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# Dairy and Food Sanitation®

A Publication of the International Association of Milk, Food and Environmental Sanitarians, Inc.

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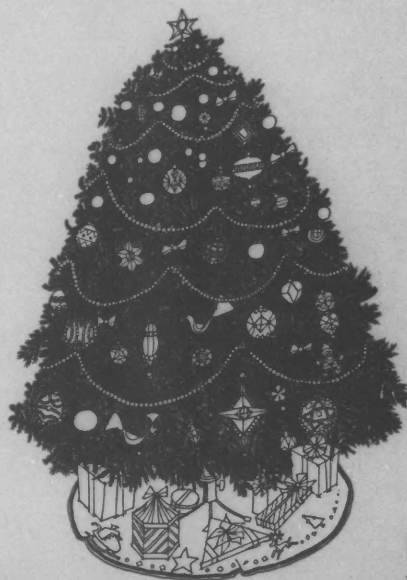
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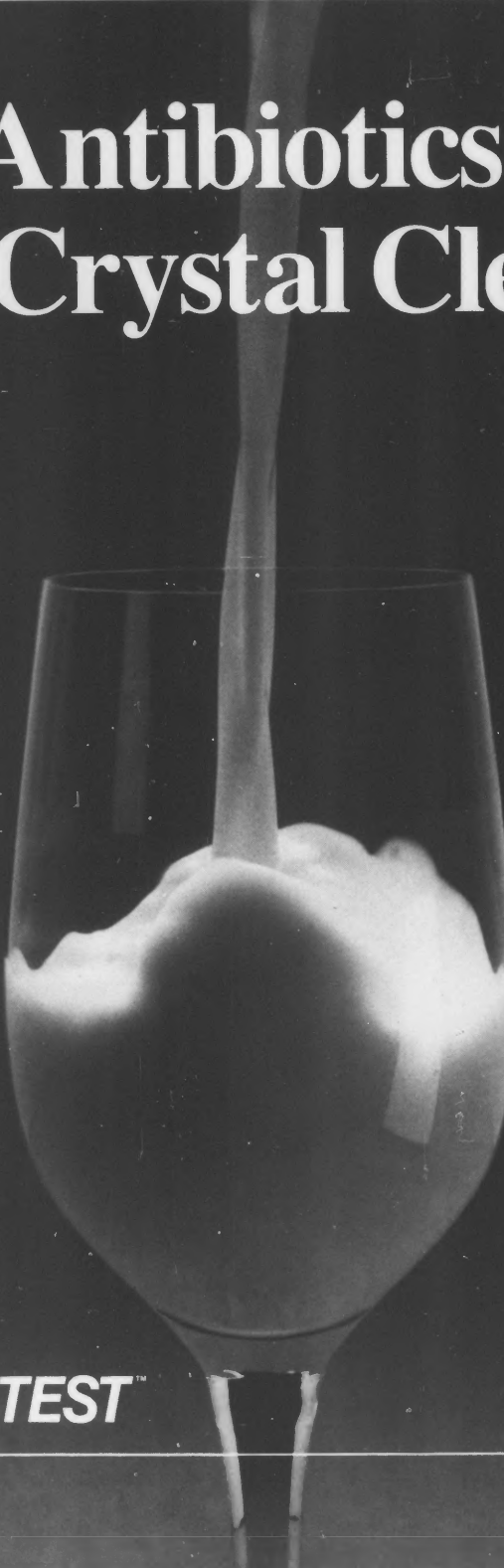
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Five (5) awards will be presented: 1st place, \$500 and a plaque; 2nd place, \$200 and a certificate; 3rd place, \$100 and a certificate; 4th place, \$50 and a certificate; 5th place, \$50 and a certificate.

### ***Purpose***

1. To encourage graduate students to present their original research at the IAMFES annual meeting.
2. To foster professionalism in graduate students through contact with peers and professional members of IAMFES.
3. To encourage participation by graduate students in IAMFES and the annual meeting.

### ***Who Is Eligible***

Graduate students enrolled in M.S. or Ph.D. programs at accredited universities or colleges whose research deals with problems related to environmental, food and/or dairy sanitation, protection and safety. Candidates cannot have graduated more than one (1) year prior to the deadline for submitting abstracts.

### ***Criteria***

1. A short abstract of the paper must be submitted to the IAMFES office by January 1 of each year. (Use the blue abstract forms from the October issue, if possible.)
2. The author must indicate on the abstract form the desire to be considered for the competition.
3. The paper and the student must be recommended and approved for the competition by the major professor or department head.
4. The paper must represent original research done by the student and must be presented by the student.
5. An extended abstract form will be sent to all who enter the competition, and must be completed and returned by the deadline date on that form.
6. Each student may enter only one (1) paper in the competition.
7. Papers are to be presented as oral papers and should be approximately fifteen (15) minutes in length with an additional five (5) minutes allowed for questions, for a total of twenty (20) minutes.
8. The use of slides or other visual aids is encouraged.
9. The papers will be judged by an independent panel of judges.
10. Awards will be presented at the annual IAMFES Awards Banquet.

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# Genetic Manipulation to Improve Food Fermentation

WILLIAM E. SANDINE

Department of Microbiology  
Oregon State University  
Corvallis, Oregon 97331

Paper presented at 12 Annual Technical Seminar, ABC Research Corporation, Gainesville, Florida, February 25, 1986.

Not everyone agrees that genetic engineering of microorganisms used in food fermentations offers hope that process economics or product quality will be greatly improved as a result. I believe they will, but at the same time recognize that even without genetic engineering, much progress will continue to be made. I hope we don't lose sight of the fact that other types of modern food science and microbiological research is still needed. Gene manipulation is very popular and newsworthy today as well as being a valuable research tool. But we shouldn't lose sight of the continued need for balanced research approaches to the important applied problems which exist in the food fermentation industry today.

To begin, I would like to highlight the important fundamental discoveries which now enable us to construct genetically improved microorganisms. It began with the discovery of DNA by Meisher, a Swiss chemist, in 1869. Seventy-five years later, in 1944, Avery and co-workers at The Rockefeller Institute proved that DNA held the genetic determinants for the properties of capsule production and virulence in pneumococci. Transformation, or the use of naked DNA to confer new properties on live recipient cells, was thus discovered. The definition of DNA structure, offered in 1953 by Watson and Crick, paved the way for understanding of the genetic code by 1965. In that same year, plasmids were found in bacteria by several workers and then restriction endonucleases were discovered by Smith and Nathans at Johns Hopkins. Following the isolation and purification of messenger RNA (mRNA), complementary to DNA in the early 1970s, reverse transcriptase was discovered which allowed scientists to make a copy of single stranded DNA complementary to a specific mRNA (cDNA). The cDNA can then be used to produce double stranded (ds) DNA for use in cloning particular genes originating in the original mRNA.

In 1972 the first recombinant DNA molecules were produced at Stanford University by Paul Berg when DNA

from 2 viruses was combined (rDNA). In 1973 Cohen and Boyer announced and subsequently patented the use of replicating bacterial plasmids containing rDNA as a method of amplifying certain gene products. This development was used to attract the attention of venture capitalists to the potential of genetic engineering. In 1977 the first genetic engineering company was founded specifically to use recombinant DNA methods to make agriculturally and medically important drugs and vaccines.

Quite a number of products already have been marketed as a result of rDNA technology. These include human insulin, human growth hormone, interferon, and a number of vaccines from cloned viral and bacterial proteins.

The genetics of bacteria used in food fermentation is still in a relative primitive state as compared to the genetics of such organisms as *Escherichia coli* and *Bacillus subtilis*. These organisms have been extensively studied from a genetic standpoint. But rapid progress with other bacteria is now being made as more scientists are turning their attention to organisms of applied interest. Lactic acid bacteria in particular are under scrutiny because they are widely used in different fermentations, they are edible, they are healthful, they inhibit spoilage and pathogenic bacteria, they can be genetically engineered and there are numerous ways they can be improved.

Bacteria of the "lactic acid type" from at least 9 genera are likely candidates for genetic engineering. These include the rod-shaped organisms from the *Lactobacillus*, *Bifidobacterium*, *Microbacterium* and *Brochothrix* genera; the coccus-shaped bacteria from the *Streptococcus*, *Leuconostoc*, *Pediococcus* and *Micrococcus* genera; and the cocco-bacillary cells of the *Propionibacterium* genus. Of these 9 genera, most genetic studies have been done on the streptococci, lactobacilli, pediococci and *Leuconostoc*, in that order. Herein I will deal only with the *Streptococcus* and *Leuconostoc* genera, organisms which are widely used in milk fermentations.

The streptococci fall into 4 groups and an unknown isolate can be properly grouped by testing it for growth at 10°C and 45°C. Pyogenic streptococci grow at neither temperature, the Viridans at 45°C but not 10°C, the Enterococcus at both temperatures and the Lactic streptococci a 10°C but not 45°C. While there are 6 species of lactic streptococci, we will be considering only those used in controlled milk fermentations, namely, *Streptococcus lactis*, *Streptococcus cremoris* and *Streptococcus*

*diacetylactis*. Characteristics of *Leuconostoc* bacteria, some of which produce diacetyl when growing associatively with lactic streptococci, are well known. While morphologically the same as lactic streptococci, *Leuconostoc* sp. may be easily distinguished by their inertness in litmus milk, their production of D(-) lactate and their resistance to the antibiotic vancomycin.

For carbohydrate fermentations the lactic acid bacteria are either homofermentative (produce only lactate from glucose) or heterofermentative (produce acids, alcohol, CO<sub>2</sub> and lactate from glucose). Therefore they are fermentative rather than respiratory and many genetic experiments center around the lactose fermentation or LAC genes. The phosphoenolpyruvate (PEP) phosphotransferase system (PTS) is used by lactic streptococci to utilize lactose. The lactose is phosphorylated during transport into the cell and then hydrolyzed into glucose plus galactose-6-phosphate by phospho- $\beta$ -galactosidase ( $\beta$ -PGal), rather than  $\beta$ -galactosidase. Of the lactic streptococci, only one strain, *S. lactis* 7962, has  $\beta$ -galactosidase. Genetic studies are also centered around this PEP lactose phosphotransferase system.

Now that we have reviewed background information on lactic streptococci and *Leuconostoc*, let's see what improvements might be desirable for lactic streptococci. What could genetic engineering do to improve the strains? At least 15 can be mentioned ranging from making them phage resistant to non-agglutinable.

From a genetic engineering standpoint, it is fortunate that lactic streptococci contain numerous plasmids. Genetic determinants coded on the plasmids can then be transferred and amplified as chimeric (rDNA) plasmids; that is, plasmids that carry newly introduced DNA from another source. At least 13 different cellular traits are plasmid determined in lactic streptococci, but most are cryptic in that their exact function is unknown.

Restriction/modification (R/M) enzymes are also the object of genetic studies in lactic streptococci. These are enzymes which modify phage DNA so that different efficiencies of plating are expressed when phages replicate on one host and then infect another. Introduction of R/M enzymes by cloning can confer phage resistance on strains and a patent to do this has been issued in Great Britain. These enzymes can also be used to construct restriction digest maps of plasmid and phage DNA. This can be helpful in plasmid and strain identification.

In a typical cloning experiment, plasmid DNA is isolated, fragmented by restriction endonuclease treatment and inserted into a replicating plasmid. Certain restriction enzymes cleave the DNA at sites with palindromic sequences, where 4 base pairs read the same forward and backward.

In order to use reconstructed chimeric plasmid DNA as vectors to introduce new genetic material, we must have an operational system for introducing and replicating the plasmids. Fortunately, five different systems exist for this in lactic streptococci. They are transduction, conjugation, protoplast fusion, transfection and transformation.

Recently we made an exhaustive search for antibiotic resistance markers to be used in genetic experiments. Unfortunately, lactic streptococci are sensitive to practically all antibiotics so there are few opportunities for selection. Except for nisin, high level naturally occurring resistance factors could not be found in any of 38 strains tested. Stepwise mutants resistant to streptomycin, however, can be selected in the laboratory and we also have isolated penicillin resistant strains which produce  $\beta$ -lactamase.

Necessary in genetic experiments is a procedure to isolate covalently closed circular (CCC) plasmid DNA free of chromosomal DNA. Several such procedures using horizontal agarose gel electrophoresis to separate and detect the CCCDNA plasmids have been published. Using these procedures, one can readily determine the plasmid profiles of various lactic streptococci using plasmids isolated from *Escherichia coli* V517 as a known standard. Numerous examples have been published and lactic streptococci are well-known for possessing numerous plasmids, some strains more than 10.

At least two genetic markers are essential for optimal growth performance of lactic streptococci during milk fermentation. These code for lactose utilization (LAC) and protease production (PRT). It has been proven that these determinants are contained on plasmid DNA and these plasmids are unstable, especially if cultures are stressed by over-incubation, antibiotics, phage infection, freezing or storage in the presence of acid end products. As a result, cheese starter cultures frequently lose their rapid acidifying properties important in quality cheesemaking. Unfortunately, we have not yet learned how to stabilize these plasmids. Studies are in progress, however, in various laboratories, in an effort to insert LAC and PRT genes in the chromosome.

This situation has emphasized the need to develop media which would enable us to recognize the four possible RT-LAC phenotypes. We have two media which will do this, called FSDA agars. FSDA I has litmus as an indicator and  $\beta$ -glycerophosphate as a buffer. FSDA II has bromocresol purple as an indicator and trimagnesium phosphate as a buffer. The 4 phenotypes are all clearly distinguishable on these media, which have a variety of uses, including the purification of lactic streptococcal starter strains to rid them of PRT<sup>-</sup> slow acid producing derivatives (see *Bacterial Starter Cultures for Foods*, page 17-18, CRC Press, 1985, S. E. Gilliland, editor).

Earlier I referred to *S. lactis* strain 7962 which possesses  $\beta$ -galactosidase rather than phospho- $\beta$ -galactosidase to hydrolyze lactose. One might expect that plasmids would have no influence on this enzyme in 7962 if it were controlled chromosomally such as in *Escherichia coli*. However, a 45-megadalton plasmid seems to be involved because we have found recently that all LAC<sup>-</sup> derivatives of 7962 lack such a plasmid. More studies are necessary to prove this.

Now I would like to discuss our recent work with *Leuconostoc*, especially concerning plasmids and vancomycin resistance in *Leuconostoc*. We discovered van-



comycin resistance by accident while screening lactic streptococci for sensitivity to this antibiotic. *Streptococcus cremoris* 290 showed a turbid zone of inhibition in response to a vancomycin disk which disappeared when the culture was purified. The contaminant was a *Leuconostoc* and this started us wondering if *Leuconostoc* had plasmids which could code for vancomycin resistance.

Recognized *Leuconostoc* species are *L. mesenteroides*, *L. dextranicum*, *L. cremoris*, *L. paramesenteroides* and *L. oenos*. The latter is important in wine deacidification, especially in Oregon, where grapes mature with a high malic acid content. We applied our plasmid DNA isolation procedure to *Leuconostoc*, using a number of different strains. It turns out that all species have numerous plasmids, except for *L. oenos*. Yet, like other *Leuconostoc*, this species is highly resistant to vancomycin, so plasmids may not be involved. However, our discovery of vancomycin resistance in *Leuconostoc* has proved very useful as a selective marker in conjugation experiments. Because of this, we were encouraged to attempt to move LAC into *Leuconostoc*. We have succeeded at this and are now attempting to move PRT as well. Having LAC<sup>+</sup> PRT<sup>+</sup> strains of *Leuconostoc* available could offer phage resistance and diacetyl flavor stability in lactic starter cultures.

Genetic studies are being done on pediococci and lactobacilli, and numerous publications concerning work on them exist. There is no question that future research will produce exciting findings.

#### Acknowledgement

Part of the findings reported herein were made by P. K. Orberg, H.-j. Tsai and L. Khosravi.

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## Keeping Our Food Safe from Animal Drugs

Besides being responsible for ensuring the safety and effectiveness of human drugs, FDA has a similar, although less well-known, responsibility for veterinary drugs. To a great degree, this involves the safety of these drugs not only for animals but also for people, because of the widespread use of drugs in animals raised for food.

To get a better understanding of how FDA protects the public health from unsafe residues of veterinary drugs in meat, eggs, and milk, FDA Consumer editor Bill Rados interviewed Dr. Gerald Guest, acting director of FDA's Center for Veterinary Medicine.

Reprinted from the July-August 1986 FDA Consumer

**Q.** Dr. Guest, both you and FDA Commissioner Frank Young have been widely quoted in the press as saying that America's food supply "is the safest in the world." What do you base that on?

**A.** Let me talk a little about the responsibilities of the Center for Veterinary Medicine and what we're all about. I think then you'll understand why I believe our country's food supply is so safe. The Food and Drug Administration, through this center, is responsible for assuring that animal drugs and medicated feeds are safe and effective and that food from treated animals is safe to eat.

Prior to approval, a new animal drug must undergo extensive testing. The drug sponsor—usually that means the manufacturer—must conduct laboratory and clinical investigations that establish the safety and effectiveness of the substance. The sponsor must also demonstrate that any drug residues remaining in a food-produc-

ing animal at slaughter pose no threat to human health.

Once the drug is approved, based on all these data, a monitoring/investigating system takes over. The U.S. Department of Agriculture's Food Safety and Inspection Service obtains samples of body tissue from slaughtered animals and analyzes those samples. Their findings are sent to FDA field offices for follow-up by our field investigators. Regulatory action is taken against those responsible for drug residues above the legal limit, and those animal carcasses found to have dangerous residues are kept from the marketplace.

Taking all of these activities into account—from extensive pre-clearance requirements through rigorous surveillance, monitoring and enforcement activities—I do indeed believe that Americans have the safest food supply in the world.

**Q.** How much are drugs used in livestock?

**A.** About four out of five food animals are given drugs during their lifetime. Some receive medication to treat specific illnesses. Often, however, drugs are given to entire herds or flocks—usually in their feed—to prevent disease outbreaks and to help the animals grow faster on less feed. About 30 percent of the chickens, 80 percent of veal calves and pigs, and 60 percent of the beef cattle raised for food in the United States are routinely given medicated feeds.

**Q.** How many different drugs are used? Are they all really necessary?

**A.** About 750 drug products are approved for use in food animals. That's about 100 different basic drugs. Virtually all of these drugs are needed to insure the continued availability of safe, wholesome and affordable animal-derived foods to the American public.

**Q.** What percentage of the animals that USDA checks are found to have illegal residues?

**A.** Residues above the legal limits are found in approximately .2 percent of poultry samples; for livestock, the rate is 1 percent.

**Q.** How is this checked? Does USDA check every animal for every drug?

**A.** USDA collects samples for routine meat inspection. They refer any violative samples to FDA for subsequent enforcement actions.

Perhaps I should explain here that FDA establishes the allowable conditions of drug use and establishes the allowable tolerances or action levels for residues of those drugs.

Each sample cannot be tested for every drug, nor is there reason to do so. Veterinary drugs are each approved for use in a particular animal species. Test methods are developed for detection and analysis of residues in that species.

USDA actually has two parts to its residue sampling program. First, they randomly check a certain number of animals at a slaughterhouse for certain drugs—or pesticides—without regard to the condition or appearance of the animals. The second type of sampling is more directed: Any animal that appears to have had any kind of an illness or that has a visible mark where a drug was injected or that comes under suspicion for some other reason is tested.

On the whole, the program is set up on a statistical basis so that, even though the number of animals checked is only a small percentage of all the animals that are slaughtered, we can be confident that what we are seeing reflects what's going on throughout the marketplace.

**Q.** How do you decide what residue levels are safe?

**A.** A drug sponsor is required to furnish the scientific information nec-

essary to demonstrate that the residues are safe in edible animal tissues—that is, meat, eggs and milk.

This scientific information includes toxicological studies, to see how hazardous the drug is. It also includes metabolism studies, to see how the animal breaks down the drug in its body. There are depletion studies, to find out how long it takes for the drug and its byproducts to clear out of the animal's meat, milk or eggs. For drugs whose early tests indicate they could be carcinogenic [cancer causing], we require lifetime feeding studies in mice and rats to accurately determine the true risk. Finally, the agency, after reviewing all the research data, establishes a tolerance level for tissue residues. Or, in some cases, a zero tolerance will be set, and no residue level will be acceptable.

**Q.** *Are all residues harmful or potentially harmful? Have people ever actually been injured, or gotten cancer, because of drug residues in meat, eggs or milk, or is this just a theoretical risk?*

**A.** One potentially serious risk of excessive drug residues is allergic reactions, which can range from a mild case of hives to severe, life-threatening anaphylactic shock.

Evidence of this actually having occurred in people from eating meat, eggs or milk with excessive drug residues, however, is rare, indeed. In fact, our surveillance has never found any actual cases of such allergic reactions caused by drug residues. There are three or four citations of residue-induced reactions in the scientific literature, but even those aren't all from the United States. One case involved a person who ate raw sausage and had a reaction. The sausage was checked and was found to contain residues of penicillin.

So it's an extremely rare occurrence, but you can't be sure how often it happens because it may go unreported, or the relationship between an allergic reaction and residues in food may not be discovered. It's important to keep in mind that

we build a 1,000-fold or 2,000-fold safety factor into our tolerances. This helps to avoid ill effects even when a residue occurs that slightly exceeds the legal limit.

The same holds true for the potential risk of cancer from residues of carcinogenic drugs. We aren't aware of any cases of cancer that can be linked to drug residues in food. Of course, such an association would be almost impossible to establish, given the many potential causes of cancer—viruses, radiation, environmental carcinogens, and so forth.

Nevertheless, you don't need, nor do you want, actual victims to make the case that the food supply must be kept free of cancer-causing residues. And, given our surveillance and enforcement programs, I'm confident it is.

**Q.** *The drug DES, widely used for many years as a growth promoter in livestock and poultry, was completely banned by FDA in 1979 because of evidence it causes cancer. Yet we later found widespread disregard for that ban. Is there evidence that the drug is still being used?*

**A.** Diethylstilbestrol (DES) had been used since 1954 in animal feeds and as implants in various species of animals. The use of the drug in livestock was banned in 1979 because of questions about the safety of its residues and because an adequate analytical method to detect those residues had not been developed.

In early 1980, we discovered that some implants that had been manufactured before the ban were still being used. In 1983, we discovered a small number of veal calves in New York that had been treated with DES. In that case, the drug had been brought into the United States from Europe. In both instances, regulatory actions were taken, and the courts backed the government's position.

There are now no approved veterinary drugs containing DES in the United States or in any country that I am aware of. Further, we aren't aware of any DES being used in

livestock in the United States. We believe that this problem has been eliminated.

**Q.** *If a drug is found to cause cancer, is it supposed to be automatically banned from use in food-producing animals?*

**A.** No, not necessarily. A provision of the Delaney anti-cancer clause of the Food, Drug, and Cosmetic Act stipulates that a carcinogenic compound can be used in food-producing animals if the drug will not harm the animals and if "no residue" of the compound will be found in any edible tissues of the animal when tested by the approved methods.

But as analytical methods have become more sensitive over the years, this exception has become unworkable. Levels of residues that were so low they were previously undetectable can now be detected. So we have proposed procedures and criteria to permit these exceedingly low levels of residues that present an insignificant risk of cancer to the public.

**Q.** *What is this insignificant-risk level?*

**A.** One in 1 million. This doesn't mean that one in every million people will contract cancer as a result of this regulation. Rather, it represents a one in 1 million increase in risk over the normal risk of cancer over a lifetime. This is considered an insignificant level of risk.

**Q.** *Recently, some supermarkets have been advertising meat from animals raised without drugs. Is this safer for consumers?*

**A.** Since our residue monitoring program effectively protects the public from any potentially unsafe residues of animal drugs in meat, eggs and milk, I see no health advantage in buying these special meats.

**Q.** *Dr. Sanford Miller, director of FDA's Center for Food Safety and Applied Nutrition, has said that microbiological contamination of food, which can cause outbreaks of food poisoning, is a bigger problem than chemical contamination. Do you agree?*

**A.** Yes, I agree with Dr. Miller's assessment. Microbiological contamination can be a problem. Illegal drug residues could conceivably be eliminated; the risk of microbiological contamination is virtually impossible to eliminate. The contamination can occur at any point in the farm-to-consumer chain-on the farm, through the processing and distribution systems, and in the American kitchen. When you consider the potential for contamination at each of the links in this chain, you have to tip your hat, I think, to the federal, state and local governments and the food industry for the remarkable job they do in safeguarding the food supply.

**Q.** *Former CVM director Lester Crawford has said that the illegal sale of veterinary drugs could have more serious public health consequences than any problem with human drugs. Do you agree?*

**A.** I believe Dr. Crawford was referring to situations of extreme misuse of veterinary drugs. In those cases, I agree that illegal use of veterinary drugs can be an even greater threat to the public health than the illegal use of human drugs. What puts a different light on this issue is that use of illegal human drugs generally involves the consent of the persons involved. But the consumer of meat, milk and eggs has no way of knowing if hazardous substances are present in those foods, and no way of knowing if unapproved drugs have been used on the animals.

The illegal import of veterinary drugs is an insidious practice that also threatens the public health. The DES episode of 1983 happened because the drug was brought from

Europe through Canada and into the United States. The U.S. Customs inspectors look for and deny entry of illegal drugs when they are identified, but just as human drugs are successfully smuggled into the country, so are animal drugs.

**Q.** *Is the animal drug industry as well regulated as the human drug industry? Isn't there a pretty widespread problem with uncontrolled sale of prescription animal drugs?*

**A.** In general, we believe that animal drugs are as well regulated as human drugs, although there are chronic problems that we are always watching.

One of these problems is the illegal sale of prescription drugs. In 1985 we took 73 regulatory actions against those firms and individuals found to be violating the law in such cases. We've also encouraged state boards of pharmacy and state boards of veterinary licensing to take more active roles in regulating distribution of veterinary prescription drugs. The states have been very effective in regulating human prescription drugs; we hope that veterinary drugs can be just as well-regulated.

Through a more active surveillance program and some special initiatives in several states last year, we do know which drugs make up the bulk of the illegal market. We're continuing the fight, and we're winning some significant battles.

**Q.** *What happens to farmers whose animals are found to have illegal residues?*

**A.** Two things. First, carcasses found with unsafe drug residues are removed from the slaughterhouse, and USDA will sample the next five animals from that farm. Second, FDA will send a regulatory letter to the farmer, outlining the violation and warning of more stringent legal action if steps are not taken to correct the problem. It is in the farmer's best interest to correct these problems early, to avoid the possibility of

more severe legal action, such as an injunction or prosecution.

It's important to remember that at least 99 percent of the livestock producers use drugs properly. We know this from the low rate of illegal residues that we find through our surveillance.

**Q.** *Do you feel like you are walking a regulatory tightrope on the one hand trying to protect consumers from unsafe food and on the other trying to avoid putting unnecessary constraints on livestock producers' ability to provide a plentiful supply of inexpensive food?*

**A.** Yes, definitely. However, when you've got a hard decision to make, you make the choice on the side of protecting the public's health.

**Q.** *There has been a long-running controversy over the use of antibiotics in livestock. Some believe that the use cuts down on their effectiveness in humans. Is the use of antibiotics in livestock and poultry decreasing as consumers become more concerned about this issue?*

**A.** In November of 1984, the Natural Resources Defense Council petitioned the secretary of health and human services to ban the routine use of penicillin and tetracyclines in animal feeds as an imminent health hazard. After a legislative hearing on the issue and review of contract reports and the published literature, the secretary denied the petition in November 1985.

We believe that over the past year the industry has decreased the routine use of penicillin and tetracyclines in animal feeds. For example, in April 1985, the National Cattlemen's Association recommended that its members suspend the use of tetracycline in beef cattle. [Editor's note: The beef cattle industry does not use penicillin in feeds.] I would rather not speculate further on this question since the agency's still reviewing the issue. However, I will say that as more alternative drugs become avail-

able, the industry will have a number of drugs that are not used for treating disease, but are reserved for food production purposes.

**Q.** Given recent and pending budget cuts, does FDA, and particularly your center, have adequate resources to protect the public from unsafe residues?

**A.** The budget cuts will have an effect on our activities. However, protection of the public health will, of course, continue to be our top priority. Our cuts in personnel and budget will be taken from areas that have little direct impact on public health. In fact, even with the cuts, we are reprogramming resources in order to increase field activities in areas of prevention of illegal residues and prevention of the illegal sale of veterinary prescription drugs.

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# "Controlling Listeria Hysteria in Your Plant"

William W. Coleman  
Minnesota Department of Agriculture

Presented at the North Central Cheese  
Industries Association Conference  
South Dakota State University  
September 3, 1986

The first step in controlling any organism is to understand some of its important characteristics. *Listeria monocytogenes* is a gram positive, facultative anaerobic bacillus. This is the reason it is present throughout the environment and is common to mud, dust, silage and various waste products. Listeria can also be found in many species of fish, fowl and over 40 common animals. While once thought to be a farm problem, it is rapidly becoming urbanized. One to five percent of humans may be asymptomatic carriers of this intracellular parasite. It is capable of slow growth at normal refrigeration temperatures of 35° - 40°F. It is also capable of surviving but not growing at temperatures below freezing. It is this temperature factor which makes listeria so important to the dairy industry. While it does not compete well with most psychrotrophs, introduction into pasteurized products will afford listeria a perfect opportunity to grow as other competing organisms have been eliminated.

Listeriosis, the disease caused by *Listeria monocytogenes*, is of most concern to a few special population groups, the most serious being pregnant women where it can result in spontaneous abortion of the fetus. Another group are the immuno-compromised people such as those on drug therapy, chemotherapy and with diseases such as AIDS. For these groups mortality rates from such infections can run from 20 to over 60%. This extremely high rate of fatalities makes it essential that listeria be eliminated from the environment of any food processing plant.

While the most obvious ways of controlling listeria are to keep it out of the plant or to eliminate it through proper processing, cleaning and sanitizing, many other factors enter into the picture.

## Keeping Listeria Out

To keep this organism out of the plant, it is necessary to understand its places of origin and how it travels from

one place to another. The environmental locations mentioned in the introduction accurately describe the conditions found on many dairy farms. *Listeria monocytogenes* lives in the soil. Muddy, dusty conditions afford it the perfect opportunity to be transported into milk and/or onto milk handling equipment. Birds and other animals often present in and around barns and milkhouses are another potential source. The cows themselves can be carriers and shedders of listeria cells. Recent research by Donnelly at the University of Vermont (1) indicated that poorly cured silage with a pH above 5 can support the growth of listeria. The feeding of such silage to lactating dairy cows will permit the transfer of this organism to the milk in rather significant numbers. Contaminated silage just may be the largest single source of listeria on the dairy farm. Further research in this area is needed.

## Steps to Controlling Listeria on the Farm

1. Be sure muddy, dusty conditions are controlled, especially in cow yards and around milkhouses.
2. Keep milking equipment clean and properly stored to protect it from dust and dirt.
3. Sanitize all milk contact surfaces just prior to use.
4. Keep cows as clean as possible.
5. Use a sanitizer to prep cows and make sure udders are dry before milkers are attached.
6. Keep all birds and other farm animals out of milking barns and away from milking equipment. Establish good insect control.
7. Feed only high quality materials and be certain fermented feeds are properly cured.
8. Check all silage for proper pH (below 5), especially silage stored in bunk silos or trenches.
9. Keep the milkhouse and bulk truck loading area clean and free of mud and animal waste.

### *Seeding of the Plant*

The next important area of consideration is how to prevent introducing this organism into the plant. Obviously, there are two main ways of carrying the listeria into the plant—either in the milk or on the equipment used to transport it there. Either way it will be difficult to prevent its daily introduction into the receiving area. Therefore, the important objective is to keep it out of the processing and packaging areas of the plant. Considering that all raw milk and all bulk trucks are potentially contaminated, it becomes essential to establish an effective control program for the receiving area of the plant.

#### *Steps to Control the Entry of Listeria into the Plant*

1. Isolate the receiving area and *everyone* associated with it from the processing and packaging areas of the plant.
2. Have no direct openings into the processing area.
3. Prohibit anything or anyone having contact with receiving from going into, passing through or working in the processing area. This means haulers, lab personnel and anything else which has come in contact with raw milk.
4. Assure that no raw product comes in contact with the floor anywhere around processing and packaging equipment. Rinsing into drains will not necessarily help.
5. Isolate raw milk tanks whenever possible with absolutely no cross-connections to finished products either through product or C.I.P. lines.
6. Keep receiving room walls and floor clean and in perfect repair, without cracks or openings of any kind.
7. Emphasize that drains, no matter what type, must be properly constructed so they can be cleaned and sanitized *daily*.
8. Remind bulk haulers not to wander through barns and cow yards but to limit their on-farm contact to the milkhous area.
9. There is a danger in using returned finished products for rework because they have the potential to contain high numbers of *listeria* as a result of its ability to grow over long periods of time at refrigeration temperatures.
10. Do not use sponges and rags as they can also support the growth of listeria.

#### *Controlling Listeria in the Processing of Milk*

Controlling listeria in the milk is not that difficult under normal conditions. Quality milk, properly pasteurized will not contain any pathogens, listeria included.

Recent research by Doyle at the University of Wisconsin (2) demonstrated that limited numbers of *Listeria monocytogenes* located *inside* somatic cells did survive

minimum pasteurization of 162-164°F for 16.4 seconds. This is of concern, but more work needs to be completed before an adjustment to pasteurization times or temperature can be recommended. The milk used by Doyle was collected from cows injected with the organism and as a result produced milk with high somatic cell counts, many well over the 1 million legal limit. Normally suspended listeria cells that are found in comingled milk will be killed under minimum pasteurization condition of 162°F for 16 seconds. The thermal death time for *Listeria monocytogenes* at temperatures of 162°F is less than 1 second. Plants who are currently heat treating milk for the manufacture of cheese should seriously consider installing proper pasteurization systems. Under normal conditions, with good quality milk, it is still likely that listeria can be eliminated with heat treatment slightly under pasteurization requirements; however, this must be considered a risky practice. It now appears that pasteurization temperatures of 170°F and above will kill the organism even in the intracellular state. To help assure low somatic cell levels and to remove other extraneous matter which could offer protection for listeria, all milk should be filtered and clarified before pasteurization. At this time it appears that high quality milk will eliminate the concern for pasteurization survival of listeria organisms.

#### *Sources of In-Plant Contamination*

Dealing with contamination from listeria now focuses on the environment within the plant which could enable the properly pasteurized product to become recontaminated.

Recent findings point to floors and floor drains as a primary source, especially in and around coolers or in areas subject to outside contamination. Air handling units operating directly within processing and packaging areas are another potential source. Raw materials of all types carried into packaging areas to support these activities could also be a source. In one plant listeria was also isolated from the sweet water and further investigation found cracks and pinholes in the HTST cooling section. Air, water or any other material which comes in contact with a dairy product after pasteurization must be considered as a potential source of pathogenic organisms capable of causing contamination of the finished product.

#### *Steps to Control Listeria in the Processing System*

1. Use high quality milk which has been filtered and clarified before pasteurization.
2. Eliminate heat treatment and use certified pasteurization systems for the manufacture of all dairy products.
3. For processing fluid products, use 170°F as a minimum pasteurization temperature for the HTST unit.

4. Check cooling and regeneration plates for cracks and pinholes.

5. Maintain sweet water or glycol systems at operating pressures below that of milk. Check for contamination frequently.

6. Disassemble and inspect the HTST system routinely to be sure it is being properly cleaned.

7. Sanitize the HTST with chemicals or hot water immediately prior to use. Be sure all areas are fully flooded and contact time is adequate.

8. Eliminate cross-connections between finished and raw product including C.I.P. lines.

#### *Steps to Control Listeria in the Plant Environment*

1. Make the cleaning and sanitizing of walls, ceilings, floors and drains part of the daily cleanup program.

2. Eliminate all direct openings from outside into the processing and packaging rooms even though they may contain screens, curtains or louvers.

3. Use bacterial filtering systems on air handling units and create a positive pressure in the processing and packaging areas.

4. Make sure dehumidifiers or air conditioning units drain away from the processing or packaging room and prevent condensate from re-entering the atmosphere. Coils and pans must be cleaned and sanitized routinely.

5. Repair all cracks in walls and floors. This is especially important in areas around floor drains where use of a good epoxy is recommended.

6. Introduce raw product and packaging materials into processing or packing rooms in as clean a form as possible.

7. Keep areas under all conveyors clean and sanitized, especially in and around coolers. Do not mix sanitizers and lubricants as they are not compatible.

8. Allow only employees associated with processing and packaging into these areas.

9. Require the use of proper clothing and footwear which is not to be worn outside of the plant even at lunch time.

10. Establish a specific environmental cleaning and sanitizing program for all areas of the plant.

#### *An Effective Program*

1. The use of a foaming chlorinated manual-type cleaner for walls, ceilings and floors is recommended.

2. Chemical sanitizers should be used at levels recently found to be effective for listeria according to EPA testing methods. (3)

Chlorine based - 100 ppm; iodine - 25 ppm; acid

anionics - 200 ppm; and quaternary ammonium - 100 ppm. These may have to be adjusted depending on in-plant use to compensate for reduction factors such as dilution and oxidation.

3. Thoroughly clean the inside of all floor drains daily using a chlorinated cleaner.

4. Check all air handling systems daily, cleaning as needed.

5. Routinely scrub and sanitize all walls and ceilings.

6. Scrub all floors daily, especially under equipment, around drains and under conveyors.

7. Sanitize all equipment surfaces with an iodine or acid-type sanitizer following clean up.

8. Fully flood all floors just prior to start up each day. A 300 ppm quaternary ammonium sanitizer is recommended.

9. Fogging exterior surfaces with 800 to 1000 ppm of quaternary ammonium sanitizer can also be an effective control.

Chlorine, while effective against listeria, can be corrosive when used under many of the conditions stated above. Steam is also effective, but should not be used as it can cause the organism to become air-borne in other than closed systems. The use of hot water is also not very practical under many of the above stated conditions, because adequate water temperature cannot be maintained.

The control points discussed in this presentation may seem drastic and somewhat unrealistic, but remember federal regulatory agencies have currently adopted a zero tolerance for listeria. This fact along with the wide range of conditions under which listeria can exist and grow makes the establishment of an effective control program essential to all plants.

It is difficult to cover in detail all the control points for every type of dairy operation. This paper has attempted to address the important areas of concern based on the information currently available.

As you develop a control program for your plant, keep abreast of new developments concerning listeria. It is important to begin *today* - before listeria hysteria hits your operation.

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Candidates will be evaluated for their performance and progress in food engineering and technology, development of machines, processes or methods for the food industry, and leadership in the professional development of the food industry.

Nominations should include a 500-word statement describing the nominee's achievements and recognition in the food industry. The entry should include; how the award criteria was met; professional and business history; published works; educational background and organizational memberships.

Nominations may be made in letter form or on the official form available from Roger Castenson, ASAE executive secretary, 2959 Niles Road, St. Joseph, Michigan 49085. Telephone: 616-429-0300.

## ***U.S. DAIRY FORUM sponsored by MIF & IAICM to be January 14-17***

The Milk Industry Foundation (MIF) and the International Association of Ice Cream Manufacturers (IAICM), sponsors of the U.S. DAIRY FORUM, announced that the 1987 industry-wide meeting will be held January 14-17, 1987, at the Bonaventure Hotel in Ft. Lauderdale, FL.

Unlike the previous two FORUMs which were held in May, the 1987 U.S. DAIRY FORUM is scheduled from Wednesday, January 14, through Saturday, January 17. MIF and IAICM President John F. Speer, Jr., who serves as U.S. DAIRY FORUM chairman, explained the scheduling change:

"The industry faces some very critical decisions in 1987, both in terms of public policy and private sector choices," Speer said. "We feel scheduling the U.S. DAIRY FORUM at the first of the new year helps set the stage for the decision process on these important issues. The January meeting date should also make it possible for an even greater number of persons to attend and participate."

The U.S. DAIRY FORUM, first held in 1985, is the only dairy industry meeting which brings together

all segments of the industry - dairy cooperatives, suppliers, processors, government officials, university experts and consumers - to discuss contemporary industry issues. In less than three years, the U.S. DAIRY FORUM has become the industry's sounding board for policy alternatives. More than 300 persons attended the 1986 FORUM.

Detailed program information and registration material can be obtained by contacting: MIF - IAICM, 888 Sixteenth Street, NW, Washington, DC 20006.

## ***Food Processors' Sanitation Workshop***

February 4 and 5, 1987. Food Processors' Sanitation Workshop. Holiday Inn, Santa Nella, CA. Presented by the University of California Cooperative Extension, Food Processors' Sanitation Association, and Golden Gate Chapter of the Environmental Management Association, along with representatives of various food trade associations. The workshop includes a wide variety of sanitation topics, including waste management, foodborne illness, safety, HACCP, basic microbiology and employee motivation. For more information, contact Kathryn J. Boor, Food Science and Technology, University of California, Davis, CA, 95616. Telephone: 916-752-1478.

## ***Acquisition of Tri-Clover Division of Ladish Co., Inc.***

Owens-Corning Fiberglas Corporation and Alfa-Laval, Inc. announced jointly today that Alfa-Laval has agreed to acquire the Tri-Clover Division of Ladish Co., Inc. of Kenosha, WI. Tri-Clover was one of the businesses acquired in Owens-Corning's September, 1985, purchase of its Aerospace and Strategic Materials Group from Armco, Inc.

Earlier this year, Owens-Corning had announced its intent to sell Tri-Clover and certain other of those operations which did not fit with Owens-Corning's long-term plans.

Tri-Clover is a leading manufacturer of stainless steel valves, fittings and pumps, as well as flow control and clean-in-place systems primarily for sale to the dairy, food processing, beverage and pharmaceutical industries.

Alfa-Laval is a multi-national organization headquartered in Sweden that has had U.S.



subsidiaries for more than 100 years. Annual group sales amount to \$1.5 billion. Alfa-Laval intends to continue operating Tri-Clover as a separate company within the world-wide Flow equipment business area, with its current management, employees and distribution network.

### **Technical Session to Address Food Problem Areas**

Presentations on bacterial pathogens, food quality, and biotechnology will be featured at ABC Research's 13th Annual Technical Seminar here, February 23-25, 1987.

Presentations will be given on *Campylobacter*, *Listeria*, *Yersinia*, and *Salmonella* during the bacterial pathogen session.

Food quality talks will cover diet and cancer, shelf-life studies, food additives, microwaveable foods, risk assessment or pre-cooked meat products, and controlled atmosphere packaging.

The biotechnology session will be concerned with rapid diagnostic methods, and the use of microorganisms in new food applications.

Further information may be obtained from:

Sara Jo Atwell  
ABC Research Corporation  
P.O. Box 1557  
Gainesville, FL 32602  
904-372-0436

### **Educational Foundation for Foodservice/Hospitality Industry**

In a move to serve the foodservice/hospitality industry more effectively, the educational and training activities of the National Restaurant Association and the National Institute for the Foodservice Industry (NIFI) will be consolidated to form a broad-based major industry Educational Foundation.

In a joint statement National Restaurant Association President G. "Jim" Hasslocher and NIFI President Thad Eure, Jr. heralded the creation of the Educational Foundation stating, "The most urgent short- and long-term industry need is the training and education of current and future employees. This new Educational Foundation will have the resources and financial strength to provide educational services for operators, food and equipment manufacturers, distributors and educators." As a demonstration of commitment, the National Restaurant Association is contributing \$1,000,000 to the Foundation's Endowment Trust Fund.

The consolidated Educational Foundation will

continue to offer all current programs and services of both the National Restaurant Association and NIFI. Thus, one organization will be responsible for the Association's conferences and seminar programs as well as the scholarship administration, educational courses and career promotion programs which were formerly handled by NIFI. The consolidated Foundation will also aggressively expand programs to serve the needs of the entire industry.

The new Foundation will be administered by Richard J. Hauer, currently the executive director of NIFI who will become the executive director of the new Foundation. He will coordinate activities with NRA's Executive Vice President, William P. Fisher. The new Foundation will be governed by a 30-member Board of Trustees, a separate, autonomous body, which will exercise all normal oversight and fiduciary responsibilities. The Board of Trustees will consist of the three elected officers of the National Restaurant Association, 13 operator trustees, 11 trustees from supplier firms and three trustees from schools and colleges.

The consolidated Foundation will be known as the Educational Foundation of the National Restaurant Association and will take effect on January 1, 1987.

### **Tamper Resistant, Tamper Evident Packaging**

The Du Pont Company participated July 16 in a special meeting in Washington of the Proprietary Association, a major trade group representing producers of over-the-counter drugs, as part of its continuing commitment to develop more effective tamper resistant and tamper evident packaging.

Company representatives described state-of-the-art systems and applications for what are considered to be two of the most effective solutions to tampering - shrink film overwraps and skin packaging. Presentations were made to the Association's expert technical committee, comprised of some 50 packaging engineers from pharmaceutical firms.

"Shrink film is being used by a growing number of OTC drug producers and several other industries, including food manufacturing," said Burt Spottiswoode, market development manager. "Studies show that a majority of consumers prefer this alternative because it provides immediate and visible evidence of in-store tampering."

Du Pont manufactures "Clysar" shrink film in several thicknesses to meet differing packaging requirements. The company also runs a packaging center in Wilmington, Del., where prospective users can see shrink film equipment demonstrated or have

sample products evaluated.

The other alternative for OTC tamper resistant and tamper evident packaging was described by Howard Weinman, market development specialist for skin packaging. It consists of traditional skin packaging and the recently introduced soft shell or soft blister skin packages.

"Recent improvements in skin packaging equipment, especially faster cycles, makes this packaging alternative more applicable to the large volume, high speed production requirements of OTC drug manufacturers," said Weinman. "Like shrink film, skin packages also provide immediate, visible evidence of tampering."

Du Pont manufactures "Surlyn" ionomer resin, which is sold to converters who manufacture the film for skin packaging applications.

### *Charles A. Sims*

Charles A. Sims recently joined the Food Science and Human Nutrition Department as Assistant Professor of Entomology. Sims received his B.S.A. in 1980, a M.S. in 1982 in Horticultural Food Science and his Ph.D. in 1986 from the Food Science Department, University of Arkansas, Fayetteville, AR.

Working as an assistant in the Horticultural Food Science Department from 1976 to 1980, Sims assisted in the laboratory analysis of grape and small fruit products while receiving his B.S.A. From 1980 to 1981, while pursuing his M.S. he was a graduate assistant in the Horticultural Food Science Department participating in research projects dealing with grapes, wine and small fruits. He served a research assistant while working on his Ph.D. in the Food Science Department from 1981 to 1986. He supervised a team conducting research on raw and processed quality of grapes and small fruits. At this time he organized and conducted enology research. For two years he served as laboratory instructor of enology.

Sims received the American Society for Enology and Viticulture/Eastern Section Scholarship (4 years), the Ralston Purina Scholarship, Institute of Food Technologists Scholarship, Ozark Food Processors Scholarship, and Freshman Academic Scholarship. He is a member of the American Society for Enology and Viticulture, American Society for Enology and Viticulture/Eastern Section, American Society for Horticultural Sciences, Institute of Food Technologists, Southern Association of Agricultural Scientists, Arkansas State Horticultural Society, Delta Upsilon Fraternity, Delta Upsilon Alumni Association, Gamma Sigma Delta, Alpha Zeta, and Phi Kappa Phi.

Sims has presented and published numerous papers in his field of research.

### *Joyce Ann Gilbert*

Joyce Ann Gilbert has joined the Food Science and Human Nutrition Department, Institute of Food and Agricultural Sciences at the University of Florida in Gainesville. She received her B.S. degree in Biology from the University of South Carolina, Columbia in 1980 and her M.S. degree in Nutritional Sciences from Clemson University, Clemson, SC in 1983. She is presently working as Dietetic Clinical Instructor in the development, management and evaluation of the Dietetic Masters/Internship program, teaching food service systems management and serving as dietetic student advisor.

From 1985-1986, prior to joining the Food Science and Human Nutrition Department, Gilbert served as Director of Food Service, Manor Care, Columbia, South Carolina. She developed a cost-effective food service, served as a nutritional assessment consultant and quality assurance coordinator, provided in-service education to health care personnel and developed patient care conferences for Manor Health Care.

From 1983-85, Gilbert was Assistant Director of Food Service for the Department of mental Health in Columbia, SC. In this position she worked with nutrition and drug interaction research, personnel management and menu evaluation. She also served as chairman of staff development, safety management and primary prevention committee, clinical nutritionist, and was a researcher on Huntington's Chorea diet.

Gilbert has published several nutrition-related papers and continues to consult in sports nutrition and geriatric nutrition. She is an active member of The American Dietetic Association and a new member of The Florida Dietetics Association.

### *Murat Balaban*

Murat Balaban has joined the faculty of Food Science and Human Nutrition Department, University of Florida, Gainesville. He received a B.Sc. in Chemical Engineering: Numerical Analysis, with honors, from Middle East Technical University, Ankara, Turkey in 1976 and received his Ph.D. in Food Engineering from the University of Washington, Seattle in 1984. In 1986, Balaban completed his postdoctoral research in mathematical modeling of simultaneous heat and mass transfer at Rutgers University.

While working on his Ph.D. at the University of Washington, he developed computer programs to be used as research and teaching support tools, developed an integrated graphics package for IBM micro-computers and conducted a series of seminars for students and faculty on the use of computers.

Balaban has also developed computer program packages in calculation of psychrometric properties with interactive graphics, automatic calculation of MPN in microbiology, automatic calculation of sterilization process in cans, computer-assisted freezer room design and demonstration of distillation calculations, with graphics. He has taught courses in food engineering and instrumentation.

Balaban received the Egtvedt fellowship from the Institute of Food Science and Technology, University of Washington. He has several publications in the field of food engineering. At present he is preparing a book on food engineering.

### *James Alexander Lindsay*

James Alexander Lindsay recently joined the Food Science and Human Nutrition Department as Associate Professor of Microbiology. He received his B.Sc. (with honors) in 1972 majoring in Genetics/Biochemistry and a Ph.D. in 1978 in Genetics/Microbiology from the Australian National University. He was employed by the Division of Food Research of the Commonwealth Scientific Industrial Research Organization (CSIRO) Sydney, Australia from 1978 to 1986 before coming to the Food Science and Human Nutrition Department.

Lindsay is a member of several American Societies. He is editor of the Spore Newsletter and a referee for several international journals. He has served on a number of international committees on microbiology and genetics and has taught or supervised students from the Australian National University, University of Sydney, McQuarie University, and New South Wales Institute of Technology.

Lindsay has been an invited lecturer at many international conferences and seminars with presentations on his field of research. He is currently interested in pursuing research on the structure, function and regulation of bacterial toxins and their role in human disease and the molecular and genetic basis of thermostability in microorganisms and its application to food processing and biotechnology. He has published numerous research papers in national and international journals.

### *Aseptic Paint Kills Bacteria*

British-made paints can not only inhibit bacterial growth but actually kill bacteria on the painted surface. WALLFLEX aseptic coatings are said to represent a breakthrough in fighting bacterial infection in hospitals, food-processing areas, kitchens,

pharmaceutical-production areas, laboratories and air-conditioning systems.

Conventionally painted surfaces of walls, ceilings, partitions, screens and ducts can form a breeding ground to support harmful bacteria and fungal growth, feeding on the paint film.

The new product is the result of nearly 25 years' development and incorporates the latest technology in protective coatings. It can be applied to all paintable surfaces and will kill almost any known type of bacteria, it is said, including those causing legionnaires' disease, salmonella food poisoning, wound sepsis and general infections (*Staphylococcus* and *Streptococcus*) and mold growth.

Particularly applicable to areas of high risk, such as hospital operating theaters and intensive-care units, it also can perform valuable service in all general-hospital sterile areas, corridors, staircases, wards, kitchens and laboratories, as well as the food-processing industry, pharmaceutical manufacturing and mortuaries. It also can be effectively applied inside ventilation and air-conditioning ducts and cooling towers to combat disease.

Offered in a wide range of colors, the product comes in gloss or eggshell finishes. It is resistant to abrasion and cracking and conforms to stringent regulations regarding the surface spread of flame. It is nontoxic to humans in use and in the application process.

For more information, contact: British Information Services, 845 Third Avenue, New York, NY 10022, 212-752-8400; or Wallglaze Ltd. (Contact: N.S. Banbury) 62 Church Road, Aston, Birmingham B6 5TY England. Telephone: Birmingham 21-328-3137; Telex: 338024.

### *Ag, Municipal Wastewater Can Be Used on Land*

Wastewater from cities, food processing plants and livestock feeding operations can be partially treated and then applied to agricultural soils and crops.

The soil removes solid particles by filtration and decomposition, says Dr. John Sweeten, agricultural engineer in waste management with the Texas Agricultural Extension Service, The Texas A&M University System. The soil also removes disease-causing organisms and retains nutrients for plant growth.

"Although soils and plants benefit from the applied organic matter, nutrients and water, land application of wastewater has to be approached more carefully than irrigation with clean water," Sweeten points out. "Otherwise, problems can develop due to overloading the soil-plant system with certain constituents that

could cause plant toxicity, soil salinity, nutrient imbalance or groundwater pollution."

Wastewater application rates should be controlled by at least three load limiting factors: hydraulic load, or depth of water applied; nitrogen load (many irrigated crops can use 200 to 300 pounds of available nitrogen per acre per year); and salt content. Too much salt will affect seed germination and crop yields and will damage soils. Also, clay soils cannot take nearly as much salt as sandy soils.

"Treated municipal effluent contains only about 10 pounds of nitrogen per acre-inch, so a farmer usually can apply about 25 to 30 inches per year to benefit his crops," says Sweeten. "With a 15 percent leaching rate, most of the salts would move on through the soil profile."

Food processing plant wastewater may be a little more concentrated than municipal sewage but also can be effectively used as enriched irrigation water, adds the engineer.

But some agricultural wastewaters, such as feedlot runoff or effluent in poultry manure treatment lagoons, may be high enough in nitrogen and salt that only 6 inches or less should be applied per year. Since it usually takes more water than this to fully irrigate a crop, wastewater can be used for supplemental irrigation, and additional or dilution water may be necessary to meet crop requirements, Sweeten points out.

He recommends a chemical analysis of both the soil and wastewater to determine how much agricultural or municipal effluent can be irrigated onto which crops. The Extension Service's Soil and Water Testing Laboratories at College Station and Lubbock as well as commercial labs can provide that type of analysis, says Sweeten.

### **Cooper Instrument Corporation Appoints Carl Goetz Vice President-Sales & Marketing**

The appointment of Carl Goetz as Vice President-Sales and Marketing has been announced by Floyd Wallace, Sr., President, Cooper Instrument Corporation, Middlefield, Connecticut.

Mr. Goetz' responsibilities will include direction of all phases of the company's marketing effort. Cooper, which celebrated its 100th anniversary in 1985, produces a broad range of mechanical and digital thermometers sold to a variety of markets including consumer; heating ventilating and air conditioning; institutional food service and original equipment manufacturers. Mr. Goetz has undertaken the restructuring of the internal sales organization, creating three new Marketing Manager positions for

the supervision of the company's various field sales organizations.

Prior to joining Cooper, Mr. Goetz served as Director of Marketing for the Valves and Fittings Division of the Crane Company. He also held positions in marketing at Imperial Eastman Company, Rawlings Sporting Goods Company, and AMF.

Mr. Goetz holds a Bachelor of Science degree from the State University of New York Maritime College and an MBA from the Bernard M. Baruch College, New York City. He resides with his wife and three children in Ridgefield, Connecticut.

### **AACC Announces New Dates For 1988 Annual Meeting**

St. Paul, MN--The American Association of Cereal Chemists (AACC) has announced new dates for the 1988 Annual Meeting, according to AACC executive vice president, Raymond J. Tarleton.

The 1988 AACC Annual Meeting is now scheduled for October 9 - 13, 1988, at the Hotel InterContinental San Diego, in San Diego, California.

The 1987 AACC annual meeting is scheduled for November 1-5, 1987, at the Opryland Hotel in Nashville, Tennessee.

Additional information about upcoming AACC annual meetings can be obtained by writing to AACC Headquarters, 3340 Pilot Knob Road, St. Paul, MN 55121, U.S.A.; Telephone: 612-454-7250; Telex (MCI/WUI) 6502439657.

The American Association of Cereal Chemists is a scientific society of more than 3300 members internationally. The Association was founded in 1915 to establish standardized methods of analysis in cereal laboratories, and to encourage research within the cereal processing industries.

**SILLIKER'S Short Course on  
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Nov. 10-14, 1986 Feb. 9-13, 1987  
Apr. 27-May 1, 1987

Of special interest to apprentice technicians, Q.A. and Q.C. personnel, and experienced workers wishing a review. It is also recommended for management personnel who wish to become familiar with the practice of laboratory methods.  
Contact Randi Faust (312) 756-3210

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Christmas  
and...*

*Happy New  
Year*



**Kathy R.  
Hathaway  
Executive Mgr.**



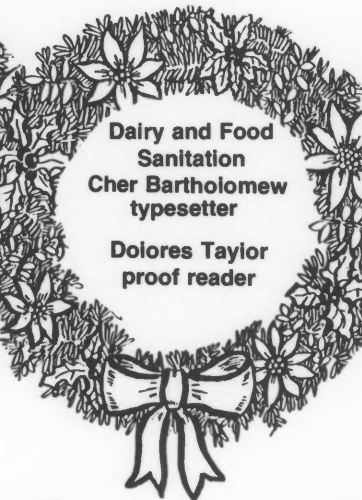
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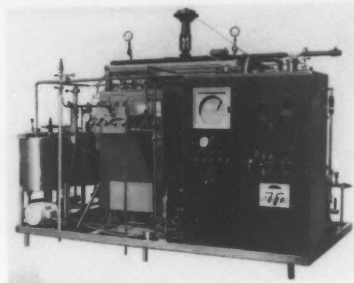


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Processors of aseptic and long life products can realize substantial new economies with the Tube-A-Tec newly designed packaged sanitary fluid systems featuring state-of-the-art tubular heat exchangers, homogenizers, controls, regeneration and other devices which result in a tremendous reduction in operating costs. The combination batching/formulation and processing units are unique in that they have UHT, Long Life and aseptic capabilities in a single system.

The first in a series of Tube-A-Tec custom systems is a single-tube design with capacities of 20 - 1,500 USGPH. Other systems in the product line have capacities to 10,000 USGPH.

Although the firm is new, its experienced engineering staff has been involved in the design of over 80 custom installations successfully operating in the field today. Innovative techniques incorporated into Tube-A-Tec systems guarantee exceptional product running time without any stop for in-run CIP or water flushing. The system provides up to 80% regeneration and homogenization temperatures can be adjusted without affecting regeneration. This regeneration feature prevents product "heat shocks" and can produce nominal energy savings to \$50,000 per year, depending upon unit size.

Tube-A-Tec operates in a broad range of speeds to match filler capacities and its high velocity product movement results in excellent product flavor as there is no opportunity for "burn-on" ... a common problem with other type systems. The design also eliminates water scale deposits and corrosion in its closed loop configuration.

Tube-A-Tec is manufactured as a complete connected skid-mounted system that is 100% pre-tested in the plant before shipment. Custom designed connections to any make filler add to operational savings and insure aseptic reliability.

For technical data, pricing estimates or consultation, contact Tube-A-Tec, 9710 S. 58th Street, Franklin, WI 53132. Telephone: 414-423-1968.

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### Pacific Scientific Introduces Match

MATCH - Spectral Matching System was developed to help the pharmaceutical industry meet current GMP requirements for raw material inspection - in REAL TIME.

MATCH is so easy to operate that it can be used by non-technical personnel at the receiving dock or on the plant floor. Virtually any material - solid or liquid - can be analyzed in seconds with little or no sample preparation. MATCH measures liquids and emulsions such as surfactants, alcohols, oils, and ointments in transmittance mode; and solids such as chemicals, packaging materials, and capsules in reflectance mode. All analyses can be done on one instrument that is controlled by an extremely easy to use software package.

MATCH uses a near infrared "fingerprint" technique which is both highly sensitive and reliable. Decisions regarding sample identity and quality can be made with confidence using the MATCH System.

For more information, contact the Sales Department, Pacific Scientific Company, Gardner/Neotec Division, 2431 Linden Lane, Silver Spring, MD 20910. Telephone: 1-800-638-2790.

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### High Pressure Pumps

The Friedrichs industrial high pressure pumps generate cleaning water pressure from 1000 to 6000 psi. They are strong, compact, very portable and extremely quiet. Unlike other high pressure pumps on the market, the patented control valve shuts off the pump automatically when the trigger is released. Squeeze the trigger and you are running again. The elimination of noise and fumes makes the Friedrichs pump especially ideal for indoor use. Pressure testing, pipe cleaning, sand blasting, sludge pump and chemical injectors are just a few of the optional accessories available.

For more information, contact: Master Blaster Corporation, 1036A First Street, Humble, TX 77338. Telephone: 713-446-1717.

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### New Wastewater Treatment Culture

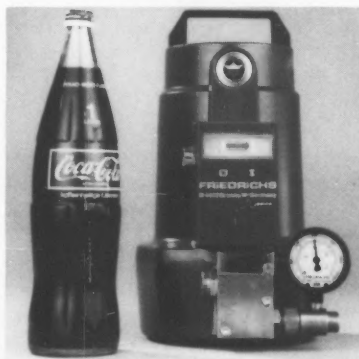
Microlife Technics (Sarasota, FL), a subsidiary of National Starch and Chemical Corp. (Bridgewater, NJ), is introducing its second microbial inoculant for wastewater treatment and starting nationwide marketing of both of its wastewater treatment inoculants. The new product, Munox, had its first commercial sale in September 1985 to the Kennedy Space Center for use in the wastewater treatment plant that serves the space shuttle assembly building and has to deal with unusual sterilants and disinfectants from the shuttle program and still meet zero-discharge requirements.

Both Munox and the earlier product, Citrox, consist of a blend of several strains of *Pseudomonas* selected for the intended uses. In ten months of field testing in water treatment plants before the first sale, Munox demonstrated efficacy in degrading a wide range of chemicals including aliphatics and aromatics, isoprenoids and terpenes, and chlorinated organics. Munox has also been used for in situ degradation of fuel oil around storage tanks.

Citrox, a blend of different *Pseudomonas* strains, was specifically developed to degrade wastes from citrus processing, especially orange peel terpenes (e.g., d-limonene) and alcohols (e.g., citronellol), which may disrupt wastewater treatment plant operations. Although Citrox has been used in citrus processing since early 1983, it can also be used to clean up wastewater from plants using crude sulfate turpentine and from the food and flavor industries where similar chemicals are found.

Microlife has more than two decades of experience in producing bacterial inoculants for food processing, including starter cultures for buttermilk, sour cream and cream dressing for cottage cheese as well as for pickles and fermented meats. It is now also working to develop, grow, and preserve bacteria to solve specific problems in wastewater and hazardous waste treatment. For more information, contact: Frederick E. Farley, Microlife Technics, Box 3917, 1833 57th Street, Sarasota, FL 33578. Telephone: 813-355-8561.

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### Mobile System Combines Four Functions In One Machine

• The Oakite® VersaJet unit combines the high pressure foam cleaning, spray washing, rinsing, and sanitizing capabilities of a central cleaning system into one mobile unit. The machine comes complete with two rinsers, two foamers and a special combination pressure wash/sanitizer. Up to three separate operations can be performed simultaneously using one VersaJet unit. It is ideal for the heavy-duty cleaning needs of the food processing and paper industries.

The VersaJet's two high pressure foamers operate on water pressure up to 650 psi for efficient, economical cleaning of walls, floors, or stationary equipment. High-pressure rinsers can utilize water up to 200°F. with a regulated discharge pressure from 100 to 650 psi. Maximum volume is 12 gallons per minute. The specially designed sanitizer automatically meters sanitizing materials as they are used.

Four undercarriage wheels enable the VersaJet to move effortlessly through the areas to be cleaned. Detergent and sanitizing solutions are dispensed directly from their shipping containers. Two 50-foot hoses are standard equipment, pressure rated to 2000 psi, or one 100-foot hose can be substituted. Also standard is an airless foam wand, six interchangeable foam nozzles, one regular wand, and a 10-foot cord.

For more information on the Oakite VersaJet, contact: Oakite Products, 50 Valley Rd., Berkeley Heights, NJ 07922. Telephone: 201-464-6900.

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### Applications Brochure For METHOCEL Food Gums

• Updated application information for microwaveable foods, fried foods, salad dressings, sauces, bakery products, diet foods, desserts, and many other food products are included in a new 12 page brochure from The Dow Chemical Company. The brochure tells how thermal gelation, an exclusive feature of METHOCEL™ Premium food gums, can increase baked volumes, improve texture in structured foods, and reduce oil absorption and



### Metal Float And Small Tank Catalog

• Seven totally new float and tank sizes and 71 new variations are shown in a catalog just published by Seymour - Sheridan, Inc. Detailed drawings for each item give dimensions, material type, weight, displacement, minimum collapse pressure, internal magnet location, etc. Parts photos illustrate interesting design ideas and demonstrate the design assistance that the manufacturer can provide.

The floats and tanks are of exceptionally high quality and are manufactured by gas tungsten arc welding of two press formed parts and the connector. Typical applications are steam traps, float switches, float valves, liquid level controls, sump pumps, etc. The high strength to weight ratio and good corrosion resistance of the metals used allow broad application. Standard metals are stainless steel and monel.

Full quality control includes periodic analysis of material, continuing dimensional inspection, and periodic testing of weight and collapse pressure. Each float is individually inspected twice for leaks by a reliable fluorescent penetrant method.

The totally new catalog (#386) is 36 pages long and describes 93 standard sizes with over 214 variations of thread size material and collapse pressure. A price list is included.

The catalog is available from Seymour - Sheridan, Inc., 264 Seymour St., Stratford, CT 06497-6298. For immediate service call Matt Morgan at 203-377-2666 or send a Telex to 5106006563 (Seymour Sher UQ).

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moisture loss in fried foods. Information on thermal gelation's important role in microwaveable foods and in controlling the viscosity of hot liquids is included.

The brochure also tells how an unusual processing technique called "delayed hydration" postpones thickening of formulations until after processing is complete. By keeping processing viscosity down, this technique lowers pumping energy costs, reduces heat exchanger fouling, assists mixing, and improves homogenization. The brochure also discusses the synergistic relationship between METHOCEL gums and starches, explaining



### Labconco's New Fume Hood Catalog

• Labconco Corporation, Kansas City, MO., introduces their NEW catalog on Protector® Laboratory Fume Hoods. This 48-page, full color catalog contains complete information on Labconco's entire fume hood line and accessories.

The introductory section of the new catalog explains the benefits of Labconco's Protector hood design and points out features which make it safe and easy to install & service. Diagrams are also pictured which illustrate the airflow variations available: add-air, by-pass and conventional.

Specifications, dimensional data and ordering information are then detailed for each Labconco hood. Listed first are the Protector® Fiberglass Hoods, available in 4-, 5-, 6- and 8-foot wide models in various configurations. Next, Labconco offers Protector Specialty Hoods designed for specific applications, such as handling Perchloric Acid and Radioisotopes. The remaining hoods listed are for labs with limited ventilation requirements.

The last section of the catalog features accessories including base cabinets, work surfaces and filler panels. To help select the correct accessories for your fume hoods, the catalog has an easy-to-follow selection guide for Protector Base Cabinets & Work Surfaces.

Labconco fume hoods are available through all major laboratory supply dealers. For a free copy of their new catalog, call Labconco at 1-800-821-5525. For more information, contact: Susan Gregory, Labconco, 8811 Prospect, Kansas City, MO 64132. Telephone: 816-333-8811, ext. 236.

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how starch levels can often be reduced without increasing ingredient costs.

For your copy, request Form No. 192-976-586 from Inquiry Services/METHOCEL; The Dow Chemical Company; Box 1206; Midland, Michigan 48641-1206. Telephone: 1-800-258-2436, Extension 26/METHOCEL.

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## New Raw Milk Inoculation Concept

• New dimension of profitability and quality assurance are now available to the cheese industry through the introduction of RMI™ (Raw Milk Inoculant), a new concept developed by Chr. Hansen's Laboratory, Inc.

RMI is a combination of specially selected, lactic acid-producing bacteria designed to activate milk's own natural inhibitor system. When activated, this system is an effective means of controlling psychrotrophic growth. Psychrotrophs, if uncontrolled, will break down the casein and butterfat in milk, adversely affecting cheese yield, texture and flavor.

In documented field trials with over 15 million lbs. of milk, RMI treated yields were increased .125 to .1384 of additional lbs. of cheese per 100 lbs. of milk. This projects to a potential increased net profit of \$135.37 to \$151.65 on every 100,000 lbs. of RMI-treated milk.

In addition to this potential yield improvement, other reported benefits are reduced downgrades due to off-flavors, better overall cheese quality and improved production efficiency.

For ease of use and handling, RMI is packaged in a frozen pellet form. This new form is a first for the U.S. cheese industry, allowing for faster action and dispersion. One container treats 100,000 lbs. of milk and can be added to milk being transferred from a tanker to the storage silos, either directly or through an in-line surge tank.

According to Chr. Hansen, its new RMI can be considered a quality control system for maintaining the integrity of stored milk with the added benefit of an extra profit margin.

For technical data and pricing, contact: Chr. Hansen's Laboratory, Inc., 9015 W. Maple St., Milwaukee, WI 53214. Telephone: 414-476-3630.

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## Model U Trap

• Eriez Magnetics has introduced a new 3-inch Model U trap designed to magnetically remove tramp metal from materials and foods containing shredded, chunky, or long, fibrous ingredients.

This trap's specially designed construction features gradual tapered transition which smoothly directs difficult-to-flow products over the magnetic faceplate. Use of diverters or baffles which could cause product breakdown or damage is avoided.

A quick disconnect clamp on the new trap facilitates fast, easy cleaning of collected ferrous metals from the magnet face. Other design features of the Model U trap include an all stainless steel housing and non-electric, high-

## EZ-SCREEN: PENICILLIN

• Granite Division, Environmental Diagnostics, Inc. has developed a new field test for the detection of penicillin. This test is currently undergoing field trials and is expected to be on the market by October 1986.

Penicillins have been used in dairy cattle management for over two decades. They are generally administered to cattle by infusion into the udder for the treatment of mastitis and orally or by injection for the treatment of a variety of other diseases. As a result, penicillins are sometimes present in milk or milk products when they arrive at the dairy. The Food and Drug Administration (FDA) will not allow detectable levels of penicillin in milk and milk products. Also, dairy processors are unable to further process the milk into fermented dairy products, such as cheese and sour cream, if penicillin residues are present.

Many tests for penicillin residues do not perform rapidly or require instrumentation that is expensive and not appropriate for field use. In contrast, the EZ-SCREEN: PENICILLIN Test can be performed in the field, produces results within five minutes and is very economical.

The self-contained EZ-SCREEN Test System is comprised of Quik-Cards® (credit-card size) and all necessary reagents. The test, when completed, produces a highly visible color change which indicates whether the sample contains levels at or above the designated sensitivity. EZ-SCREEN: PENICILLIN will detect levels of penicillin residues of 2 ppb (.003 I.U./ml.) in milk samples.

Other EZ-SCREEN Tests available include Aflatoxin, Chloramphenicol, Gentamicin, Neomycin, Paraquat, Parathion, Sulfadimethoxine, Sulfamethazine, and Tylosin.

For further information on EZ-SCREEN: PENICILLIN or any of the other EZ-SCREEN Tests please write or call: Granite Division, Environmental Diagnostics, Inc., PO Box 908, 2990 Anthony Road, Burlington, NC 27215. 919-226-6311 or 1-800-344-1116.

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strength Erium® powered permanent magnetic circuit for low-cost operation.

With compact overall dimensions, the Model U trap can be installed in any 3-inch liquid line up to 150-psi, 132-gpm of fluid or strained materials. Standard construction has ACME sanitary thread on inlet and outlet ends. Optional flanged connections as well as tri-clover, cherry burrel, and other special ends are available.

For further information on the new Model U trap, write: Eriez Magnetics, Separation Division, P.O. Box 10608, Erie, Pennsylvania 16514, or call: 1-800-628-1200, ext. 616.

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## Foss Food Technology Corp. Announces Two New MILKO-SCAN Analyzers

• Food Food Technology Corporation has announced the introduction of the MILKO-SCAN 132 and MILKO-SCAN 134. These units complement the successful MILKO-SCAN 133 which has been on the market for 1 year.

The 132 model will be the most inexpensive infrared unit ever offered and comes in two versions. Version 1 can measure fat and protein and is seen as a replacement for all the old technology fat only instruments currently in use. Version 2 will measure fat and total solids and is designed to meet the needs of the ice cream industry. As well as being capable of measuring most ice cream mixes directly, it can be used for milks, creams, etc., thereby offering considerable advantage over conventional and microwave drying ovens.

The 134 model offers all the features of the other models plus dual fat measurement capability (A + B). All models are microprocessor controlled, have error monitoring and self-diagnostic capabilities, and use the most up-to-date technology. Other useful features include auto calibration, auto zero setting, and keyboard control. For more information, contact: Dolores Kupka, Foss Food Technology corp., 10355 W. 70th St., Eden Prairie, MN 55344.

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## Delkor's New Case Loading System

• Delkor Industries, Inc. has developed a new case loading system for vend-pack products that require accurate counts of delicate food packages. The system collates and loads individually wrapped packets of filled crackers, stacked 10 high in rows of 12. Speeds are up to 800 pieces per minute. The system is based on the standard Delkor Model FALS Former, Accumulator, Loader, Sealer.

High speed is achieved through use of dual in-feed mechanisms, photo optical monitoring, and all-mechanical handling. The FALS has two conveyors that move product to the loading position. The dual feed keeps the line moving at full speed even if self-monitoring electronics signal one conveyor to stop. Photo optical controls electronically monitor product configuration, compensating for varying product dimensions common to baked goods. The all-mechanical accumulator loads product into cases for gentle product handling at high speeds.

For further information, contact: Delkor Industries, Inc., 2920 Talmage Avenue S.E., Minneapolis, Minnesota 55414. Telephone: 612-331-7923.

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## Food Protection Certification Programs

Two programs designed to result in a food protection certificate for food service managers are now available. The newest program offers a food protection certificate and includes a listing in the program's national registry. The certificate is offered by the Educational Testing Service. A free program sampler is available providing background on the certification process, a candidate bulletin of information including detailed test content outline and sample questions, and Documentation of Validity report which includes a simple procedure for relating test content to local objectives. The sampler can be obtained by phoning Charles Teryek, Program Director, toll free at 800-251-FOOD or write Food Protection Certification Program, Center for Occupational and Professional Assessment, Educational Testing Service, CN00650, Trenton, New Jersey 08650-9965.

The National Institute for the Foodservice Industry (NIFI) updated and expanded their visual aid program which is designed to supplement their Applied Foodservice Sanitation Course. The course has been expanded to include new information on recently identified potentially hazardous foods and how to work with pest control operators and health inspection personnel. For more information, write NIFI, 20 North Wacker Drive, Suite 2620, Chicago, Illinois 60606, or phone 312-782-1703, NY State Dept. of Health, Food Protection Bull. 2/86.

## HACCP Update

One of the questions you will have to answer when you are developing monitoring points in an establishment is what action can the operator take with food when the monitoring point procedure is not followed? In other words, if the operator finds that a liquid potentially hazardous food is cooling in a deep container or that ready-to-eat meat has been placed on a work surface next to raw poultry, what is he to do? You and the operator have previously agreed that liquid potentially hazardous foods will be cooled in shallow containers and that separate work areas will be used for raw and ready-to-eat foods. Now the operator has identified that the appropriate monitoring point procedure has not been followed. What should or may the operator do with the food in these and similar situations?

When you are working with the operator to develop monitoring points, think of the points as a specification with tolerance limits above and below for acceptance. Likely occurrences that might cause the procedure to fall outside the acceptable limits should then be anticipated and planned for. It is not reasonable to assume that

operators have your knowledge of food microbiology and, therefore, would be able to reason out the appropriate remedy to the missed monitoring point.

In the case of the food being cooled in the deep pot, it might still be safe to portion the food to shallow containers, or to bring the food back to a boil on the stove and then properly rapidly cool it. The ready-to-eat meat contaminated by the poultry could be cooked to 165°F before service. Some foods that are not processed according to an established monitoring point procedure may have to be discarded, but that would not be the only solution. Proper care in developing the program will be repaid with a monitoring point procedure that will be followed. NY State Dept. of Health, Food Protection Bull. 2/86.

## Human Salmonellosis Principles of Investigation and Control

This is a 50-page booklet, edited by Drs. Franklin White and Lamont Sweet, representing the Proceedings of a Salmonellosis Symposium held 15-23 November 1984, during an educational course offered under the auspices of the four provincial Departments of Health in Atlantic, Canada, and at the request of the Atlantic Branch, Canadian Institute of Public Health Inspectors. The symposium was conducted by the Institute of Public Affairs in cooperation with the Department of Community Health and Epidemiology, Dalhousie University. Contents include an overview of foodborne diseases, recent trends in salmonellosis, epidemiological concepts, the role of the laboratory, a report of a major Atlantic, Canada outbreak, practical tips on investigation, and a paper on the investigation of endemic salmonellosis.

Copies are available (\$5.00) from the *Department of Community Health and Epidemiology, Dalhousie University, 5849 University Avenue, Halifax, Nova Scotia, B3H4H7*. Can. Diseases Weekly Report 4-19-86.

## FDA Interpretation - Potential Chemical Migration From Reused Plastic Food Containers

*Question:* Does the potential migration of substances from single-use plastic food containers into other foods preclude reuse of these containers?

*Definition:* "Food additives" mean all substances, the intended use of which results or may reasonably be expected to result, directly or indirectly, either in their becoming a component of food or otherwise affecting the characteristics, directly or indirectly, of food packed in



the container. If there is no migration of a packaging component from the package to the food, it does not become a component of the food and this is not a food additive.

"Single-use articles" means items intended by the manufacturer to be used and discarded. For the retail food industry, this term includes items such as aluminum foil pie pans, mayonnaise jars, plastic pudding buckets, bread-wrappers, pickle barrels and number 10 vegetable cans. This term does not include "single-service articles" as defined in the model codes.

*Discussion:* Single-use plastic articles used by processors to package food are being reused for food storage or preparation by some retail food operators. Public health officials must consider two issues - cleanability and migration of toxic components - when deciding whether or not single-use items can be accepted for reuse.

The model food sanitation code provisions relating to design and construction of multi-use utensils for cleanability are detailed and have been widely applied by regulatory officials for many years. Plastic articles have often been rejected for multiple use based on these criteria. In some cases, plastic containers have initially been accepted as being cleanable and reusable, only later to be rejected because of cracking, crazing, deforming or softening. This is considered non-conformance with the codes' durability provisions. FDA believes that the cleanability/durability issues are clear to regulatory officials and are, therefore, not the issues addressed in the question of this interpretation.

On the other hand, evaluation of the extent and nature of plastic components migrating from plastic containers into a diversity of foods during repeated uses and under a variety of conditions is extremely complex. This interpretation examines the public health concern that reuse of single-use plastic containers could result in components of the plastic migrating into foods resulting in adulteration.

A food is deemed to be adulterated under the Federal Food, Drug, and Cosmetic Act "... if its container is composed, in whole or in part, of a poisonous or deleterious substance which may render the contents injurious to health ... ."

Plastic food container components which migrate into food must meet certain standards of safety. Manufacturers must file a Food Additive Petition with the FDA, providing data in support of the safety of any component migrating from the plastic container into food. FDA considers these data with respect to both the maximum quantity of the additive to be expected in different types of foods and the total daily consumer intake. The Agency also takes into account the fact that migration of components from plastics is greatest during the initial uses of the container and diminishes with succeeding uses.

Single-use plastic containers are made of either *approved* material or material approved for a *specific use*. Approved plastic cannot, on site, be distinguished from

specific-use plastic.

Containers made of *approved* materials pose no hazard to consumers from migration of substances into food and they may be safely reused in contact with any food.

Containers made of *specific-use* plastic pose little risk to consumers from migration of substances into food since:

- they are only rarely encountered in retail food establishments,
- most are not reusable for other foods from a practical standpoint (e.g., narrow-necked bottles),
- second-use food contact time is typically short (certainly less than one year), and
- they often physically deteriorate if used inappropriately (soften at high temperature, become permeable to oily liquids, etc.).

Because there is little or no public health danger from substances migrating out of single-use plastic containers into food, there appears to be no compelling need to prohibit the practice of reuse on this basis.

*Interpretation:* The potential migration of substances from single-use plastic food containers into other foods does not preclude reuse of these containers.

Copies of this interpretation are available from the Editor, Food Protection Bulletin. (FDA Code Interpretation No. 4-101, August 23, 1985.) Food Protection Bulletin, NY State Dept. of Health, Vol. 2., No. 3, 1986.

## How Heat Resistant Are Foodborne Viruses?

Viruses are the most often reported etiology (including suspected etiologies) of foodborne disease in New York State. Hepatitis A, the Norwalk-like agents and rotavirus have accounted for all of the confirmed outbreaks of viral etiology in New York State over the past five years. How heat resistant are these viruses?

The vast majority of viruses are inactivated at temperatures of 60°C (140°F) or less. Viruses of the parvoviridae and picornaviridae are among the most heat resistant. Picornaviridae are of the most public health significance; hepatitis and the gastroenteritis viruses will probably be included in this group or in the parvoviridae (1).

Hepatitis A virus heat resistance has been studied but remains unknown. It is suspected to be extremely heat resistant but some of the heat resistance studies are flawed. Problems with laboratory cultures or criticism of the design of vessels to immerse the test virus in the heating medium have prevented effective studies or cast doubt on others. There is little doubt that the Hepatitis A virus can survive temperatures above 60°C (140°F) (1).

Rotavirus has been shown to be more heat resistant than highly heat resistant strains of *Salmonella*. At 65°C (149°F) in whole milk, it took 144 seconds to inactivate rotavirus while it took only 34 seconds to inactivate a

heat resistant strain of *Salmonella*. Some food or fecal material constituents may actually have a protective effect on virus, making inactivation times even longer (2).

Other parvoviruses have been shown to survive processing at the milk pasteurization times and temperatures advocated in the U.S. Public Health Service milk ordinance and code (63°C for 30 minutes or 72°C for 15 minutes). If such viruses are present in the environment and contaminate the food supply, they probably will survive most low-temperature (<100°C) thermal processes used in the home and industry (4). For example, shellfish are often cooked or steamed only until their shell opens; for soft-shell clams (*Mya arenaria*) this nearly always takes less than one minute and happens at temperatures less than 70°C. Continued steaming for an additional 4 to 6 minutes was needed to insure that the clam tissue reached the approximate temperature of the steam (ca.200°F) (3).

#### References

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Food Protection Bulletin. NY State Dept. of Health, Vol. 2, No. 3. 1986.

### Outbreak of an Unusual *Salmonella* Serotype Spread By Goat's Milk - British Columbia

On 1 October 1985, *Salmonella berta* was isolated by the Division of Laboratories, B.C. Ministry of Health, in Vancouver, from a specimen submitted from an infant in hospital to Chilliwack. This serotype is rare in B.C., having only been identified once before in 1981 from another area of the province. The same serotype was subsequently isolated and identified from a stool specimen submitted by the infant's father who was also ill. Upon discussion with the Upper Fraser Valley Health Unit in Chilliwack, it was learned that the suspected vehicle for transmission was raw goat's milk which had been distributed locally by an area farmer. Three consecutive stool specimens from the goat's owner who was asymptomatic were found to be positive for *S. berta*. A sample of the raw goat's milk was submitted to the Veterinary Pathology Laboratory in Abbotsford and to the Division of Laboratories in Vancouver; *S. berta* was isolated by both laboratories. Stool specimens from 5 different members of

the family that owned the goats were all positive for *S. berta*; however, they were all asymptomatic. Stool samples from 2 other members of the family which had received the milk were negative for *Salmonella*, as were repeat specimens from the 2 members who had previously been positive.

In the follow-up investigation fecal samples from chickens, goats and a horse on the farm were all negative for *Salmonella*; however, a fecal sample from the farm dog was positive for *S. berta*. No stool specimens were received from other users of the milk. This incident again emphasized the dangers of drinking raw unpasteurized milk.

*Editorial Comment:* *S. berta* is a rare serotype in Canada. In 1983 there were only 2 human isolates (1 in Ontario and 1 in Quebec). Ontario had 1 in 1984, and to date in 1985 there have only been 2 human isolates made (from Ontario). However, the most important aspect of this report is that people continue to drink raw unpasteurized milk despite the warnings. Only pasteurized or sterilized milk from cows or goats is safe for human consumption. Can. Diseases Weekly Report 12/28/85.

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San Miguel Corp.  
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***Immunoassays in Food Analysis.*** Edited by B. A. Morris and M. N. Clifford, Elsevier Applied Science Publishers, New York.

The book is based on the Proceedings of a Symposium on "Immunoassays in Food Analysis" held at the University of Surrey in Guildford, England, in September of 1983. The volume contains the texts of the papers presented at the symposium. The papers are organized into sections each of which covers several topics. The first section deals with the "Principles of Immunoassay" including enzyme immunoassay and alternative labels such as fluorescence and luminescence in non-isotopic immunoassays. The second section is on the "Application to Macromolecules" including species identification of meat in raw, unheated products, determination of soy protein in meat products, and techniques for estimation of staphylococcal enterotoxins in foods. The third section is devoted to the "Application to Small Molecules" including an ELISA method for Ochratoxin A in food, and use of immunoassay for monitoring anabolic (growth promoting) hormones in meats. A glossary, history and extensive bibliography are also included.

The book contains useful reference material, but does not come through as a comprehensive, complete reference or "how to" manual on the subject. Its coverage is selective, for example no chapters deal with immunoassays for aflatoxins or intact microorganisms, and therefore limited. In spite of this, the book does provide a useful introduction and background to the subject of immunoassays in food analyses.

**Lloyd B. Bullerman**

*University of Nebraska  
Lincoln, NE*

***Quality Control.*** Richard C. Vaughn, ISU Press, Ames, IA.

Professor Vaughn has provided a simple, fairly easy to read book on the use of statistical quality control (SQC) in the quality control/assurance function. The author states in the preface that the aim of this book is to present an overall picture of quality control, the risks associated and other developments. The book provides a picture of one of the many tools available to a quality assurance professional—that is, the use of statistics.

Chapters 1 and 2 provide a view of the history of statistical quality control and the risks of product liabilities. Chapters 3 to 6 cover basic principles and uses of control charts. Chapters 7 to 13 present tools and applications for product control. The last two chapters cover reliability and some comments about a "good" vs. a "bad" quality control organization. The reviewer must stress that the book discusses only one of the many tools available to a quality assurance professional. *Quality Control* is not a book about quality assurance philoso-

phies, techniques and technologies.

Various areas in the book are worth highlighting. Six pages showing all the symbols used in SQC are available in the beginning of the book. This is a very handy tool for a beginning practitioner of SQC. Also, a good set of appendix tables are available to the reader. However, the most noticeable chapter is Chapter 11, covering standard sampling (MIL-STD-105D). A reproduction of the standard is included in the chapter and various tables are attached.

Professor Vaughn discusses production liability in Chapter 2. Although not pertaining to SQC, it provides the reader a very good summary of the laws that apply to product liability and the responsibility of the manufacturer in supplying a high quality, consistent product that meets all consumer expectations.

*Quality Control* is a good, simple book for a beginning quality professional. It provides the reader with the basic concepts of an important quality tool, SQC. The quality professional will thus need other sources to further educate himself/herself on quality assurance principles and philosophies. This book can be used as a reference book in quality control, SQC or quality measurement courses.

**Dr. Ricardo Alvarez**

*Pizza Hut, Inc.*

*PepsiCo*

*Wichita, KS*

***Advances in the Microbiology and Biochemistry of Cheese and Fermented Milk.*** Edited by F. Lyndon Davies and Barry A. Law, Elsevier Applied Science Publishers, New York.

*Advances in the Microbiology and Biochemistry of Cheese and Fermented Milk*, edited by F. Lyndon Davies and Barry A. Law lives up to its title by presenting to the reader current scientific information on fermented dairy products. Prospective readers should be cautioned that this book deals with highly scientific data and contains very little information which would have immediate application to the production of fermented dairy products.

The nine chapters of this 260 page book can be divided into roughly three areas. The first of these areas is covered in chapter one and deals with the coagulation of milk and the development of cheese texture. The approach to this topic is from viewing the microstructure of the cheese and many photomicrographs are included. The next four chapters deal with the organisms utilized for the production of fermented milk products and cheese. The chapters cover the following topics: a) the taxonomy and identification of the bacteria used to produce fermented dairy products; b) the physiology and growth of these organisms; c) the genetics of dairy lactic acid bacteria; and d) bacterio-phage which attack these bacteria. The final four chapters cover topics related to flavor development. Specifically, the chapters detail, a)



flavor development in fermented milks; b) flavor development in cheeses; c) accelerated ripening of cheese; and d) non-sensory methods of assessing cheese flavor.

The chapters are written in a very understandable manner. The authors of the various chapters give enough basic information to give the reader a starting point. From here the authors relate the current advances in the various areas. Each of the chapters is very well referenced, thus providing a good point from which to research a particular subject. Overall this book would be a worthwhile addition to the library of anyone engaged in research or has an interest in cheese and fermented milk and the organisms responsible for them.

**David E. Smith**

*Department of Food Science and Nutrition  
University of Minnesota  
St. Paul, MN*

**Mass Catering.** R. H. G. Charles, WHO Regional Publications.

The inside front cover of the book gives the following background on the World Health Organization. "The WHO Regional Office for Europe is one of six Regional Offices throughout the world, each with its own programs geared to the particular health of the countries it serves."

The European region's programs concentrate on problems associated with the industrial society, which characterizes most of the members. This industrial accent is very evident throughout the book, particularly noticed in the examples and situations that are discussed.

*Mass Catering* is a rather short book consisting of seventy pages containing twelve chapters. The book's first four chapters deal with general aspects of public health in regard to mass catering, specifically: General Problems, General Methods of Control, Recent Technology, and Training. These chapters contain information on contamination, hygienic practices, raw materials, planning/licensing, inspections, epidemiology, and the use of slow cookers, microwaves, and cook freeze/chill equipment.

The remainder of the book deals with specific problems of particular aspects of catering. These chapters include information on institutional and welfare catering (hospitals, schools, homes for the elderly, meals on wheels), canteens in factories and commercial establishments, open air catering (disasters and festivals), tourist hotels and holiday camps, travel catering (airplanes and ships), and banqueting.

The final chapter is a summary listing fourteen points of basic food safety concerns, which are excellent! The last item summarized concerns mass catering in particular; it also sums up the theme of the book, "If you can't do it properly, don't do it at all."

The book classifies mass catering as an efficient and economical way of providing food for a large number of people, but because of the large scale and complexity,

mass catering has the potential to cause illness to a large number of people.

The book's aim then is "to draw attention to the relationship between mass catering and public health and to show where further information can be found." This goal is accomplished--for the most part.

At the end of most chapters was a bibliography of books and papers, and those appear to be very useful. A few chapters though, including those on canteens, catering for travelers, and banqueting, contain no bibliographies.

The book is designed and intended for use by health officials who have little knowledge of commercial catering, and for food, trade and other officials and commercial interests that have little knowledge of public health.

The author states, "This book does not set out to be a technological manual or a textbook of food hygiene or the epidemiology of food-borne disease."

The chapters dealing with hospital, school, festival, and travel catering were especially good. They mainly relate to past food-borne outbreaks, economic impacts, why they happened, and how to prevent them from occurring again.

The book contains eight sketch type illustrations which were very simple and direct. They were easy to follow and very meaningful and pertinent.

All quoted temperature ranges for proper and safe food handling were in degrees Centigrade. This may create a problem if the °C scale is not known, or if it cannot be converted to the °F scale.

I felt the book was straightforward and factual and found it very easy to read and entertaining.

I agree with the author that *Mass Catering* should not be used as a textbook by itself, but would suggest it as an additional reference to a text or teaching manual.

**Kevin Anderson, R.S.**

*Ames Health Dept.  
Ames, IA*

**Fungi and Food Spoilage.** by John I. Pitt and Ailsa D. Hocking, Academic Press, Orlando, FL.

In reviewing this book, I find it to be excellent as a reference source on mycological food spoilage, though the authors Australian and tropical background are notably expressed. The book is well illustrated with pictures, drawings and identification keys of the various fungi.

A chapter is provided for each genus with discussion of the characteristics of the group. Specific details and listing of the species follows with descriptions of their isolation, identification and economic importance.

**David Peper**

*Siouxland District Health Dept.  
Sioux City, IA*





New WPHSA Officers: back row (l to r), Tyrone Welty and Gary Hickman; front row, Sandi Palmer and Sandra Knop.

### Wyoming Public Health Sanitarians Association Holds Annual Meeting

The Wyoming Public Health Sanitarians Association held its annual business meeting on September 24, 1986 during their Annual Education Conference at Thermopolis, WY. New officers were elected for two-year terms at that time.

The new officers are: Tyrone Welty, Casper - President; Sandra Knop, Green River - President-Elect; Sandra Palmer, Cheyenne - Secretary; Abe Knapp, Casper - Treasurer; and Gary Hickman, Cheyenne - Past-President.

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**Where Does Culturing Fit Into Mastitis Control?**

**Part I**

Bacteriologic examination of milk samples (culturing) is essential to identify the organisms responsible for mastitis. It is impossible to develop an effective control program without first identifying the organisms. Also, culturing is necessary to isolate individual organisms before any antibiotic sensitivity testing can be done. Antibiotic sensitivity testing can play an important role in the selection of effective treatment.

One of the problems in the laboratory is that examination of samples from clinical cases often yields negative results. This occurs when cows have been treated with antibiotics prior to sample collection. Antibiotics present in the milk inhibit growth of the bacteria you're trying to culture. Bacteria also can be engulfed by white blood cells in the milk and therefore, not grow on the laboratory media because of the higher cell counts caused by the infection. It is frustrating to receive a negative laboratory report from a sample submitted from a cow which you know had clinical mastitis.

Do not depend on the results from only one sample! A single sample submitted from a herd problem can be very misleading, particularly if that sample has been contaminated with one of the coliform organisms as a result of careless collection methods. Samples for culture must be collected in an aseptic manner. Milk is an ideal medium and any organism from the teat, udder, flanks or hands which contaminates the sample will grow. Samples collected without strict sanitation and careful procedures are worthless and can be misleading.

The one thing that stands out as most important when it comes to bacterial cultures for mastitis is the collection of "clean" samples. Contamination by even the smallest speck of dust results in something that may be even worse than worthless results--misleading results. Whatever winds up in the vial sent to the laboratory will grow on the culture plate. If it comes from your hand, the side of the cow or a teat that was not cleaned properly, you could be misled and think it was the organism causing your mastitis problem. All samples must be collected in a manner that insures that results will be meaningful. They should be collected by a veterinarian, under veterinary supervision or following the directions of your veterinarian. A previous column suggested a technique for collection.

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**Report of the Subcommittee on  
Water Treatment and Protection**

**IAMFES Farm Methods Committee**

The Water Treatment and Protection Subcommittee has been largely inactive during the past year as the result of conflicting duties of the Subcommittee Chairman. Fortunately, many groups are now recognizing the urgency for action in developing and protecting agricultural water resources.

USDA, EPA, various state and local agencies, and the media have published numerous releases recently to alert the general public about the damaging and dangerous aspects of environmental pollutants in our water supplies. Human and livestock health and the healthfulness of our agricultural crops may be in jeopardy unless present unwise practices are corrected.

Large quantities of water are necessary for producing milk and other foods on American farms. Good quality water must be available and plentiful, every day of the year. Regulations relating to milk production require water be safe and protected from excessive contamination. Water to be used in hydro cooling vegetables and for processing most foods must be potable and protected from many types of environmental contaminants.

Such water is becoming increasingly hard to find. In many areas, water quality and/or quantity are approaching crisis situations already. As urban populations continue to expand into areas previously available for production of agricultural crops and products, agricultural units become concentrated into ever smaller production zones. Secondary sources of water must be used to supplement the inadequate primary water supplies. Seldom are these secondary water supplies of suitable quality for food production without some type of treatment.

It has been estimated that it takes 230 gallons of water to produce a quart of milk, half that to produce a loaf of bread. The growing, harvest-

ing, preparing, and processing of food for a meal of the typical American family may use at least 2000 pounds of water. Where will water of good quality be found in such quantities in the future?

Few new sources of water have been developed in recent years despite the rather regular cycles of drought that have appeared in various parts of the country. Yet concentrations of food production units in smaller and smaller areas create ever increasing demands on local water supplies. Purity of public water supplies must be assured by appropriate and frequent testing. Few rural or farm water supplies can provide similar supervision.

The dairy industry has recognized for many years that potable water was essential for milkhouse uses. On the other hand, water protection for farm animal use was of little concern. The industry now is coming to realize that many animal pathogens come from or are transported by the water supply. Suitable treatment is essential to protect the health of the farm family and farm animals.

Surface water supplies have long been considered to be contaminated by undesirable microorganisms and chemicals of natural or man-made origin. Today underground systems are becoming polluted with a similar variety of pollutants.

Increased mechanization and automation in all food production operations require ever-increasing amounts of water. Yet, nature provides no more water and the human population does little to utilize existing water supplies more effectively. Processing and cleaning systems must be planned which are more water-efficient. Multiple-use methodology must be developed to avoid the tremendous waste of water which is common in the food industry today. Water treatments which are reliable and simple to operate must be made available since dairy farms and rural populations cannot provide the expertise necessary for operating municipal systems.

No longer can we take rural water

supplies for granted. New sources must be brought into production. They must be protected and treated so that the physical, chemical, and microbiological qualities are assured to produce food products which are safe and possess the desirable taste and aesthetic characteristics demanded by today's more discriminating consumer.

The Federal Extension Service and many state Extension groups have established task forces to identify water quality problems. They will establish educational efforts which inform local officials and the public about the rapidly developing crisis in water quality and safety and measures which can be taken to prevent future degradation of this essential resource.

The Northeast Dairy Practices Council published recently its "Guidelines for Potable Water on Dairy Farms" (NDPC Publication 30, March 1986). EPA has a mandate to regulate leaking underground storage tanks (LUST) under the Hazardous and Solid Waste Amendments of 1984. Numerous research efforts are now underway by private and academic units to understand the movement of various pollutants in the underground water environment.

Recent research has demonstrated water contaminants - chemicals, pesticides, microbes - travel faster and deeper than earlier engineering studies indicated. Lateral movements may be (are) a significant problem both in speed and area affected. Available isolation methods are insufficient to detect certain pathogenic microorganisms even though they are present in sufficient numbers to cause disease.

The Water Treatment and Protection Subcommittee should be continued to monitor developments in this important field of water availability, quality, and safety.

**IAMFES Sustaining  
Membership Report - 1986**

The Executive Board determined that the Membership and Sustaining Membership Committees could be tied together for a consolidated ap-

proach. Ruth Fuqua has taken the chairmanship of both the membership and sustaining membership committees.

Dramatic increases in sustaining memberships came in 1986, with the addition of 12 members for a total of 45 sustaining members. The increase is entirely attributable to the IAMFES Advertising Department who in the efforts to attract Journal advertisers or exhibitors for the Annual Meeting, convinced the contacts to become sustaining members as well.

A new brochure for potential sustaining members has been developed this year and is currently in use. The art work and print are an improvement, depicting IAMFES as a truly professional organization. The brochure explains the Developing Scientist Award and Guest Lecturer series, which began this year.

Plans for next year are to increase sustaining membership even further, with mailings, further work by advertising, and "buttonholing" prospective new sustaining members.

#### **Membership Committee Recommendations for 1987**

The membership committee recommended specific activities for the coming year at its meeting in Minneapolis which will aid in our "quest" to attract and keep new members. We submit these items for Board concurrence:

1. Recognize new members at the annual meetings through a name tag designation and a new member reception. Suggested timing for a new member reception is a continental breakfast on Monday morning. At the reception, new members could meet each other and be briefed on activities in which they can participate. Suggestions for briefing would be posters describing committee work, affiliate activities, etc. Additionally, an invitation to the reception should be sent out to new members from the IAMFES office with an RSVP return card which would be returned to the host affiliate.
2. Registration fees for non-members at the annual meeting should be adjusted so that registration automatically includes membership--i.e., \$70.00 for non-members as opposed to \$40.00. IFT, AOAC and other organizations use this method with fair success. If the non-member wished to become a member, he would fill out an application form, and become a member at that point. Otherwise, he would remain a non-member and would receive no ribbon. (The committee liked the idea of ribbons which designated "Member" and suggests this become standard each year.)
3. When the booth is displayed, someone should be with it at all times, especially at the affiliate or annual meetings.
4. The affiliate council agreed to provide the membership committee with a contact person in each affiliate who would be responsible for membership areas. In this way, we can pass along direct membership info., and have a contact who can provide affiliate contacts to help IAMFES increase in the affiliate.
5. Continue the membership drive concept, both at the individual member and affiliate levels.
6. Revise the membership application form to include a checklist of interests, i.e., quality control, regulatory, milk, food, etc. Not only will this give us a good profile of the membership, it could also assist committees in attracting working committee members.
7. Students are our growth potential. There is currently no "push" to attract student members. As students use the *Journal of Food Protection* in researching for papers, the membership committee suggests a full page two to three times per year which calls attention to student membership and the Developing Scientist Award competition.
8. The contact list for university professors in food science, environmental sanitation, etc., should be developed and used to provide information pertaining to the organi-

zation that can be passed along (or used).

#### **IAMFES Membership Committee Report - 1986**

The membership committee has excellent news to report for 1986.

First, the committee was established this year with a new chairman, Ruth Fuqua, and is comprised of six members representing all segments and areas of the membership. The committee members are Don Berg, Land O' Lakes; Henry Atherton, University of Vermont; Doug Park, Michigan Department of Health; Ricardo Alvarez, Pizza Hut; Joe Smucker, FDA; Joe Goddard; Texas Tech. University; James Steele; Alberta Department of Public Health.

The committee met on Monday, August 4 to discuss current membership status and to consider new ways of attracting new members in the future.

The current membership has increased for the first time in many years. Membership for 1986 is up 200 members from 1985.

Increases in membership were due to: 1) The membership drive contest 2) The distribution of Journals at various meetings for advertising purposes

The increases were significant, and the credit should go to the IAMFES Advertising Department under Kate Wachtel and Kathy Hathaway. The work of the committee itself has just begun, and plans are to improve on the base of 1986, taking the programs from last year and expanding upon them.

The increases came mainly through direct memberships rather than through affiliates. For this reason, the membership committee will be focusing on attracting direct members in the coming year. Lists of new direct members will be sent to the affiliates so that they, in turn, can attract the direct members to become affiliate members as well.

These efforts, combined with affiliate work to persuade affiliate members to become IAMFES members, should enhance the increases from 1986.



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

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

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

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## Submitting Articles

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

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

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

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## Types of Articles

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

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

### Book Reviews

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

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## Preparation of Articles

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

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

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

## Illustrations, Photographs, Figures

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

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

## Examples of Proper Bibliographic Citations

### Paper in a journal

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

### Paper in a book

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

### Book

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

### Patent

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



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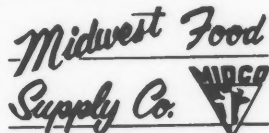
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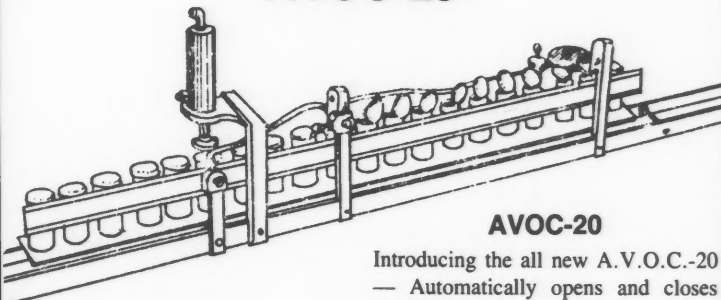
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Abstracts of papers in the December Journal of Food Protection

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**Distribution of Coliphages in Various Foods**, J. E. Kennedy, Jr., C. I. Wei and J. L. Oblinger, Food Science and Human Nutrition Department, University of Florida, Gainesville, Florida 32611 and College of Agriculture, University of Missouri, Columbia, Missouri 65211

*J. Food Prot.* 49:944-951

The distribution of coliphages in various foods and the relationship between the incidences of coliphages and bacterial indicators were investigated. A total of 120 food samples comprising twelve products and including fresh meats, shellfish, vegetables and processed meats, were analyzed for indigenous coliphages using *Escherichia coli* hosts C, C-3000 and B. Bacterial analyses included enumeration of *E. coli*, fecal coliforms and coliforms, as well as aerobic plate counts and *Salmonella* analyses. Coliphages were detected ( $\geq 10$  PFU/100 g) in 56% of samples and eleven of twelve products. Coliphages, *E. coli*, fecal coliforms and coliforms were recovered at a level of at least 30 organisms per 100 g in 43, 43, 68 and 81% of samples, with overall mean recoveries of 13, 19, 93 and 4300 organisms/100 g, respectively. Highest and lowest recoveries of coliphages and *E. coli* were from fresh meats and vacuum-packaged processed meats, respectively. Significant nonparametric correlations between coliphages, *E. coli*, fecal coliforms and coliforms were found among all food samples.

**Characterization of Coliphages Recovered from Foods According to Temperature of Infectivity**, J. E. Kennedy, Jr., C. I. Wei and J. L. Oblinger, Food Science and Human Nutrition Department, University of Florida, Gainesville, Florida 32611 and College of Agriculture, University of Missouri, Columbia, Missouri 65211

*J. Food Prot.* 49:952-954

Coliphages recovered from 38 samples of ten different food products were characterized with regard to temperature of infectivity. High temperature (HT) phages were capable of reproduc-

tion at or above 30°C, mid temperature (MT) phages over a range of 20 to 42°C and low temperature (LT) phages at or below 20°C. The percentage of HT coliphages isolated with *Escherichia coli* C-3000 host were consistently higher than corresponding percentages with *E. coli* C host. Coliphages recovered from all products were primarily HT or MT coliphages.

**Enterotoxigenicity of *Staphylococcus aureus* from Anterior Nares of Dining Hall Workers**, Abiodun A. Adesiyun, Ifedapo Raji and Vivian Yobe, Department of Veterinary Public Health and Preventive Medicine and Department of Microbiology, Ahmadu Bello University, Zaria, Nigeria

*J. Food Prot.* 49:955-957

The frequency of isolation of enterotoxigenic *Staphylococcus aureus* in dining hall workers of a Nigerian University was determined. Of a total of 186 workers sampled, 47 (25.3%) were carriers of enterotoxigenic *S. aureus* in their anterior nares, including 19 (22.4%) of 85 cooks and 11 (23.9%) of 46 stewards. Fifty-five (26.6%) of 207 strains of *S. aureus* tested produced staphylococcal enterotoxins A (SEA), B (SEB), C (SEC), D (SED) or E (SEE). SEA predominated, with 18 (8.7%) strains elaborating it and representing 32.7% of all enterotoxigenic strains. SEC and SED were produced by 14 (6.8%) and 13 (6.3%) strains, respectively, and 9 (4.3%) strains produced SEB and SEE. It appears that SEA poses the greatest risk to students consuming foods contaminated by *S. aureus* of nasal origin from these workers.

**Assessment of the Microbiological Quality of Spices and Herbs**, Josephine Pafumi, Arnott's Research Centre, P.O. Box 65, Homebush, NSW 2140, Australia

*J. Food Prot.* 49:958-963

This investigation of the microbiology of spices and herbs has resulted in the isolation of pathogenic, potentially pathogenic and spoilage organisms. Tests undertaken included Standard Plate Count (SPC), Yeast and Mold Count, counts for *Escherichia coli*, coliforms, *Bacillus cereus*, presumptive *Clostridium perfringens*; and the presence of *Salmonella*. The SPC ranged from less than  $1.0 \times 10^2$  cfu/g in cloves and cayenne pepper to  $2.0 \times 10^8$  cfu/g in black peppercorns. Most other spices and herbs averaged a total microbial load

of about  $1.0 \times 10^5$  cfu/g. Cloves and cayenne were the only spices found to be free of *B. cereus*, *C. perfringens*, coliforms, *E. coli*, and *Salmonella* spp.; and low in mold count. In contrast, peppercorns consistently had the highest level of microbial contamination, containing high levels of all organisms tested. Sporeformers and coliforms were detected in most other spices and herbs; *B. cereus* at a load ranging from less than  $1.0 \times 10^2$  cfu/g to  $1.0 \times 10^5$  cfu/g, with most being less than  $1.0 \times 10^3$  cfu/g (except for cinnamon and broken mace which yielded higher counts); presumptive *C. perfringens* counts were usually  $<1.0 \times 10^2$  cfu/g (except for mixed herbs and ground paprika); and coliforms at  $<10$ /g (except for ground paprika which yielded higher counts). *Salmonella* was isolated from black peppercorns, white peppercorns and fenugreek seed at a relatively high incidence level (8.2, 1.5, 7.1%, respectively). Fumigation with ethylene oxide proved effective; resulting in *Salmonella*-free spices and substantial reduction ( $>90\%$ ) in the overall organism count. The spice toxicity tests in regard to *Salmonella* demonstrated that diluted spice:pre-enrichment ratios of 1:1000 are necessary for cloves, pimento, cinnamon, oregano and mustard seed to confidently isolate this organism of public health concern.

**Musty Aroma Compounds Produced by Selected Molds and Actinomycetes on Agar and Whole Wheat Bread**, Natholyn D. Harris, Carol Karahadian and Robert C. Lindsay, Department of Nutrition and Food Science, Florida State University, Tallahassee, Florida 32306 and Department of Food Science, University of Wisconsin, Madison, Wisconsin 53706

*J. Food Prot.* 49:964-970

Musty aroma compounds produced by cultures of *Streptomyces odorifer*, *Streptomyces griseus*, *Penicillium roqueforti*, *Aspergillus flavus*, *Aspergillus niger*, and *Botrytis cineria* when grown on agar and whole wheat bread were isolated and identified using headspace entrainment and GC-MS analysis. Actinomycete cultures produced the most intense musty aromas, which were attributed to the presence of 2-methylisoborneol and geosmin, whereas *P. roqueforti* and *B. cineria* cultures produced an overall musty-fruity odor quality caused by the combination of 2-methylisoborneol and 8-carbon alcohols and ketones. Several musty compounds in the cultures were not identified including an intensely musty, cat-like aroma compound produced by *A. flavus*. Seven musty aroma-type categories are proposed to assist in defining musty taints produced by microorganisms in food and feedstuffs.

**Non-Detection of Enteroviruses in Shellfish Collected from Legal Shellfish Beds in Massachusetts**, Khalifa I. Khalifa,

Barbara Werner and Ralph Timperi, Jr., Microbiology Department, Faculty of Medicine, Suez Canal University, Ismailia, Egypt and Center for Laboratories and Communicable Disease Control, Massachusetts Department of Public Health, Jamaica Plain, Massachusetts 02130

*J. Food Prot.* 49:971-973

Eighty-five samples of shellfish (50 soft shell clams, 21 hard shell clams and 14 oysters) were examined for the presence of human enteric viruses. In addition, bacterial contamination levels, both fecal coliform and standard plate count, were determined. Seventy-five samples were harvested from open shellfish areas and 10 samples from restricted shellfish areas during seasonal opening. Enteroviruses were not detected in any of the samples tested. In contrast, 33 (30 from open beds and 3 from restricted areas) of 82 shellfish samples had levels of bacterial contamination that exceed current regulatory limits for shellfish.

***Bacillus subtilis* rec Assay for Quantification of Aflatoxins**, Miguel D'Aquino, Silvia Bejar and Ernesto Bollini, Department of Toxicology (Hygiene & Public Health), Faculty of Pharmacy and Biochemistry, Buenos Aires University, Junin 954, 1113 Buenos Aires, Argentina

*J. Food Prot.* 49:974-976

The *Bacillus subtilis* 1791 rec<sup>-</sup> assay was used to quantify genotoxic mycotoxins. This assay is based on detection of mycotoxin-produced DNA alterations arising from recombinational deficiency in rec<sup>-</sup> cells. Aflatoxin B<sub>1</sub> showed a linear dose-response relationship when the inhibition halo was taken as a parameter for the evaluation procedure. Assays carried out with or without hepatic microsomal activation exhibited a similar response.

**The Psychophysical Relationship Between Color and Sodium Chloride Concentrations in Model Systems**, S. R. Gifford and F. M. Clydesdale, Department of Food Science and Nutrition, Massachusetts Agricultural Experiment Station, University of Massachusetts, Amherst, Massachusetts 01003

*J. Food Prot.* 49:977-982



A 10-member taste panel evaluated the effect of color on salt perception using magnitude estimation. Samples, colored to simulate commercial chicken broth were formulated by addition of increasing amounts (0.00 - 4.10%) of 0.05% FD&C Red 40 to a constant volume of 0.10% FD&C Yellow 5 in double-distilled deionized water. In each of four experiments, five color intensities were evaluated at five NaCl concentrations over a range of 0.14 - 1.06% (w/v). The Gardner XL - 23 colorimeter was used to obtain L, a and b values from which the objective color parameter  $\log \cot^{-1} (a/b)$  was calculated.  $\log \cot^{-1} (a/b)$  correlated well with log color intensity and was therefore, suitable as a predictor. In all experiments, panelists were able to detect differences among the NaCl concentrations ( $P < 0.001$ ) regardless of color. The perception of saltiness increased with increasing salt concentration as a linear power function with slopes greater than one. Although color tended to confuse the perception of saltiness, this effect was not significant.

**Growth and Survival of *Yersinia enterocolitica* in Yogurt,**  
Ahmed A-H. Ahmed, Moustafa K. Moustafa and Tawfik A. El-Bassiony, Department of Food Hygiene, Faculty of Veterinary Medicine, Assiut Univeristy, Assiut, Egypt

*J. Food Prot.* 49:983-985

Two lots of yogurt were prepared to contain two different strains of *Yersinia enterocolitica* (E675 serotype 0:3 and 2653 serotype 0:8) at an initial inoculum of  $2 \times 10^6$  cells/ml, and then were refrigerated at  $5 \pm 1^\circ\text{C}$  for 7 d. Numbers of *Y. enterocolitica*, as well as pH value of yogurt were determined every 24 h. *Y. enterocolitica* survived until the end of the week at a population of 8,000 and 10,000 cells/ml for each strain, respectively. The pH value of yogurt decreased sharply from 6.3 to 4.5 by the end of preparation, and a low value of 4.2 was reached at the end of refrigerated storage.

**Effect of a Mixture of *Lactobacillus casei* and *Lactobacillus acidophilus* Administered Orally on the Immune System in Mice,** Gabriella Perdigon, Maria Elena Nader de Macias, Susana Alvarez, Marta Medici, Guillermo Oliver and Aida Pesce de Ruiz Holgado, Centro de Referencia para Lactobacilos (CERELA), Chacabuco 145, 4000 Tucumán, Argentina and Facultad de Bioquímica, Química y Farmacia, Universidad Nacional de Tucumán, Argentina

*J. Food Prot.* 49:986-989

The effects of an orally-administered mixture of *Lactobacillus casei* and *Lactobacillus acidophilus* on the immune system in Swiss albino mice were studied. Non-fermented milk containing viable cultures of both microorganisms was fed for different consecutive days to the animals, the effect of such feeding on their immune system was evinced by macrophage and lymphocyte activation. An increase both in the in vitro phagocytic activity of peritoneal macrophages and in the carbon clearance activity was observed. As regard the lymphocytic activity, the mixture produced a higher activation than that in the control mice. The enhanced macrophage and lymphocytic activity by administering cultures via the oral route, suggest the advisability of using the mixture of bacteria for a more efficient stimulation of the host immune response.

**Survey of Bulk Tank Milk using Blood-Esculin Agar Count,**  
J. S. Hogan, J. W. Pankey, P. Murdough and D. W. Howard, Department of Animal Sciences, Animal Health Section, Hills Science Building and Computer and Statistical Services, The University of Vermont, Burlington, Vermont 05405

*J. Food Prot.* 49:990-993

Milk from bulk tanks of 2,931 dairy herds were sampled and evaluated using trypticase blood-esculin agar, somatic cell, standard plate and preliminary incubation counts. Percent samples with trypticase blood-esculin agar counts  $> 1 \times 10^2$  colony forming units/ml by organisms were *Staphylococcus aureus*, 33; *Staphylococcus spp.*, 84; *Streptococcus agalactiae*, 47; esculin-positive streptococci, 72; coliforms, 73; and other microbes, 89. Trypticase blood-esculin agar counts were useful for identifying primary bacterial contaminants. Correlations were low between trypticase blood-esculin agar counts of specific bacterial groups and somatic cell, standard plate and preliminary incubation counts.

**Psychrotrophic Growth and Thermal Inactivation of *Listeria monocytogenes* as a Function of Milk Composition,** Catherine W. Donnelly and Elizabeth H. Briggs, Department of Animal Science, University of Vermont, Burlington, Vermont 05405

*J. Food Prot.* 49:994-998

*Listeria monocytogenes* strains 19111, 19113, 19115, F5027 and F5069 were grown in 11% nonfat milk solids, skim milk and whole milk at 4, 10, 22, and  $37^\circ\text{C}$  to determine the influence of temperature and milk composition on growth and thermal resistance. Milk composition affected cellular growth. The psychrotrophic growth of *L. monocytogenes* serotype 4b strains

was enhanced in whole milk when compared to skim milk or 11% NFMS. This enhancement of psychrotrophic growth was not observed for serotype 1 or 3 strains. The stimulatory effect of whole milk on serotype 4b *L. monocytogenes* strains was most dramatic at 10°C where cells increased from  $7.9 \times 10^0$  to  $5.8 \times 10^6$  CFU/ml within 48 h. Milk composition did not affect the thermal resistance of *L. monocytogenes*. All strains used in this study had a  $D_{62.7^\circ\text{C}}$  value of 1.0 min or less, therefore, pasteurization as defined by current FDA guidelines should eliminate this organism from raw milk with a large margin of safety. Post-pasteurization contamination of dairy products with *L. monocytogenes* must be eliminated since the psychrotrophic nature of this organism ensures survival and proliferation during refrigerated storage.

**Influence of Sodium Substitution with Potassium on Microbial and Organoleptic Spoilage Patterns in Sliced Vacuum-Packed Pasteurized Pork Loin**, J.-J. S. Nielsen and P. Zeuthen, Department of Biotechnology, Food Technology, The Technical University of Denmark, DK-2800 Lyngby, Denmark  
*J. Food Prot.* 49: 999-1002

Sliced, cured, cooked and smoked pork loin was produced with sodium chloride or a mixture of sodium and potassium chloride, with each preparation of pork loin having the same water activity (0.967-0.968). The pork loins were sliced, vacuum packaged and stored at 2, 5 and 10°C. Microbial spoilage was determined using selective and nonselective media to enumerate total aerobic bacteria, lactics, *Brochothrix thermosphacta*, gram-negative bacteria and yeasts. Spoilage was also

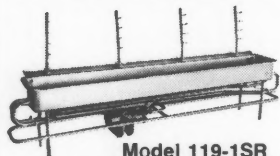
determined using sensory evaluation. Generally, the influence of sodium substitution on microorganisms was minimal. Organoleptic scores were similar for the two preparations of pork loin, hence no adverse effect of sodium substitution was observed.

**Is Refrigeration Enough to Restrain Foodborne Pathogens?** Samuel A. Palumbo, U.S. Department of Agriculture, Eastern Regional Research Center, 600 East Mermaid Lane, Wyndmoor, Pennsylvania 19118

*J. Food Prot.* 49:1003-1009

Holding foods at 5°C has traditionally been viewed as adequate to restrain the growth of foodborne pathogens. However, a group of "new" foodborne pathogens has emerged, some of which are capable of competitive growth at 5°C in foods. Bacteria fitting this criterion include *Clostridium botulinum* type E, *Yersinia enterocolitica*, enterotoxigenic *Escherichia coli*, *Listeria monocytogenes* and *Aeromonas hydrophilia*. A second area discussed is the effect of low temperature (5°C) on survival of foodborne pathogens. Both *Campylobacter jejuni* and *Brucella* survive for longer periods at 5°C compared to 25 or 37°C. A third area considered is the growth of certain pathogens (*Salmonella*, *Staphylococcus aureus*, *Vibrio parahaemolyticus*, *Bacillus cereus*) at temperatures slightly above 5°C up to 12°C. Hence, temperature abuse of a food could readily generate a hazard in a food. The use of refrigeration (5°C holding of a food) can no longer be deemed sufficient to keep foods safe from bacterial hazards either by growth of the "new" pathogens or increased survival. Further, even brief temperature abuse can create hazards from certain bacteria.

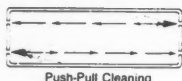
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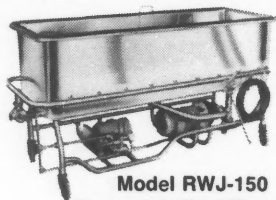


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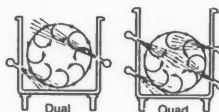
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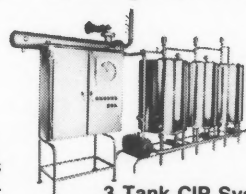
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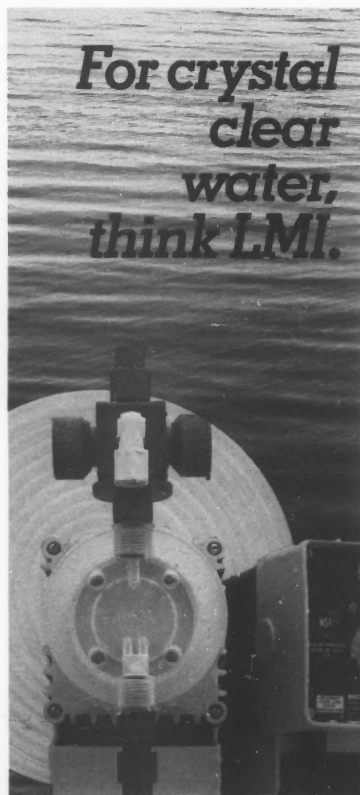
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## 1987

January 12-23, BAKING FOR ALLIED AND NON-PRODUCTION PERSONNEL, Manhattan, Kansas. Contact Registrar at 1-800-633-5137 or write: Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502.

January 14-17, U.S. DAIRY FORUM, to be held at the Bonaventure Hotel in Ft. Lauderdale, FL. For more information contact: MIF-IAICM, 888 Sixteenth St., N.W., Washington, DC 20006.

January 19-21, PACKAGING, Manhattan, Kansas. Contact Registrar at 1-800-633-5137 or write Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502.

January 21-23, PATENT LAW FOR SCIENTISTS & ENGINEERS, New Jersey. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, New Jersey 08816-0964. 201-238-1600.

January 26-28, BAKING PRODUCTION TECHNOLOGY, location to be announced. Contact Registrar at 1-800-633-5137 or write: Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502.

January 26-28, COOLING TOWER TECHNOLOGY AND WATER TREATMENT, New Jersey. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, NJ 08816-0964. 201-238-1600.

January 26-29, BASIC FOOD PROCESSING SANITATION, Manhattan, Kansas. Contact Registrar at 1-800-633-5137 or write: Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502.

January 26-29, PRACTICAL COMBUSTION CONTROL & INSTRUMENTATION, New Jersey. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, New Jersey 08816-0964. 201-238-1600.

January 26-30, SPECIALIZED COOKIE PRODUCTION FOR THE RETAIL BAKER, Manhattan, Kansas. Contact Ellen Thurlo at 1-800-633-5137 or write: Ellen Thurlo, Research Department, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502.

January 27-30, INDUSTRIAL MEMBRANE TECHNOLOGY, East Brunswick, New Jersey. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, New Jersey 08816-0964. 201-238-1600.

February 4-5, FOOD PROCESSORS' SANITATION WORKSHOP, to be held at the

Holiday Inn, Santa Nella, CA. For more information contact: Kathryn J. Boor, Food Science and Technology, University of California, Davis, CA 95616. 916-752-1478.

February 5-7, FOOD ADDITIVES, THE CHANGING CLIMATE? 1ST INTERNATIONAL CONGRESS, to be held at the Hilton Hotel, Vienna, Austria. For more information contact Secretariat of the Food Additives, The Changing Climate, 1st International Congress, 30 Deane Way, Ruislip, Middlesex HA4 8SX, England.

February 9-12, BAKING TECHNOLOGY, New Jersey. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, New Jersey 08816-0257. 201-238-1600.

February 10-11, OREGON DAIRY INDUSTRIES ANNUAL CONFERENCE, to be held at the Red Lion Inn, Springfield, OR 97477. For more information contact: June Daley, Exec. Secretary, Oregon Dairy Industries, 503-754-3131.

February 11-12, DAIRY AND FOOD INDUSTRY CONFERENCE: THE OHIO STATE UNIVERSITY. For information contact John Lindamood, Department of Food Science and Nutrition, 2121 Fyffe Road, The Ohio State University, Columbus, OH 43210-1097

February 18-20, PATENT LAW FOR SCIENTISTS & ENGINEERS, Denver, Colorado. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, New Jersey 08816-0964. 201-238-1600.

February 19, WESTERN NEW YORK IFT SYMPOSIUM, Pest Management and Sanitation, Rochester, NY. For more information contact Donald L. Downing, Cornell University - NYSAES, Geneva, NY 14456. 315-787-2273.

February 23-25, ABC RESEARCH, 13TH ANNUAL TECHNICAL SEMINAR. For more information contact Sara Jo Atwell, ABC Research Corporation, P.O. Box 1557, Gainesville, FL 32602. 904-372-0436.

February 23-25, FAMFES 1987 EDUCATIONAL CONFERENCE, to be held at the Louisville, Kentucky, Executive Inn. For more information contact: Bland Doris, 711 Cottonwood Drive, Bowling Green, KY 42101.

February 23-26, INDUSTRIAL MEMBRANE TECHNOLOGY, Los Angeles, California. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, New Jersey 08816-0964. 201-238-1600.

February 24-27, CONTRACTING & CONTRACT MANAGEMENT OF PROCESS PLANTS, Houston, TX. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, NJ 08816-0964. 201-238-1600.

March 2-5, SENSORY EVALUATION, New Jersey. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, New Jersey 08816-

0257. 201-238-1600.

March 3-4, VIRGINIA ASSOCIATION OF SANITARIANS AND DAIRY FIELDMEN'S ANNUAL MEETING, to be held at Virginia Polytechnic Inst. and State University. For more information contact: W. J. Farley, Rt. 1, P.O. Box 247, Staunton, VA 24401. 703-434-3897.

March 9-11, FOOD TEXTURE TECHNOLOGY, New Jersey. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, New Jersey 08816-0257. 201-238-1600.

March 9-11, NUTRITIONAL ASPECTS OF FOOD PROCESSING, New Jersey. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, New Jersey 08816-0257. 201-238-1600.

March 10-12, WESTERN NEW YORK IFT SYMPOSIUM, Freezing Technology, Geneva, NY. For more information contact: Donald L. Downing, Cornell University - NYSAES, Geneva, NY 14456. 315-787-2273.

March 18, INDIANA DAIRY INDUSTRY CONFERENCE. For more information contact: James V. Chambers, Food Science Department, Smith Hall, Purdue University, West Lafayette, IN 47907. 317-494-8279.

March 19-20, MOISTURE MANAGEMENT IN FOOD SYSTEMS, New Jersey. For more information contact: The Center for Professional Advancement, Box H, East Brunswick, New Jersey 08816-0257. 201-238-1600.

March 23-27, MID-WEST WORKSHOP IN MILK AND FOOD SANITATION, The Ohio State University. For more information contact: John Lindamood, Department of Food Science and Nutrition, 2121 Fyffe Road, The Ohio State University, Columbus, OH 43210-1097.

March 25-27, MICHIGAN ENVIRONMENTAL HEALTH ASSOCIATION ANNUAL MEETING, to be held at the Hilton Hotel, 28th St., Grand Rapids, MI. For more information contact: Ike Volkers, Environmental Health, Michigan Dept. of Health, 3500 N. Logan, Lansing, MI 48909. 517-335-8268.

March 26, WESTERN NEW YORK IFT SYMPOSIUM, Better Process Control School Refresher, Rochester, NY. For more information contact: Donald L. Downing, Cornell University - NYSAES, Geneva, NY 14456. 315-787-2273.

March 31 - April 1, WESTERN FOOD INDUSTRY CONFERENCE, to be held at the University of California, Davis, CA. For more information contact: Robert Pearl, Conference Chairman, 916-752-0980 or Shirley Rexroat, Conference Coordinator, Department of Food Science and Technology, University of California, Davis, CA 95616.

April 7-8, WESTERN NEW YORK IFT SYMPOSIUM, Wine Industry Workshop, Rochester, NY. For more information contact Donald L. Downing, Cornell University - NYSAES, Geneva, NY 14456. 315-787-2273.

April 22-24, SOUTH DAKOTA ENVIRONMENTAL HEALTH ASSOCIATION

ANNUAL MEETING, to be held in Aberdeen, SD. For more information contact: Stan Iwagoshi, South Dakota Dept. of Health, 1320 S. Minnesota Ave., Suite A, Sioux Falls, SD 57105. 605-335-5037.

April 27-30, AOAC SPRING TRAINING WORKSHOP AND EXPOSITION, to be held at the Skyline Hotel, 101 Lyon Street, Ottawa, Ontario, Canada. For more information contact: Graham MacEachern, Agriculture Canada, Laboratory Service Building 22, Central Experimental Farm, Ottawa, Ontario, Canada K1A-0C5 (613) 994-1991 or James Lawrence, Health & Welfare Canada, Health Protection Branch, Tunneys Pasture, Ottawa, Ontario, Canada K1A-0L2. 613-990-8495.

May 11-14, WESTERN NEW YORK IFT SYMPOSIUM, Better Process Control School, Rochester, NY. For more information contact: Donald L. Downing, Cornell University - NYSAES, Geneva, NY 11456. 315-787-2273.

May 11-14, PURDUE ASEPTIC PROCESSING AND PACKAGING WORKSHOP. For more information contact: James V. Chambers, Food Science Department, Smith Hall, Purdue University, West Lafayette, IN 47907. 317-494-8279.

May 17-20, CANADIAN INSTITUTE OF FOOD SCIENCE & TECHNOLOGY ANNUAL MEETING, to be held at the Hamilton Convention Centre, Hamilton, Ontario. Theme: Biotechnology - Challenge for the Food Industry. For more information contact: Dr. V. F. Rasper, Conference Chairman, Department of Food Science, University of Guelph, Guelph, Ontario N1G 2W1. 519-824-4120.

May 18-20, THE PA DAIRY SANITARIANS & LABORATORY DIRECTORS ANNUAL MEETING, to be held at Penn State University, J. O. Keller Convention Center, State College, PA. For more information contact: Audrey Throne, Hershey Choc. Co., 19 E. Chocolate Ave., Hershey, PA 17033. 717-534-4031.

July 10-18, SEVENTH INTERNATIONAL WORKSHOP ON RAPID METHODS AND AUTOMATION IN MICROBIOLOGY, to be held at Kansas State University, Manhattan, KS. For more information contact: Dr. Daniel Y.C. Fung, Director of the workshop. 913-532-5654.

August 2-6, IAMFES 74TH ANNUAL MEETING, to be held at the Disneyland Hotel, Anaheim, California. For more information contact Kathy R. Hathaway, IAMFES, Inc., PO Box 701, Ames, IA 50010. 800-525-5223, in Iowa 515-232-6699.

September 24-25, SWEETENERS IN FOODS: SENSORY, PROCESSING AND HEALTH ASPECTS, to be held at Kansas State Union, Kansas State University, Manhattan, KS. For more information contact: Dr. Carol Setser or Dr. Karen Penner, Department of Foods and Nutrition, Justin Hall, Kansas State University, Manhattan, KS. 913-532-5508.

1988

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

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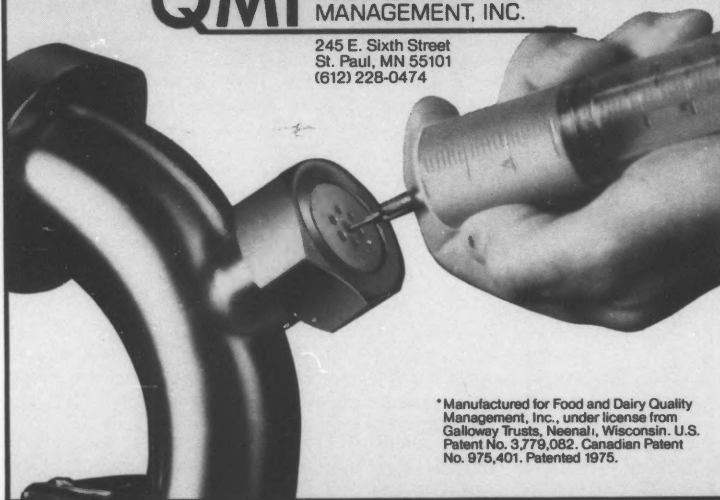
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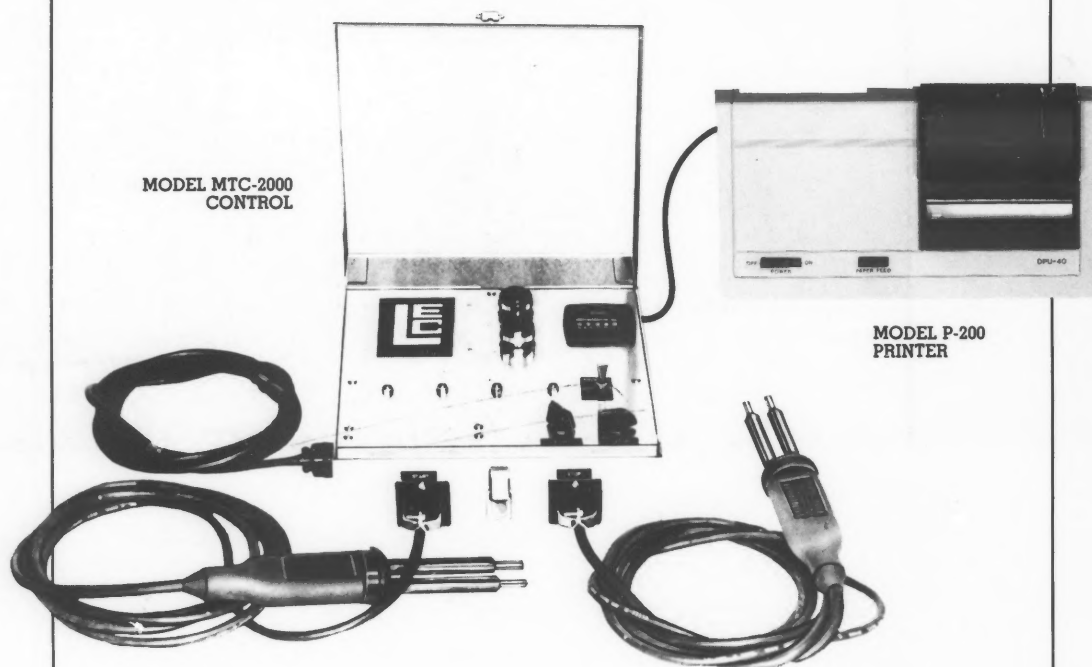
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