidly amount chicks reared on some types of litter, e.g., woodshaving litter (*42*). This indicates that culturing litter for *Campylobacter* as an indicator of infection, as is often suggested for *Salmonella (41)* may be of limited value. However, this needs to be reevaluated in light of the possibility that a possible viable but non-culturable state exists for campylobacters.

It is clear that *C. jejuni* can survive in an aqueous environment and will remain viable up to 3 to 4 weeks (*5*). Therefore, if central water supplies in chicken houses become contaminated, the organisms could spread to the newly-placed birds (*7,27,35*).

Rollins (*34*) and Pearson et al. (*34*) studied *Campylobacter* colonization on a farm in England and were not able to isolate *Campylobacter* from well water, poultry drinking water, fresh feed, fresh litter, rodents, air or poultry house walls, ceilings, and fans. However, direct microscopy revealed spiral bacteria in the drinking water by an indirect fluorescent antibody methods, and *Campylobacter* were demonstrated in the drinking water supply, the watering system in certain houses, used litter and exposed feed. The indirect fluorescent antibody results indicated that *Campylobacter* cells were present in many of the samples that were not culturable by standard methods. As these cells often appeared in clumps on the filtered preparations it was suggested that the cells may have been "microcolonies" dislodged from the biofilm encrusting the water supply systems. Pearson et al. (*34*) using polymerase chain reaction methodology reported that water containing viable but non-culturable *C. jejuni* was responsible for the colonization of chicken on the broiler farm. Oyofo et al., (*32*) were able to detect *Campylobacter* deoxyribonucleic acid DNA in 2 of 15 water samples from which *Campylobacter* was not culturable. No samples were collected from a poultry farm where *C. jejuni* was endemic. Thus, newer methodologies suggest that more research on water supplies on broiler farms needs to be conducted.

Annan-Prah and Janc (*1*) sampled domestic and free-living animals on broiler farms and found cattle pigs, dogs, swallows, sparrows, rats and mice, living on the premises were often infected with *C. jejuni/coli.* Campylobacters were also isolated from houseflies and farmer's boots (Humphries; In press). However, these organisms were not isolated from fecal samples of 71 farmers and their family members. Other studies have found cattle (*5,26,29*), swine (*4,5,29*), dogs (*5,26*), free birds (*23,37*), rodents (*1,5,25*) and houseflies (*1,36,37*) to be infected with *Campylobacter*. Eighty-seven percent of rats and 50% of houseflies (*Musca* spp.) captured in the vicinity of poultry houses have been shown to be culture positive (*38*). Annan-Prah and Janc (*1*) found the same Penner serogroup in broilers and hens, and in cattle, pigs, dogs and mice. Therefore, the risk of infection is inversely proportional to the standard of biosecurity and appropriate measures are

required to restrict transfer of fecal material from infected units to susceptible young flocks (*38*).

Rollins (*35*) and Pearson et al. (*34*) demonstrated a reduction from 80% to 20% in the colonization rate of chickens with a collective intervention regimen that focused on improvement of hygiene on the farm. Interventions included: maintaining an effective level of free chlorine in the water supply; removing used feed and litter before introducing new birds; and de-scaling of header tanks, supply lines and drinkers with high pressure hot water washing and soaking with quaternary ammonium compounds. An analogous reduction was observed for the isolation of the endemic strain in the human case reports in the region supplied by the farm where interventions were put in place. Upon termination of these interventions, the prevalence of *Campylobacter* rose to pre-intervention levels.

It may eventually be demonstrated that the exposure of chicks to beneficial flora early in their life will aid them in resisting or reducing colonization by *Campylobacter* by means of competitive exclusion (CE) and competitive inhibition. The results of attempts to utilize CE may depend upon many factors, including the specific bacterial species that make up the flora and supplemental nutrients provided to aid that flora in creating conditions that are antagonistic to colonization with *Campylobacter* (*43*).

Campylobacter Control Practices at the Broiler Grow-out Level

Contamination of flocks during grow-out has been identified as the major source of infection in poultry. Although vertical transmission of *C. jejuni* from parent to progeny is not likely to occur, most broiler flocks are known to become *Campylobacter*-positive several weeks after they are placed in grow-out houses. This suggests contamination from an environmental source (*14,34,40*). Control measures, including adequate cleaning and disinfection of the broiler houses and hygienic barriers, have been shown to be very effective in eliminating *C. jejuni* from broiler houses (*34,35*).

With this overview, the following suggestions are provided to reduce the level and/or number of broiler flocks that are colonized by *Campylobacter*. The suggestions listed below should be considered with the clear understanding that the epidemiology of *Campylobacter* in chickens and its ecology during production have not been completely defined.

1. Broiler production practices should be in conformance with the National Broiler Council recommendations on Good Manufacturing Practices, including thorough cleaning and disinfecting of equipment and broiler houses.
2. Grow-out houses should be constructed to exclude wild birds and rodents since they are frequent carriers of *Campylobacter*. A continuing program of rodent control should be practiced to prevent or reduce the possibility of rats or mice introducing *Campylobacter* into the flock.
3. Clean drinking water should be made available to chicks. This can best be accomplished by using municipal or other tested and approved water sources and a nipple drinker system. It is recommended that where water quality is questionable, on-line chlorination systems should be installed with a continuous monitoring system to assure appropriate levels of chlorine. The nipple drinker offers the advantage of supplying water that is not contaminated by the fecal droppings from other chickens. Such contamination is difficult, if not impossible, to avoid with the open trough or cup-type systems. Attempts should be made to thoroughly clean the biofilms from watering systems.
4. Accepted biosecurity practices should be implemented in the operation of the broiler houses. All pets such as dogs or cats should be excluded from the interior of the house. A change of footwear should be required before entering the broiler house. Thorough cleaning of footware prior to entering houses is recommended. (Humphries; In press). Chick placement boxes or pans should be cleaned and thoroughly disinfected before reuse to prevent the spread of any microorganisms throughout the broiler operation (*2*).

Transfer of *Campylobacter* During Slaughter and Processing

Spread of *Campylobacter* to the surface of poultry carcasses apparently occurs within the processing plant. Jones et al. (*22*) isolated *Campylobacter* from 20% of the cloacal swabs as birds entered the plant, 52% following immersion chilling, and 31.6% at retail. The organism can be spread either from within the intestinal tract, or from the bacteria on the external surfaces of the bird.

When the occurrence of *C. jejuni* in poultry products was studied in the Netherlands (*17*), it was observed that the processing of affected flocks resulted in contamination of the processing line; spread of contamination seemed to be unrelated to the type of chilling e.g., immersion or air chilling. Campylobacters were isolated from the air and in the hanging, scalding and defeathering, and eviscerating departments of the plant.

Campylobacter jejuni has been recovered from the scald-tank water, feathers, offal flumes, chiller and equipment (*3,50*). Processing steps that may spread contamination are: transport to plant, electrical stunning, immersion scalding, defeathering, evisceration, continuous waterbath chilling and use of recycled water. Wempe et al. (*50*) found the chilling tank and feather picker to be the areas of major cross-contamination in poultry processing plants. Hartog et al. (*17*) found that cross-contamination also occurred in the air chilling of broiler carcasses. Manual, as well as mechanical, evisceration was found to be the major source of contamination by Baker (*3*) and Mehle (*28*).

Campylobacter Control Practices in Poultry Processing

A critical step in eliminating or reducing the presence of *Campylobacter* during processing is the control of cross-contamination between the birds of the same flock or from flock to flock. Current knowledge and technologies for processing poultry will not totally prevent carcass contamination with *Campylobacter*. The control of all potentially hazardous microorganisms in food processing and preparation can be accomplished through the utilization of the HACCP approach.

The basic requirements of microbial control are common to all processing steps. Some elements found to be beneficial in the overall control program in poultry processing are:

- sanitary dressing procedures (including reconditioning steps);
- rinses and washes of equipment to minimize or reduce cross-contamination;
- spray systems with chlorine or other bacterial control treatments on the carcass and related contact surfaces whenever possible;
- counterflow water systems for scalding and chilling; and
- proper temperature control at processing points, including proper chilling or freezing of the final product.

Studies conducted by the Food Safety and Inspection Service (FSIS) of the United States Department of Agriculture in Puerto Rico (*19,20,21*) demonstrated plant changes could decrease the numbers of pathogens. The FSIS study suggested four procedures for microbial control:

- use of hand sanitizers or disposable plastic gloves;
- treatments such as chlorinated water rinses of automated cutting equipment and belt rinses to reduce post chiller cross-contamination;
- keep cutting/packaging areas refrigerated to reduce the outgrowth of the organism in the processing environment; and
- frequent sanitation of contaminated machines, utensils and/or personnel to prevent the organism from being transferred from the carcass surface to contact surfaces.

A large-scale test of processing modifications was completed in five commercial plants (*48*). The processing changes generally reduced both the prevalence levels of *Campylobacter*. These modifications were recommended by the National Broiler Council and are listed below:

- counter current scalding;
- addition of a bird wash at the exit of the scalder;
- addition of 20 ppm total chlorine to the bird wash in the picking room; the water used on the transfer belt, and the final wash;
- addition of chlorine in the chill water at a level to allow for 1 to 5 ppm free chlorine in the overflow from the chill tank.

Other research areas include decontamination procedures for carcasses and the effect of modified atmosphere packaging. Poultry slaughtering operations should include approved decontamination strategies to reduce the incidence and levels of *Campylobacter*. Several promising intervention strategies for controlling pathogens in broiler processing are briefly described in Appendix A. Irradiation is an effective means of eliminating *C. jejuni* from packaged fresh poultry. Poultry plants may now irradiate fresh or frozen product at 1.5 to 3.0 kiloGray, the smallest, most practical "dose" of irradiation for bacterial control (*10*).

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APPENDIX

Campylobacter in Food Distribution

During distribution, raw foods of animal origin (e.g., milk, poultry, beef, pork and seafood) must be maintained under conditions which prevent the multiplication of campylobacters. Attention to detail during the transportation, shipping, storage and display of these products is essential in assuring their safety. Three factors are critical in food distribution.

1. *Cross-contamination*

Preventing cross-contamination between raw animal products and ready-to-eat foods is the most important factor to be controlled in food distribution. Raw and ready-to-eat foods should be stored separately in refrigerated vehicles during transportation, and in commercial refrigerators and freezers upon delivery. This procedure will prevent the transfer of contaminated juices from raw to ready-to-eat products due to inadvertent leakage of packages during shipping and storage. Personnel who receive food shipments should always observe the conditions under which foods are delivered. Examine packages upon receipt for damage or leaking juices, and carefully oversee the proper storage of foods in commercial refrigerator/freezers to prevent cross-contamination. If leakage or spoilage of contents occurs, the contaminated environmental surfaces affected should be cleaned and sanitized thoroughly, and the adulterated products should be reconditioned or destroyed as appropriate.

2. *Proper packaging*

Proper packaging with approved packaging films and equipment is necessary to prevent contamination and to insure proper integrity of the food product. The packaging must be kept intact throughout the distribution system.

3. *Temperature control*

Another critical factor in the distribution system is the holding temperature of the product. Campylobacters do not grow or compete well with other bacteria at abusive temperatures, and will not multiply at temperatures below 29.4° C (85° F). Raw foods of animal origin should be stored at appropriate temperature and be used on a first-in, first-out basis. Temperatures of products must be carefully monitored and controlled during their transportation, storage and display.

Intervention Strategies for Controlling Pathogens in Broiler Processing

Since bacterial contamination of raw foods of animal origin is a concern, the poultry processing industry and its suppliers are actively seeking solutions to pathogen reduction. A number of recent intervention strategies have been tested and evaluated for controlling pathogens during broiler processing. These techniques are in various stages of development and plant testing for efficacy.

Four of these intervention strategies for pathogen reduction are outlined below:

1. *Trisodium phosphate*

This is a patented process approved by U.S. Department of Agriculture (USDA) for reducing *Salmonella* spp. on broiler carcasses. The process involves preparing a highly concentrated solution of trisodium phosphate dodecahydrate. Post kill birds are then continuously dipped and drenched while moving on the rehang line through a treatment tank containing the solution. After treatment, carcasses continue without rinsing into further processing or packaging. The treatment solution must be continuously recirculated through a filter/treatment system to remove particulate matter washed off the carcasses. Fresh treatment solution is continuously metered into the system to replace material carried out by the process.

The exact mechanism of efficacy is unknown; however, it is hypothesized to be a combination of pH, ionic strength and fat removal. During defeathering, bacteria may find their way into open feather follicles and subsequently be protected by lipid smearing. Trisodium phosphate may remove this protection, allowing the offensive bacteria to be washed away.

The trisodium phosphate dip process was tested over continuous 16 h daily shifts, treating approximately 80,000 birds per day. The results indicated a reduction of the incidence of *Salmonella* spp. from 17% to 0% during a 3-day processing plant test, and from 19.4% to 0.8% during a 4-day processing plant test. *Escherichia coli* and Enterobacteriaceae counts have also been substantially reduced. *Campylobacter* is also reduced with this process.

2. *Chlorine dioxide*

Disinfection of chiller water in poultry processing plants has been the subject of at least two independent studies in the past two years. Conventional water treatment in poultry processing has utilized chlorine or hypochlorite for pathogen control. Since chlorinated organics have been identified as possible mutagens and carcinogens, chlorine dioxide offers an alternative to chlorine that is more effective against pathogenic bacteria, forms minimal chlorinated compounds or other disinfection by-products of consequence, and is less corrosive to the plant environment.

Chlorine dioxide is a very effective livestock drinking water treatment for the same reasons that it is effective in municipal systems. Chlorine dioxide does not chlorinate organic matter in the water, allowing maintenance of a disinfectant residual and microbial control of the water supply. Environmental treatment using chlorine dioxide containing foam has been approved by USDA for the control of avian influenza. This foam treatment has been used in poultry houses and in hatcheries, where it has been demonstrated to reduce surface bacteria without significantly affecting hatchability.

When 1.39 ppm residual chlorine dioxide was used in poultry chiller water, no salmonellae were recovered from the carcasses and shelf life was extended.

In 1979, a Memorandum of Understanding (MOU) between the EPA and the FDA effectively eliminated food contact chemicals in food processing, including USDA facilities, that were not Generally Recognized as Safe (GRAS) or approved for use under the Food, Drug and Cosmetic Act. Chlorine dioxide did not meet either criterion and was withdrawn from use in chiller water. A West Coast chemical company has commissioned work to satisfy USDA and Food and Drug Administration (FDA) requirements for approval of the application of chlorine dioxide to chiller water. This use, if successful, will greatly expand the ability of processors to safely control patogenic organisms in their operations.

3. *Ozone*

Two pilot studies using ozone to treat water in broiler chiller tanks have demonstrated microbial reduction as well as chiller water quality improvement. A chiller water recycling unit takes water from the poultry chiller overflow, cleans it and returns it to the chiller tank. The system is designed to improve the microbial quality of the product and save the processor energy, water, and sewer costs through eliminating a major portion of the chilled fresh water consumption.

The process uses an ozone-air mixture to alter the surface chemistry of the organic contaminants in the water, and reduces the numbers of pathogens that are present. As the organic load is continually reduced by removing foam, the portion of the ozone that is available to act as a disinfectant is increased, thereby reducing the numbers of the pathogens present.

4. *Ionized silver*

Ionized silver has been found to be an effective means to control microorganisms during poultry processing. The use of silver as a bactericide has a long history, dating back to Greek and Roman civilizations. Ionized silver is used today to give astronauts clean water during space missions.

The silver ion generators should be located near the chiller tank and should be connected to the water supply line. Silver electrodes generate silver ions into the water supply. Silver in ionized form at the indicated levels provides a safe method of controlling or eliminating pathogenic bacteria during poultry processing. Plant tests are needed to confirm laboratory studies on the effectiveness of ionized silver in poultry processing plants.

Facts About *Campylobacter* for Retail Food, Food Service and Regulatory Agency Personnel

This fact sheet provides some basic information about *Campylobacter* for individuals working in retail food stores and food service establishments. Food industry employees need to know:

- The characteristics of *C. jejuni*;
- The disease that it causes;
- How the organism can be controlled or killed; and
- How to prevent campylobacteriosis.

The Organism

Campylobacter jejuni are small, curved, rod-shaped bacteria that are commonly found in the intestinal tracts of poultry, cattle, swine, rodents, cats, dogs, wild birds and some humans without necessarily causing illness. The bacteria have also been found in untreated water. *Campylobacter* passes from feces to the environment, and raw poultry, raw milk and untreated water are common vehicles for transmitting the organisms to humans, thus causing illness.

Researchers in government, academia and the private sector are searching for new ways control this bacterium and reduce its presence in raw foods. The industry's use of HACCP in food production, processing and in distribution is an important step, but this control strategy must be used in conjunction with HACCP control procedures and safe food handling practices in retail food stores, food service operations and homes.

Campylobacteriosis

Campylobacteriosis is a disease that results when someone consumes *Campylobacter* that are present in raw milk, untreated water, improperly handled food, or undercooked meats, poultry and shellfish. Symptoms of the infection, which occur one week after the bacteria are ingested, include diarrhea (sometimes bloody), stomach pain and nausea, as well as fever, headache and muscle pain. Serious complications may arise, but these are uncommon.

Foods Implicated

Mishandled poultry is the food believed to be most commonly associated with sporadic, individual cases of campylobacteriosis. Contaminated raw milk and water are most often associated with outbreaks of campylobacteriosis involving two or more persons. Human infections have also been associated with dogs and cats.

Prevention and Control

Since it is likely that contaminated raw ingredients will enter the kitchen, it becomes very important for individuals in the retail food and food service industries to eliminate this organism through safe food handling and preparation practices. These procedures are also used to prevent other types of food-borne illness.

Strictly adhering to safe food handling practices makes good sense because these practices will help to control all bacterial pathogens including *Campylobacter*. Campylobacteriosis can be prevented by following these simple rules:

- People who are ill with gastrointestinal symptoms (vomiting and diarrhea) should not work with food or in food preparation areas.
- Use only pasteurized milk.
- Use only water from approved sources.
- Prevent cross-contamination of ready-to-eat foods by storing and handling these products separately, and do not permit cooked foods to contact equipment that may have been contaminated by raw foods.
- Practice good personal hygiene when processing, handling or preparing foods. Always wash hands thoroughly after handling raw meat.
- Thoroughly and properly clean and sanitize all equipment, food utensils and contact surfaces on a routine and frequent basis.
- Cook foods to temperatures required by state regulations.
- If food is hot, keep it above 140°F.
- Quickly chill leftovers in shallow containers to less than 40°F (4°C). Reheat items quickly to 165°F (74°C); do not use warming equipment or steam tables to reheat foods.
- Check food and equipment temperatures frequently with a thermometer.
- Keep food storage, processing and serving areas free of insect and rodent pests.
- Operate mechanical dishwashers in accordance with manufacturers' instructions.
- For handwashing dishes, use a good detergent and water at 110° to 112°F (43° to 49°C). Remove all soil and rinse water. Sanitize with hot 170° (77°C) or higher, or use an approved chemical sanitizer.
- All food service equipment should meet or be equivalent to National Sanitation Foundation standards to insure the design is easy to clean and sanitize.
- Rotate perishable foods based on first-in, first-out principles.

Facts for Consumers About *Campylobacter jejuni*

Campylobacter jejuni bacteria may cause more human food-borne illness than *Salmonella* bacteria. The irony is that these bacteria are also very fragile – and are easily destroyed by cooking. Here are some facts about the *C. jejuni* organism, the disease it can cause, and ways to prevent illness.

The Organism

Campylobacter jejuni bacteria are commonly found in the intestinal tracts of poultry, cattle, swine, rodents, cats, dogs, wild birds and some humans, without necessarily causing illness. The bacteria have also been found in untreated water. *Campylobacter jejuni* pass from animal feces to the environment; that is how they are transferred to raw poultry, raw milk and untreated water. These are common "vehicles" that carry the bacteria to humans.

Researchers in government, academia and the private sector are searching for new ways to control the bacterium and reduce its levels on raw foods, particularly in the animal production environment. The industry's use of HACCP food processing systems is a step forward, but it must go hand in hand with safe food handling practices by distributors, retailers and food handlers in homes, restaurants, schools and other institutional kitchens.

What is Campylobacteriosis?

Campylobacteriosis is the infection caused when someone quite literally consumes "too many" of the bacteria – in raw milk, untreated water, improperly handled food, or undercooked meats, poultry and shellfish. Mishandled poultry is the food believed to be most commonly associated with sporadic, individual cases of campylobacteriosis. Contaminated raw milk and water are most often associated with food-borne outbreaks of campylobacteriosis involving two or more persons. However, *Campylobacter*-contaminated water has caused infections in individual travelers and outbreaks affecting thousands. Human infections have also been associated with infected cats and dogs.

Symptoms of the infection, which usually occur within 2 to 10 days after the bacteria are ingested, include fever, headache and muscle pain, followed by diarrhea, stomach pain and nausea. Health complications of campylobacteriosis can include meningitis and possibly reactive arthritis (rare and almost always short-term). Those with underdeveloped immune systems (such as newborns), weakened immune systems (the elderly, persons with AIDS and other diseases), and with artificially suppressed immune systems (some cancer patients) are believed to be more susceptible to campylobacteriosis complications. Most Americans have a lot to gain by preventing *Campylobacter* infections.

How Can Campylobacteriosis Be Prevented By Consumers?

The Committee believes that universal pasteurization of milk and proper treatment of all drinking water might prevent 80% of *Campylobacter* outbreaks in the United States. Most sporadic cases of campylobacteriosis could be prevented by proper handling of foods of animal origin, especially poultry products.

There is a risk associated with consuming raw foods of animal origin. This risk can be avoided by only consuming pasteurized milk, thoroughly cooked red meat, poultry and seafood, and water from approved sources. In addition, good food handling practices in the home reduce the risk of illness. Prevention tips are:

- If you believe that you are immunocompromised, seek advice from your physician on both your true physical state and on food preparation.
- Don't drink untreated water.
- Don't drink unpasteurized (raw) milk.
- Don't eat raw molluscan shellfish.
- Wash hands thoroughly before preparing foods and especially after handling raw foods.
- Avoid "cross-contaminating" other foods by thoroughly washing cutting boards, utensils, countertops and hands after contact with raw meat and poultry.
- Follow the principles of safe food handling, whether you are preparing food in the home, restaurants, hotels or institutional kitchens.
- Keep raw and cooked foods separate when shopping, on counter tops, during preparation, during cooking, and when storing in the refrigerator.
- Thorough cooking kills *Campylobacter* bacteria. Prepare foods according to recipe time and temperature requirements. Keep hot foods hot prior to serving (above 140°F).
- If foods are to be reheated, heat thoroughly to an internal temperature of 165°F or above.
- Keep cold foods cold throughout preparation and serving. A temperature below 40°F is best.
- Chill leftover food rapidly in shallow containers.
- Wrap and cover foods stored in your refrigerator. Maintain refrigerators at temperatures between 34 to 40°F.

Federal Register

Thiodipropionic Acid and Dilauryl Thiodipropionate; Proposed Removal of GRAS Status; Withdrawal of Proposed Rule

Agency: Food and Drug Administration, HHS.

Action: Proposed rule; withdrawal.

Summary: The Food and Drug Administration (FDA) is withdrawing its proposal to remove thiodipropionic acid and dilauryl thiodipropionate from the list of direct human food ingredients that are generally recognized as safe (GRAS). FDA proposed to remove these substances because it had not, at that time, received any reports that these substances were in use as direct human food ingredients. The agency is withdrawing the proposal because of a report that these substances are being directly used in food.

For Further Information Contact: F. Owen Fields, Center for Food Safety and Applied Nutrition (HFS-207), Food and Drug Administration, 200 C St. S.W., Washington, DC 20204, 202-254-9528.

Supplementary Information: Thiodipropionic acid and dilauryl thiodipropionate are listed in §§182.3109 and 182.3280 (21 CFR 182.3109 and 182.3280), as GRAS for direct food use as chemical preservatives at levels not exceeding 0.02 percent of the fat or oil content. Thiodipropionic acid and dilauryl thiodipropionate are listed in §181.24 (21 CFR 181.24) as prior-sanctioned ingredients for use as antioxidants in food-packaging material, and are permitted for use as antioxidants in §175.300 *Resinous and polymeric coatings* (21 CFR 175.300). In addition, indirect use of thiodipropionic acid is listed in §178.2010 *Antioxidants and/or stabilizers for polymers* (21 CFR 178.2010).

In the Federal Register of August 13, 1982 (47 FR 35240), FDA proposed to remove thiodipropionic acid and dilauryl thiodipropionate from the list of direct human food ingredients that are GRAS. FDA stated that it was proposing to take this action because FDA had not, at that time, received any reports that these substances were in use as direct human food ingredients.

FDA received three comments in response to its proposal. All three comments opposed the removal of these substances from the list of direct human food ingredients that are GRAS. One of the comments contained information on the direct use of these ingredients in food. In addition, two of the comments expressed concern that removing these compounds from the list of direct GRAS ingredients would cause confusion about the GRAS or prior-sanctioned status of these substances for indirect uses. Finally, two of the comments stated that the fact that the agency had not received any reports of these substances being used in food was not an adequate reason to remove them from the list of direct food ingredients that are GRAS.

FDA has considered all of these comments. In view of the comment that these substances are being directly used in food, we have concluded that the original basis for the agency's proposal to remove these substances from the GRAS list is not valid. FDA also wishes to clarify that its proposal to remove these substances from the list of direct human food ingredients that are GRAS would not have affected their allowed indirect uses under §§175.300, 178.2010, or 181.24, as suggested by two of the comments.

Therefore, under the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.), the agency announces that it is withdrawing the proposal that it published in the Federal Register of August 13, 1982 (47 FR 35240), to remove thiodipropionic acid and dilauryl thiodipropionate from the list of direct human food ingredients that are GRAS.

Dated: October 24, 1994. William K. Hubbard, Interim Deputy Commissioner for Policy. [FR Doc. 94-27315; Filed 11-2-94; 8:45 a.m.]

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UpDates

Neogen Names Vice President

Neogen Corporation has named David Ledden, Ph.D. to the position of the Vice President of Research and Development.

Ledden will be responsible for overseeing all of Neogen's research and development programs at all locations as well as the management of the Lansing diagnostic laboratories.

Prior to his new position at Neogen, Ledden was most recently Manager of Immunoreagents and Protein Chemistry at Boehringer Mannheim in Indianapolis where he managed a 25 person R&D group. Ledden has also held R&D management positions at 3M Corporation and the Ames Division of Miles Laboratories. Ledden received his B.S. and M.S. degrees in biochemistry from Penn State University and his Ph.D in biochemistry from the University of Louisville.

"We are pleased to have Dr. Ledden aboard," said Neogen's president and CEO James Herbert. "I know he will make a strong contribution in our research and development activities that will help Neogen reach its annual revenue goal of $100 million."

Neogen is a Lansing, Michigan-based company with divisions located in Illinois, Kentucky and New Jersey. The company develops and markets products to control residues and improve quality in the food, agriculture, pharmacologics, and environmental industries.

NSF *International* Appoints New President and CEO

Dr. Dennis R. Mangino assumed the position of President and Chief Executive Officer of NSF *International* becoming only the fourth person in NSF's 50-year history to hold this position.

He succeeds Dr. Nina I. McClelland, who will continue in her role as Chairman of the Board of Directors. McClelland served as President and CEO for 14 of her 26 years with NSF, succeeding Robert M. Brown and founding president Walter F. Snyder.

"NSF's Board of Directors feel Dr. Mangino's experience makes him uniquely qualified for the position of NSF President and CEO," said McClelland. "In particular, his considerable experience in laboratory operations and quality management systems impressed us as being highly relevant to NSF's product certification and management systems registration services."

Mangino joins NSF from Weirton Steel Corporation in Pittsburgh where he was Vice President of Quality Assurance and Research and Development. Previously he held senior management and research positions with EniChem Americas, Inc., BP America, Inc., and PPG Industries, Inc.

He holds both a Ph.D and BS degree from Rutgers University in Ceramic Science and Ceramic Engineering, respectively, and completed the Program for Management Development, Harvard Graduate School of Business.

In addition to his industrial experience, Mangino worked with Senator John D. Rockefeller IV in promoting advanced technology through the formation of regional corporate partnerships.

NSF is an independent, not-for-profit company that develops public health safety standards and certifies products for compliance with those standards. The NSF Mark is the most widely recognized and trusted symbol of public health safety. NSF is also an ISO 9000 quality systems registrar.

NSF is headquartered in Ann Arbor, Michigan with additional offices in the United States, Canada, and Europe and test facilites in Michigan and California.

Pro-Tek Packaging Group, Inc. Appoints Peter Conrad to Central Regional Sales Manager

Peter Conrad has joined Pro-Tek Packaging Group, Inc., a leading manufacturer and supplier of stock and custom decorated heat shrink film for tamper-evident protection and primary package labeling, as the Central Regional Sales Manager.

Conrad, a member of IOPP, was former Director of Sales and Marketing for Complete Packaging Inc., where he was responsible for product development at the contract packager servicing the health and beauty aids, confectionery, food, and household products markets.

For more information, contact Pro-Tek Packaging Group, Inc.; 73 Oser Ave.; Hauppauge, NY 11788: (516) 436-7900.

Warne Boyce Takes ACIL Helm

ACIL, the association of independent scientific, engineering and tesing firms, recently inducted A. Warne Boyce, Chairman of Microbac Laboratories, Pittsburgh, Penn., for a two-year term as President.

Boyce founded Microbac Laboratories with his wife, Dr. Doreen Boyce, in 1969. The company specializes in microbiological, analytical and environmental testing services and operates a national network of more than 20 laboratories. He is also president of Oberco Analytical Systems, Inc., a manufacturer of laboratory instrumentation, based in Long Island, NY.

In his inaugural address, Boyce outlined his goals for ACIL during his tenure: to build awareness of the third-party testing industry, and to play a leadership role in the formulation of a national laboratory accreditation system, which would put U.S. testing businesses on a level playing field with their international counterparts and would reduce much of the costs and duplication existing in the U.S. today.

Boyce has been active with ACIL for more than a decade, joining the Board of Directors in 1988. He is a former chairman of ACIL's eastern division, and serves on the executive committee's of the association's microbiological/analytical chemistry section and environmental section.

A native of South Africa, Boyce graduated from Rhodes University, R. S. A. and Oxford University in England. He came to the U.S. in 1962 as an executive vice president of British-owned Megator Corporation.

A past president of the Pennsylvania Small Business/TEC, Boyce currently serves on the Board of the Greater Pittsburgh Chamber of Commerce and is a member of the Parent Board of Mestek, Inc., a NYSE corporation. Earlier this year, Microbac was named 1994's growth corporation by the Pennsylvania Environmental Council.

Also elected to ACIL national office were: President-elect Troy F. Stallard, President of Standard Laboratories, South Charleston, W. Va: Treasurer - J. James Pearce, Jr., President of Hilltop Research, Inc., Cincinnati, Ohio; and Secretary - Steven A. Bowser, President of Bowser-Morner, Inc. in Dayton, Ohio.

The other members of ACIL's Board of Directors are: immediate Past President Gerald S. Allen, P.E., President of SERCO Laboratories, St. Paul, Minn.; Susan R. Arneson, Vice President of Marketing and Business Development, Testing Engineers & Consultants, Inc., Troy, Mich.; J. Stephen Duerr, Ph.D., P.E., CPC, President, Metuchen Analytical, Inc., Edison, N.J.; Pedro T. Guzman, President, Inchcape Testing Services, Vienna, Va.; Edward Huffman, Jr., Ph.D., President Huffman Laboratories, Golden, Colo.; E. Woody Lingo, P.E., Senior Vice President for Law Engineering, Inc., Atlanta, GA; and Ramona Lee Northington, Laboratory Director, West Coast Analytical Services, Inc. Santa Fe Springs, Calif.; and Jerry R. Weathers, P.E., President, Trinity Engineering Testing Corp., Austin, Texas.

ACIL (formerly the American Council of Independent Laboratories) was founded in 1937 and represents an industry of nearly $12 billion per year. ACIL's 400 member companies operate facilities across the U.S. and abroad and provide a wide range of analytical, testing, engineering, inspection, R & D and consulting services to clients in industry, commerce and government. ACIL promotes ethical and professional business practices throughout the industry, and serves its members, their clients and the public through education and advocacy.

Pall Corporation's Scientific and Laboratory Services Department Becomes ISO 9001 Certified

Pall Corporation's Scientific and Laboratory Services (SLS) Department headquartered in Port Washington, New York, recently received ISO 9001 certification. ISO 9001 is the most comprehensive document in the ISO 9000 series of standards and describes a Quality Systems – Model for Quality Assurance in Design/Development, Production, Installation and Servicing. Certification involved the audit and approval of the SLS quality systems procedures against the ISO 9000 standards by an independent accrediting body, Lloyd's Register Quality Assurance Limited. Accreditation is maintained by a series of surveillance audits every six months; and full re-assesment audits are performed every three years.

Obtaining ISO 9001 certification is third party recognition of Pall's quality systems, which assures customers that they are consistently supplied with products and services that meet their requirements for reliability, functionality and delivery. The service provided by SLS is the delivery of technical assistance. Pall Corporation is one of the first companies to receive ISO 9001 certification for a service department. SLS Departments in the United Kingdom and in Japan have also recently received ISO 9000 certification. Combined with ISO 9000 certification received for its manufacturing and sales and marketing operations, Pall Corporation is one of the first companies to have demonstrated in depth, system-wide excellence on a global basis.

The SLS Department, which consists of about 400 scientists and engineers, is supported by more than 20 well-equipped laboratories located throughout the United States, Europe, and Asia. SLS provides technical, scientific and laboratory assistance in evaluating and solving complex filter application and contamination control problems for its customers. SLS has developed a partnership with its customers in each of three markets – aeropower, health care and fluid processing – a support system which provides process improvement through cost-effective solutions to fluid clarification and purification problems.

For more information, please contact Pall's Scientific and Laboratory Services Department at 25 Harbor Park Drive, Port Washington, New York 11050, phone (516) 484-3600 or outside New York (800) BUY-PALL.

FDA Inspection Manual Now Available from Government Institutes

The FDA Investigations Operations Manual, one of the most comprehensive sources of FDA compliance information, is now available to industry from Government Institutes. This useful and easy-to-follow book details FDA sampling, evidence documentation, and inspection guidelines, which are used in determining compliance with FDA regulations. Compiled by the U.S. Department of Health and Human Services with the Food and Drug Administration, this inspection manual explains not only the FDA regulations but also the legal and court procedures that can result from violation of these regulations.

Because this manual was designed for FDA inspectors to use in conducting inspections, it is a valuable tool for industry to use in complying with FDA standards, and serves as a guide to what current and past information the inspectors are permitted to collect. This manual also thoroughly explains the legalities behind and reasons for recall activities, including the removal and labeling/promotional materials.

In addition to a complete telephone directory of headquarters and regional contacts, the FDA Investigations Operations Manual contains the following:

1. Federal and State Cooperation
   - Federal Agency Interaction
   - State Operation Authority
   - International Memorandum of Understandings
2. Sampling
   - Dealer Relations
   - Collection Techniques
   - Documentation
3. Establishment Inspection
   - Management Relations
   - Evidence Development
   - Food, Drug, Devices, Biologics
4. Imports
   - Records Review
   - Import Sample Collection
   - Import Detention
5. Regulatory
   - Statutory Authority
   - Reconditioning & Destruction
   - Consent Decree
6. Investigations
   - Complaints
   - Investigation of Food-borne Outbreaks
   - Non-Attack Disaster Procedures

Appendices included: Food Color Additives, 21 CFR - Selected

Parts, Insects, Calendars, Blood Values, Conversion Factors, and District Maps.

About the Publisher:

Government Institutes was founded in 1973 to provide continuing education and practical information on environmental, health and safety regulatory topics. Publications include nearly 200 books written by the top experts in the field. These books offer the latest and most accurate information, addressing every aspect of the environmental, health and safety fields. They are practical tools which explain business' obligations under each law in plain, understandable language. Government Institutes' public educational programs reach tens of thousands of professionals each year, bringing together the leading authorities from industry, business, and govern-ment to shed light on solving the problems and challenges faced by the regulated community.

Videojet Receives PMMI 1994 Export Achievement Award

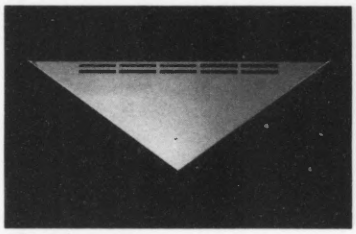
Videojet Systems International, Inc., renowned world leading manufacturer of industrial and graphic ink jet printers, high speed imaging, addressing and mailing equipment, and in-line graphic control and postal coding systems has been presented with the 1994 Export Achievement Award for Product Development by the Packaging Machinery Manufacturers Institute (PMMI). The 1994 awards were presented by Jeff Ake, PMMI's Global Marketing Committee Chairman, at the PMMI Fall Meeting, September 21-23, 1994, in Itasca, IL.

The award presented to Videojet recognizes special product development to meet the needs of international customers. Videojet developed foreign language software and touch-screen instructions, as well as printers that can be used in 14 different languages, icons and symbols are used to instruct operators or implement commands, so the equipment is readily functional in many countries. Videojet was also the 1991 recipient of PMMI's Exporter of the Year Award.

This award program was instituted to recognize the export successes of member companies and to encourage others to participate in international trade. Member companies can nominate themselves or other members in any of the seven award categories they feel are applicable to their business. In all, 36 companies vied for the awards this year, which were selected by the Presidents Advisory Council.

Videojet employs over 1,250 people worldwide and is headquartered in Wood Dale, IL (USA). Videojet products are sold and serviced to more than 60 countries by a direct force in the U.S., subsidiaries in France, Germany, Ireland, The Netherlands, and the United Kingdom, a joint venture in Japan, and more than 70 distributors, OEMs, and agents worldwide.

Further information on Videojet industrial and graphic ink jet printers, high speed imaging, addressing and mailing equipment, in-line graphic control systems and postal coding systems, fluids, and accessories is available from Videojet Systems International, Inc., 1500 Mittel Boulevard, Wood Dale, IL 60191-1073, USA or call 1-800-654-4663.



Gilbert Industries, Inc.

Gilbert® Introduces Revolutionary New Wall Sconce/Fly Trap

The new Gilbert® Flying Venus™ wall-sconce creates an elegant blue-gold ambiance for your favorite room; while secretly providing 24-hour, non-stop, silent-capture of filthy disgusting flies. Every restaurant, dining room, and hospital hallway should have at least one.

The Gilbert® Flying Venus™ is a serious integrated pest management tool. Though not as powerful as Gilbert®'s larger insect light traps; the beautiful Flying Venus™ goes where no ILT has gone before, adding a whole new last line of defense, increasing the effectiveness of the overall fly control system, helping to reduce the need for chemical methods.

Gilbert Industries, Inc. – Jonesboro, AR.

Reader Service No. 357

Motomco Introduces New Prebaited HAWK Mouse Bait Stations

Motomco Ltd. introduces a new prebaited HAWK Bait Station for mouse control situations.

These new mouse bait stations are designed to keep bait away from non-target animals and children by using a unique lock and key system. Constructed from heavy duty plastic, HAWK prebaited Mouse Bait Stations are reusable. When bait is eaten, simply rebait the station.

The unique triangle design allows for effective placement in corners and along walls where mice travel.

The new HAWK Prebaited Mouse Bait Station comes baited with a 1 oz. HAWK Chunx. The active ingredient is bromadialone, a single feeding anticoagulant.

Made with human food-grade material, HAWK Chunx are irresistible to mice. Chunx are extruded with grooved edges to give mice ample gnawing area.

Motomco, Ltd. – Madison, WI.

Reader Service No. 361

KNESS Helps PCOs Respond to Environmental Concerns

Due to strong customer demand, KNESS Mfg. Co., Inc., introduces the improved STICK-ALL™ DEPOT and STICK-ALL™ Glueboard traps. This innovative design combines the advantages of a non-toxic glueboard and a galvanized steel housing to protect the glueboard from dust and debris, or accidental contact – while hiding trapped pests from view.

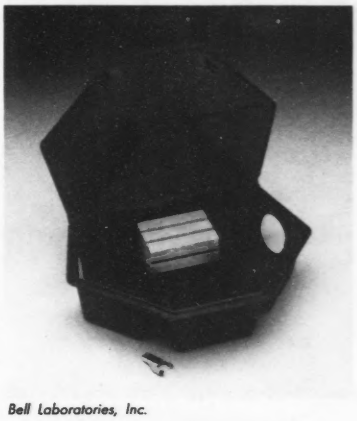
The STICK-ALL™ DEPOT and STICK-ALL™ Glueboard traps are ideal for use in homes, childcare centers, restaurants, public areas and other locations where nontraditional pest control methods may be preferred.

Measuring less than 3 inches in height, the STICK-ALL™ DEPOT fits into confined spaces and its 9-inch length and 7-inch width requires a small footprint area. Its unique entry design leads pests – both insects and rodents – directly to 24 square inches of glueboard contact area. The disposable, pre-scented STICK-ALL™ Glueboards contain no poisons or harmful chemicals and, when used with the STICK-ALL™ DEPOT, are safe around children and pets.

Changing the STICK-ALL™ Glueboard is quick and easy – slide open the lid, drop the old glueboard in the trash, peel the protective paper from the new gluebaord and place in the STICK-ALL™ DEPOT, then slide the lid closed. Preprinted forms are also available for PCOS to record service dates.

Kness Mfg. Co., Inc. – Albia, IA.

Reader Service No. 360



Bell Laboratories, Inc.

New Tamper-Resistant Protecta LP Introduced

Bell Laboratories, Inc., introduces PROTECTA LP, a new tamper-resistant, rat-size bait station designed for indoor use.

A larger version of Bell's popular mouse-size PROTECTA

RTU, PROTECTA LP features a patented triangular design with strategically angled entry holes that allow it to fit snug in a corner or along walls where rodents travel.

PROTECTA LP, which stands for Low Profile, measures 3 3/8 inches tall, allowing it to fit under or between pallets.

Like the entire line of Protecta bait stations, PROTECTA LP is made of heavy-duty, injection-molded plastic with a one-piece hinge.

Bell Laboratories, Inc. – Madison, WI.

Reader Service No. 348

HAWK Rodenticide Now Available in Retail-Sized 1.5 oz. Place Pacs in a 4-Pack Box

Motomco's HAWK Rat and Mouse Bait is now available in retail boxes of four 1.5 oz. place pacs.

HAWK pelleted bait contains the superior strength toxicant, Bromazdiolone, which kills rats and mice after only one feeding. Made with human food grade ingredients, rodents find HAWK pelleted bait irresistible.

Each premeasured place pac of HAWK Rat and Mouse Bait makes rodent control cleaner and more convenient for consumers. Place pacs keep bait fresh and prevent bait contamination from dust, moisture, or odors. The premeasured pacs fit in tight areas, burrows, and bait stations, making rodent control easy and effective.

Motomco Ltd. – Madison, WI.

Reader Service No. 358

Prism Gold Medal Program Goes National

Prism Guaranteed Pest Elimination, based in Miami, FL. is expanding the market for its Integrated Pest Management (I.P.M.) System. Originating in the Northeast, the product is now available in selected markets.

Engineered to specifically serve the food processing and retailing industries, Gold Medal protection adheres fully to a "quality process management" model.

As Dr. Zia Siddiqi, corporate technical director observes, "several major influences are emerging in the food industry, one is an increased focus on food product safety, legal compliance and protection of property and the environment. Another is the need for food processors to meet international quality standards set by global trading alliances. We have proven over the past fifteen years that our I.P.M. system fills the bill on both these respects."

Prism is a subsidiary of S.C. Johnson Wax Company, and offers services, business-to-business throughout the United States and Canada, through its affiliate, PCO Services, Inc.

Prism – Miami, FL.

Reader Service No. 359

TOMCAT Bait Chunx Now Packaged in Retail 8-Piece Bag

Motomco's single-feeding TOMCAT Bait Chunx are now available in a convenient eight-piece bag, designed for any rodent control situation.

This new TOMCAT size holds eight 1 oz. Bait Chunx and is sized for consumer convenience. TOMCAT Bait Chunx bag keeps bait fresh and ready to use. Traditional green and gold packaging easily identifies the TOMCAT brand for customers.

TOMCAT Bait Chunx contain the superior strength toxicant, diphacinone, which kills mice after only one feeding.

Motomco, Ltd. – Madison, WI.

Reader Service No. 345

Labconco Corporation

Labconco Offers Free Subscription to *Laboratory Dialog* Newsletter

Labconco Corporation publishes a semiannual newsletter for readers in the scientific community.

This eight-page newsletter includes short articles on technical processes and procedures, applications for a variety of laboratory apparatus, and case studies from end users of Labconco products. Each issue also contains a literature review detailing free brochures and catalogs available from Labconco.

For your free subscription, circle the reader service number below.

Labconco Corporation – Kansas City, MO.

Reader Service No. 349

New Portable Hygiene Monitor from Idexx

Idexx Laboratories announces a new system to monitor results of cleaning effectiveness. The lightweight, portable Lightning™ system is designed for use on the production floor in food processing and food-service industries.

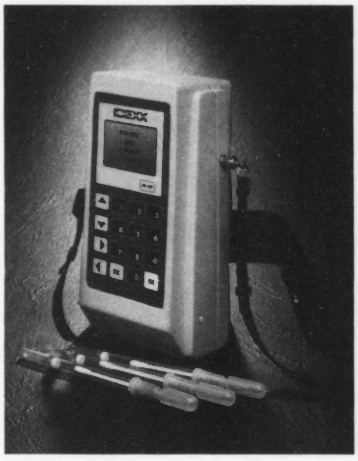
The Lightning system is a bioluminescence assay which will detect food residue, bacteria, yeast and mold by measuring adenosine triphosphate (ATP). By providing instantaneous on-site feedback, a

cleaning crew can validate the effectiveness of their efforts and take immediate action to avoid food contamination.

The Lightning system consists of a hand-held luminometer and disposable, self-contained swab devices. The swab device contains pre-measured reagents so no pipeting steps or additional solutions are required. The user simply swabs the test area, activates the swab device, inserts it into the luminometer, and reads the results. The entire test takes less than two minutes. The luminometer has the ability to store up to 2000 results. Customized software enables users to store, analyze and graph results on a personal computer.

Idexx Laboratories, Inc. – Westbrook, MA.

Reader Service No. 347



Idexx Laboratories

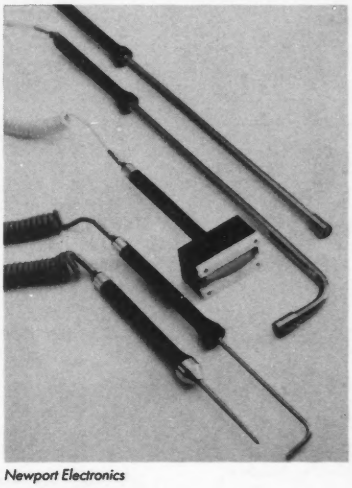
Unique Handheld Surface/ Insertion Temperature Probes

Newport Electronics, Inc., a leader in digital instrumentation, announces the new 88000 Series, fast and highly accurate surface/temperature measurement probes with specialized features to fit any application possible. Available in K (Chromel-Alumel) and E (Chromel-Constantan) calibrations and capable of withstanding surface temperatures up to 1400°F/760°C. All 88000 Series probes come with retractable sensor cable which expands to 5 ft., and SMP subminiature male connector, and a TAS-3 mini-to-standard transition adaptor.

With over 50 different styles to choose from, the 88000 Series can be used on stationary, moving or rotating surfaces. Many models are available with unique heads to accommodate various applications. Swivel head probes allow for 180° rotation, and are used where different head orientations and alignments are necessary. Many surface/insertion probes feature a unique replaceable element design, with one additional element included.

Newport Electronics – Santa Ana, CA.

Reader Service No. 350



Newport Electronics

LGC Introduces a New Windows Data System for Mass Spectrometers

LGC is announcing a NEW Microsoft™ Windows™ Data System for Mass Spectrometers. This software/hardware combination is engineered for rapid sample throughput and routine use. The **Galaxy 2000™** for Windows takes advantage of the advanced features of the Microsoft Windows operating system, such as providing the use of a mouse or track ball pointer device; group and application icons; program and file manager; Windows accessories; pull-down menus; dialog boxes; on-line help; the control panel allowing the ability to customize the work environment; and other common Windows applications. The **Galaxy 2000** product line is compatible with the latest in PC hardware and Windows technology.

The **Galaxy 2000** for Windows enhances the productivity of new ion traps and quadrupole mass spectrometers as well as upgrades the performance of older laboratory instruments. It can be easily fitted to any commercially available analogue and some digital mass spectrometers.

This new data system is ideally suited for the automatic analysis of a wide range of samples and is designed for ease-of-use with the research scientist in mind. Advanced automation capabilities allow the mass spectrometer to operate completely unattended for sample analysis and data procesing.

LGC – San Jose, CA.

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DAIRY

- **The Bulk Milk Hauler: Protocol & Procedures** - (8 minute videotape). Teaches bulk milk haulers how they contribute to quality milk production. Special emphasis is given to the hauler's role in proper milk sampling, sample care procedures, and understanding test results. (Iowa State University Extension)

- **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 procedures. 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)

- **Cold Hard Facts** - This video is recommended for training personnel associated with processing, transporting, warehousing, wholesaling and retailing frozen foods. It contains pertinent information related to good management practices necessary to ensure high quality frozen foods. (National Frozen Food Association)

- **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)

- **Ether Extraction Method for Determination of Raw Milk** - (26 minute video). Describes the ether extraction procedure to measure milkfat in dairy products. Included is an explanation of the chemical reagents used in each step of the process. (CA-1990)

- **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 milk house. 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)

- **Frozen Dairy Products** - (27 minute videotape). Developed by the California Department of Food and Agriculture. Although it mentions the importance of frozen desserts, safety and checking ingredients; emphasis is on what to look for in a plant inspection. Everything from receiving, through processing and cleaning and sanitizing is outlined, concluded with a quality control program. Directed to plant workers and supervisors, it shows you what should be done. (CA-1987)

- **The Gerber Butterfat Test** - (7 minute video). Describes the Gerber milkfat test procedure for dairy products and compares it to the Babcock test procedure. (CA-1990)

- **High-Temperature, Short-Time Pasteurizer** - (59 minute videotape). Provided 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)

- **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, facilities 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)

- **Mastitis Prevention and Control** - (2-45 minute videos). This video is ideal for one-on-one or small group presentations. Section titles include: Mastitis Pathogens, Host Defense, Monitoring Mastitis, Mastitis Therapy, Recommended Milking Procedures, Postmilking Teat Dip Protocols, Milk Quality, Milking Systems. (Nasco)

- **Milk Plant Sanitation: Chemical Solution** - (13 minute video). This explains the proper procedure required of laboratory or plant personnel when performing chemical titration in a dairy plant. Five major titration are reviewed ... alkaline wash, presence of chlorine and iodophor, and caustic wash and an acid wash in a HTST system. Emphasis is also placed on record keeping and employee safety.

- **Milk Processing Plant Inspection Procedures** - (15 minute videotape). Developed by the California Department of Food and Agriculture. It covers pre and post inspection meeting with management, but emphasis is on inspection of all manual and cleaned in place equipment in the receiving, processing and filling rooms. CIP systems are checked along with recording charts and employee locker and restrooms. Recommended for showing to plant workers and supervisors. (CA-1986)

- **Pasteurizer: Design and Regulation** - (15 1/2 minute videotape). This tape provides a summary of the public health reasons for pasteurization and a nonlegal definition of pasteurization. The components of an HTST pasteurizer, elements of design, flow-through diagram and legal controls are discussed.

- **Pasteurizer Operation** - (10 1/2 minute videotape). This tape provides a summary of the operation of an HTST pasteurizer from start-up with hot water sanitization to product pasteurization and shut-down. There is an emphasis on the legal documentation required.

- **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)

- **Safe Milk Hauling - You're the Key** - (34 minute videotape). Recommended for anyone who samples, measures and collects milk from dairy farms. The purpose of this tape is to acquaint milk handlers with the proper procedures for sampling and picking up milk at the farm and delivering it safely to the handling plant. This tape provides an excellent review for experienced milk haulers and shows step-by-step procedures for novice milk haulers. (Cornell University)

- **3-A Symbol Council** - (8 minutes). A video which was developed to make people in the dairy and food industries aware of the 3-A program and its objectives.

- **10 Points to Dairy Quality** - (10 videos). Provides in-depth explanation of a critical control point in the residue prevention protocol. Illustrated with on-farm, packing plant, and milk-receiving plant scenes as well as interviews of producers, practicing veterinarians, regulatory officials and others. (Dairy Quality Assurance)

FOOD

- **BISSC - A Sign of Our Times** - (video). The presentation was prepared by the Baking Industry Sanitary Standards Committee. The purpose of BISSC, formed in 1949 by six of the national organizations serving the baking industry, is to develop and publish voluntary standards for the design and construction of bakery equipment. Those Standards are now recognized as the definitive sanitation standards for equipment used in the baking industry.

- **Close Encounters of the Bird Kind** - (18 minute videotape). A humorous but in-depth look at *Salmonella* bacteria, their sources, and their role in food-borne disease. A modern poultry processing plant is visited, and the primary processing steps and equipment are examined. Potential sources of *Salmonella* contamination are identified at the different stages of production along with the control techniques that are employed to insure safe poultry products. (Topek Products, Inc.)

- **Food Irradiation** - (30 minutes). Introduces viewers to food irradiation as a new preservation technique. Illustrates how food irradiation can be used to prevent spoilage by microorganisms, destruction by insects, overripening, and to reduce the need for chemical food additives. The food irradiation process is explained and benefits of the process are highlighted. (Turnelle Productions, Inc.)

- **Food Quality, Food Safety, and You!** - (80 slides, script, and cassette tape). This is an educational program designed for consumers. The presentation deals with the role of the consumer in maintaining the freshness, quality and safety of food in the home. It is intended for use by home economists, dieticians, cooperative extension agents and others interested in food quality and safety. (Cornell University)

- **Food Safe—Food Smart—HACCP and its Application to the Food Industry** - (2-16 minute video modules). Module 1 - Introduces the seven principles of HACCP and their application to the food industry. Viewers will learn about the HACCP system and how it is used in the food industry to provide a safe food supply. Module 2 - Provides guidance on how to design and implement a HACCP system. It is intended for individuals with the responsibility of setting up a HACCP system. (Alberta Agriculture, Food and Rural Development)

- **Food Safe - Series I** - (4-10 minute videos). (1) "Receiving & Storing Food Safely", details for food-service workers the procedures for performing sight inspections for the general conditions of food, including a discussion of food labeling and government approval stamps. (2) "Food-service Facilities and Equipment", outlines the requirements for the proper cleaning and sanitizing of equipment used in food preparation areas. Describes the type of materials, design, and proper maintenance of this equipment. (3) "Microbiology for Food-service Workers", provides a basic understanding of the microorganisms which cause food spoilage and food-borne illness. This program describes bacteria, viruses, protozoa, and parasites and the conditions which support their growth. (4) "Food-service Housekeeping and Pest Control", emphasizes cleanliness as the basis for all pest control. Viewers learn the habits and life cycles of flies, cockroaches, rats, and mice. (Perennial Education)

- **Food Safe - Series II** - (4-10 minute videos). Presents case histories of food-borne disease involving (1) *Staphylococcus aureus,* (sauces) (2) *Salmonella,* (eggs) (3) *Campylobacter,* and (4) *Clostridium botulinum.* Each tape demonstrates errors in preparation, holding or serving food; describes the consequences of those actions; reviews the procedures to reveal the cause of the illness; and illustrates the correct practices in a step-by-step demonstration. These are excellent tapes to use in conjunction with hazard analysis critical control point training programs. (Perennial Education)

- **Food Safe - Series III** - (4-10 minute videos). More case histories of food-borne disease. This set includes (1) Hepatitis "A", (2) *Staphylococcus Aureus* (meats), (3) *Bacillus Cereus*, and (4) *Salmonella* (meat). Viewers will learn typical errors in the preparation, holding and serving of food. Also included are examples of correct procedures which will reduce the risk of food contamination. (Perennial Education)

- **Food Safety is No Mystery** - (34 minute videotape). This 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) Available in Spanish.

- **Food Safety: For Goodness Sake, Keep Food Safe** - (15 minute videotape). Teaches foodhandlers the fundamentals of safe food handling. The tape features the key elements of cleanliness and sanitation, including: good personal hygiene, maintaining proper food product temperature, preventing time abuse, and potential sources of food contamination. (Iowa State University Extension)

- **HACCP: Safe Food Handling Techniques** - (22 minute videotape). The video highlights the primary causes of food poisoning and emphasizes the importance of self-inspection. An explanation of potentially hazardous foods, cross-contamination, and temperature control is provided. The main focus is a detailed description of how to implement a Hazard Analysis Critical Control Point (HACCP) program in a food-service operation. A leader's guide is provided as an adjunct to the tape. (The Canadian Restaurant & Foodservices Association)

- **Is What You Order What You Get? Seafood Integrity** - (18 minute videotape). Teaches seafood department employees about seafood safety and how they can help insure the integrity of seafood sold by retail food markets. Key points of interest are cross-contamination control, methods and criteria for receiving seafood and determining product quality, and knowing how to identify fish and seafood when unapproved substitutions have been made. (The Food Marketing Institute)

- **Northern Delight - From Canada to the World** - A promotional video that explores the wide variety of foods and beverages produced by the Canadian food industry. General in nature, this tape presents an overview of Canada's food industry and its contribution to the world's food supply. (Ternelle Production, Ltd.)

- **Proper Handling of Peracidic Acid** - (15 minute videotape). Introduces paracidic acid as a chemical sanitizer and features the various precautions needed to use the product safely in the food industry.

- **Purely Coincidental** - (20 minute video). A parody that shows how food-borne illness can adversely affect the lives of families that are involved. The movie compares improper handling of dog food in a manufacturing plant that causes the death of a family pet with improper handling of human food in a manufacturing plant that causes a child to become ill. Both cases illustrate how handling errors in food production can produce devastating outcomes. (The Quaker Oats Company) Available in Spanish.

- **On the Front Line** - (18 minute video). A training video pertaining to sanitation fundamentals for vending service personnel. Standard cleaning and serving procedures for cold food, hot beverage and cup drink vending machines are presented. The video emphasizes specific cleaning and serving practices which are important to food and beverage vending operations. (National Automatic Merchandising Association) Available in Spanish.

- **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 workers.

- **100 Degrees of Doom ... The Time and Temperature Caper** - (14 minute videotape). Video portraying a private eye tracking down the cause of a *Salmonella* poisoning. Temperature control is emphasized as a key factor in preventing food-borne illness. (Educational Communications, Inc.)

- **Pest Control in Seafood Processing Plants** - (26 minute videotape). Videotape which covers procedures to control flies, roaches, mice, rats and other common pests associated with food processing operations. The tape will familiarize plant personnel with the basic characteristics of these pests and the potential hazards associated with their presence in food operations.

- **Principles of Warehouse Sanitation** - (33 minute video). This videotape gives a clear, concise and complete illustration of the principles set down in the Food, Drug and Cosmetic Act and in the Good Manufacturing Practices, as well as supporting legislation by individual states. (American Institute of Baking)

- **Product Safety and Shelf Life** - (40 minute videotape). Developed by Borden Inc., this videotape was done in three sections with opportunity for review. Emphasis is on providing consumers with good products. One section covers off-flavors, another product problems caused by plant conditions, and a third the need to keep products cold and fresh. Procedures to assure this are outlined, as shown in a plant. Well done and directed to plant workers and supervisors. (Borden-1987)

- **Safe Food: You Can Make a Difference** - (25 minute videotape). A training video for food-service workers which covers the fundamentals of food safety. An explanation of proper food temperature, food storage, cross-contamination control, cleaning and sanitizing, and handwashing as methods of food-borne illness control is provided. The video provides an orientation to food safety for professional foodhandlers. (Tacoma-Pierce County Health Department)

- **Safe Handwashing** - (15 minute videotape). Twenty-five percent of all food-borne illnesses are traced to improper handwashing. The problem is not just that handwashing is not done, the problem is that it's not done properly. This training video demonstrates the "double wash" technique developed by Dr. O. Peter Snyder of the Hospitality Institute for Technology and Management. Dr. Snyder demonstrates the procedure while reinforcing the microbiological reasons for keeping hands clean. (Hospitality Institute for Technology and Management)

- **Sanitation for Seafood Processing Personnel** - A training video suited for professional foodhandlers working in any type of food manufacturing plant. The film highlights Good Manufacturing Practices and their role in assuring food safety. The professional foodhandler is introduced to a variety of sanitation topics including: 1) foodhandlers as a source of food contamination, 2) personal hygiene as a means of preventing food contamination, 3) approved food storage techniques including safe storage temperatures, 4) sources of cross-contamination, 5) contamination of food by insects and rodents, 6) garbage handling and pest control, and 7) design and location of equipment and physical facilities to facilitate cleaning.

- **Sanitizing for Safety** - (17 minute video). Provides an introduction to basic food safety for professional foodhandlers. A training pamphlet and quiz accompany the tape. Although produced by a chemical supplier, the tape contains minimal commercialism and may be a valuable tool for training new employees in the food industry. (Indiana -1990)

- **Seafood Q & A** - (20 minute VHS). Anyone who handles seafood, from processor to distributor to retail and food service, must be prepared to answer questions posed by customers. This tape features a renowned nutritionist and experts from the Food & Drug Administration, the National Marine Fisheries Service, and the National Fisheries Institute who answer a full range of questions about seafood safety. Excellent to educate and train employees about seafood safety & nutrition. (National Fisheries Institute)

- **SERVSAFE® Serving Safe Food** - (Four videotapes). This video series illustrates and reinforces important food safety practices in an informative and entertaining manner. The material is presented in an easy to understand format, making it simpler for employees to learn and remember this essential information. Each video includes a leader's guide that provides all the information managers need to direct a productive training session. (Educational Foundation of the National Restaurant Association)

- **SERVSAFE® Serving Safe Food Second Edition** - (Six videotapes). The program still covers all the major areas of food safety training, but there is an added emphasis on training employees to follow HACCP procedures. The second edition program includes an Employee Guide, Leader's Guide and six instructional videos. (Educational Foundation of the National Restaurant Association)

- **Supermarket Sanitation Program - "Cleaning and Sanitizing"** - (12.5 minute videotape). Contains a full range of cleaning and sanitizing information with minimal emphasis on product. Designed as a basic training program for supermarket managers and employees.

- **Supermarket Sanitation Program - "Food Safety"** - (10.5 minute videotape). Contains a full range of basic sanitation information with minimal emphasis on product. Filmed in a supermarket, the video is designed as a basic program for manager training and a program to be used by managers to train employees.

- **Wide World of Food-Service Brushes** - An 18 minute video tape that discusses the importance of cleaning and sanitizing as a means to prevent and control food-borne illness. Special emphasis is given to proper cleaning and sanitizing procedures and the importance of having properly designed and constructed equipment (brushes) for food preparation and equipment cleaning operations.

- **Your Health in Our Hands - Our Health in Yours** - (8 minute videotape). For professional foodhandlers, the tape covers the do's and don'ts of foodhandling as they relate to personal hygiene, temperature control, safe storage and proper sanitation. (Jupiter Video Production)

ENVIRONMENTAL

- **The ABC's of Clean - A Handwashing & Cleanliness Program for Early Childhood Programs** - For early childhood program employees. This tape illustrates how proper handwashing and clean hands can contribute to the infection control program in daycare centers and other early childhood programs. (The Soap & Detergent Ass'n.)

- **Acceptable Risks?** - (16 minute VHS). Accidents, deliberate misinformation, and the rapid proliferation of nuclear power plants have created increased fears of improper nuclear waste disposal, accidents during the transportation of waste, and the release of radioactive effluents from plants. The program shows the occurrence of statistically anomalous leukemia clusters; governmental testing of marine organisms and how they absorb radiation; charts the kinds and amounts of natural and man-made radiation to which man is subject; and suggests there is no easy solution to balancing our fears to nuclear power and our need for it. (Films for the Humanitites & Sciences, Inc.)

- **Air Pollution: Indoor** - (26 minute VHS). Indoor air pollution is in many ways a self-induced problem ... which makes it no easier to solve. Painting and other home improvements have introduced pollutants, thermal insulation and other energy-saving and water-proofing devices have trapped the pollutants inside. The result is that air pollution inside a modern home can be worse than inside a chemical plant. (Films for the Humanities & Sciences, Inc.)

- **Asbestos Awareness** - (20 minute videotape). This videotape discusses the major types of asbestos and their current and past uses. Emphasis is given to the health risks associated with asbestos exposure and approved asbestos removal abatement techniques (Industrial Training, Inc.)

- **Down in the Dumps** - (26 minute VHS). Garbage is no laughing matter. The fact is that we are running out of space to dump the vast amounts of waste we create each day. Since many of the former methods of disposal are environmentally unacceptable, what are we to do? The program examines the technological approaches to the garbage dilemma, including composting, resource recovery, and high-tech incinerators, and public reaction to the creation of new waste treatment facilities. (Films for the Humanities & Sciences, Inc.)

- **EPA Test Methods for Freshwater Effluent Toxicity Tests (using Ceriodaphnia)** - (22 minute tape). Demonstrates the Ceriodaphnia 7-Day Survival and Reproduction Toxicity Test and how it is used to monitor and evaluate effluents for their toxicity to biota and their impact on receiving waters and the establishment of NPDES permit limitations for toxicity. The tape covers the general procedures for the test including how it is set up, started, monitored, renewed and terminated.

- **EPA Test Methods for Freshwater Effluent Toxicity Tests (using Fathead Minnow Larva)** - (15 minute tape). A training tape that teaches environmental professionals about the Fathead Minnow Larval Survival and Growth Toxicity Test. The method described is found in an EPA document entitled, "Short Term Methods for Estimating the Chronic Toxicity of Effluents & Receiving Waters to Freshwater Organisms." The tape demonstrates how fathead minnow toxicity tests can be used to monitor and evaluate effluents for their toxicity to biota and their impact on receiving waters and the establishment of NPDES permit limitations for toxicity.

- **Food-Service Disposables: Should I Feel Guilty?** - (11 1/2 minute videotape). The video, produced by the Food-service & Packaging Institute, Inc., national trade association of manufacturers and suppliers of single service articles for food service and packaging, examines such issues as litter, solid waste, recycling, composting and protection of the earth's ozone layer, makes for an excellent discussion opener on the theme of conservation of natural resources (trees, fresh water and energy) and the environmental trade-offs (convenience, sanitation and family health) that source reduction necessarily entails. (Foodservice & Packaging Institute, Inc.)

- **Garbage: The Movie** - (24 1/2 minute videotape). A fascinating look at the solid waste problem and its impact on the environment. Viewers are introduced to landfills, incinerators, recycling plants and composting operations as solid waste management solutions. Problems associated with modern landfills are identified and low-impact alternatives such as recycling, reuse, and source reduction are examined. (Churchill Films)

- **Global Warming: Hot Times Ahead?** - (23 minute videotape). An informative video tape program that explores the global warming phenomenon and some of the devastating changes it may cause. This program identifies greenhouse gases and how they are produced by human activities. Considered are: energy use in transportation, industry and home; effects of deforestation, planting of trees and recycling as means of slowing the build-up of greenhouse gases. (Churchill Films)

- **Kentucky Public Swimming Pool and Bathing Facilities** - (38 minute videotape). It was developed by the Lincoln Trail District Health Department in Kentucky and includes all of their state regulations which may be different from other states, provinces and countries. It was very well done and could be used to train those responsible for operating pools and waterfront bath facilities. All aspects are included of which we are aware, including checking water conditions and filtration methods. (1987)

- **Putting Aside Pesticides** - (26 minute VHS). This program probes the long-term effects of pesticides and explores alternative pest-control efforts; biological pesticides, genetically-engineered microbes that kill objectionable insects, the use of natural insect predators, and the cross-breeding and genetic engineering of new plant strains that produce their own anti-pest toxins. (Films for the Humanities & Sciences, Inc.)

- **Radon** - (26 minute VHS). This program looks at the possible health implications of radon pollution, methods homeowners can use to detect radon gas in their homes, and what can be done to minimize hazards once they are found.

- **RCRA - Hazardous Waste** - (19 minute video). This videotape explains the dangers associated with hazardous chemical handling and discusses the major hazardous waste handling requirements presented in the Resource Conservation and Recovery Act. (Industrial Training, Inc.)

- **The New Superfund: What it is & How it Works** - A six-hour national video conference sponsored by the EPA. Target audiences include the general public, private industry, emergency responders and public interest groups. The series features six videotapes that review and highlight the following issues:

- **Tape 1 - Changes in the Remedial Process: Clean-up Standards and State Involvement Requirements** - (62 minute videotape). A general overview of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and the challenge of its implementation. The remedy process —·long-term and permanent clean-up – is illustrated step-by-step, with emphasis on the new mandatory clean-up schedules, preliminary site assessment, petition procedures and the hazard ranking system/National Priority List revisions. The major role of state and local government involvement and responsibility is stressed.

- **Tape 2 - Changes in the Removal Process: Removal and Additional Program Requirements** - (48 minute videotape). The removal process is a short term action and usually an immediate response to accidents, fires and illegally dumped hazardous substances. This program explains the changes that expand removal authority and require procedures consistent with the goals of remedial action.

- **Tape 3 - Enforcement and Federal Facilities** (52 minute videotape). Who is responsible for SARA clean-up costs? Principles of responsible party liability; the difference between strict, joint and several liability; and the issue of the innocent landowner are discussed. Superfund enforcement tools- mixed funding, De Minimis settlements and the new nonbinding preliminary allocations of responsibility (NBARs) are explained.

- **Tape 4 - Emergency Preparedness and Community Right-To-Know** - (48 minutes). A major part of SARA is a free-standing act known as Title III: The Emergency Planning and Community Right-To-Know Act of 1986, requiring federal, state, and local governments and industry to work together in developing local emergency preparedness/response plans. This program discusses local emergency planning committee requirements, emergency notification procedures, and specifications on community right-to-know reporting requirements, such as using OSHA Material Safety Data Sheets, the emergency & hazardous chemical inventory and the toxic chemical release inventory.

- **Tape 5 - Underground Storage Tank Trust Fund and Response Program** - (21 minutes). Another addition to SARA is the Leaking Underground Storage Tank (LUST) Trust Fund. One half of the U.S. population depends on ground water for drinking – and EPA estimates that as many as 200,000 underground storage tanks are corroding and leaking into our ground water. This program discusses how the LUST Trust Fund will be used by EPA and the states in responding quickly to contain and clean-up LUST releases. Also covered is state enforcement and action requirements, and owner/operator responsibility.

- **Tape 6 - Research and Development/Closing Remarks** - (33 minutes). An important new mandate of the new Superfund is the technical provisions for research and development to create more permanent methods in handling and disposing of hazardous wastes and managing hazardous substances. This segment discusses the SITE (Superfund Innovative Technology Evaluation) program, the University Hazardous Substance Research Centers, hazardous substance health research and the DOD research, development and demonstration management of DOD wastes.

❑ **Sink A Germ** - (10 minute videotape). A presentation on the rationale and techniques for effective handwashing in health care institutions. Uses strong imagery to educate hospital personnel that handwashing is the single most important means of preventing the spread of infection. (The Brevis Corp.)

❑ **Waste Not: Reducing Hazardous Waste** - (35 minute VHS). This tape looks at the progress and promise of efforts to reduce the generation of hazardous waste at the source. In a series of company profiles, it shows activities and programs within industry to minimize hazardous waste in the production process. Waste Not also looks at the obstacles to waste reduction, both within and outside of industry, and considers how society might further encourage the adoption of pollution prevention, rather than pollution control, as the primary approach to the problems posed by hazardous waste. (Umbrella films)

OTHER

❑ **Diet, Nutrition and Cancer** - (20 minute video). Investigates the relationship between a person's diet and the risk of developing cancer. The film describes the cancer development process and identifies various types of food believed to promote and/or inhibit cancer. The film also provides recommended dietary guidelines to prevent or greatly reduce the risk of certain types of cancer.

❑ **Eating Defensively: Food Safety Advice for Persons with Aids** - (14 1/2 minute videotape). While HIV infection and AIDS are not acquired by eating foods or drinking liquids, persons infected with the AIDS virus need to be concerned about what they eat. Foods can transmit bacteria and viruses capable of causing life-threatening illness to persons infected with AIDS. This video provides information for persons with AIDS on what foods to avoid and how to better handle and prepare foods. (FDA/CDC)

❑ **Ice: The Forgotten Food** - (14 minute video). This training video describes how ice is made and where the critical control points are in its manufacture, both in ice plants and in on-premises locations (convenience stores, etc.); it documents the potential for illness from contaminated ice and calls on government to enforce good manufacturing practices, especially in on-premises operations where sanitation deficiencies are common. (Packaged Ice Association)

❑ **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, in federal, state and local agencies. (1987)

❑ **Personal Hygiene & Sanitation for Food Processing Employees** - (15 minute videotape). Illustrates and describes the importance of good personal hygiene and sanitary practices for people working in a food processing plant.

❑ **Psychiatric Aspects of Product Tampering** - (about a 25 minute, 1/2" videocassette). This was presented by Emanuel Tanay, M.D. from Detroit, 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. Tamper proof packaging and recalls are essential. Tampering and poisoning are characterized by variable motivation, fraud and greed. Law enforcement agencies have the final responsibilities. Tamper proof containers are not the ultimate answer. (1987)

❑ **Tampering: The Issue Examined** - (37 minute videotape). Developed by Culbro Machine Systems, this videotape is well done. It is directed to food processors and not regulatory sanitarians or consumers. A number of industry and regulatory agency management explain why food and drug containers should be made tamper evident. (Culbro-1987)

If you are interested in checking out any of our audio-visuals, please fill out this form with the box or boxes checked as to which presentations you wish to view. Mail to: IAMFES, Lending Library, 6200 Aurora Avenue, 200W, Des Moines, IA 50322. (Material from the Lending Library can be checked out for two weeks only so that others can benefit from its use.)

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Dairy, Food and Environmental Sanitation, Vol. 15, No. 3, Pages 174-176

3-A Sanitary Standards for Steam Injection Heaters for Milk and Milk Products Number 61-00

(Formerly Number 08-171)

Formulated By
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

It is the purpose of the IAMFES, USPHS, and DIC in connection with the development of the 3-A Sanitary Standards Program to allow and encourage full freedom for inventive genius or new developments. Steam injection heater specifications heretofore or hereafter developed which so differ in design, materials, and fabrication or otherwise as not to conform to the following standards but which, in the fabricator's opinion, are equivalent or better, may be submitted for the joint consideration of the IAMFES, USPHS, and DIC at any time. **NOTE:** Use current revisions or editions of all referenced documents cited herein.

A SCOPE

A1 These standards cover the sanitary aspects of steam injection heaters used to heat milk or milk products when the heater is on processing equipment or in the pipelines conveying milk or milk products.

A2 In order to conform with these 3-A Sanitary Standards, steam injection heaters shall comply with the following design, material, and fabrication criteria.

B DEFINITIONS

B1 *Product:* Shall mean milk and milk products.

B2 **Surfaces**

B2.1 *Product Contact Surfaces:* Shall mean all surfaces which are exposed to the product and surfaces from which liquids may drain, drop or be drawn into the product.

B2.2 *Nonproduct Contact Surfaces:* Shall mean all other exposed surfaces.

B3 **Cleaning**

B3.1 *Mechanical Cleaning or Mechanically Cleaned:* Shall mean soil removal by impingement, circulation or flowing chemical detergent solutions and water rinses onto and over the surfaces to be cleaned by mechanical means in equipment or systems specifically designed for this purpose.

C MATERIALS

C1 **Metals**

C1.1 Product contact surfaces shall be of stainless steel of the American Iron and Steel Institute (AISI) 300 Series[1] or corresponding Alloy Cast Institute[2] (ACI) types (See Appendix, Section E.), or metal which is equal in cleanability to stainless steel of the foregoing types and which under conditions of intended use is equally corrosion resistant, nontoxic and nonabsorbent except that:

C2 **Nonmetals**

C2.1 Rubber and rubber-like materials may be used for gaskets, O-rings, seals and parts having the same functional purposes.

C2.1.1 Rubber and rubber-like materials when used for the above specified application(s) shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Number 18-.

C2.2 Plastic materials may be used for gaskets, valve plugs, valve body liners, nozzles, O-rings, seals and parts having the same functional purposes.

C2.2.1 Plastic materials when used for the above specified application(s) shall conform with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Number 20-.

C2.3 Rubber and rubber-like materials and plastic materials having product contact surfaces shall be of such composition as to retain their surface and conformational characteristics when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment or sterilization.

C2.4 Bonded rubber and rubber-like materials and bonded plastic materials having product contact surfaces shall be of such composition as to retain their surface and conformation characteristics when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment or sterilization.

C2.4.1 The final bond and residual adhesive, if used, on bonded rubber and rubber-like materials and bonded plastic materials shall be nontoxic[3].

C3 In a processing system to be sterilized by heat and operated at a temperature of 250°F (121°C) or higher, all materials having product contact surface(s) used in the construction of steam injection heaters and nonmetallic component parts shall be such that they can be (1) sterilized by saturated steam or water under pressure (at least 15.3 psig or 106 kPa) at a temperature of at least 250°F (121°C) and (2) operated at the temperature required for processing.

C4 **Nonproduct Contact Surfaces**

C4.1 Nonproduct contact surfaces shall be of corrosion-resistant material or material that is rendered corrosion resistant. If coated, the coating used shall adhere. Nonproduct contact surfaces shall be relatively nonabsorbent, durable, and cleanable. Parts removable for cleaning having both product contact and nonproduct contact surfaces shall not be painted.

D **FABRICATION**

D1 **Surface Texture**

D1.1 All product contact surfaces shall have a finish at least as smooth as a No. 4 ground finish on stainless steel sheets and be free of imperfections such as pits, folds and crevices in the final fabricated form. (See Appendix, Section F.)

D2 **Permanent Joints**

D2.1 All permanent joints in metallic product contact surfaces shall be continuously welded. Welded areas on product contact surfaces shall be at least as smooth as a No. 4 ground finish on stainless steel sheets, and be free of imperfections such as pits, folds, and crevices.

D3 **Cleaning and Inspectibility**

D3.1 Steam injection heaters that are to be mechanically cleaned shall be designed so that the product contact surfaces of the steam injection heater and all nonremoved appurtenances thereto can be mechanically cleaned and are easily accessible and readily removable for inspection employing simple hand tools, if necessary, available to operating or cleaning personnel.

D3.2 Product contact surfaces not designed to be mechanically cleaned shall be accessible for cleaning and inspection when in an assembled position or when removed. Demountable parts shall be readily removable using simple hand tools, if necessary, available to operating or cleaning personnel.

D4 **Draining**

D4.1 All product contact surfaces shall be self-draining except for normal clingage.

D5 **Fittings**

D5.1 All sanitary fittings and connections shall conform with the applicable provisions of the 3-A Sanitary Standards for Sanitary Fittings for Milk and Milk Products, Number 63-.

D6 **Gaskets**

D6.1 Gaskets having a product contact surface shall be removable or bonded.

D6.2 Bonded rubber and rubber-like materials and bonded plastic materials having product contact surfaces shall be bonded in a manner that the bond is continuous and mechanically sound so that when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment or sterilization the rubber and rubber-like material or the plastic material does not separate from the base material to which it is bonded.

D6.3 Grooves in gaskets shall be no deeper than their width.

D6.4 Gasket grooves or gasket retaining grooves in product contact surfaces for removable gaskets shall not exceed 1/4 in. (6.35 mm) in depth or be less than 1/4 in. (6.35 mm) wide except those for standard O-rings smaller than 1/4 in. (6.35 mm), and those provided for in Section D5.1.

D7 **Radii**

D7.1 All internal angles of 135 degrees or less on product contact surfaces, shall have radii of not less than 1/4 in. (6.35 mm) except that:

D7.1.1 Smaller radii may be used when they are required for essential functional reasons, such as those in bushing seats. In no case shall such radii be less than 1/32 in. (0.794 mm).

D7.1.2 The radii in gasket grooves, gasket retaining grooves, or grooves in gaskets, shall be not less than {1/8 in. (3.18 mm) except for those standard, 1/4 in. (6.35 mm) and smaller O-rings, and those provided for in Section D5.1.

D7.1.3 The radii in grooves for standard 1/4 in. (6.35 mm) O-rings shall not be less than 3/32 in. (2.38 mm) and for standard 1/8 in. (3.18 mm) O-rings shall be not less than 1/32 in. (0.794 mm).

D8 **Springs**

D8.1 Any coil spring having product contact surfaces shall have at least 3/32 in. (2.381 mm) openings between coils including the ends when the spring is in a free position.

D9 **Sterilization Systems**

D9.1 Steam injection heaters and nonmetallic component parts shall comply with the applicable provisions of this standard and the following:

D9.2 The construction shall be such that all product contact surfaces can be (1) sterilized by saturated steam or water under pressure (at least 15.3 psig or 106 kPa) at a temperature of at least 250°F (121°C) and (2) operated at the temperature required for processing.

D10 **Threads**

D10.1 There shall be no threads on product contact surfaces.

D11 **Nonproduct Contact Surfaces**

D11.1 Nonproduct contact surfaces shall have a smooth finish, free of pockets and crevices, and be readily cleanable and those surfaces to be coated shall be effectively prepared for coating.

APPENDIX

E **STAINLESS STEEL MATERIALS**

Stainless steel conforming to the applicable composition ranges established by AISI for wrought products, or by ACI for cast products, should be considered in compliance with the requirements of Section C1 herein. Where welding is involved, the carbon content of the stainless steel should not exceed 0.08%. The first reference cited in C1 sets forth the chemical ranges and limits of acceptable stainless steel of the 300 Series. Cast grades of stainless steel corresponding to types 303, 304, and 316 are designated CF-16F, CF-8, and CF-8M, respectively. The chemical compositions of these cast grades are covered by ASTM specifications[4] A351/A351M, A743/A743M and A744/A744M.

F **PRODUCT CONTACT SURFACE FINISH**

Surface finish equivalent to 150 grit or better as obtained with silicon carbide, properly applied on stainless steel sheets, is considered in compliance with the requirements of Section D1 herein. A maximum Ra of 32 µin. 0.80 µm, when measured according to the recommendations in ANSI/ASME B46.1 - Surface Texture[5], is considered to be equivalent to a No. 4 finish.

G **STEAM FOR PRODUCT CONTACT**

A method of producing steam of culinary quality for steam injection heaters will be found in the 3-A Accepted Practices for a Method of Producing Steam of Culinary Quality, Number 609-.

These 3-A Sanitary Standards are effective November 20, 1994.

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[4] *Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187 (215) 299-5400.*

[5] *Available from American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017-2392 (212) 705-7722.*

Dairy, Food and Environmental Sanitation, Vol. 15, No. 3, Page 177

3-A Sanitary Standards for Polished Metal Tubing for Milk and Milk Products

Number 33-01

Formulated By
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

It is the purpose of the IAMFES, USPHS, and DIC in connection with the development of the 3-A Sanitary Standards Program to allow and encourage full freedom for inventive genius or new developments. Specifications for polished metal tubing , heretofore or hereafter developed which so differ in design, materials, and fabrication or otherwise as not to conform to the following standards but which, in the fabricator's opinion, are equivalent or better, may be submitted for the joint consideration of the IAMFES, USPHS, and DIC at any time. **Note:** Use most current revisions or editions of all referenced documents cited herein.

A SCOPE

A1 These standards cover the sanitary aspects of polished metal tubing used to conduct milk and milk products. These standards do not apply to tubing used in pneumatic conveying systems for dry milk and dry milk products.

A2 In order to conform with these 3-A Sanitary Standards, tubing shall comply with the following material and fabrication sections.

B DEFINITIONS

B1 *Product*: Shall mean milk and milk products.

B2 **Surfaces**

B2.1 *Product Contact Surfaces*: Shall mean all surfaces which are exposed to the product.

B2.2 *Nonproduct Contact Surfaces*: Shall mean all other exposed surfaces.

C MATERIALS

C1 Product contact surfaces shall be of stainless steel of the AISI 300 Series[1] (See Appendix, /Section E.), or stainless steel of other AISI Series which under conditions of intended use is at least as corrosion resistant as stainless steel of AISI 300 Series and is nontoxic and non-absorbent.

D FABRICATION

D1 All product contact surfaces shall have a ground and/or polished finish at least as smooth as a No. 4 finish on stainless steel sheets free of imperfections such as pits, folds and crevices. (See Appendix, Section F.)

D2 Tubing shall be of the seamless or welded types.

D3 Stainless steel tubing shall comply with the applicable provisions of ASTM[2] Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing Designation A270. The finish of product contact surfaces shall be as provided in D1 above.

D4 Nonproduct contact surfaces shall have a smooth finish and be free of pockets and crevices and be readily cleanable.

APPENDIX

E STAINLESS STEEL MATERIALS

Stainless steel conforming to the applicable composition ranges established by AISI for wrought products should be considered in compliance with the requirements of Section C.1 herein. Where welding is involved, the carbon content of the stainless steel should not exceed 0.08 percent. The reference cited in C.1 sets forth the chemical ranges and limits of acceptable stainless steel of the 300 Series.

These 3-A Sanitary Standards are effective November 20, 1994 at which time the 3-A Sanitary Standards for Polished Metal Tubing for Milk and Milk Products, Number 33-00, are rescinded and become null and void.

[3] *Available from the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017-2392 (212) 705-7722.*

Dairy, Food and Environmental Sanitation, Vol. 15, No. 3, Pages 178-184

3-A Accepted Practices for Farm Milk Cooling and Storage Systems

Number 611-00

Formulated By
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

It is the purpose of the IAMFES, USPHS, and DIC in connection with the development of the 3-A Sanitary Standards Program to allow and encourage full freedom for inventive genius or new developments. Farm milk cooling and storage system specifications heretofore or hereafter developed which so differ in design, materials, and fabrication or otherwise as not to conform to the following standards but which, in the fabricator's opinion, are equivalent or better, may be submitted for the joint consideration of the IAMFES, USPHS, and DIC at any time. **NOTE:** Use current revisions or editions of all referenced documents cited herein.

A SCOPE

A1 These 3-A Accepted Practices shall pertain to equipment used for farm milk cooling and storage systems. These systems shall begin at the inlet of the heat exchanger and end with the milk storage vessel from which the raw milk is removed from the dairy farm.

A2 In order to conform with these 3-A Accepted Practices, farm milk cooling and storage systems shall comply with the following design, material, fabrication, cooling and installation criteria.

B DEFINITIONS

B1 *Product:* Shall mean milk.

B2 **Surfaces**

B2.1 *Product Contact Surfaces:* Shall mean all surfaces which are exposed to the product and surfaces from which liquids may drain, drop, or be drawn into the product.

B2.2 *Nonproduct Contact Surfaces:* Shall mean all other exposed surfaces.

B3 **Cleaning**

B3.1 *Mechanical Cleaning or Mechanically Cleaned:* Shall mean soil removal by impingement, circulation or flowing chemical detergent solutions and water rinses onto and over the surfaces to be cleaned by mechanical means in equipment or systems specifically designed for this purpose.

B3.2 *Manual (COP) Cleaning:* Shall mean soil removal when the equipment is partially or totally disassembled. Soil removal is effected with chemical solutions and water rinses with the assistance of one or a combination of brushes, nonmetallic scouring pads and scrapers, high or low pressure hoses and tank(s) which may be fitted with recirculating pump(s), and with all cleaning aids manipulated by hand.

B4 *Safe Water:* Shall mean water from a supply properly located, protected and operated and shall be of a safe, sanitary quality. The water shall meet the standards prescribed in the National Primary Drinking Water Regulation of the Environmental Protection Agency (EPA) as referenced in The Code of Federal Regulations[1] (CFR), Title 40, Parts 141, 142 and 143. (Information also available from the Environmental Protection Agency (EPA) Drinking Water Hot Line - 800-426-4791.)

B5 *Milk Transfer Line:* A pipe which performs the single function of transporting milk.

B6 *Precooling:* Shall be the partial cooling of milk in a plate or tubular heat exchanger before the milk enters the cooling tank.

B7 *Instant Cooling:* Shall be the cooling of milk to storage temperature in a plate or tubular heat exchanger before the milk enters the storage or cooling tank.

B8 *Coolant (Cooling Media):* Shall be the recirculated cold water which is used in coolers and heat exchangers, and shall include those systems in which a nontoxic freezing-point depressant is used, is from a safe source and is protected from contamination.

B9 *Simple Hand Tools:* Shall mean implements normally used by operating and cleaning personnel such as a screwdriver, wrench or hammer.

C **MATERIALS**

C1 The materials of product contact surfaces of equipment included in the farm milk cooling and storage systems for which there are 3-A Sanitary Standards or 3-A Accepted Practices shall comply with the material criteria of the applicable standards or accepted practices.

C2 Product contact surfaces shall be of stainless steel of the American Iron and Steel Institute (AISI) 300 Series[2] or corresponding Alloy Cast Institute[3] (ACI) types (See Appendix, Section G.), or metal which under conditions of intended use is at least as corrosion resistant as stainless steel of the foregoing types, and is nontoxic and nonabsorbent, except that:

C2.1 Rubber and rubber-like materials may be used for sealing applications, O-rings, drip deflectors and parts having the same functional purposes. (Also see C1 herein.)

C2.2 Rubber and rubber-like materials when used for the above specified application(s) shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Number 18-.

C2.3 Plastic materials may be used for drip shields, O-rings, seals, gaskets and parts having the same functional purpose or for protective caps for sanitary tubing, fittings or vents. (Also see C1 herein.)

C2.4 Plastic materials, when used for the above specified applications, shall comply with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Number 20-.

C2.5 Rubber and rubber-like materials and plastic materials having product contact surfaces shall be of such composition as to retain their surface and conformational characteristics when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment.

C2.6 The final bond and residual adhesive, if used, on bonded rubber and rubber-like materials and bonded plastic materials shall be nontoxic[4].

C2.7 Bonded rubber and rubber-like materials and bonded plastic materials having product contact surfaces shall be of such composition as to retain their surface and conformation characteristics when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment.

C3 All nonproduct contact surfaces shall be of corrosion-resistant material or material that is rendered corrosion-resistant. If coated, the coating used shall adhere. All nonproduct contact surfaces shall be relatively nonabsorbent, durable, and cleanable. Parts removable for cleaning having both product contact and nonproduct contact surfaces shall not be painted.

D **FABRICATION**

D1 The fabrication criteria of equipment included in the farm milk cooling and storage system for which there are 3-A Sanitary Standards or 3-A Accepted Practices shall be those of the applicable standards or accepted practices. Other equipment shall conform to the following fabrication criteria:

D2 **Surface Texture**

D2.1 All product contact surfaces shall have a finish at least as smooth as a No. 4 ground finish on stainless steel sheets and be free of imperfections such as pits, folds and crevices in the final fabricated form. (See Appendix, Section H.) The measuring rod of an immersion type measuring device may have a dull finish to facilitate reading.

D3 **Gaskets**

D3.1 Gaskets having a product contact surface shall be removable or bonded.

D3.2 Bonded rubber and rubber-like materials and bonded plastic materials having product contact surface shall be bonded in a manner that the bond is continuous and mechanically sound so that when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment, the rubber and rubber-like material or the plastic material does not separate from the base material to which it is bonded.

D3.3 Grooves in gaskets shall be no deeper than their width.

D3.4 Gasket grooves or gasket retaining grooves in product contact surfaces for removable gaskets shall not exceed 1/4 in. (6.35 mm) in depth or be less than 1/4 in. (6.35 mm) wide except those for standard O-rings smaller than 1/4 in. (6.35 mm), and those provided for in Sections D5 and D6.

D4 **Radii**

D4.1 All internal angles of 135° or less on product contact surfaces, shall have radii of not less than 1/4 in. (6.35 mm) except:

D4.1.1 Those provided for in Section D6 and D7.

D4.1.2 The minimum radii in grooves for standard 1/4 in. (6.35 mm) O-rings shall not be less than 3/32 in. (2.38 mm).

D4.1.3 The minimum radii in grooves for standard 1/8 in. (3.18 mm) O-rings shall be not less than 1/32 in. (0.794 mm).

D4.1.4 Radii smaller that 1/4 in. (6.35 mm) may be used when they are required for essential functional reasons, such as O-ring grooves. In no case shall such radii be less than 1/32 in. (0.794 mm).

D5 All tubing shall conform with the applicable provisions for welded sanitary product pipelines found in the 3-A Accepted Practices for Permanently Installed Product and Solution Pipelines and Cleaning Systems Used in Milk and Milk Product Processing Plants, Number 605- and with the 3-A Sanitary Standards for Polished Metal Tubing for Dairy Products, Number 33-.

D6 All sanitary fittings and connections shall conform with the applicable provisions of the 3-A Sanitary Standards for Sanitary Fittings for Milk and Milk Products, Number 63-. (Also see D1.)

D7 All sensor connections having product contact surfaces shall conform to the 3-A Sanitary Standards for Sensor and Sensor Connections Used on Milk and Milk Products Equipment, Number 09-. (Also see D1 herein.)

D8 Pressurized air, if used, shall be produced in accordance with applicable provisions of the 3-A Accepted Practices for Supplying Air Under Pressure in Contact with Milk and Milk Products and Product Contact Surfaces, Number 604-.

D9 All permanent joints in metallic product contact surfaces shall be continuously welded.

D10 Farm milk cooling and storage systems that are to be mechanically cleaned shall be designed so that the product contact surfaces of the milk system and all nonremovable appurtenances thereto can be mechanically cleaned and are accessible for inspection.

D11 Product contact surfaces not designed to be mechanically cleaned shall be easily accessible for cleaning, and inspection either when in an assembled position or when removed. Demountable parts shall be readily removable using simple hand tools.

D12 Appurtenances having product contact surfaces shall be mechanically cleanable, either when in an assembled position or shall be manually cleanable when disassembled. All product contact surfaces shall be so designed as to facilitate inspection. Demountable parts shall be readily removable using simple hand tools.

D13 Bonded rubber and rubber-like materials and bonded plastic materials having product contact surfaces shall be bonded in a manner that the bond is continuous and mechanically sound so that when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment the rubber and rubber-like material or the plastic material does not separate from the base material to which it is bonded.

D14 All product contact surfaces shall be self-draining or be drainable except for normal clingage.

D15 Nonproduct contact surfaces shall have a smooth finish, be free of pockets and crevices, and be readily cleanable. Surfaces to be coated shall be effectively prepared for coating to assure adhesion.

E SPECIAL CONSIDERATIONS

E1 Storage tanks may be used as a component of farm milk cooling and storage systems. Storage tanks, if used, shall conform to 3-A Sanitary Standards for Storage Tanks for Milk and Milk Products, Number 01- or 3-A Sanitary Standards for Farm Milk Storage Tanks, Number 30-.

E2 Storage tanks as outlined in E1, if used, shall comply with the following:

E2.1 If storage tanks are used, means for mechanical and/or air agitation shall be provided that will result in a variation in milk fat content of the product in the tank of not more than plus or minus 0.1% as determined by the Official AOAC Milk Fat Test[5], when the tank is filled to (1) 100% of its capacity with product and the agitator has been in operation for 5 min if the capacity of the tank is less than 1500 gal (5678 L) or (2) 100% of its capacity with product and the agitator has been in operation for 10 min if the capacity of the tank is 1500 gal (5678 L) or larger.

E2.2 A measuring device of the immersion type or of the direct reading gauge type, if provided, shall comply with E2.1.1 or E2.2.2.

E2.2.1 **Immersion Type:** An immersion measuring device shall comply with the applicable provisions of the National Institute of Standards and Technology Handbook 44-1994 or current Edition, section 4.42 Farm Milk Tanks, S Specifications S.3.7, Graduations, pages 4-10 and 4-11. The measuring rod shall have graduation marks not less than 0.005 in. (0.10 mm) in width and not exceeding 0.008 in. (0.20 mm) in depth. The measuring rod consists of a graduated portion, a seat to engage the measuring rod supporting bracket or other supporting means and a handle. It does not include the supporting bracket or other means of support. The measuring rod may be two or more parts welded together or may be

one piece. The handle shall extend above the bridge or main cover on open type tanks, or shall be above the milk overflow level in closed type tanks. The tank serial number stamped or etched on the rod shall be located as high on the rod as practical. The opening through which the measuring rod extends shall be protected against liquids or other contaminants entering the tank from that portion of the measuring rod outside the tank.

E2.2.2 **Direct Reading Gauge:** Any farm cooling and storage tank with a capacity of greater than 2000 gal (7570 L) shall be equipped with an external gauge assembly. The direct reading gauge shall be of the glass or plastic tube type and shall be sanitary in design and construction and shall be readily accessible for cleaning or shall be designed for mechanical cleaning. The gauge shall comply with the applicable provisions of the code entitled National Institute of Standards and Technology Handbook 44 - 1994 or current Edition, Section 4.42 Farm Milk Tanks, S Specification, S.3.6, External Gauge Assemblies page 4-10. If designed for mechanical cleaning, the inside diameter of the gauge parts shall be sufficiently uniform that all product contact surfaces will be cleaned. It shall be designed and constructed so that all product in the gauge will be discarded. Means to accomplish this shall be provided at the lowest point and in such a manner that product in the gauge will not enter the tank outlet nor re-enter the tank. The valve shall be close coupled. The distance, measured along the passage for the product in the tank to the gauge valve, from the nearest point on the shell to the ferrule or flange for the valve shall not be more than the smaller of (1) twice the nominal diameter of the passage or (2) 5 in. (127 mm).

E3 Farm milk cooling and holding tanks may be used as a component of a farm milk cooling and storage system. Farm tanks, if used, shall conform with the 3-A Sanitary Standards for Farm Milk Cooling and Holding Tanks, Number 13-.

E4 Plate-type heat exchangers may be used as a component of farm milk cooling and storage systems. If used, they shall conform to the 3-A Sanitary Standards for Plate-Type Heat Exchangers for Milk and Milk Products, Number 11-.

E5 Tubular heat exchangers may be used as a component of farm milk cooling and storage systems. If used, they shall conform to 3-A Sanitary Standards for Tubular Heat Exchangers for Milk and Milk Products, Number 12-.

F REFRIGERATION CRITERIA

F1 The milk cooling system shall be provided and may be comprised of a precooling device such as a plate-type heat exchanger or tubular heat exchanger and a tank of either storage type or cooling type. The system shall have sufficient cooling capacity to accomplish the following:

F1.1 The milk shall be cooled to 50°F (10°C) within the first hour after milking and 40°F (4.4°C) within the second hour after milking, provided the blend temperature after the first milking does not exceed 50°F (10°C).

F1.1.1 For every day pickup, the cooling system shall be rated to cool at least 50% of maximum tank capacity.

F1.1.2 For every other day pickup, the cooling system shall be rated to cool at least 25% of maximum tank capacity.

F2 Control

F2.1 The system shall be provided with an automatic refrigeration control capable of functioning on a change in product temperature of not more than plus or minus 2°F at 37°F (1.1°C at 2.8°C).

F2.1.1 The tank shall be provided with automatic, intermittent, timed agitation which operates a minimum of 5 min each hour when milk is in the tank.

F3 Cooling Information

Storage tanks complying with E3 shall have an information or data plate permanently attached in such a way as to be effectively sealed and giving the following information:

F3.1 This tank is designed for (everyday or every-other day) pick-up. Maximum rate at which milk can enter this tank and meet the cooling requirements of the 3-A Sanitary Standards for Farm Milk Cooling and Holding Tanks, Number 13-, is _____ U.S. Gal per hour (_____ L per hour). When milk enters the tank at the maximum rate, the minimum condensing unit capacity is [a] _____ BTU /hr at [a] _____°F ([a] _____ kJoules/hr at [a] _____°C) suction temperature.

The BTU (kJoules) capacity specified is to be at the saturated suction temperature designed by the manufacturer. NOTE: The information on the data plate shall be rated as if the tank is the only source of cooling.

F3.2 In determining cooling capacity, the ambient temperature shall be 90°F (32°C) and when water cooled condensers are used, the refrigerant condensing temperature shall be not less than 103°F (39°C).

F3.3 Re-Rating the Precooling System: When the tank is part of a farm milk cooling and storage system, the maximum rate at which milk may enter the tank may be increased by the amount given in the following table. NOTE: For every 6°F (3.3°C) that

milk drops below 98°F (37°C) before it enters the tank, the maximum rate milk may enter the tank may be increased by 10% or the minimum condensing unit capacity may be decreased by 10%.

F3.3.1 **TABLE** - Rerate Factors for Data Plates

MilkEnter	Flowrate Factor[A]	Condense Factor[B]
98°F	1.00	1.00
90°F	1.13	0.87
80°F	1.30	0.70
70°F	1.47	0.53
60°F	1.63	0.37
50°F	1.80	0.20
40°F	1.97	0.03

[A] Multiply data plate flowrate by flowrate factor.

[B] Multiply data plate condensing unit capacity by condenser factor.

APPENDIX

G STAINLESS STEEL MATERIALS

Stainless steel conforming to the applicable composition ranges established by AISI for wrought products, or by ACI for cast products, should be considered in compliance with the requirements of Section C2 herein. Where welding is involved, the carbon content of the stainless steel should not exceed 0.08%. The first reference cited in C2 sets forth the chemical ranges and limits of acceptable stainless steel of the 300 Series. Cast grades of stainless steel corresponding to types 303, 304, and 316 are designated CF-16F, CF-8, and CF-8M, respectively. The chemical compositions of these cast grades are covered by ASTM specifications[6] A351/A351M, A743/A743M and A744/A744M.

H PRODUCT CONTACT SURFACE FINISH

Surface finish equivalent to 150 grit or better as obtained with silicon carbide, properly applied on stainless steel sheets, is considered in compliance with the requirements of Section D2 herein. A maximum Ra of 32 µin. (0.80 µm), when measured according to the recommendations in ANSI/ASME[7] B46.1 - Surface Texture, is considered to be equivalent to a No. 4 finish.

I DIAGRAMS

I1 The following drawings are intended to demonstrate general principles only, and are not intended to limit individual ingenuity. The design used should conform with the sanitary requirements set forth in these 3-A Accepted Practices. The following examples are included in the Appendix:

Drawing Name	Figure	3-A Drawing
Farm Cooling Tank System	1	3-A 611-00-01
Farm Cooling Tank with Precooling	2	3-A 611-00-02
Instant Cooling System with Storage Tank	3	3-A 611-00-03
Instant Cooling System with Cooling Tank	4	3-A 611-00-04

These 3-A Accepted Practices shall become effective November 20, 1994.

[1]For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (202) 783-3238.

[2]The data for this series are contained in the AISI Steel Products Manual, Stainless & Heat Resisting Steels, November 1990, Table 2-1, pp. 17-20. Available from the American Iron and Steel Society, 410 Commonwealth Drive, Warrendale, PA 15086 (412) 776-1535.

[3]Steel Founders Society of America, Cast Metal Federation Building, 455 State Street, Des Plaines, Il 60016 (708) 299-9160.

[4]Adhesives shall comply with 21 CFR 175 – Indirect Food Additives: Adhesives and Components of Coatings. Document for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (202) 783-3238.

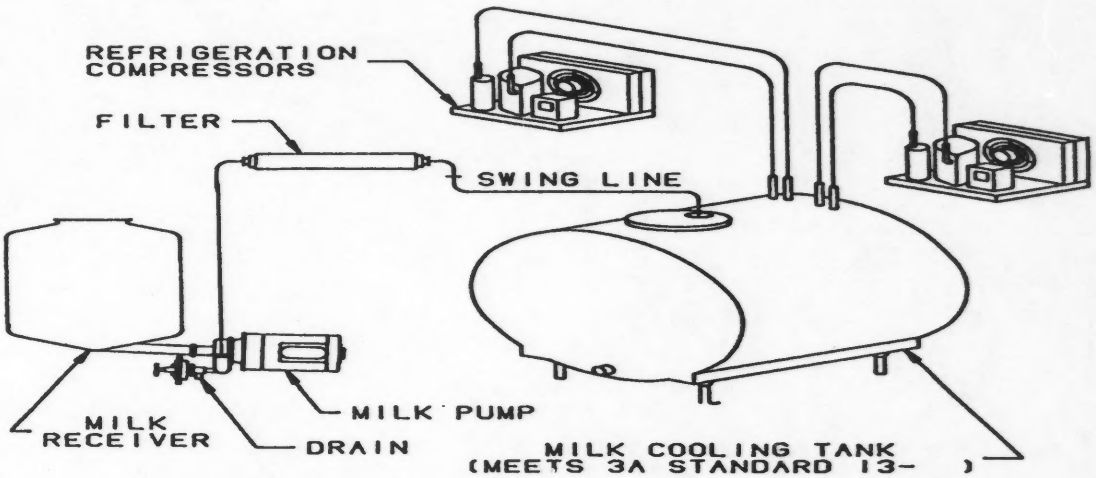
[5]The method of making these tests will be found in the following reference: Official Methods of Analysis: Available from the AOAC International, 2200 Wilson Boulevard, Suite 400, Arlington, VA 22201-3301 (703) 522-3032.

[6]Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187 (215) 299-5400.

[7]Available from the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017-2392 (212) 705-7722.

3-A DRAWING
FARM MILK COOLING
AND STORAGE SYSTEMS

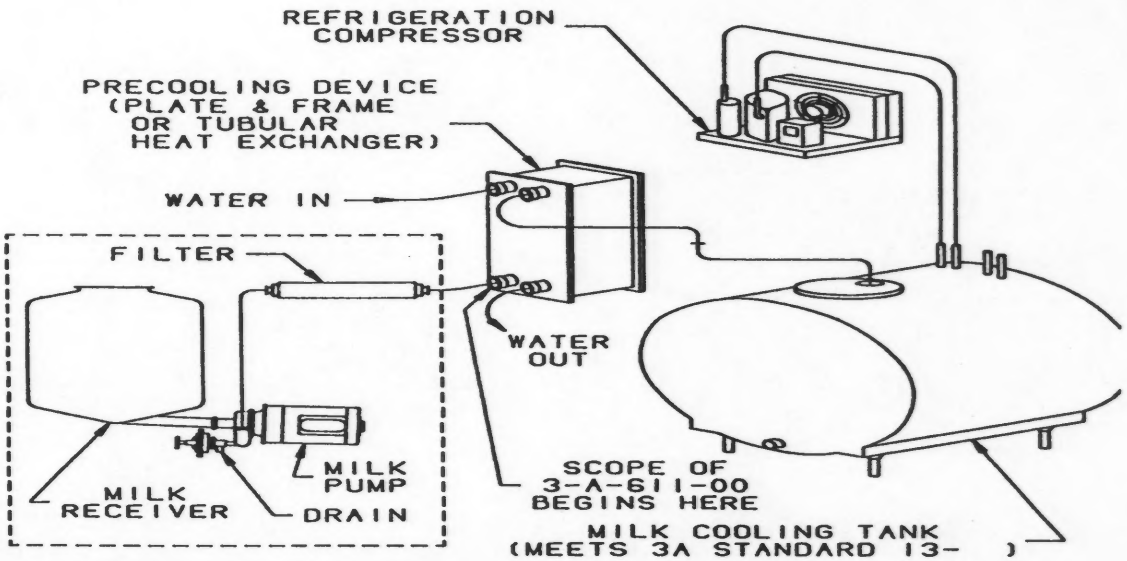
3-A 611-00-01



TYPICAL SYSTEM WITH DIRECT EXPANSION TANK
(ALL COOLING DONE IN TANK)
(NOT COVERED BY THIS PRACTICE - INFORMATION ONLY)

3-A DRAWING
FARM MILK COOLING
AND STORAGE SYSTEMS

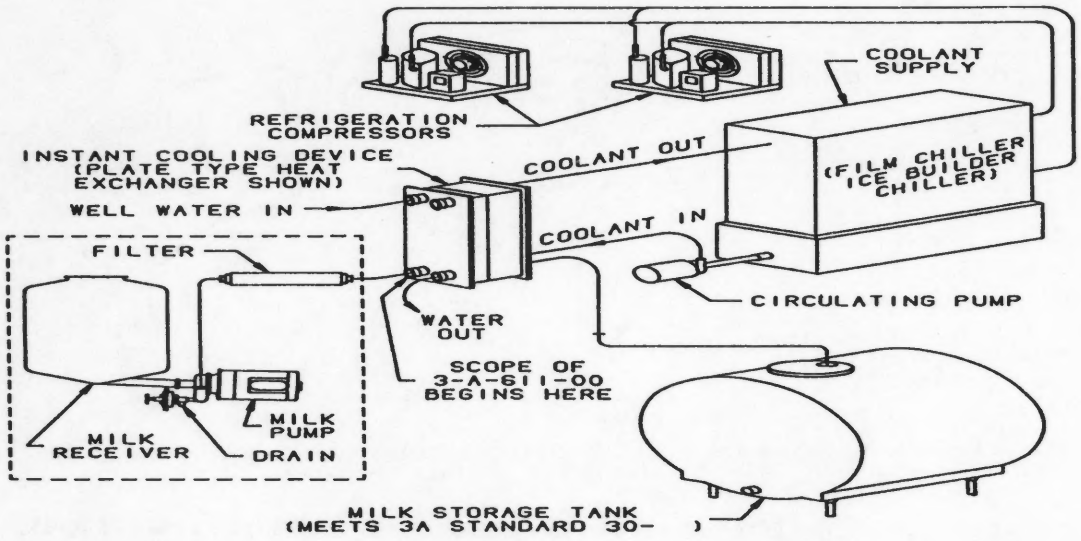
3-A 611-00-02



PRECOOLING SYSTEM WITH COOLING TANK
(PARTIAL COOLING BY TANK)

3-A DRAWING
FARM MILK COOLING
AND STORAGE SYSTEMS

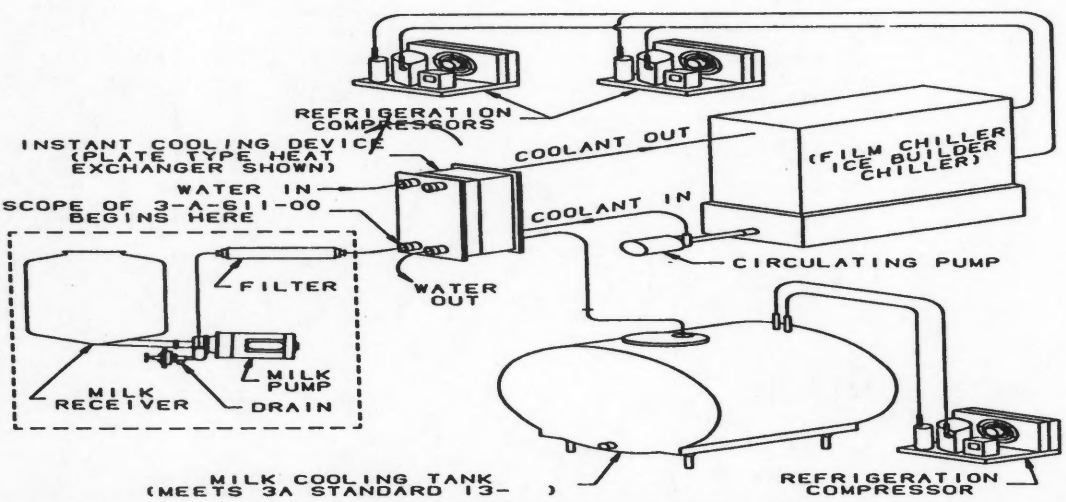
3-A 611-00-03



INSTANT COOLING SYSTEM WITH MILK STORAGE TANK (ALL COOLING OUTSIDE TANK)

3-A DRAWING
FARM MILK COOLING
AND STORAGE SYSTEMS

3-A 611-00-04



INSTANT COOLING SYSTEM WITH COOLING TANK (MOST OF COOLING DONE OUTSIDE TANK)

Dairy, Food and Environmental Sanitation, Vol. 15, No. 3, Pages 185-187

3-A Accepted Practices for a Method of Producing Steam of Culinary Quality

Number 609-01

Formulated By
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

It is the purpose of the IAMFES, USPHS, and DIC in connection with the development of the 3-A Sanitary Standards Program to allow and encourage full freedom for inventive genius or new developments. Steam of culinary quality specifications heretofore or hereafter developed which so differ in design, materials, and fabrication or otherwise as not to conform to the following practices, but which, in the fabricator's opinion, are equivalent or better, may be submitted for the joint consideration of the IAMFES, USPHS, and DIC at any time. **NOTE:** Use current revisions or editions of all referenced documents cited herein.

A **SCOPE**

A1 These 3-A Accepted Practices shall pertain to the sanitary aspects of the equipment and filters used in the supplying of steam of culinary quality which comes in contact with milk or milk products or product contact surfaces. The system shall begin with the steam inlet of the entrainment separator and terminate at the steam inlet of the process equipment.

A2 In order to conform with these 3-A Accepted Practices, equipment for supplying steam of culinary quality, as defined herein, shall comply with the following design, material, fabrication, and installation criteria.

B **DEFINITIONS**

B1 *Steam of Culinary Quality:* Shall mean steam that is free of entrained contaminants, is relatively free of water in liquid form and is suitable for use in direct contact with milk or milk products or product contact surfaces.

B2 *Product:* Shall mean milk and milk products.

B3 *Safe Water:* Shall mean water from a supply properly located, protected and operated and shall be of a safe, sanitary quality. The water shall meet the standards prescribed in the National Primary Drinking Water Regulation of the Environmental Protection Agency (EPA) as referenced in The Code of Federal Regulations[1] (CFR), Title 40, Parts 141, 142 and 143. (Information also available from the Environmental Protection Agency (EPA) Drinking Water Hot Line - 800-426-4791.)

B4 **Surfaces**

B4.1 *Product Contact Surfaces:* Shall mean surfaces in contact with culinary steam from the inlet of the sanitary check valve to the point of attachment at the equipment in which it shall be used.

B4.3 *Nonproduct Contact Surfaces:* Shall mean all other exposed surfaces.

C **MATERIALS**

C1 **Metals**

C1.1 Product contact surfaces shall be of stainless steel of the American Iron and Steel Institute (AISI) 300 8 Series[2] or corresponding Alloy Cast Institute[3] (ACI) types (See Appendix, Section E.), or metal which under conditions of intended use is at least as corrosion resistant as stainless steel of the foregoing types, and is nontoxic and nonabsorbent, except that:

C2 **Nonmetals**

C2.1 Rubber and rubber-like materials may be used for gaskets and parts having the same functional purposes.

C2.1.1 Rubber and rubber-like materials when used for the above specified application(s) shall conform with the applicable provisions of the 3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Number 18-.

C2.2 Plastic materials may be used for gaskets and parts having the same functional purposes.

C2.2.1 Plastic materials when used for the above specified application(s) shall conform with the applicable provisions of the 3-A Sanitary Standards for

Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Number 20.

C3 **Culinary Steam Filters**

C3.1 Culinary steam filters shall consist of materials which, under the conditions of intended use, are nontoxic, nonmedia releasing, and do not release toxic volatiles or other contaminants to the steam.

C3.2 Bonding materials in the filter media, if used, shall be nontoxic[4], nonvolatile, and insoluble under all conditions of use.

D **FABRICATION AND INSTALLATION**

D1 Product contact surfaces shall be readily accessible for cleaning and inspection either when in an assembled position or when removed. Demountable parts shall be readily removable using simple hand tools, if necessary, available to operating and cleaning personnel.

D2 The system shall include the following components and shall be installed in the sequence listed below:

D2.1 An entrainment separator capable of removing particles 10 microns in size and larger, and with an associated condensate trap.

D2.2 A filter capable of removing 95% of the particles 2 microns in size or larger, and with an associated condensate trap.

D2.2.1 The system shall be provided with a method for measuring differential pressure across the filter media to indicate the need for filter replacement or cleaning of reusable filters.

D2.2.2 Disposable filter media shall not be cleaned and reused.

D2.3 A means of sampling the steam or condensate downstream of the filtering device.

D2.4 A sanitary check valve meeting the applicable provisions in 3-A Sanitary Standards for Vacuum Breakers and Check Valves for Milk and Milk Products (Formerly 08-17 M), Number 58-.

D3 The system may include the following optional components: valves, orifices, strainers, pressure gauges and piping for control and convenience in operation.

D4 Stainless steel pipe, fittings, and valves shall be used downstream of the filter.

D5 Sanitary tubing, fittings, valves, and instrument connections shall be used downstream of the sanitary check valve.

D6 **Sanitary Tubing**

D6.1 All metal tubing shall conform with the applicable provisions for welded sanitary product pipelines found in the 3-A Accepted Practices for Permanently Installed Product and Solution Pipelines and Cleaning Systems Used in Milk and Milk Product Processing Plants, Number 605- and with the 3-A Sanitary Standards for Polished Metal Tubing for Dairy Products, Number 33-.

D7 **Sanitary Fittings**

D7.1 All sanitary fittings, connections and throttling valves, if used, shall conform with those applicable provisions of the 3-A Sanitary Standards for Sanitary Fittings for Milk and Milk Products (Formerly 08-17), Number 63-, 3-A Sanitary Standards for Compression-Type Valves for Milk and Milk Products (Formerly 08-17 A), Number 53- or 3-A Sanitary Standards for Pressure Reducing and Back Pressure Regulating Valves for Milk and Milk Products (Formerly 08-17 N), Number 64-.

D8 **Instrument Connections**

D8.1 All instrument connections having product contact surfaces shall conform with the applicable provisions of the 3-A Sanitary Standards for Sensors and Sensor Fittings and Connections for Milk and Milk Products Equipment, Number 09-.

APPENDIX

E **STAINLESS STEEL MATERIALS**

Stainless steel conforming to the applicable composition ranges established by AISI for wrought products, or by ACI for cast products, should be considered in compliance with the requirements of Section C1.1 herein. Where welding is involved, the carbon content of the stainless steel should not exceed 0.08%. The first reference cited in C1.1 sets forth the chemical ranges and limits of acceptable stainless steel of the 300 Series. Cast grades of stainless steel corresponding to types 303, 304, and 316 are designated CF-16F, CF-8, and CF-8M, respectively. The chemical compositions of these cast grades are covered by ASTM specifications[5] A351/A351M, A743/A743M and A744/A744M.

F **BOILER FEED WATER**

F1 Safe water or water supplies acceptable to the regulatory jurisdiction should be used.

G **BOILER OPERATION**

G1 A supply of clean, dry steam is necessary for proper equipment operation; therefore, boilers and steam generation equipment should be operated in such a manner as to prevent foaming, priming, carry-over and excessive entrainment of boiler water into the steam. Carry-over of boiler water additives can result in the production of off-flavors. Manufacturers' instructions regarding recommended water levels and blow-downs should be consulted and rigorously followed. The blow-down of the boiler should be carefully watched, so that over-concentration of the boiler water solids and foaming are avoided. It is recommended that periodic analysis be made of condensate samples. Such samples should be taken from the condensate outlet of the final steam separating equipment or the line between the final steam separating equipment and the point of the introduction into the process equipment.

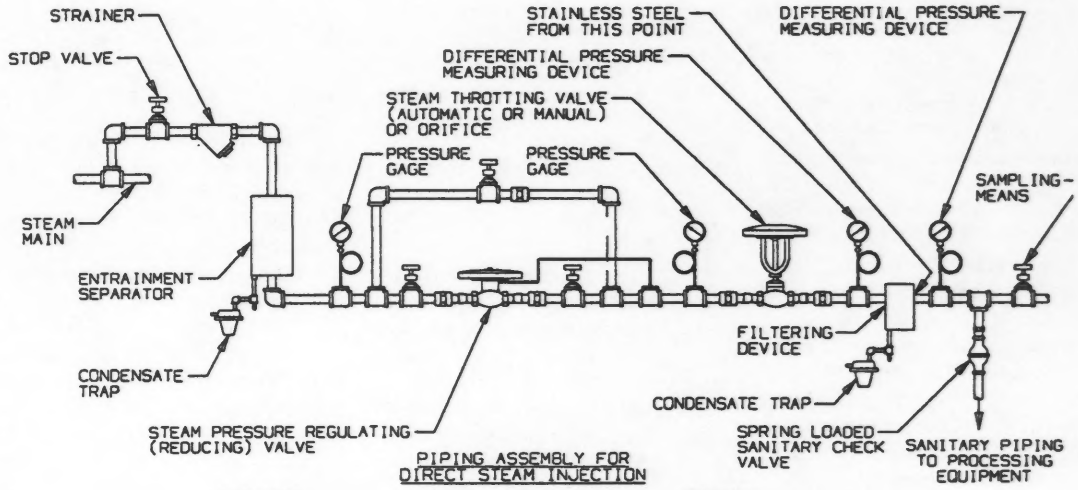
G2 Most boiler feed water must be treated to prevent corrosion and scale in boilers and/or to facilitate sludge removal for proper boiler care and operation.

Boiler feed water treatment and control shall be under the supervision of trained personnel or a firm specializing in industrial water conditioning. Such personnel should be informed that the steam is to be used for culinary purposes. Pretreatment of feed water for a boiler or steam generating system, to reduce water hardness before entering the boiler or steam generator by ion exchange or acceptable procedures, is preferable to addition of condition compounds to boiler water. The list of boiler water additives that may be safely used in the preparation of culinary steam will be found in the Code of Federal Regulations, Title 21, Chapter 1, Part 173, Subpart D, Section 173.310. Boiler compounds containing cyclohexlamine, diethylaminoethanol, hydrazine, morpholine, octadecylamine and trisodium nitriotriacetate are not permitted. Greater amounts of boiler water treatment compounds should not be used other than the minimum necessary for controlling boiler scale or other boiler water treatment purposes and no greater amount of steam should be used than necessary. Tannin is also frequently added to boiler water to facilitate sludge removal during boiler blow-down. This product, although included in the list of approved boiler additives, has been reported to give rise to odor problems and for this reason should be used with caution.

H DIAGRAMS

H1 This diagram is intended to demonstrate general principles only, and are not intended to limit individual ingenuity. The design used should conform with the sanitary requirements set forth in these 3-A Accepted Practices. The following example is included in this Appendix:

3-A PRACTICE
DIRECT STEAM INJECTION
3-A-609-01



PIPING ASSEMBLY FOR DIRECT STEAM INJECTION

REQUIRED

1. ENTRAINMENT SEPARATOR
2. FILTERING DEVICE
3. DIFFERENTIAL PRESSURE MEASURING DEVICE
4. MEANS OF SAMPLING CONDENSATE
5. SANITARY CHECK VALVE
6. CONDENSATE TRAPS

OPTIONAL

1. STRAINER
2. STEAM PRESSURE REGULATOR
3. STEAM THROTTLING VALVE
4. ORIFICES
5. PRESSURE GAUGES

These revised Practices shall become effective November 20, 1994, at which time 3-A Accepted Practices for a Method of Producing Steam of Culinary Quality, Number 609-00 shall become null and void.

[1]For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (202) 783-3238.

[2]The data for this series are contained in the AISI Steel Products Manual, Stainless & Heat Resisting Steels, November 1990, Table 2-1, pp. 17-20. Available from the American Iron and Steel Society, 410 Commonwealth Drive, Warrendale, PA 15086 (412) 776-1535.

[3]Steel Founders Society of America, Cast Metal Federation Building, 455 State Street, Des Plaines, IL 60016 (708) 299-9160.

[4]Adhesives shall comply with 21 CFR 175 - Indirect Food Additives: Adhesives and Components of Coatings. Document for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (202) 783-3238.

[5]Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187 (215) 299-5400.

Coming Events

APRIL

•**3, GMP Seminar,** St. Louis, MO. Presented by ASI Food Safety Consultants. Learn the dos and don'ts of GMPs. For more information call (800) 477-0778; in MO (314) 725-2555; fax (314) 727-2563.

•**3-5, Management of Technology,** a short course offered by the American Association of Cereal Chemists (AACC) in Chicago, IL. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

•**4, HACCP Seminar,** St. Louis, MO. Presented by ASI Food Safety Consultants. Learn how to develop and implement your own HACCP program. For more information call (800) 477-0778; in MO (314) 725-2555; fax (314) 727-2563.

•**4-7, Pasta and Durum Wheat,** a short course offered by the American Association of Cereal Chemists (AACC) in Fargo, ND. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

•**5, Food Biotechnology 101 — A Primer,** Sheraton Crystal City, Arlington, VA. Sponsored by the Food Processors Institute in cooperation with the National Food Processors Association. For more information, call FPI at (202) 393-0890; fax (202) 637-8068.

•**6, Seminar to Discuss Food Recall Crisis Management,** Washington, DC.; sponsored by the American Institute of Baking in cooperation with the U.S. Food and Drug Administration. Tuition fee is $295. For more information, contact the Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502 or call (913) 537-4750 or (800) 633-5137.

•**10-12, SERVSAFE® Serving Safe Food Seminar,** San Francisco, CA. Presented by the Educational Foundation of the National Restaurant Association, the seminar will feature the new Serving Safe Food Certification Coursebook. Cosponsored by the California Restaurant Association, located at the San Francisco Airport Marriott. For fees and more information, contact The Educational Foundation's customer service department at (800) 765-2122.

•**11-13, Seminar to Discuss Pretzel Production Technology,** Manhattan, KS. Tuition fee is $525. For more information, contact the Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502 or call (913) 537-4650 or (800) 633-5137.

•**12-14, Marketing for the Technical Manager,** a short course offered by the American Association of Cereal Chemists (AACC) in Minneapolis, MN. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

•**24-26, SERVSAFE® Serving Safe Food Seminar,** Chicago, IL. Presented by the Educational Foundation of the National Restaurant Association, the seminar will feature the new Serving Safe Food Certification Coursebook. Located at the Midland Hotel. For fees and more information, contact The Educational Foundation's customer service department at (800) 765-2122.

•**24-26, SERVSAFE® Serving Safe Food Seminar,** New Orleans, LA. Presented by the Educational Foundation of the National Restaurant Association, the seminar will feature the new Serving Safe Food Certification Coursebook. Co-sponsored by the Louisiana Restaurant Association, located at the Holiday Inn Crown Plaza. For fees and more information, contact The Educational Foundation's customer service department at (800) 765-2122.

•**25-28, Dough Reology,** a short course offered by the American Association of Cereal Chemists (AACC) in Rutgers University, NJ. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

MAY

•**1-3, NIR Technology,** a short course offered by the American Association of Cereal Chemists (AACC) in Chicago, IL. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

•**2-4, Seafood Quality Evaluation Workshop for Analytical Laboratories and the Seafood Industry,** National Marine Fisheries Service Western Inspection Branch, Bell, CA. Cosponsored by the Univ. of CA Sea Grant Extension Program, U.S. Food and Drug Administration, U.S. Dept. of Commerce, and National Food Processors Association. For more information, contact Pamela Tom, Food Science and Tech. Dept., UC Davis, Davis, CA 95616-8598; telephone (916) 752-3837; fax (916) 752-4759; e-mail pdtom@ucdavis.edu.

•**8-10, Introduction to Food Chemistry,** a short course offered by the American Association of Cereal Chemists (AACC) in Chicago, IL. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

• **14-16, Natural Packaging in the Cold Storage of Food,** Montreal, Quebec, Canada. Program 1: Production and Characteristics of Natural Packaging; Program 2: Use of Natural Packaging for Refrigerated Products; Program 3: Disposing of Natural Packaging; and Program 4: Natural Packaging – Irradiation and Refrigeration Technology. For more information, contact Mr. Marco Lagimoniére, Co-coordinator, Food Research and Development Center, 3600 Casavant Blvd. West, St. Hyacinthe, Quebec, Canada; telephone (514) 773-1105; fax (514) 773-8461.

• **14-19, The First Pan American Conference on Food Safety,** Mexico City, Mexico. For more information, contact Lili Merritt, Director Meetings and Conferences, International Life Sciences Institute, 1126 Sixteenth St., NW, Washington, DC 20036; telephone (202) 659-0074; telex 6814107 NUFOUND; fax (202) 659-3859.

• **16-19, Water Activity and Stability of Drugs, Foods, and Biologics,** a short course offered by the American Association of Cereal Chemists (AACC) in St. Paul, MN. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

• **22-25, Wet Milling,** a short course offered by the American Association of Cereal Chemists (AACC) in Champaign-Urbana, IL. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

JUNE

• **19-30, Postharvest Technology Short Course,** UC Davis Campus. Topics include an overview of harvesting and postharvest handling systems, preparation for market, storage methods and equipment, transport systems and environmental control, energy use in postharvest procedures, and appropriate technology for postharvest handling of horticultural crops in developing countries. The fees are $475 for one week, and $725 for both weeks. For more information or to enroll, call toll free in CA (800) 752-0881; outside CA call (916) 757-8777.

• **20-21, Starch: Structure, Properties, and Food Uses,** a short course offered by the American Association of Cereal Chemists (AACC) in Heverlee, Belgium. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

• **22-23, Batter and Breading Technology,** a short course offered by the American Association of Cereal Chemists (AACC) in Chorleywood (London) UK. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

• **26-27, Chemical Leavening,** a short course offered by the American Association of Cereal Chemists (AACC) in Chorleywood (London) UK. For more information, contact Marie McHenry, Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; telephone (612) 454-7250; fax (612) 454-0766.

NOVEMBER

• **4-6, 6th Egyptian Conference of Dairy Science and Technology,** Cairo, Egypt, organized by The Egyptian Soc. of Dairy Science. For more information, contact Dr. M. H. Abd El-Salam, National Research Center, Dokki, Cairo, Egypt; telephone (20-2-625 026) or fax (20-2-700 931).

Advertising Index

IAMFES Offers the Dairy Practices Council
"Guidelines for the Dairy Industry"

IAMFES has agreed with the Dairy Practice Council to distribute their *"Guidelines for the Dairy Industry."* DPC is a non-profit organization of education, industry and regulatory personnel concerned with milk quality and sanitation throughout 15 northeastern/mid-Atlantic states. However, its membership and subscriber rosters list individuals and organizations throughout the United States, Canada and Japan.

For the past 25 years, DPC's primary mission has been the development and distribution of educational guidelines directed to proper and improved sanitation practices in the production, processing, and distribution of high quality fluid milk and manufactured dairy products.

The DPC Guidelines are written by professionals who comprise five permanent Task Forces. Prior to distribution, every Guideline is submitted for approval to the key milk control sanitarian in each of the 15 states which are now active participants in the DPC process. Should any official have an exception to a section of a proposed guideline, that exception is noted in the final document.

The Guidelines are renown for their common sense and useful approach to proper and improved sanitation practices. We think that they will be a valuable addition to your professional reading library.

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3 Selected Personnel in Milk Sanitation
7 Sampling Fluid Milk
8 NE Ext. Publ., Conferences, Short Courses, Correspondence Courses and Visual Aids in Dairying
9 Fundamentals of Cleaning and Sanitizing Farm Milk Handling Equipment
10 Fluid Milk Shelf-Life
11 Sediment Testing and Producing Clean Milk
13 Environmental Air Control & Quality for Dairy Food Plants
14 Clean Room Technology
16 Handling Dairy Products From Processing to Consumption
17 Causes of Added Water in Milk
18 Abnormal Milk--Fieldman's Approach
21 Raw Milk Quality Tests
22 Control of Antibacterial Drugs and Growth Inhibitors in Milk and Milk Products
23 Preventing Rancid Flavors in Milk
24 Troubleshooting High Bacteria Counts of Raw Milk
25 Cleaning and Sanitizing Bulk Pickup and Transport Tankers
28 Troubleshooting Residual Films on Dairy Farm Milk Handling Equipment
29 Cleaning and Sanitizing in Fluid Milk Processing Plants
30 Potable Water on Dairy Farms
31 Composition and Nutritive Value of Dairy Products
32 Fat Test Variations in Raw Milk
33 Brucellosis and Some Other Milkborne Diseases
34 Butterfat Determinations of Various Dairy Products
35 Dairy Plant Waste Management
36 Dairy Farm Inspection
37 Planning Dairy Stall Barns
38 Preventing Off-flavors in Milk
39 Grade A Fluid Milk Plant Inspection
40 Controlling Fluid Milk Volume and Fat Losses
41 Milkrooms and Bulk Tank Installation
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43 Farm Tank Calibrating and Checking
44 Troubleshooting Dairy Barn Ventilation Systems
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46 Dairy Odor Control
47 Naturally Ventilated Dairy Cattle Housing
48 Cooling Milk on the Farm
49 Postmilking Teat Dips
50 Farm Bulk Milk Collection Procedures
51 Controlling the Accuracy of Electronic Testing Instruments for Milk Components
52 Emergency Action Plan for Outbreak of Milkborne Illness in the Northeast
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Preview of the 82nd IAMFES Annual Meeting

Monday Morning — July 31, 1995

Practical Approach to Quality Milk — General Session

- NCIMS Update and Structure of NCIMS
- 3-A Sanitary Standards Now and in the Future
- Laying the Groundwork for HACCP and ISO 9000
- Dairy Product Shelf Life Tests for Quality Control and Research and Development
- National Mild Drug Residue Database
- Practical Solutions to Pathogens from Milk and/or Other Animal Products
- Design, Installation, and Maintenance of Plate Heat Coolers

Technical Session — Control of Food-borne Microorganisms

- Shelf Life Extension & Safety of Fresh Pork Treated with High Hydrostatic Pressue
- Microbial Monitoring of Irradiated, Commercially-Prepared, Chub-Packed Ground Beef
- Reduction of *Salmonella typhimurium* on Chicken Carcasses Using Pulsed Electricity
- Isolation and Characterization of Gram-negative Bacteria, Isolated from Ground Beef, that Exhibited Inhibition of *Escherichia coli* O157:H7
- Inhibition of a Psychrotrophic *Clostridium* Species by Sodium Diacetate and Sodium Lactate in a Cook-in-the-Bag, Refrigerated Turkey Breast Product
- Inhibitory Effects of Sucrose Fatty Acid Esters, Alone and in Combination with EDIA and Organic Acids, on *Listeria monocytogenes* and *Staphylococcus aureus*
- Evaluation of Colicins for Inhibition Against Diarrheagenic Verotoxigenic *Escherichia coli* Strains
- Inhibition of *Listeria monocytogenes* and *Aeromonas hydrophila* on Cooked Beef by Plant Extracts Combined with Dried Whey Preparations of Antagonistic Bacteria
- Control of *Listeria monocytogenes* on Catfish Fillets (Ictalurus punctatus) Using Food Grade Antimicrobials
- Microbial Decontamination of Fecally Contaminated Carcasses as Affected by Various Temperature Water Sprays and Steam
- Disinfection of Cutting Boards by Microwave Energy

International Approaches to Meat Safety and Quality

- Why Should a Food Producer/Processor Become ISO 9000 Certified?
- Integrated Quality Control in the Pig Sector
- General Principles of ISO 9000 and ISO 45000: HACCP, TQM and ISO Links
- An Integrated System of ISO 9000 and ISO 45000 Certificates in the Control of Food Hygiene
- Quality Systems in a Canadian Meat Processing Operation
- Application of HACCP Principles and Beyond: Beef Slaughter and Fabrication

An Introduction to Molecular Typing Methods for the Food Microbiologist (Sponsored by ILSI)

- A General Introduction to the Hows and Whys of Molecular Typing
- Riboprint – A Novel Automated Ribotyping Method for Molecular Typing of Food-borne Microorganisms
- RAPD Typing of Food-borne Pathogens – An Overview
- The Use of PFGE for the Molecular Typing of Food-borne Pathogens
- Methods for Data Capture, Analysis, and Interpretation of Electrophoretic Gels

Posters — Growth/Behavior of Food-borne Microorganisms

- Growth of *Listeria monocytogenes* and Listeriolysin O Secretion in Broth Containing Salts of Organic Acids
- Heat-resistance of *Listeria monocytogenes* Increases when Production of Osmoprotectants is Induced
- The Incidence of Pathogenic Microorganisms in Aquacultured Rainbow Trout (*Oncorhynchus mykiss*)
- A Comparision of Quantitative Levels of *Escherichia coli* O157:H7, *Klebsiella pneumoniae*, *Campylobacter*, and *Salmonella* in Fresh Blue Crab (*Callinectes sapidus*)

- Survival and Growth of *Escherichia coli* O157:H7 on Produce
- Thermal Resistance of *Aeromonas hydrophila* in Liquid Whole Egg
- The Incidence of Pathogens in Aquaculture Recirculation Water Systems and a Comparision of Their Presence to Fish Size and Stocking Densities
- Growth and Survival of *Listeria monocytogenes* in Minimally Processed Green Beans as Influenced by Modified Atmosphere Packaging, NaCl Treatment and Storage Temperature
- Radiosensitivity of *Listeria monocytogenes* Following Split-Dose Application of Gamma Radiation
- Growth of *Yersinia enterocolitica* on Osmotically Dehydrated Broccoli Packaged in Modified Atmospheres and Stored at 10°C
- Survival/Growth of Gram-Positive Bacteria in Reconditioned, Potable, and Non-chlorinated Water
- Presence of *Listeria* Species in Market Beef
- Susceptibility of Pre-evisceration Washed Carcasses to Contamination by *Escherichia coli* O157:H7 and Salmonellae
- The Potential of Danish Market Cheeses to Support Growth of Food-borne Pathogens
- Influence of Temperature Abuse on Growth of *Clostridium perfringens* from Spores in Cooked Turkey
- Effect of High pH on the Survival of *Salmonella typhimurium, Salmonella newport* and *Campylobacter jejuni* in Poultry Scald Water at 55°C
- Growth of *Salmonella* & *Vibrio cholerae* in Reconditioned Water

Monday Afternoon — July 31, 1995

Practical Approach to Quality Milk — Plant Session

- Technical Challenge in Progressing from Conventional Milk Processing to Aseptic Processing
- Issues of Using Reclaimed Water
- Emergency and Recall Coordination
- Innovations in Plant Design and Processing
- Public Health and Regulatory Aspects of Emerging Milk Plant Technology

Practical Approach to Quality Milk — Farm Session

- Dairy Farmstead Evaluation as a Response to Environmental Issues – University Viewpoint
- Environmental Issues – Dairy Producer Viewpoint
- Design Challenges in Modern Milking Equipment
- Current Cleaning Chemical Technology & Recommendations for Maximum Cleaning Effectiveness
- Futuristic Dairy Farm Design

Technical Session — Detection and Enumeration Methods

- Rapid Multianalyte Immunoassay to Screen for Antibiotic Residues in Milk
- The Rapid Charm Phosphatase Test Conforms with USDA Requirements for Cooked Meat and Gauges Microbial Log Reduction
- Specificity of Four Monoclonal Antibodies Produced Against *Salmonella typhimurium*
- Antigenicity of 35 and 24 kDa Outer Membrane Proteins of *Salmonella*
- A New Petrifilm™ Method for *Enterobacteriaceae* Testing
- Ontario's Inspection Protocol for Undrawn Dressed Poultry (UDP): A Model for Standards Development for Ethnic Markets
- Re-engineering of Licensing Audit for Ontario Abattoirs
- The Application of Risk Assessment and Standard Audit Principles for Compliance Verification in Ontario Inspected Abattoirs
- A Computer Program for Managing a Food-borne Disease Surveillance Network & Compiling Surveillance Data
- International Trends in HACCP

Posters — Control of Food-borne Microorganisms

- Modeling the Effect of Temperature on Growth Rate and Lag Time of *Bacillus Stearothermophilus* Using Variance Stabilizing Transformations
- Antimicrobial Action of a Nisin-Based Treatment Against *Salmonella typhimurium* in Fresh Pork Loin
- Effect of Trisodium Phosphate on *Listeria monocytogenes* Attached to Rainbow Trout
- *Nannocystis exedens* as a Potential Biocompetitive Agent Against Toxigenic *Aspergillus flavus* and *Aspergillus parasiticus*
- Reduction of Food-borne Pathogens on Beef Carcass Tissue Using Sodium Bicarbonate and Hydrogen Peroxide
- Efficacy of Trisodium Phosphate for Killing *Salmonella* on Tomatoes
- Expanded Models for Predicting the Non-Thermal Inactivation of *Listeria monocytogenes*

- Effect of Chlorine Dioxide Spray Washes for Reducing Fecal Contamination on Beef
- Antimicrobial Properties of Volatile Horseradish Distillates
- Effect of Processing Protocols on the Quality of Aquacultured Fresh Catfish Fillets
- A Model for the Effects of Temperature, pH and Lactate on the Survival of *Escherichia coli* O157:H7
- Intervention Through the Use of Hand-trimming, Chemical Sanitizers and Hot Water Spray-Washing to Remove Fecal and Microbiological Contamination from Beef Adipose Tissue
- Influence of Fat Content in Pork Liver Sausage on Growth of *Listeria monocytogenes* and Its Inhibition by Lactate and Sorbate
- Destruction of *Listeria monocytogenes* on Catfish Fillets Using Lactic Acid and Monolaurin
- Sensitization of *Escherichia coli* to Nisin and Lysozyme by High Hydrostatic Pressure, EDTA and Chitosan
- Effects of Lactate, Spice Oil, and pH Levels on the Growth and Survival of *Escherichia coli* O157:H7 at 35 and 4°C
- Comparison of Mathematical Models to Estimate Growth Rate of *Escherichia coli* O157:H7 at Fluctuation Temperatures
- A Survey of College Students' Knowledge of Food Safety & Home Food Preparation Practices
- Feasibility of Using Food Grade Food Additives to Control the Growth of *Clostridium perfringens*
- Effect of Time of Exposure of Beef Fat Fascia to *Escherichia coli* ATCC 11370 on Its Removal by Spray-Washing with Chemical Solutions and 35° or 74° Water
- Sensitivity of Six Strains of *Listeria monocytogenes* to Nisin in Broth at pH 5, 6 and 7
- Ecology and Control of Bread Spoilage by Rope

Tuesday Morning — August 1, 1995

Hurdles to Improve Safety and Quality of Ready-To-Eat (RTE) Meats

- Pretreatment of Meat in the Slaughter Process
- Food Additives in Processed Meats
- Packaging and Storage Conditions to Enhance Meat Safety
- Elimination of Pathogens on Red Meats with Irradiation
- Novel Approaches in Hurdles Technology
- Hurdles in Getting Hurdle Approval

Technical Session — Growth/Behavior of Food-borne Microorganisms

- Influence of pH and Incubation Temperature on Virulence and Fatty Acids of *Yersinia enterocolitica*
- Growth of *Listeria monocytogenes* and *Yersinia enterocolitica* on Cooked Poultry Stored Under Modified Atmosphere at 3.5, 6.5 and 10°C
- Natural Occurrence of *Listeria monocytogenes* in Fresh Blue Crab (*callinectes sapidus*) Meat & Its Growth Characteristics at Refrigeration Temperatures
- The Effect of Iron Levels on Growth, Toxicity and Adherence of Enterohemorrhagic *Escherichia coli*
- Acid Adaptation in *Listeria monocytogenes* Scott A
- Stress Protein and Fatty Acid Composition Effects on Heat Resistance of *Escherichia coli* O157:H7
- Survival Characteristics & Injury of *Escherichia coli* O157:H7 During Conventional & Microwave Heating at Constant Temperatures
- Comparison of D_{55C} Values of Antibiotic-resistant and Antibiotic-sensitive Strains of *Salmonella*
- Biological Characterization of *Enterobacter sakazakii*
- Spoilage Ecology of Vacuum-Packaged Vienna Sausages

Emerging Issues in Microbiological Food Safety (Sponsored by ILSI)

- Bovine Spongiaform Encephalopathy – Potential Risk from Foods
- Survival of *Cryptosporidium oocystes* in Beverages
- Growing Concerns and Recent Outbreaks of Enterohemorrhagic *Escherichia coli* - non-O157:H7
- Staphylococcus – Are There Coagulase Negative Toxigenic Strains on the Horizon?
- *Arcobacter* and *Helicobacter* - Risks for Foods and Beverages
- Dealing with an Expanding, Global Food Supply

Poster Session — Detection and Enumeration Methods

- Genomic Fingerprinting of *Bifidobacterium* spp. from an Infant
- Evaluation of Universal Preenrichment Versus Lactose Broth Plus Various Plating Media for Isolating Salmonellae from Naturally Contaminated Fresh Chicken and Pork Sausage
- Evaluation of an Automated Assay for the Detection of *Listeria monocytogenes* in Food Products
- Optimization of Polymerase Chain Reaction Parameters Utilizing an Experimental Design Approach

- Antibiotics and Sulfonamides in Meat Samples Destined to Human Consumption
- Biodegradation of Aflatoxins by *Flavobacterium aurantiacum* in Culture Media
- Lightning™: Introduction of a Machine-Side Rapid Hygiene Monitoring System
- Evaluation of Microbial Swabs for Releasing HCMC and Their Viability on Ice Using 3M™ Petrifilm™
- A New Rapid Method for the Detection of *Escherichia coli* O157 in Raw Meat
- Detection of *Escherichia coli* O157:H7 in Foods by Multiplex PCR
- Determination of Trace Elements in Muscle, Liver & Kidney from Pork Produced in Sonora, Mexico
- Chemical and Mineral Analysis of Surimibased Seafood Products
- Comparison of ISO-Grid™, DRBC, Petrifilm™, and PDA Pour Plate Methods for Enumerating Yeasts and Molds on Shredded Cheese
- Use of Blue Lake as an Indicator of Bacterial Penetration into Eggs
- Rapid Estimation of Raw Milk Quality
- Evaluation of a Miniaturized Microbial Inhibition Assay for Screening of Antimicrobial Residues in Animal Tissues
- Comparison of Five Media for Enumeration of *Escherichia coli* O157:H7
- The Charm Alkaline Phosphatase Test: Rapid Bioluminescence Method for the Determination of Alkaline Phosphatase in Pasteurized Milk and Other Dairy Products – Collaborative Study
- Charm Cloxacillin Antibody Performance Validated for Bulk Tank Milk
- A New Rapid Method for Detection & Enumeration of *Listeria monocytogenes* in Food Samples
- Validation of Predictive Mathematical Models to Demonstrate Applicability to Foods
- Detection by PCR of *Campylobacter jejuni* in Contaminated Chicken Products
- E*Colite, The New Standard in Monitoring Coliforms & *Escherichia Coli* Contamination in Water

Tuesday, August 1, 1995 — Afternoon

General Session — Equivalency of Inspection — Impact of NAFTA and GATT

- Equivalency of Inspection – Practical Realities in the Real World
- The European Perspective on Equilibrating International Meat and Poultry Inspection Systems

Wednesday, August 2, 1995 — Morning

Current Issues in Food Services A Practical Symposium — Part 1

- Food Code – A Practical Approach
- Plan Review – Standardization for Efficiency
- Integrated Pest Control in Food Facilities
- Equipment Cleaning and Sanitization
- Overcoming the "All or Nothing" Approach to HACCP Implementation at the Retail Level

Minimally-Processed Packaged Vegetables

- Fresh Produce Processing – A Global Industry Perspective
- The Effect of Farm Management Practices on the Microbial Condition of Fresh Minimally-Processed Vegetables
- Fresh Produce Processing – Retail Industry Perspective
- Factors Important in Determining Shelf Life of Minimally-Processed Vegetables
- What's New in Modified-Atmosphere Packaging of Fresh Cut Packaged Vegetables
- Presence and Public Health Implications of Food-borne Pathogens on Minimally Processed Packaged Vegetables
- Present and Emerging Control Measures for Minimally-Processed Packaged Vegetables

Alternative Processing Strategies for Pasteurization of Foods

- Radurization – The Pasteurization of Foods by Ionizing Radiation
- High Pressure Processing as an Intervention Strategy for Food Safety
- Chemical Treatments for Decontamination of Poultry
- Electrical Properties of Foods and the Application of High Voltage Pulsed Electric Fields Technology
- Oscillating Magnetic Field Stabilization of Foods
- Product Development Considerations for Ohmic Processing

New Emerging Food-borne Disease Agents — Are They for Real?

- The *Campylobacter* Family *(Arcobacter, Campylobacter, and Helicobacter)*
- The Mycobacteria Group (*Mycobacterium Avium, Paratuberculosis and Tuberculosis*)
- New Issues in Food and Environmental Virology
- An Update on Parasites in Food, Water and the Environment

- Interesting Incidents of Food-borne Disease, Including Those from Bluegreen Algae

Wednesday, August 2, 1995 — Afternoon

Current Issues in Food Services
A Practical Symposium — Part 2

- Current Food-borne Pathogen: *Escherichia coli* O157:H7 – A Current Review
- Current Food-borne Pathogen: *Vibrio vulnificus*
- Communicable Diseases: Bare Hand Contact with Food – Why Isn't Hand Washing Good Enough?
- Vacuum Packaging
- OSHA in the Workplace

Seafood Symposium

- Update on Seafood HACCP and Current Regulations
- HACCP Training for Seafood Processors
- Microbiological Seafood Safety: What's New
- The Seafood Hotline: What Questions Do Consumers Ask?
- The Safety of Mail Order Seafood

ILSI N.A. — Sponsored Research Update

- Use of Carrot Extract to Control *Listeria monocytogenes*
- Development of a Simple, Sensitive, Quantitative Procedure for Enumerating *Listeria monocytogenes*
- Use of *in vitro* Primer-Directed Enzymatic Amplification of DNA for Rapid Detection of *Listeria monocytogenes:* Studies with Food Samples
- Establishment of a Bovine Surveillance Program for *Escherichia coli* O157:H7 in Washington State
- Lipid Compounds as Novel Barriers for Control of *Listeria monocytogenes*
- Application of Novel Bacteriocins as Biocontrol Agents Towards *Listeria monocytogenes* in Foods: Properties and Inhibitory Effectiveness
- Evaluation of Penicillin Binding Proteins for Subtyping *Listeria monocytogenes*
- Insertion Sequence Finger-Printing: a New Subtyping System for *Escherichia coli* O157:H7 Strains

82nd IAMFES Annual Meeting
Spouse/Companion
Tours and Special Events

A Day of Discovery
Monday, July 31 - 9:00 a.m. — 3:00 p.m.
Cost: $30 ($35 on-site) Lunch on your own

Our tour begins atop Mt. Washington, where the spectacular view of the whole Pittsburgh scene unfolds, a view that prompted Frank Lloyd Wright to call this the world's most beautiful setting for a city. Tourgoers may ride down the hill in an incline, a veritable museum on wheels, and be picked up by the coach at the base.

The Strip, center of the wholesale produce market in Pittsburgh, offers a true potpourri of scents, sights, and sounds. The Society for Art in Crafts, recently moved to The Strip, exhibits an international array of crafts in clay, fiber, metal, wood and a variety of other materials, all created since 1985.

The North Side of Pittsburgh was originally platted as Depreciation Land Grant settlement. Later, in 1848, a group of streets was laid out and named to commemorate battles and personalities of the Mexican War of 1846...Taylor, Resaca, Palo Alto, Buena Vista, Monterey, Sherman and the like. Known as the MEXICAN WAR STREETS, the area was a pleasant, middle-class, residential area with distinctive row-like homes reflecting Italienate, Second Empire, Queen Anne, Richardsonian Romanesque and other Victorian architectural styles. A major decline within the area was reversed in the 1960s to the point that this intriguing neighborhood was placed on the National Register of Historic Places by 1975.

Before returning to the Hilton, one further stop is made: at THE AVIARY, the world's largest birdhouse, where free flying feathered friends in brilliant hues present a dazzling display. Now, whoever said Pittsburgh was for the birds is proven to be correct!

Amish Country
Tuesday, August 1 - 9:00 a.m. - 5:00 p.m.
Cost: $30 ($35 on-site) Lunch on your own

The Amish is one of the most distinctive societies in America today. In 1693 Jacob Amman, their founder, brought these gentle people to this country from Switzerland. By the mid-18th century, hundreds had settled in Pennsylvania. The rolling countryside of this area of the state attracted the Amish with its fertile land. They befriended the Lenape Indians who had long ago settled here, and today you can witness their still-thriving existence.

This visit among the Amish includes shopping at an Amish home where quilts made by the Amish from as far away as Wisconsin are displayed to tempt the discriminating buyer. In nearby Volant, a 19th Century mill now serves as a country store containing toys, gifts, Amish quilts and furniture sharing space with old mill machinery. In addition to the mill there are over 80 shops and small restaurants that will meet anyone's needs.

Five miles south, the holidays come early at the Country House Christmas Shop, a restored Victorian home brimming with enough ornaments, gifts and decorations to make one forget December is several months away. A cool drink is served on the return trip to Pittsburgh.

A Day at the Carnegie & Station Square
Wednesday, August 2 - 9:00 a.m. - 3:00 p.m.
Cost: $30 ($35 on-site) Lunch on your own

Andrew Carnegie's gift to the people of Pittsburgh, THE CARNEGIE, houses four cultural centers under one roof. The MUSEUM OF ART is highly regarded for its permanent collection ranging from the old masters to the contemporary, with a fine representation of The Impressionists. A specially-arranged one hour tour, conducted by a trained museum docent, gives insight and enhancement to the fabulous works of renowned artistic masters. With time to explore on one's own (one-half hour) following the tour, a wealth of treasures await at The Carnegie. The Hillman Hall of Minerals and Gems displays over 2000 dazzling specimens and the world famous dinosaur collection is but a short walk away.

Then it's All Aboard for STATION SQUARE, the lively riverfront restoration of the former P. & L.E. Railroad, now a complex of exciting shops, boutiques, historic memorabilia and fine restaurants.

Following this delightful respite, guests will enjoy shopping on their own in the Freight House Shops before returning to the Hilton.

Children's Activity Room
July 31 - August 2 - 8:30 a.m. - 4:00 p.m.
Cost: Free

A children's activity room will be available for children ages 4 - 12. The children's room will consist of adult supervision and structured activities.

Monday Night Social Event
An Ethnic Evening on the Three Rivers
July 31 - 6:00 p.m. - Cruise until 10:30 p.m.
Cost: $45 ($50 on-site)

The ethnic variety of Pittsburgh's people contributes to its cultural richness. Influenced by the more than seventy distinct nationality groups that have claimed Pittsburgh as their home, an unforgettable dinner cruise has been created to combine the music and food representing a selection of the countries that have so enhanced this area.

At the Hilton, we will escort you through Point State park to board the magnificent sternwheeler, the Gateway Clipper Fleet's Party Liner. Pittsburgh's three rivers set the stage for an unforgettable event, as the evening sun, glistening on the waters and reflecting on the majestic buildings of this vital city, creates a rare backdrop for this festive evening.

Following dinner, guests will be entertained by Don Brockett's Company, an action packed frolicking family variety show that everyone is sure to enjoy!

The evening draws to a close as guests view the spectacular evening lights of the city and are returned to Point State Park for the guided walk back to the Hilton.

Traditional IAMFES Gatherings
Ivan Parkin Lectureship
Sunday, July 30 - 7:00 p.m.

Followed by the Cheese and Wine Reception for the Opening of the Education Exhibits. An opportunity to greet old friends, make new ones and view the excellent technical displays.

IAMFES Annual Awards Reception and Banquet Wednesday, August 2
Reception: 6:00 p.m. Banquet: 7:00 p.m.
Cost: $30 ($35 on-site)

IAMFES Kids Pizza Banquet
Wednesday, August 2 - 6:30 p.m. - 9:30 p.m.
Cost: $15 ($20 on-site)

Adult supervised for children ages 4 and up. Pizza, pop and activities will be provided.

82nd IAMFES Annual Meeting Registration Form

Hilton Hotel & Towers — Pittsburgh, PA — July 30 - August 2, 1995
(Use photocopies for extra registrations)

FOR OFFICE USE
Registration # _____ Date Rec'd. _____ First initial _____ Last name _____

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

Title Employer

Mailing Address (Please specify: Home or Work)

City State Country Postal/Zip Code

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Telephone # Fax #

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Please check where applicable:
- ___ IAMFES Member
- ___ Non-Member
- ___ Local Arrangements
- ___ 30 Yr. Member
- ___ 50 Yr. Member
- ___ Past President
- ___ Executive Board
- ___ Speaker
- ___ Honorary Life Member
- ___ Exhibitor
- ___ IAMFES Sustaining Member
- ___ IAMFES Program Advisory Committee

Sign up to become a NEW member
and take advantage of the member discount.

REGISTRATION:	MEMBERS	NON-MEMBERS	AMOUNT
Registration (Banquet included)	$170 ($205 on-site)	$250 ($285 on-site)	_____
Student Member	$ 20 ($ 25 on-site)	Not Available	_____
One Day Registration (Circle: Mon/Tues/Wed)	$ 90 ($110 on-site)	$120 ($140 on-site)	_____
Spouse/Companion (Name): _____	$ 25 ($ 25 on-site)	$ 25 ($ 25 on-site)	_____
Children (14 & Under), Name: _____	FREE	FREE	_____

NEW MEMBERSHIP FEES:		
Membership with *Dairy, Food & Environmental Sanitation*	$ 60	_____
Membership with *Dairy, Food & Env. Sanitation & Journal of Food Protection*	$ 90	_____
•Student Membership ❒ *Dairy, Food & Env. San.* or ❒ *Journal of Food Protection*	$ 30	_____
•Student Membership with *Dairy, Food & Env. San. & Journal of Food Protection*	$ 45	_____
•Full-time student verification required.		
SHIPPING CHARGES: OUTSIDE THE U.S. - SURFACE RATE	$ 22.50 per journal	_____
AIRMAIL	$ 95.00 per journal	_____

OTHER FEES:	PER PERSON		
Cheese and Wine Reception (Sun., 7/30)	FREE	_____	_____
An Ethnic Evening on the Three Rivers (Mon., 7/31)	$ 45 ($ 50 on-site)	_____	_____
IAMFES Awards Banquet (Wed., 8/2)	$ 30 ($ 35 on-site)	_____	_____
Children's Banquet (Wed., 8/2)	$ 15 ($ 20 on-site)	_____	_____

SPOUSE/COMPANION EVENTS:	PER PERSON		
A Day of Discovery (Mon., 7/31)	$ 30 ($ 35 on-site)	_____	_____
Amish Country (Tues., 8/1)	$ 30 ($ 35 on-site)	_____	_____
A Day at the Carnegie & Station Square (Tues., 8/2)	$ 30 ($ 35 on-site)	_____	_____

❒ Please indicate here if you have a disability requiring special accommodations.

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Registration Information

Send payment with registration to IAMFES, 6200 Aurora Avenue, Suite 200W, Des Moines, IA 50322-2838. Make checks payable to IAMFES. Pre-registration must be post-marked by June 30, 1995. The pre-registration deadline will be strictly observed. For additional information contact Julie Heim at 1-800-369-6337.

Refund/Cancellation Policy

The IAMFES policy on refunds and/or cancellations is as follows: Registration fees, minus a $35 processing fee, will be refunded for written cancellations post-marked by July 15, 1995. No refunds will be made for cancellations post-marked after July 15, 1995, however, the registration may be transferred to a colleague with written notification to IAMFES.

Exhibitor Information

An exhibition of products and consulting services will be at the Hilton Hotel & Towers. For more information on exhibiting at the conference, please contact Rick McAtee at 1-800-369-6337.

Guest Room Committment
GOOD UNTIL JUNE 30, 1995
Make Your Reservation Now

HOTEL RESERVATIONS
IAMFES

82nd Annual Meeting
July 30-August 2, 1995
Hilton Hotel & Towers
Pittsburgh, PA

Please check accommodation requested:

❑ Single (1 person) ❑ Triple (3 persons)
❑ Double (2 persons) ❑ Quad (4 persons)

Bed type:

❑ King Bed
❑ 2 Queen Beds

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❑ Please indicate here if you have a disability requiring special accommodations.
All room rates are subject to prevailing taxes.
Reservations must be received by hotel prior to arrival.

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SPECIAL REQUESTS _____

After June 30, 1995 reservations will be accepted on a space availability basis only. Reservations will be held until 6:00 p.m. on the date of arrival, unless guaranteed by one night advance deposit, payable by certified check or a Major Credit Card.

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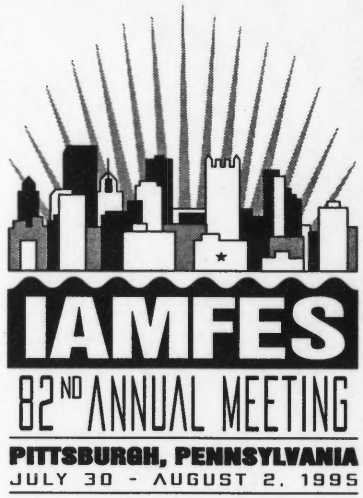

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☐ Membership with DFES $60
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☐ Check here if you are interested in information on joining your state/province chapter of IAMFES

SUSTAINING MEMBERSHIP

☐ Membership with BOTH journals $450
(Includes exhibit discount, July advertising discount, company monthly listing in both journals and more)

STUDENT MEMBERSHIP

☐ Membership PLUS including both journals $45

☐ Membership with *Journal of Food Protection* $30

☐ Membership with *Dairy, Food and Environmental Sanitation* $30

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International Association of Milk, Food and Environmental Sanitarians, Inc.

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Quantity | Total $

_____ Procedures to Investigate Waterborne Illness — _____
$6.00 member or government; $9.00 non-member

_____ Procedures to Investigate Foodborne Illness - 4th Edition — _____
$6.00 member or government; $9.00 non-member

_____ Procedures to Investigate Arthropod-borne and Rodent-borne Illness — _____
$6.00 member or government; $9.00 non-member

_____ Procedures to Implement the Hazard Analysis Critical Control Point System — _____
$6.00 member or government; $9.00 non-member

_____ Pocket Guide To Dairy Sanitation — _____
$.50/member or government; $.75/non-member (minimum order of 10)
($2.50 shipping for each order of 10)

Multiple copies available at reduced prices.
Phone our order desk for pricing information on quantities of 25 or more.

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Company _____

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101	116	131	146	162	176	191	206	221	236	251	266	281	296	311	326	341	356	371	386
102	117	132	147	163	177	192	207	222	237	252	267	282	297	312	327	342	357	372	387
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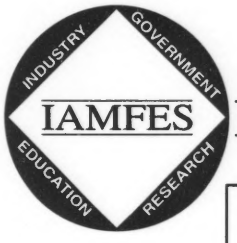

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114	129	144	160	174	189	204	219	234	249	264	279	294	309	324	339	354	369	384	399

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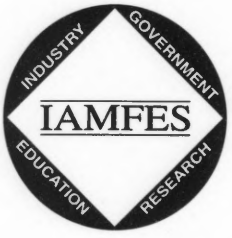

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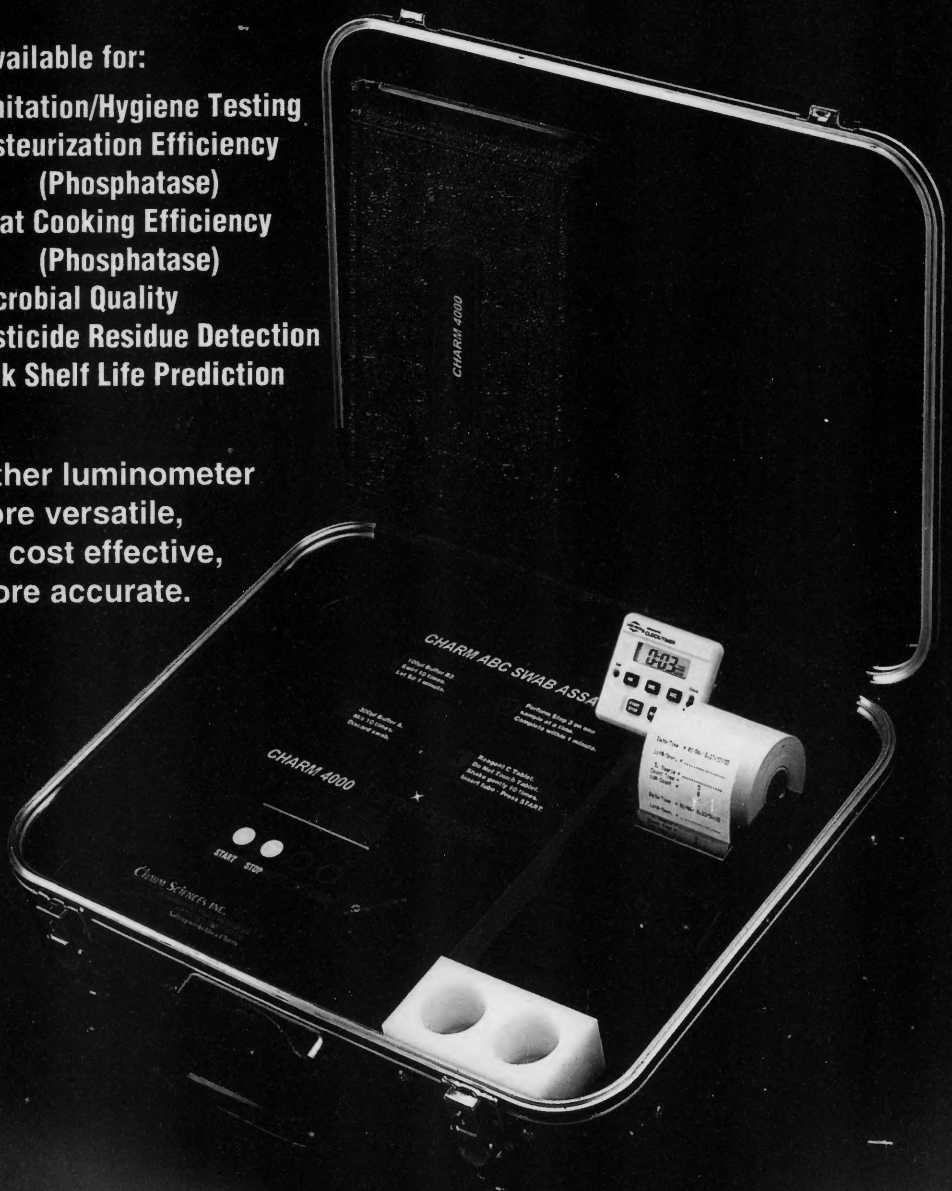

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