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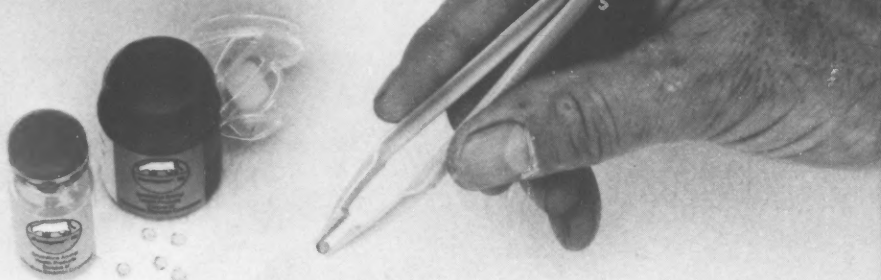
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Can Refrigeration Keep Our Foods Safe?

Samuel A. Palumbo

Presented at the April 1985 USDA Workshop, Philadelphia, PA.

What I would like to discuss is a reflection of my own career in Food Microbiology. Specifically, I'd like to review two of the major changes that have occurred in the last 25 years in Food Microbiology. When I began graduate school, the food microbiology book was Frazier's *Food Microbiology* (1). In fact, it was the only general food microbiology text available at the time. In it, Frazier mentioned only three bacteria as causative agents of food poisoning (Table 1 - top). These were *Clostridium botulinum* (types A and B), *Staphylococcus aureus*, and *Salmonella*. It can readily be observed that normal refrigeration (5°C) should be more than adequate to restrain their growth and activity in foods and thus eliminate the hazard of food poisoning.

In the intervening years, the number of pathogenic organisms has increased such that Frazier and Westhoff (2) have added several bacteria to the list (Table 1 - bottom). Besides the presence of additional food poisoning bacteria, the list contains organisms which seem to violate one of the sacred tenets of food microbiology: keeping food cold (5°C) will prevent food poisoning. There is now a group of five food-borne pathogenic bacteria which are capable of growth at 5°C and below. It is the purpose of this presentation to review and discuss these organisms and some of their characteristics. The five bacteria to be discussed are (listed somewhat in chronological order of their emergence): *Clostridium botulinum* type E, *Yersinia enterocolitica*, enterotoxigenic *Escherichia coli*, *Listeria monocytogenes*, and *Aeromonas hydrophila* (Table 2). The organisms are listed in the table along with the foods they are associated with, minimum temperature of growth, symptoms, and pathogenicity factors/mechanisms. Each organism will be dealt with individually, including a general discussion of the bacteria and their emerging problems. In addition, there will be a brief discussion of pathogens growing at temperatures slightly above 5°C.

Clostridium botulinum type E.

The ability of *C. botulinum* type E to grow at or below 5°C was known from the mid-1950's and before, but it wasn't until outbreaks of food poisoning attributed to smoked whitefish occurred in the early 1960's that its

Table 1. Food Poisoning Bacteria and their minimum temperatures.

Organism and type	Minimum temperature
<i>Clostridium botulinum</i> ^a types A and B	10°C for growth 15°C for germination
<i>Staphylococcus aureus</i> ^a	15.6°C
<i>Salmonella</i> ^a	not at refrigeration temperatures
<i>C. botulinum</i> type E ^b	3.3°C
<i>C. perfringens</i> ^b	20°C ^c
<i>Vibrio parahaemolyticus</i> ^b enteropathogenic	5 to 8°C ^d not known for the group as a whole
<i>Escherichia coli</i> ^b	not known
<i>Shigella</i>	not known
<i>Bacillus cereus</i> ^b	10-20°C
<i>Yersinia</i> ^b	4°C ^c
Arizona ^b (currently <i>Salmonella arizonae</i>)	as for <i>Salmonella</i>
β-hemolytic streptococci (<i>Streptococcus pyogenes</i>)	no growth at 10°C ^c

^aFrazier (1).

^bFrazier and Westhoff (2).

^cBergey's Manual of Determinative Bacteriology, 8th Ed., 1974 (3).

^dBeuchat (4).

hazard became fully known and appreciated (5). *C. botulinum* type E is largely a marine organism (6), in contrast to types A and B which are largely soil organisms. Outside of its somewhat unique ecological niche, the organism is generally a typical *C. botulinum* with some minor differences: a) type E spores are much less heat resistant than type A and B spores and b) the molecular weight of type E toxin is lower than that of types A and B.

In addition to the food poisoning outbreaks attributed to type E, there have been several inoculated pack studies which further demonstrate *C. botulinum* type E's ability to grow at refrigerator temperatures. Schmidt et al. (7) observed growth and toxin production by two strains of type E at 38°F (3.3°C) in a beef stew medium. Kautter (5) inoculated smoked ciscoes with type E spores and vacuum packaged the fish; toxin was demonstrated at

Table 2. Food Poisoning bacteria capable of growth at 5°C.

Organism/strain	Characteristics		Foods associated with outbreaks	Lowest temperature of growth and toxin production, °C	Disease produced	Pathogenicity mechanism
	General	Distinguishing				
<i>C. botulinum</i> type E	gm + ^a anaerobic spore-forming rod	production of serologically distinct toxin	marine products fish	3.3	neuromuscular paralysis	toxin
<i>Yersinia enterocolitica</i>	gm - facultative rod	presence of 42-48 Mdal plasmid	animal origin water	4	diarrheal/gastro-intestinal (symptoms vary according to age)	unknown
enterotoxigenic <i>E. coli</i>	gm - facultative rod	presence of plasmids coding colonization factor and LT and ST	animal origin	4	diarrheal	LT and ST toxins
<i>Listeria monocytogenes</i>	gm + pleomorphic rod	---	animal origin (milk) cabbage (grown on field manured with infected feces)	3	generalized systemic infection	organism itself
<i>Aeromonas hydrophila</i>	gm - facultative rod	---	animal origin water	4-5	diarrheal, infection wound	unknown-several possibilities -hemolysin -cytotoxin -enterotoxin

a) gm⁺ = gram positive; gm⁻ = gram negative.

10°C in 5 days without any apparent signs of quality reduction. Solomon et al. (8) found that unheated spores of non-proteolytic type E would grow and produce toxin in crab meat at 12°C in 14 days. Cann et al. (9) observed toxin production by type E (inoculated at the level of 10² spores/package) in fresh herring after 15 days storage at 5°C.

Simunovic et al. (10) have reviewed the growth potential of nonproteolytic types of *C. botulinum* in pasteurized, restructured meat products. They grouped non-proteolytic strains of types B and F along with those of type E and found references in the literature that strains of type E and nonproteolytic type B as well as type F can grow and produce toxin at temperatures below 5°C.

Yersinia enterocolitica

Yersinia enterocolitica is a facultatively anaerobic short gram-negative rod currently classified as part of the family Enterobacteriaceae (11). *Y. enterocolitica*, along with the related organisms *Y. intermedia*, *Y. frederiksenii* and *Y. kristensenii*, have been isolated from a wide variety of foods, especially those of animal origin (12, 13). These same foods have also been incriminated in small outbreaks of food poisoning as well as two large outbreaks. Chocolate milk served with school lunches was the vehicle in the first (14), where the milk apparently

became contaminated during processing after pasteurization. Several ill school children underwent appendectomies before the bacterial nature of the illness was ascertained. These sick children had mesenteric lymphadenitis and ileitis, with symptoms mimicing acute appendicitis. Reconstituted powdered milk and turkey chow mein were the vehicles in the second outbreak which occurred at a day camp (15). In this outbreak, five of the seven hospitalized campers underwent appendectomies.

Y. enterocolitica is of interest because of its ability to grow at 5°C. In fact, Zink et al. (16) have reported that cold enrichment (14-21 days at 4°C) can be used to isolate this organism from food or clinical specimens. Aulisio et al. (17) have reported that cold enrichment was very useful in recovering *Y. enterocolitica* from a variety of meats, shellfish, and vegetables.

As indicated above, *Y. enterocolitica* and *Y. enterocolitica*-like organisms occur widely in nature, yet not all are pathogens. Hill et al. (18) have indicated that only *Y. enterocolitica* of Nelehn's biotypes 2, 3, and 4 possess virulence factors associated with pathogenicity. Pathogenic significance has been ascribed to several characteristics in different isolates: the invasion of HeLa cells, tissue invasiveness as revealed by the Sereny test in guinea pigs or mice, lethality in adult or suckling mice, heat-stable enterotoxin elaboration, adult gerbil lethality, and detachment of monolayers of HEp-2 cells

in tissue culture (18). Except for the heat-stable enterotoxin and invasion of HeLa cells, the virulence determinants of *Y. enterocolitica* are encoded by a plasmid of 42 to 48 Mdals. Hill et al. (18) have developed a procedure for detecting and enumerating plasmid-containing *Y. enterocolitica* in foods by DNA colony hybridization techniques. Their procedure employs 26°C incubation temperature because it has been shown that higher incubation temperatures typically used for human pathogens (35 to 37°C) can cause loss of the virulence plasmid.

Enterotoxigenic *Escherichia coli*

The presence of *Escherichia coli* in food has traditionally been viewed with a type of ambivalence (i.e., not good, but not bad). Its role is generally one of an indicator of fecal contamination—if *E. coli* is present in a food, then there is a possibility that enteric pathogens may be there too. Further, in a heat processed product such as pasteurized milk, its presence is an indication of underprocessing or recontamination with raw milk. Outbreaks of food poisoning attributed to *E. coli* in soft fermented cheese in the early 1970's changed these traditional views of *E. coli* in foods (19). Enteropathogenic *E. coli* (EEC-defined as any *E. coli* with the potential to cause diarrheal disease) can be further subdivided into four categories (20). Of these four categories, only enterotoxigenic *E. coli* (ETEC) is reviewed here because of its ability to grow and produce toxin at refrigeration temperatures (5°C).

Enterotoxigenic strains of *E. coli* produce heat labile (LT) and/or heat-stable (ST) enterotoxins (20). In addition to toxin production, these strains also produce a colonization factor (cf) in the form of host specific fimbriae. Sack (21) has reviewed the topic of human diarrheal disease caused by ETEC and indicated that both toxin production and cf are coded by a plasmid. Sack has also reported that, under laboratory conditions, these ETEC strains are capable of transferring this plasmid to nontoxin producing strains of *E. coli* as well as to strains of *Salmonella*. At present, it is not known whether ETEC strains can transfer the plasmid to all members of the enteric group. Witter (22) reported that members of enteric genera, including *Aerobacter* (*Enterobacter*), *Proteus*, *Serratia* as well as *Escherichia*, as psychrotrophic. The potential exists for the transfer of the toxin plasmid to various psychrotrophic bacteria with the conversion of these "normal flora" bacteria to ones of public health significance and hazard.

At present, there has been one report of the production of ST at 4°C. Olsvik and Kapperud (23) determined that three strains of *E. coli* could produce ST at 4°C in TSB (tryptic soy broth) and TSB with cream. Since they only studied two temperatures, 4 and 22°C, no data were available on the effect of intermediate temperatures on the amount of toxin produced. Further experiments should investigate intermediate temperatures as well as other factors controlling toxin production. Additional

studies should also determine the extent to which the plasmid can be transferred among the enteric group, and if it can be transferred to other gram negative bacteria such as pseudomonads.

Hill (24) and Hill and Payne (25) described a DNA colony hybridization technique for the identification of enterotoxigenic *E. coli*. Their procedure is similar to the one they developed for virulent *Y. enterocolitica*. The procedure involves spotting of cultures on nitrocellulose filters on MacConkey Agar followed by incubation. Colonies were then lysed *in situ*, the DNA hybridized to P³²-labeled purified LT gene DNA and the positive colonies identified by auto-radiography. The method provides a ready means for identifying enterotoxigenic *E. coli* and should be an excellent way to survey food and environmental samples for "hazardous/dangerous" *E. coli*.

Listeria monocytogenes

Listeria monocytogenes is a gram positive non-spore forming pleomorphic rod. It is often viewed in clinical specimens as a coryneform contaminant. The organism is not usually associated with food products, but when present, it can cause any one of a series of quite serious systemic infections including meningo-encephalitis, infectious mononucleosis-like syndrome, septicemia in adults (often imposed on other disorders), pneumonia, endocarditis, and local abscesses as well as other symptoms (26).

Outbreaks of *L. monocytogenes* infections have implicated foods of animal origin both directly (milk from an infected herd or cheese) and indirectly (cole slaw made from cabbage grown in a field fertilized with manure from an infected herd of sheep) (18a, 27, 28).

In the first two instances (milk or cole slaw), the ability of the organism to grow at 5°C was prominent. In fact, the organism often can be isolated from infected material (clinical specimen or food) only after cold enrichment.

Gray and Killinger (26) have indicated that *L. monocytogenes* is capable of growth in culture at temperatures from 3° to about 45°C, with the optimum between 30° and 37°C. In the case of the contaminated cole slaw, the organism was able to survive and outgrow the normal flora of the cabbage; the outbreak occurred several months after the cabbage was harvested. In addition to competitive growth at low temperatures, Gray and Killinger (26) have reported that *L. monocytogenes* is more pathogenic (virulent) when grown at low temperatures. This may explain the first two outbreaks: the low temperature enriched for the organisms in the milk and in the cabbage. Even though there were relatively few cells, these cells were quite virulent. At present, the mechanism(s) of virulence is not known. It is possible that *L. monocytogenes* may contain temperature sensitive virulence plasmids as in the case of *Y. enterocolitica*.

At present, the extent of *L. monocytogenes* occurrence in foods is not known. Food surveys can provide data of this type and further work will permit assessment of the hazard from this bacterium.

Aeromonas hydrophila

The last organism to be considered is *Aeromonas hydrophila*. This most recent addition is currently emerging as a human pathogen, especially as a cause of diarrhea. Though the organism has long been recognized as a pathogen of fish and amphibians (29), it is only recently that it has become of concern with its frequent isolation from cases of human diarrhea (30). Buchanan has indicated that *A. hydrophila* is one of several "new" pathogens of interest and concern to food microbiologists (31). Of specific concern to this discussion is the ability of *A. hydrophila* to grow at low temperatures, 1° to 5°C. This was reported in the older literature as well as by Eddy (32). Palumbo et al. (33), found that clinical isolates of *A. hydrophila* grew relatively rapid at 4° to 5°C in culture broth.

As part of a continuing interest and study of *A. hydrophila* in our laboratory, Palumbo et al. (34), developed a new medium for the quantitative detection of *A. hydrophila* in foods. Using the recently developed starch ampicillin agar, Palumbo et al. (34), detected the presence of *A. hydrophila* in virtually all retail samples of fresh fish, seafood, poultry, red meat, and raw milk purchased. Of particular concern and specific interest to this review is the fact that the *A. hydrophila* count increased during one week's storage at 5°C. This increase occurred in the presence of very large numbers of normal background organisms present in the various foods. Thus, both clinical and food isolates of *A. hydrophila* are capable of competitive growth at refrigeration temperatures.

Pathogens growing at temperatures just above 5°C.

A second group of bacteria will be discussed briefly. The bacteria in this group do not fit into the original scope of the review; these organisms which are able to grow at temperatures just slightly above the 5°C refrigeration temperature are listed in Table 3. These data indicate that the organisms are capable of growth under conditions of slight temperature abuse. Wyatt and Guy (39) sur-

Table 3. Food poisoning bacteria capable of growth at temperatures slightly above the ideal 5°C.

Organism	Food and temperature at which growth observed
<i>Vibrio parahaemolyticus</i>	oysters--8°C ^a
<i>Bacillus cereus</i>	culture broth--12°C ^b
<i>Salmonella</i>	chicken a la king--6.7 to 7.7°C ^c
	culture broth--5.2°C ^d
	ground pork--10°C ^e

^aThompson and Thacker (35).

^bMol (36).

^cAngelotti, Foter and Lewis (37).

^dMatches and Liston (38).

^eAlford and Palumbo (42).

veyed the temperatures of meat holding facilities in supermarkets and found that 7 of 10 had temperatures above 45°F (7.2°C). Torrey and Marth (40) measured the air temperature of home refrigerators and found that the mean air temperature ranged from 3.9° to 11.9°C; they also observed that opening the door caused an increase of as much as 18.5°C. Bryan et al. (41) in a survey of food handling practices and equipment of airline catering operations, found that many prepared foods were exposed to temperatures above 45°F (7.2°C) for several hours and that some of the equipment was incapable of maintaining food temperatures below 45°F (7.2°C). Since various retail and consumer foods often can be exposed to periods of time above 5°C, this second group of bacteria also can generate health hazards. In most instances, these organisms can grow competitively with the background flora. For example, Alford and Palumbo (42) observed the growth of three stereotypes of *Salmonella* in ground pork at 10°C containing 2% NaCl and the normal gram negative microflora of meat.

The purpose of this presentation was to inform the reader of new scientific data that indicate normal refrigeration (holding of food at 5°C) cannot be absolutely relied on to restrain the growth of all food poisoning bacteria. This temperature was adequate to restrain the traditional "big three" food-borne pathogens (*C. botulinum* types A and B, *S. aureus* and *Salmonella*), but not the group of five psychrotrophic pathogens. This group occurs primarily in foods of animal origin. Three (enterotoxigenic *E. coli*, *A. hydrophila*, and *Y. enterocolitica*) cause "typical" food poisoning including various diarrheal/gastrointestinal symptoms, one (*L. monocytogenes*), various generalized systemic infections, and one (*C. botulinum* type E), neuromuscular paralysis.

The optimum temperature for these five organisms is 30-35°C and, as with most organisms, reducing food holding temperature towards freezing reduces the organisms' growth rate. While these five organisms usually do not become the predominant flora, they can increase in number at 5°C. Palumbo et al. (34), observed a 10 to 1000-fold increase of natural flora *A. hydrophila* in a variety of retail seafood, poultry, and red meat samples held one week at 5°C. Palumbo (unpublished data) did, however, observe a somewhat greater increase in the number of *A. hydrophila* when the organism was inoculated into radiation pasteurized ground pork when compared with the increase in number when the normal flora of the pork was present. Cann et al. (9) observed greater toxin production by *C. botulinum* type E when the organism was inoculated into radiation sterilized herring. In the case of *L. monocytogenes* in cabbage, the organism apparently outsurvived the natural flora of the cabbage. *Y. enterocolitica* has been shown to be capable of competitive growth in some foods. Thus, this group of five organisms can grow in foods held at 5°C and do it competitively.

At present, there is no single method of control to prevent the generation of a hazard from any of the five or-

ganisms besides a 12D heat process or freezing. The goal of virtually all food processors is to increase refrigerated shelf life of fish, meat, dairy products, refrigerated doughs, bakery products, and beverages. The hazards of the emerging food-borne pathogens must, therefore, be prevented in refrigerated foods by some means other than excluding them since exclusion of a "normal" flora is impossible. The organisms of this group are at least facultatively anaerobic, so that vacuum packaging does not offer a means of preventing their growth. Though NaCl levels of 3-4% would probably offer protection when combined with low temperature, there is currently a push to lower the NaCl content of processed foods, especially in meats, because of the concerns over the possible relationship between NaCl and hypertension. A likely control mechanism would be to lower the pH of fresh foods either through acidification or fermentation, though having all refrigerated fresh foods acidic might prove a little boring.

A few general comments on the possible control of these organisms can be offered. Three of the organisms (ETEC, *Y. enterocolitica*, and *A. hydrophila*) could be killed by a heating step similar to milk pasteurization. *L. monocytogenes* can readily be controlled by pH values below 5.6 (they are killed by pH values of 5.3 and below (26)). *C. botulinum* type E can be controlled by chemical inhibitors (e.g., nitrite, sorbate) or acidification.

If rapid and sensitive tests for these five organisms were available, food processors could more easily assess their level in a fresh food and the resulting possible hazard. Currently, however, fresh food handlers and processors should be aware of this group of bacteria and their ability to grow at 5°C.

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Evaluation of an Energy-Storage System for Electrical Water Heaters Used in Milkhouses on Dairy Farms

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INTRODUCTION

Off-peak electricity rates vary to some extent, but in all cases offer significant savings over rates applied during other hours of service. Most electricity suppliers find it to their advantage to encourage increased usage of off-peak service. This is particularly true of relatively small electric cooperatives, both in terms of reducing cost of operation and providing incentives to members.

Electric water heaters are commonly used in milkhouses to provide hot water for cleaning and sanitizing. A number of off-peak services may be offered, and may in fact reduce rates to users. However, the majority, if not all systems used in northern states of the United States require some input—a “spiking”—of electricity during high-cost hours of the day. In cooperation with the Minnesota Extension Service, North Pine Electric Cooperative, Inc., Finlayson, Minnesota, planned and installed a system of water heating in a milkhouse on a Minnesota farm, a system designed to be supplied with electricity only during off-peak hours, i.e., from 11:00 p.m. to 7:00 a.m. The study reported herein is an evaluation of that system and a comparison between it and the former, conventional water heating system. The major objective was to determine the feasibility of using two super-insulated water heaters, in parallel hook-up and on off-peak electrical service, for hot water used for cleaning and sanitizing milking equipment. One heater was designated for use during morning clean-up, the other to store hot water for use during evening cleaning operations. Water and electrical utilization, temperature parameters and milk quality were investigated. Because the dairy farmer had a particularly good prior record of milk quality, it was of significant interest to determine whether or

not that record of performance could be maintained. To that end, it was also considered of major importance to profile temperature changes during the cleaning cycle, and to ascertain whether or not end-of-cycle solution temperatures could be held above 110°F. And lastly, at the core of this study, was the desire to determine the savings that might accrue to a dairy farmer on a system of off-peak water heating.

MATERIALS AND METHODS

Milk Lines and Equipment

The dairy farm on which the water heater system was installed carried a 60-cow herd. The milking system consisted of a two-inch diameter, around-the-barn pipeline 330 feet in length. Milk was stored in a 600-gallon bulk tank which was cleaned and sanitized every other day. The pipeline was designed for semi-automated cleaning. Washing solutions were made up in one compartment of a two-compartment metal wash sink. The washing cycle was initiated and terminated manually, and ranged between 15 and 20 minutes duration. The bulk tank was cleaned-in-place by means of a spray ball.

Water Utilization

A water meter was installed on the cold water intake line of the conventional system, and one meter each on each of the intake lines of the two super-insulated water heaters. Recordings of readings were taken on a computerized system in which data were generated on a print-out form.

KWH of Electricity Utilization

An electric meter was installed to record electricity utilization on the one-heater conventional system through the duration of the study of that system. One meter was installed on each of the two super-insulated tanks for determining electricity utilization on each of those units

separately. All readings were taken automatically on a computerized system, and data generated on printout sheets at 15-minute intervals 24 hours each day.

Temperature Measurements

A remote strip chart temperature recorder was installed outside the milkhouse, with the recording lead placed on the return line outlet of the CIP system. The lead itself was affixed so as to provide a measurement of the wash solution temperature per se, the first reading of any given wash cycle being the solution temperature following the completion of one cycle. That is, the wash solution made a single pass through the pipeline and was exiting the return line when the first solution temperature measurement was actually taken. Because the strip chart recorder operated 24 hours each day, it also served to indicate the milkhouse temperature during intervals between wash-ups. A single roll of recording chart provided for 14 days of temperature measurements prior to replacement. The chart was graduated to read from 32° to 212°F in 3°F graduations.

Temperature measurements inside the water heaters were recorded by the Power Company at 15-minute intervals throughout the day on a computerized system. Computer printouts were made available for analysis.

Milk Quality Analysis

Samples of milk were taken from the bulk tank at regular intervals twice each month. Samples were held in Whirlpak containers under refrigerated conditions prior to analysis.

Each sample was analyzed by the Plate Loop method both prior to and after preliminary incubation of the milk at 55°F for 18 hours. The Plate Loop method was applied as described in Standard Methods for the Examination of Dairy Products (1).

A somatic cell count was made on each sample by the Coulter Counter method described in Standard Methods for the Examination of Dairy Products (1).

Temperature of milk in the bulk tank at pick-up was also recorded in order to evaluate this aspect as it might relate to milk quality.

Water Heater Systems

The water heater used prior to installation of the new system was a standard 80-gallon unit approximately 12 years old. The insulation value is unknown. In one small section near the bottom, rust had nearly penetrated the metal shell. Hence, the heater was not well-adapted for energy conservation. At the same time, however, it was a heater and system not unlike many units presently used in milkhouses. In that respect, it was not atypical and can be considered reflective of conditions existing on a number of dairy farms.

After gathering data on the preceding unit, it was removed and replaced with two super-insulated water heaters (Model EXR 120S, Mor Flo Industries, Inc., Cleveland, Ohio 44128-4296). These heaters were 120-gallon capacity each, with 6000 watt heating elements. They were lined with porcelain and insulated with 2-1/2 inches of polyurethane foam. An R value calculated to include the polyurethane and the metal shell and paint was determined to be approximately 12. The tanks were placed side by side on top of a 1-inch slab of styrofoam. In this way, the bases of the two units were insulated from the cement floor of the milkhouse. Size and arrangement of the milkhouse made it necessary to place the water heaters on the wall opposite the wash vats, approximately 12 feet away. Water lines were bracketed to the ceiling of the milkhouse but were not insulated. The hot water lines were fitted with heat traps to prevent outflow of heat from the water tanks. Although it would be appropriate to do so, the cold water lines in this case were not heat-trapped.

The two water heaters were installed in parallel (not in series), to be operated independently, and were fitted with globe-type, on-off valves. The thermostats were set at 170°F.

Data on the old system were taken during the period November 11, 1984 to March 19, 1985, an interval that included the coldest months of the year. The new system was evaluated from mid-March of 1985 through February 7, 1986. This system, too, therefore, was evaluated during the coldest time of the year.

RESULTS AND DISCUSSION

Temperature Considerations

Proper cleaning of milking equipment by clean-in-place methods requires end-of-cycle wash solution temperatures no lower than about 110°F. This temperature is above the melting point of milkfat and generally assures minimal redeposit of fat on equipment surfaces. It is a temperature likewise conducive to holding other soil in suspension, thereby aiding removal.

Table 1 provides a number of average temperature observations made during operation of both the old and the energy-storage system of heating water. The data reflect essentially the same season of the year for both systems. Milkhouse temperatures ranged from 37 to 43°F at morning milking, and from 43 to 54°F during evening milking. Water temperature inside the two super-insulated heaters averaged about the same during the winter months given. However, average temperatures are not truly descriptive of the kind of temperature conditions that might exist in a tank reserved for evening clean-up, one in which water has been stored for perhaps 12 hours or more. Much more significance can and should be placed on average wash cycle temperatures. As shown in Table 1, very little difference was noted between the two heat-

ing systems. Beginning-cycle solution temperatures ranged from 137 to 141°F, ending temperatures 117 to 122°F. The duration of the wash cycle was perhaps slightly less for the new than the old system, but certainly well within appropriate cycle times.

Temperature data in Table 2 describe isolated profiles specifically selected to reflect conditions that existed on the coldest days of the year, for the new system solely. Milkhouse temperatures reached 35°F in the morning just prior to milking. At evening on such days, milkhouse temperature ranged near 40°F. In all instances, end-of-cycle wash solution temperatures were in an appropriate range. On only one day did the temperature reach near 110°F. In this case, the wash cycle was somewhat longer in duration than that noted on other days when prevailing temperature conditions were also low. This emphasizes the need, of course, to carefully observe cycle time durations, an essential aspect no matter which water heating system is used. Another factor of importance is the pipeline temperature at the time the washing cycle is initiated. If clean-up takes place directly following milking, as it should, the pipeline is yet warm from the milk flow through it. Milkline temperature at end of milking, as measured on the return line, rarely if ever fell below 77°F during this study. Heat loss from wash solutions could

be expected to be lessened accordingly, compared to that which would be experienced on colder surfaces.

Milk Quality

Ultimately, of course, proof of acceptable cleaning and sanitizing procedures is best reflected in the microbiological quality of the milk. Table 3 shows data that consider three quality parameters: plate loop counts, preliminary incubation counts, and somatic cell counts. The average plate loop and somatic cell count for the year 1984, under the old system of water heating, was 7,900 and 400,800/ml, respectively. No preliminary incubation counts were made during that time. However, all three counts were made on milk under the old system during the period November 1984 through March 10, 1985. Data in Table 3 show these results, also. The final tests, on March 10, indicate a lapse from usual control. Both the plate loop count and preliminary incubation count were comparatively higher than previous tests. This fact is mentioned not because the one lapse is indicative of a major problem; the counts overall reflect the highest standards of control. Rather, the fact is pointed out to suggest that occasional lapses do occur, irrespective of the washing system being used. On the new system, a somewhat

TABLE 1. Temperature observations taken before and after conversion to energy-storage system

Month/System	Avg. Temp. (°F) in Milkhouse		Avg. Temp (°F)		Avg. Solution Temp. (°F) at Start and End of Wash Cycle		Duration (minutes)
	a.m.	p.m.	Inside Heater No. 1	Inside Heater No. 2	Start ^a	End ^a	
Old System:							
December (1984)	43	48			141	122	18
January (1985)	36	46			134	119	22
February	37	43			138	117	20
March	40	54			137	122	20
New System:							
November (1985)	43	45	161	155	137	122	18
December	38	44	162	160	137	118	16
January (1986)	41	47	164	166	137	119	18

^aThese temperatures are averages of morning and evening wash cycles combined.

TABLE 2. Wash solution temperature at beginning and end of wash cycle on coldest days of the year

Milkhouse Temperature (°F)		Wash Solution Temperature (°F)		Wash Solution Temperature at Start and End of Wash Cycle (°F)		Duration of Wash Cycle (min)
a.m.	p.m.	Begin	End	Start	End	
40		137	122			16
	41			137	119	18
37		137	122			12
	41			140	122	15
38		137	119			16
	41			137	111	22
35		137	122			15
38		137	122			15
	38			137	119	18
38		137	119			18
35		137	122			15
	41		116			16

TABLE 3. Temperature of milk at pick-up and counts of select quality tests of raw milk before and after conversion to energy-storage system

Date/System	Temp. of Milk at Pick-up (°F)	Plate Loop Count (X 1,000)	Preliminary Incub. Count (X 1,000)	Somatic Cell Count (X 1,000)
Old System:				
1984 (12-mo. avg.)	38	7.9	--	400.8
11/11/84	37	14	--	500
12/9	38	1	--	330
1/15/85	38	6	4	510
1/29	38	3	6	200
2/12	38	1	1	190
2/20	38	3	1	200
3/10	38	23	380	360
Average (old system):		7.36	78.4	336.4
New System:				
3/26/85	39	8	9	260
4/15	48	11	7	250
4/21	45	11	7	450
5/9	38	12	4	270
5/23	40	8	11	220
6/21	43	4	9	310
7/23	40	4	6	430
8/14	40	7	7	450
8/26	39	7	2900 (LA?)*	330
9/5	40	16	10	280
9/15	38	8	6	310
10/15	39	4	15	210
10/27	40	13	180	230
11/13	40	7	11	180
11/18	38	4	2	380
12/4	42	16	--	350
12/30	40	7	2	290
1/14/86	38	5	7	280
1/28	43	11	6	370
2/6	38	10	5	240
Average (new system):		8.65	16.9	304.5

*This is an estimated count and has been considered to be a "laboratory accident" and inappropriate for use in calculating the average preliminary incubation count in view of the consistently low counts preceding and following it.

TABLE 4. Water utilization from water heaters before and after conversion to energy-storage system

Date/System	Heater No. 1 (gal)	Heater No. 2 (gal)	Total (gal)	Gallons Per Mo.	Gallons Per Day
Old System:					
2/4/85 - 3/19/85	4018	---	4018	2897 ^a	93 ^b
New System:					
3/21/85 - 2/07/86	15173	15260	30433	2912	93.9

^aCalculated on a 31-day month.

^bWater utilization averaged 83.6 gal per day when the pipeline alone was washed, cleaned and sanitized and 128.5 gal per day when both pipeline and bulk tank were cleaned and sanitized.

higher-than-usual count occurred on October 27, 1985. The exceedingly high count noted on September 26, 1985, an estimated count, appears as likely to be an improperly handled and, therefore, contaminated sample as a true reflection of the actual count of the milk, particularly in view of results obtained beforehand after this date.

Overall, the data in Table 3 indicate only slight, if any change in milk quality under the two systems of water heating. The somatic cell count actually went down over the duration of the study. Factors other than equipment cleanliness could also have contributed significantly to that fact, but obviously the new system was not a serious detriment to mastitis control. The results generally indicate the potential to maintain low-count milk under procedures of consistent attention to cleaning and sanitizing following each and every milking.

Water Utilization

Table 4 presents data on water utilization. There was no reason to believe that the two systems would differ in this respect (assuming no use over and above the cleaning operation) and indeed the figures indicate as much. Under both systems, water utilization averaged about 93 gallons per day. Further analysis indicated that utilization ranged near 83 gallons per day on those days when the milk pipeline alone was cleaned and sanitized, and 123 gallons per day when both pipeline and bulk tank were cleaned and sanitized.

Electrical Energy Utilization and Cost

This project was undertaken to determine the feasibility of a water heater system in the milkhouse environment specifically and solely utilizing off-peak electrical input. A number of systems are set up to use off-peak heating, but under arrangements in which the heater is "spiked" for one to two hours during the day, and at the higher rates for the latter input. The author is also aware of at least one electric cooperative that is considering a spiking arrangement in which two hours of regular service (between one and three o'clock in the afternoon) will be provided at "off-peak" rates. Obviously, a number of useful, less costly methods are available. Nevertheless, the least costly system of all is the one that is served on the basis of off-peak rates delivered solely during off-peak hours.

As shown in Table 5, the existing rates for the dairy farm evaluated in this study was 8.75¢/KWH during regular hours, and 2.6¢/KWH during off-peak hours. Not only was the overall electrical utilization less on the energy-storage system (1100 KWH vs. 1307 KWH per month), the monthly savings in cost of electricity was \$85.79. For this farm, cost and installation of water heaters was approximately \$1000. The pay-back on investment was, therefore, 11.7 months.

TABLE 5. Average electrical utilization and cost before and after conversion to energy-storage system

Dates/ System	Total KWH	KWH Per Month	Cost Per Month
Old System:			
11/27/84- 3/18/85	4723	1307	\$114.39 ^a
New System:			
3/21/85- 2/07/86	11497	1100	\$ 28.60 ^b
			Difference = \$ 85.79 ^c

^aCalculated at 8.75¢/KWH, 31-day month.

^bCalculated at 2.6¢/KWH, 31-day month.

^cBecause the cost of this system, including heaters and plumbing and electrical costs was about \$1000, the pay-back period was one year.

Within one year, therefore, this farmer had paid off the investment costs and now stands to produce milk at a savings of a little over \$1000 annually.

Both electricity rates and condition/type of existing water heaters would determine potential savings. Where a single, well-insulated heater currently exists, the two-heater system could be developed by addition of only one other heater. It is only necessary to keep in mind that the heater used to store hot water during the day should be the one that carries the maximum insulation. In some cases, that purpose might be served by use of an insulated jacket. In addition, it is highly recommended that heat traps be placed on both hot and cold water lines, that the heaters be placed on insulated surfaces, that tanks be placed as close as possible to wash sinks, and that hot water lines and possibly even the underside of wash vats be insulated. Potential savings in energy costs can be significant indeed.

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Meeting Registration Form

IAMFES

**74th Annual Meeting
August 2-6, 1987
Disneyland Hotel
Anaheim, CA**

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August 1 & 2, Saturday and Sunday

Special group tickets provide entrance to Disneyland via a monorail ride for unlimited use of rides and attractions. Spend a day at Disneyland and go back to your hotel room to relax. Return to the park for the electrical parade which is held each night around 9 p.m. This part of the program is provided on the weekend so the whole family can enjoy the fun. Special prices for Disneyland good only on Saturday and Sunday, August 1 & 2. Adults: \$14.25; Children: ages 3-12, \$10.75.

SOUTH COAST AREA TOUR

August 3, Monday

9:30 a.m. - 3:30 p.m.

Tour the South Coast area of Orange County including San Juan Capistrano and Laguna Beach. Visit the Old Mission at San Juan Capistrano and the Sawdust Festival at Laguna Beach. Many other attractions. Lunch is not included. Cost: \$12/person.

A DAY OF BEAUTY TOUR

August 4, Tuesday

8:30 a.m. - 3:30 p.m.

A bus tour to the Merle Norman Classic Beauty Collection at San Sylmar is scheduled. San Sylmar is a treasure house of functional fine art. Everything inside has been restored to perfect working order . . . a unique tribute to days gone by. Sorry, children under 12 are not permitted. San Sylmar is a treasure house of beauty, please dress accordingly (no jeans, shorts, halter-tops, or thongs). Child care is available from the Disneyland Hotel for a fee, contact Wendy, extension 5527, at the hotel for more information.

On the return trip, a stop will be made at Lawry's Center for lunch and a tour of their processing facilities.

The only costs are for lunch and bus transportation. \$26.00

ORANGE COUNTY SHOPPING MALLS

August 5, Wednesday

Shuttle bus tours of Orange County Shopping Malls. This will be by individuals or small groups. Information on malls and shuttle buses will be available at the registration table. Cost will be nominal.

DAIRY TOUR

August 6, Thursday

Tour of California-style dairies in the Chino and Corona area of Southern California. Also, a visit will be made to Golden Cheese Company of California in Corona. Bus transportation and lunch will be provided.

SOCIAL EVENTS THROUGHOUT THE MEETING

Cheese & Wine Reception, Sunday Evening
Mexican Fiesta, Monday Evening
Awards Banquet and Reception, Wednesday Evening

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IAMFES

**74th Annual Meeting
August 2-6, 1987
Disneyland Hotel
Anaheim, CA**



The California Association of Dairy and Milk Sanitarians will be hosting the 74th IAMFES Annual Meeting, August 2-6, 1987. They cordially invite you to participate in the educational sessions, view the educational table top exhibits, renew old friendships, make new acquaintances, enjoy the Mexican Fiesta, spouse activities and the hospitality and beauty of Southern California at the Disneyland Hotel in Anaheim.

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IAMFES Secretary Candidates



H. Michael Wehr

Mike Wehr serves as Administrator of Laboratory Services Division, Oregon Department of Agriculture, with responsibility for program management of food, dairy and pesticides analytical programs. He also serves as administrator of a statewide pesticides and human health assessment program and is actively involved in establishing international laboratory accreditation programs for the Department. During his 14 years with the Oregon Department of Agriculture, he has held a variety of analytical and laboratory supervisory positions and is the recipient of the Oregon Governor's Management Award.

Mike received his Bachelor's Degree from the University of California, Berkeley, in Food Science; his Master's Degree in Food Science from Oregon State University; and his Ph.D. in Biochemistry also from Oregon State University.

An active member of IAMFES and the Oregon affiliate for 10 years, Mike has served on the laboratory, program and nominating committees and has been a speaker and symposia chairman at international meetings.

Mike has also been active in the professional area. As chairman of the Association of Official Analytical Chemists, he helped to administer the method approval process for AOAC. As part of the APHA Technical Committee on Standard Methods for the Examination of Dairy Products, he helped to prepare the fifteenth edition and co-authored the chapter on Laboratory Quality Assurance and Safety. He serves on the IMS Laboratory Committee and has served on the Long Range Planning Committee for both AOAC and the Institute of Food Technologists.

He currently serves as a member and past chairman of the Dairy Research Foundation Science Advisory Committee and is a member of the Editorial Board for the Journal of Dairy Science. He has published several technical papers in the food field, particularly in the area of microbiological standards for foods. Mike has been elected to American Men and Women of Science and is cited in Who's Who in the West, Community Leaders of America, and the International Who's Who of Contemporary Achievement.



Bob Sanders

Bob is currently serving as Deputy Chief of the Milk Safety Branch for the Food and Drug Administration. He has been in the headquarters office since 1972. He has also served as Milk and Food Consultant in New York (Region II) and Chicago (Region V). He has over 25 years of active duty as a commissioned officer in the United States Public Health Service.

Before entering the Public Health Service he spent ten years in milk sanitation work in his native state of Iowa. Two as a milk rating officer for the State Health Department and eight as Chief Milk Sanitarian for the city of Des Moines. He is a 1950 graduate of Iowa State University in Dairy Industries and holds an MPH from the University of Michigan.

He has been a member of IAMFES and the Iowa affiliate of IAMFES since 1954 and is a past president of the Iowa affiliate. He has served on many committees for IAMFES. He is currently on the Journal Management Committee for *Dairy and Food Sanitation*, the Farm Methods Committee, and is one of IAMFES's representatives to the Sanitarians Joint Council, and currently is serving as Secretary-Treasurer of the council.

Bob is FDA's designated member of the Executive Board of the National Conference on Interstate Milk Shipments and the Steering Committee of the 3-A Sanitary Standards Committees.

Bob and his wife Grace live in Gaithersburg, Maryland. They have two sons and four grandchildren. Their hobbies include golf and square dancing.



International Medal Presentation to Warren S. Clark, Jr., (l) Executive Director of the American Dairy Products Institute. Presented by Jean-Marc Dath, Lacto Serum France, S.A., Verdun, France.

Clark Receives International Award

Warren S. Clark, Jr., Executive Director of the American Dairy Products Institute, was presented with an International Medal, honoring his installation onto the council of the "Confrérie des Tateurs de Petit Lait." The medal was presented to Dr. Clark by Mr. Jean-Marc Dath, Lacto Serum France, S.A., at the 1986 International Whey Conference banquet held on October 28 at the Chicago O'Hare Marriott Hotel in Chicago, Illinois.

The "Confrérie des Tateurs de Petit Lait" is a French Society devoted to the development and promotion of whey products, as well as the preservation of the whey processing industry. Dr. Clark, who is the seventh person to be recognized as a member of the council of the society, is the first person in the U.S. to be given that recognition.

The Fourth Annual Cheese Research and Technology Conference

The Fourth Annual Cheese Research and Technology Conference sponsored by the Center for Dairy Research and the Walter V. Price Cheese Research Institute, University of Wisconsin will be held on March 25 and 26, 1987 at the Dane County Forum and Sheraton Inn and Conference Center, Madison, Wisconsin. The larger meeting room at the Forum will accommodate the anticipated increased attendance and will enhance the presentation of slides and other visual aids.

The Conference will feature two major topics;

Nutritionally Modified Cheese with talks on reduced fat, reduced sodium, reduced cholesterol and mineral enhancement of cheese and Characteristics of Cheese Required for Processing, Drying, Cold-Pak and Food Entrees. There will also be reports of current research activities of the Institute. Research reports will include:

- *Listeria* in cheese
- Heat resistance of *Listeria*
- Flavor development in cheese made from UF-treated milk
- Manufacture of cheese from UF-treated milk
- Calcium lactate crystallization on cheese
- Process cheese spreads

Laurie Muller, recently retired director of CSIRO, Melbourne, Australia will be the keynote speaker at the banquet Wednesday evening and will speak on the topic "The Development of the CSIRO Process for Cheddar Cheese Manufacture from Ultra-Filtered Milk."

FOR PROGRAM INFORMATION: Call 608-262-0275 or write to: Mark E. Johnson, Department of Food Science, UW-Madison, 226 Babcock Hall, 1605 Linden Drive, Madison, WI 53706.

FOR ENROLLMENT INFORMATION: Call 608-263-1672 or write to: Agricultural Conference Office, Jorns Hall, 650 Babcock Drive, Madison, WI 53706.

If you have registered previously for this Conference, you are automatically on the mailing list.

Seeds of the Future

In a one-day conference at the White Plains Hotel in White Plains, New York on April 29, 1987, faculty from the Institute of Food Science will summarize for food industry registrants several key findings and new knowledge stemming from researches in nutrition, packaging, processing, food safety, new products and related technologies.

This conference is a step in fostering communications between Cornell researchers and the food marketing community, via face-to-face explanation of research output, and notation of opportunities which can be developed therefrom in new and improved food products.

Recognizing that conventional reporting results in a one- or two-year lag, it was decided to try more direct communication, to better match the needs of industry for a continuous flow of ever-improving food and beverage products.

At the conference, a newly revised patent policy of the University will also be described. Patents are applied for on appropriate new technology, and can be licensed to interested parties under the policy. Examples of successfully commercialized food product

developments initiated within the Institute of Food Science will be shown and described at the conference.

The Institute membership includes 54 faculty at the Geneva and Ithaca, New York, campuses, who conduct research sponsored by both public and private funds. Nine members will make short presentations at the "Seeds of the Future" conference, which is limited to 125 persons.

For further information and registration, contact: Dr. John Kinsella, Chairman, Institute of Food Science, Department of Food Science, Stocking Hall, Ithaca, NY 14853. Telephone: 607-255-7616.

Flu Facts

The word *flu* is frequently used to describe a variety of nonspecific diseases, especially viral diseases. Consequently, persons ill with "the flu" have little understanding of how they became ill or how to prevent further spread of the disease.

Influenza is an infection of the respiratory tract. It is characterized by sore throat, sneezing, and nasal congestion. More severe cases of influenza occur when the upper portion of the lungs become infected and congested. Influenza is caused by influenza viruses A, B, and C. Commonly, these viruses undergo slight changes so that new strains of influenza periodically arise. For this reason, there are many strains of influenza virus. However, all strains cause infection in the respiratory tract - not in the digestive tract.

Often referred to as a "cold", influenza is easily transmitted from one person to another. Transmission occurs when virus laden respiratory discharges travel from an ill person to a susceptible person. For example, when an infected individual sneezes, droplets containing the virus may contaminate the surrounding environment. Although it is possible for a susceptible person to inhale the virus and thus become infected, it is more probable that the healthy person will inadvertently contaminate his or her hands, subsequently place their hand(s) on the nose or mouth, and thereby complete the transfer of virus. In other words, the susceptible person is more likely to contract influenza by self infection with influenza virus from an ill person. Healthy individuals can protect themselves from influenza by simply keeping their hands away from their face. Obviously, this is not always possible. So alternatively, you can avoid influenza infection by frequently and thoroughly washing your hands.

Viral gastroenteritis is an infection of the intestinal tract. It is characterized by nausea, diarrhea, vomiting, chills, and fever. Many refer to this type

of illness as the "24 hour flu". However, viral gastroenteritis is not caused by influenza virus. It is caused by a variety of viruses which are biologically unique and different from the influenza virus. Viruses which cause diarrheal diseases infect the digestive tract where they replicate and disturb the normal function of the intestines and bowel. Like influenza virus, viruses which cause gastroenteritis are easily transmitted from one person to another. Ill persons pass the virus each time they have a bowel movement. Microscopic amounts of fecal material may contain large numbers of virus. Susceptible individuals may become infected by the ingestion of very small numbers of these highly contagious viruses. Unlike influenza virus, viruses which cause gastroenteritis are easily transmissible through food. Epidemics of viral gastroenteritis have been caused by the transfer of virus from a single infected individual, through food, to thousands of healthy persons. For this reason, it is critical that persons who are ill with diarrheal disease carefully wash their hands, especially after using the toilet. Additionally, these persons should never prepare or handle food which will be consumed by susceptible persons.

In summary, influenza and viral gastroenteritis are unique and different types of diseases. Although both are commonly referred to as "the flu", the viruses which cause these diseases, their mode of transmission, and control measures are different. And now that you have the FLU FACTS, you can protect both yourself and the people who rely upon you to stop the spread of disease.

By Terry W. Lawrence, R.P.S.
Marion County Health Dept.
Indianapolis, IN

Peterson Projects Future of Dairy Product Research

Separating milk into components will allow the dairy industry to produce new products and remain competitive in the marketplace, Edward A. Peterson, chief executive officer of the United Dairy Industry Association, told the Northeast Dairy Practices Council recently in Ellenville, NY.

Component separation, according to Peterson, will enable product developers to create alternative dairy foods for those consumers who currently consume no or limited amounts of dairy products.

"We must look toward product developers to increase opportunities on a long-term basis," Peterson said. "Farms will become more efficient and milk production will continue to increase by the year 2000. Product research will find new niches needed

for dairy products."

New foods made possible by component separation will contain all or part of the components found in milk, Peterson explained. Others will utilize more or less of a certain component - such as calcium or lactose - to form a product appealing to consumers.

Peterson discussed several technologies which will permit component separation of milk including ultrafiltration, freeze concentration and supercritical fluid extraction.

"Ultrafiltration is one technology we have all heard a lot about recently," Peterson said. The process filters out certain components of milk by screening at the molecular level.

This concentration of milk can produce a variety of ingredients for different facets of the dairy industry, according to Peterson.

"Take the specialty cheese industry, for example," he said. "Fats and other components necessary for cheese making can be added to ultrafiltered ingredients to make new cheeses."

Ultrafiltration could also reduce the amount of lactose in whole, lowfat or skim milk. "This product would provide an acceptable, nutritious alternative to those who are lactose intolerant and currently not enjoying milk to its fullest," Peterson said.

New component separation processes are not limited to ultrafiltration. Freeze concentration removes water by lowering the temperature of milk and forming ice crystals.

The remaining solution could be reconstituted, processed or combined to improve the flavor and taste of existing evaporated, condensed, fluid or non-fat dry milk.

Yet a third technology, called supercritical extraction, may allow researchers to remove cholesterol from dairy products.

"Taken together, these technologies will create major changes in the dairy industry," Peterson explained. "Dairy products will be lower in fat, cholesterol, calories, sodium and even lactose.

"All of these advances - both in product and process research - should result in a highly attractive array of dairy products available to consumers at appealing prices."

United Dairy Industry Association conducts a total dairy product promotion program representing 95 percent of the nation's dairy farmers and 85 percent of domestically marketed milk.

Winders Endow Bascom Professorship in Food Science at UW-Madison

William C. Winder, emeritus professor of food

science at the University of Wisconsin-Madison, and his wife, Rebecca Stewart Winder, have established a trust for the benefit of the UW-Madison Department of Food Science.

The charitable remainder trust will be used to establish the Winder-Bascom Professorship in Food Science, says department chairman Daryl Lund. Following the Winders' lifetimes, proceeds of the trust will be transferred to the UW Foundation for the department.

The UW Foundation established Bascom Professorships in 1973 to encourage superior teaching and research by providing a stipend for conferences, books, teaching assistants, travel and other scholarly activities. They have been awarded to some 45 UW-Madison faculty since the program began.

"The Food Science Department appreciates the gift, which will be used to support an outstanding faculty member," Lund says. "This is a lasting gift that demonstrates the Winders' commitment to the teaching and research programs of the department." The professorship will be in food chemistry, food engineering or food microbiology.

Rebecca Stewart was born in Logan, Utah, where she was known as a musician and equestrienne. Before her marriage to Bill Winder, she attended Utah State University, where she majored in music and business administration. In Madison, she studied piano at the Wisconsin School of Music. She also played violin with the Madison Civic Symphony Orchestra.

Bill Winder earned his doctorate in Dairy Industry and Bacteriology at UW-Madison in 1949, and joined the Food Science Department that year.

"Bill was an outstanding teacher," recalls Pat Johnson, a former student of Winder's who is now a professor of Food Science at UW-Madison. "He had a profound understanding of the underlying principles of dairy-related food chemistry, and he excelled at conveying both the theoretical and practical aspects of those principles to students.

"He also taught ice-cream making, and was in charge of ice cream production at Babcock Hall. We all know Babcock Hall's reputation for high-quality ice cream - Bill Winder is responsible for much of that reputation," Johnson says.

Winder's research interests include utilization of ultrasound in food science and analytical procedures in foods. The ultrasound analytical equipment he developed is in use today, according to Johnson.

He taught courses in market milk, condensed milk products, ice cream, and the physical chemistry of food products. For his outstanding teaching, he received the American Dairy Science Association-Milk Industry Foundation Distinguished Teaching Award.

Friends of the Winders can contribute to the Winder-Bascom Professorship Fund through the UW Foundation, 702 Langdon St., Madison WI 53706.

Research Will Increase Milk Production Efficiency Soon

The dairy industry is enduring a period of adjustment, and bovine growth hormone may play an important role in the survival of small to medium-sized dairy farms, say three agricultural economists.

Synthetic bovine growth hormone (BGH) is expected to be available for commercial use in 1988. When administered daily during the second and third trimester of lactation, it can increase milk output by as much as 40 percent.

If small farms lag behind large farms in adopting BGH, they will have a tougher time competing as their net worth is eaten up by costs, say Robert D. Yonkers, James W. Richardson, and Ronald D. Knutson, economists with the Texas Agricultural Experiment Station, and Boyd M. Buxton, economist with the U.S. Department of Agriculture - Economic Research Service.

Even without BGH, the dairy industry is under severe pressure, in part because of the 1985 farm bill. Regionally, the toughest outlook is for the Upper Midwest and for moderate and smaller sized farms in the Southwest, the researchers say.

And the adoption of BGH will create an immediate need for fewer dairy cows - and fewer dairies, they say.

The research team examined potential effects of BGH on the structure of the dairy industry under two different milk price support levels, and as a result, they outline agricultural policy changes that can help dairy producers adjust.

Early study of BGH "indicates nearly instantaneous increases in productivity of substantial magnitude. Given the current situation of surplus production and excess capacity in the dairy industry, the potential impact of BGH goes beyond short run profits to early adopters," the economists say.

The study team used budgets and financial statements for efficient, well-managed dairy farms and updated them for 1985 conditions. Even though Upper Midwest farms grow most of their own feed, cropland requirements and the need to protect livestock from winter weather mean those farms have considerably higher fixed asset investments per cow.

Cattle that are administered BGH require more feed to produce the increased amount of milk, so feed costs are increased about \$5 per hundredweight, and the hormone itself costs between 8 and 18 cents per dose.

Using four different adoption rates, the researchers employed a farm level dairy simulation model (DAIRYSIM) to simulate the annual economic activities of a dairy farm over a 10-year planning horizon.

At the end of each year, the farm's income

statement, cash flow statement, and balance sheet were evaluated to determine the farm's solvency.

"With or without BGH adoption, substantial differences were found regionally in the probability of farm survival," partly because of the higher price of milk in federal milk order markets distant from the Upper Midwest, the researchers say.

In both the Upper Midwest and Southwest, the probability of the very large farm surviving was much higher than for moderate sized farms; a 52-cow, Upper Midwest farm had a less than 20 percent chance of survival under all scenarios, the researchers say.

The moderate sized Upper Midwest and Southwest dairy farms experience a small increase in the probability of survival when BGH is adopted within 2 years of availability versus no adoption at all, but that benefit vanishes as the length of the lag expands to 4 years, the economists say.

A \$1 drop in the milk price support level has a particularly adverse impact on dairies in the Upper Midwest and on moderate size dairies in the Southwest, the researchers say.

"It is interesting to note that even under this drastic a decline in milk price, the Southeast dairies continue to survive, and even prosper," the study team writes.

"The regional differences in the probability of survival suggest substantial distortions in milk pricing under federal milk orders," they say. A 1985 farm bill decision to increase support payments in the Southeast further aggravates the problem, they say.

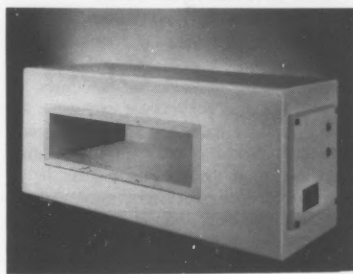
Milk surpluses resulting in dairy program costs exceeding \$2 billion in 1984 placed substantial pressure to reduce milk price supports. The adoption of BGH will only serve to increase the level of uncertainty and the need for adjustment in the milk industry, the researchers say.

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New Product News

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



First "Hands Off" Metal Detector

• The first metal detector capable of automatically "phasing out" the signal produced by electrically conductive "wet" foods such as meat, dairy, bread, seafood and poultry products, and cooked meats, pickles and sandwiches, is introduced by Goring Kerr Inc.

The new Auto-Phase Metal Detector represents a major breakthrough because it eliminates the frequent manual phasing adjustments that were previously required to the detector to cancel signals produced by the "wet" foods.

These manual adjustments were necessary when inspecting conductive products or whenever their ingredients or temperatures changed.

Goring Kerr's patented Auto Phase Metal Detector, designated model Tek III, now eliminates all human involvement with the detector's operation and the line interruptions it caused, and helps speed changeover from one product to another.

Auto-phasing also provides greater security against contamination because it ensures that the detector is always operating at peak efficiency. (In the past, with manual phasing, there was a high probability that the detector's sensitivity might be set below the peak efficiency required to detect metal contamination.)

Now, on product start-up or change, the Tek III automatically phases itself as it inspects the first two products on the line. The phase setting is then maintained until a new setting is required, at which time the automatic phase-setting process is repeated.

Another exclusive feature in the Goring Kerr metal detector is Narrow Zone Detection which precisely identifies a contaminated product and signals the reject mechanism to remove only that item from the line, thus minimizing waste.

For more information, contact: Jan Schutz, Vice-President, Goring Kerr Inc., 85 Oriskany Drive, Tonawanda, NY 14150. Telephone: 716-876-6900. In Canada, contact: John Tames, Communica Limited, 334 Dundas Street East, Toronto, Ontario, M5A 2A1. Telephone: 416-922-2191.

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New NEMA 4 Cabinet

• For ultra-clean environments such as dairy or food processing plants, pharmaceutical filling rooms or other induction cap sealing operations requiring optimum sterility, a new watertight, NEMA 4 enclosure is available from Enercon Industries Corporation.

This cabinet enables users to operate induction cap sealing systems in presence of water for safe and trouble-free washdown for sterile operating environments. The system meets NEMA 4 (National Electrical Manufacturers Association) classifications and is standard on Enercon's line of 3 and 5 KW systems. The cabinet is also available in stainless steel, for maintenance-free operations.

For more information on low-frequency, solid state cap sealing systems for clean room environments, contact: David Markgraf, Vice President/Marketing, Enercon Industries Corporation, P.O. Box 773, Menomonee Falls, WI 53051. Telephone: 414-255-6700.

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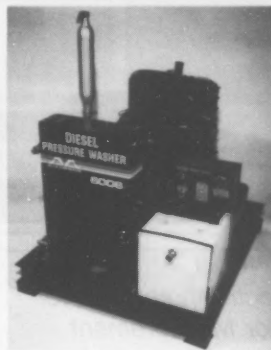
New Brochure Highlights Level Control Applications

• A new, six-page brochure illustrating level control applications for liquids, slurries, granulars, interface, and open channel flow, has just been released by Drexelbrook Engineering Co. The two-color pamphlet introduces RF/Admittance technology and gives an overview of typical applications for Drexelbrook level and flow instrumentation. A variety of installations are described pictorially in an easy-to-follow format. Photos of basic product offerings are coupled with the major operating features.

Readers should find it simple to identify their areas of interest and select the appropriate family of products to fill their level control requirements.

For more information, contact: Teresa Simeon, Drexelbrook Engineering Company, 205 Keith Valley Road, Horsham, PA 19044. Telephone: 215-674-1234.

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CW-6006-MDK Pressure Washer

• Whatever the application - from cleaning highway bridge decks to petroleum pipelines - Mi-T-M's Model CW-6006-MDK can handle it fast. This cold water pressure washer generates the 6000 PSI needed for those jobs yet list price is far below the cost of the competition. Although economical, this cold water pressure washer was designed for heavy industrial use with unique features like the manually operated clutch to disengage the pump for reduced wear and easier engine startup. Also, the 40 H.P. water cooled Kubota Diesel engine lowers fuel consumption, high capacity radiator facilitates cooler operation and proper unit isolation eliminates vibration.

For more information contact: Barbara Osterholz, Mi-T-M Corporation, Box 50, Peosta, IA 52068. Telephone: 800-553-9053; in Iowa 800-942-0014.

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Bacto McBride Listeria Agar

• Difco Laboratories is pleased to announce the availability of Bacto McBride *Listeria* Agar. It is the medium used by dairy and food accounts to isolate *Listeria monocytogenes*, the organism associated with recent outbreaks of food contamination.

Bacto McBride *Listeria* Agar is a partially selective solid medium for use in isolating *Listeria monocytogenes* from mixed cultures.

The medium of choice, recommended by the FDA for optimal recovery of *Listeria*.

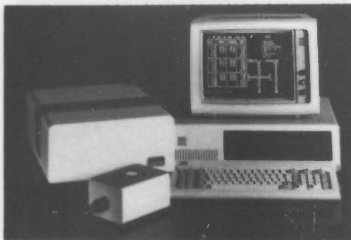
Used AFTER a cold enrichment procedure for optimal recovery of *Listeria*.

Allows for characteristic blue to blue-gray cast colonies after 48 hours at 35 C.

It can be used by Industrial accounts, specifically food and dairy labs using milk or other dairy products as ingredients.

For more information, contact: Difco Laboratories, P.O. Box 1058, Detroit, MI, USA, 48232. Telephone: 313-961-0800, 1-800-521-0851, telex: 23 56 83 Difco Lab Det.

Please circle No. 260
on your Reader Service Card



Low-Cost Spectrophotometer for Color Measurement

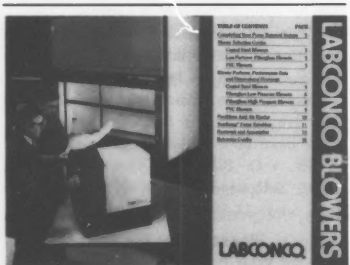
• Pacific Scientific, Gardner/Neotec Division, has introduced THE COLOR MACHINE, a low-cost array spectrophotometer designed to measure the color of liquids, powders, solids, and pastes. THE COLOR MACHINE employs 45°/0° geometry, correlating to visual observations, and circumferential illumination, which eliminates the need for multiple measurements of directional or textured products.

THE COLOR MACHINE features automatic standardization and a fiber optic sensor not found in any other 45°/0° spectrophotometer. A built-in microprocessor commands the unit to periodically restandardize itself when ambient conditions or self-monitored instrument functions indicate the need. The fiber optic sensor uses a remote head designed for added sampling versatility and accurately measures area 6mm or larger in any orientation.

When coupled with an IBM PC-XT/AT or compatible, THE COLOR MACHINE and software offers a powerful system for color measurement in nine color scales, five illuminants, 2 or 10 degree observers, and five color indices. The software also features complete spectral data and multiple spectral curves, keyboard entry of spectral and tristimulus data, asymmetric tolerancing, data storage and recall, statistical analysis of variation between like samples, and color differences. All information is available for output to any IBM compatible printer.

For more information on THE COLOR MACHINE, contact: Sales Department at Pacific Scientific, Gardner/Neotec Division, 2431 Linden Lane, Silver Spring, MD 20910. Telephone: 800-638-2790 or 301-495-7000.

**Please circle No. 261
on your Reader Service Card**



New Hi-Tech Culture Blend for Dairy Foods

• A major technological breakthrough for the dairy foods industry is announced by Chr. Hansen's Laboratory, Inc. of Milwaukee, WI, with the introduction of NU*TRISH® A + B that, for the first time, successfully combines the normal intestinal bacteria *Bifidobacteria bifidum* and *Lactobacillus acidophilus* in a single culture that can be added to dairy foods in substantial amounts without affecting taste.

NU*TRISH A + B follows the successful market acceptance of acidophilus as a value-added product for processors at little additional manufacturing expense.

With the current emphasis on nutrition, backed by government surveys indicating that Americans are not receiving full nutritional benefit in their daily dietary intake, NU*TRISH A + B is expected to make a large impact in the market for consumers of all ages.

For more information, contact: Chr. Hansen's Laboratory, 9015 W. Maple St., Milwaukee, WI 53214. Telephone: 414-476-3630.

**Please circle No. 262
on your Reader Service Card**

Labconco Releases New Literature on Blowers

• Labconco Corporation has released a new 16-page brochure on their complete line of Blowers. Detailed specifications are included on Labconco's Coated Steel Blowers, Fiberglass Low & High Pressure Blowers, PVC Blowers, Perchloric Acid Air Ejectors and Swirlaway Fume Scrubbers. In addition, the brochure lists all ductwork and accessories available for Labconco blowers and fume hoods.

Because the proper selection and sizing of blowers insures the safe, energy-efficient performance of your fume hoods, Labconco includes a Blower Selection Guide in the brochure. The guide indicates which blower models are sized to accommodate each Labconco Fume hood.

Labconco blowers may also be used with other fume hoods and in other industrial applications. Thus, the reader can select the right blower from the product features, performance data and dimensional drawings provided in the brochure. To further help the reader, blower sizing instructions are given.

Labconco blowers and fume hoods are available through all major laboratory supply dealers. For a free copy of their new Blower brochure, call 1-800-821-5525.

For more information, contact: Susan Gregory, Labconco, 8811 Prospect, Kansas City, MO 64132. Telephone 816-333-8811.

**Please circle No. 263
on your Reader Service Card**

Revolutionary Relutherm Heat Exchanger With Pollution Control

• Heat and Control, Inc. has just introduced to the world market Relutherm, the original pollution control heat exchanger. For many years, the Relutherm System has gently, effectively heated cooking oil and oxidized emissions from the cooking process in the plants of European processors, where emission regulations are quite stringent. Experience with over 200 installations has refined the system, to produce a heat exchanger which heats cooking oils and incinerates odor-laden gases and particulates coming from the cooking process. It eliminates the need for a costly after-burner or precipitator, and is available in sizes from 850,000 BTU/Hr. to 22 million BTU/Hr. transfer to the cooking oil. And in one clean, efficient package, you get 82% thermal efficiency and 100% pollution control.

Designed for the snack food and prepared food industries, the Relutherm System can be used whenever cooking oil heating is required, from potato chips to pork skins to fish sticks. This unique system offers a dual-purpose burner combustion/pollution oxidizing chamber, and a gas-to-oil exchanger for gently heating the cooking oil. An optional hot water heat recovery exchanger is available as well.

For more information, contact: Theresa Nelson, Heat and Control, Inc., 225 Shaw Road, South San Francisco, CA 94080. Telephone: 415-871-9234 or call toll free 1-800-227-5980 outside California.

**Please circle No. 264
on your Reader Service Card**

Penzyme® III Antibiotic Residue Test

• In 1985, SmithKline Animal Health Products introduced Penzyme®, a screen test to determine antibiotic residue in raw milk. Penzyme is an enzymatic, colorimetric method for rapid determination of all beta-lactam antibiotics. They include penicillin, cloxacillin, cephalirin and others extensively used in the treatment of dairy cattle diseases, particularly mastitis. Penzyme is currently being used on the farm, in the truck, in reload stations and at the processing plant.

Penzyme III is simpler and quicker. You add the enzyme to a milk sample and incubate for five (5) minutes. Next, add one tablet and incubate for ten more minutes. Then read the results. A pink/orange color represents a negative result. A yellow color represents a positive result.

For more information, contact: AnnMarie Gormley, SmithKline Animal Health Products, 1600 Paoli Pike, P.O. Box 2650, West Chester, PA 19380. Telephone: 800-523-4835, ext. 281-7506 or 215-251-7400.

**Please circle No. 265
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Food Science Facts

For The Sanitarian



Dr. Robert B. Gravani
Cornell University
Ithaca, NY

BACTERIAL FOODBORNE DISEASES

Due to the fact that Bacterial Foodborne Diseases is a long subject, we have split it into two sections. The first section will be printed here and the second section will be printed in March.

Diseases transmitted by foods are known as foodborne diseases or foodborne illnesses and result from ingesting foods that contain pathogenic microorganisms (or their toxins), poisonous chemicals, parasites or viruses (1,2,3,4). Although there are many food related illnesses, the Center for Disease Control (CDC) has classified and summarized about 400 of them (5). While these diseases range from abalone poisoning to zygomycosis, many are rare and occur sporadically. Others are quite common and are frequently the cause of outbreaks in the U.S. It is important that consumers be aware of the foodborne diseases that are of primary public health importance and know how to prevent them.

Although diseases transmitted by foods are quite complex and have been classified in many ways, one of the most understandable classification schemes is shown in Figure 1. The diseases are categorized according to the

four major causative agents - bacteria, chemicals, parasites and viruses (6). Most food related illnesses can be further classified as either: 1) intoxications, 2) infections, 3) toxicoinfections or 4) poisonings.

1) Intoxications are caused by the ingestion of the metabolic products (toxins) that are formed and excreted by certain microorganisms such as bacteria, molds or algae when they grow in foods (5).

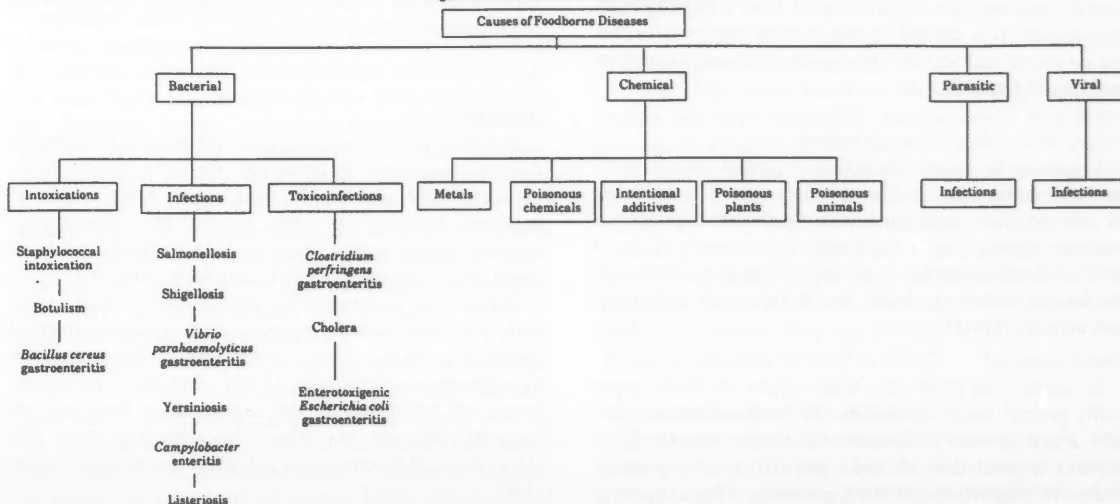
2) Infections are caused when pathogenic microorganisms invade the intestinal mucosa, where they multiply or pass to other organs (5).

3) Toxicoinfections are caused when pathogenic microorganisms enter the body and produce enterotoxins during their growth in the intestinal tract (1). An enterotoxin is a toxin that acts on the small intestine causing massive secretion of fluid into the intestinal lumen which leads to the symptoms of diarrhea.

4) Poisonings usually occur when people consume poisonous substances that occur naturally in some foods or that may be intentionally or accidentally added to foods during harvesting, processing, transportation, storage or preparation (5).

In the past, foodborne diseases were described as "ptomaine poisoning." This term is a misnomer since it

Figure 1. Classification of Foodborne Diseases



refers to a class of substances found in decaying animal or vegetable matter (7). It does not accurately describe the causes of foodborne illnesses and should not be used when referring to illnesses transmitted by foods.

It should be noted that not all people who eat a contaminated food will become ill and not all of those who become ill will experience the same symptoms (3,4). Sometimes this concept is difficult to understand, but it is true for all foodborne diseases. The severity of the symptoms varies with the:

- concentration of the organisms, enterotoxin or chemical contaminant in the food;
- amount of food consumed; and
- susceptibility of the individual consuming the food.

Contrary to what many people believe, the growth of most foodborne pathogens does not necessarily produce any noticeable changes in the appearance, smell or nature of the food product. Only laboratory testing can determine whether harmful bacteria are present in the food. Therefore preventive measures are the key to ensure the safety of food.

The diseases transmitted by foods that are of primary public health importance will be reviewed and discussed in this and the next issue of *Food Science Facts*. Bacterial foodborne diseases will be covered in this issue while chemical, parasitic and viral diseases will be covered in the next issue. The classification scheme in Figure 1 will be used as a framework for this review.

Intoxications

Staphylococcal Intoxication

Staphylococcal food poisoning is one of the most frequently occurring foodborne diseases in the U.S. (1,4,6). This disease accounted for 25.8% of the confirmed cases of foodborne illness in the U.S. from 1972 to 1978 (6). It continues to be an important problem for food processors, the food service industry and consumers (4).

While many strains of *Staphylococcus aureus* can cause a wide variety of infections in or on the body of humans and animals, staphylococcal food poisoning is an intoxication. It is caused by one or more enterotoxins that are produced and secreted by strains of *S. aureus* as they multiply in foods (1,4,8).

Nature and Source of the Organism

S. aureus is a very ubiquitous organism that is commonly found in nature. The principle source or reservoir of this organism associated with foodborne outbreaks is humans. Staphylococci are found in the noses of up to 60% of healthy people; in the throat; on skin, especially the hands; on hair; in feces; and in infections of humans and animals (1,4,8).

Foods Involved

S. aureus can grow in a wide variety of foods, especially protein foods or mixtures of foods containing protein which provide a favorable pH range. Any food that requires a great deal of hand preparation is a possible source of staphylococcal food poisoning. These bacteria

are also capable of growing in foods that contain high levels of salt or sugar. They prefer temperatures between 95°F to 98.6°F but can grow at temperatures as low as 44°F and as high as 118°F (4,8,9). Staphylococci are often naturally controlled by the activity of competing microorganisms that may be present in foods.

Foods that have been involved in staphylococcal outbreaks include (1,4,8,10):

- meats like ham, corned beef, genoa salami, bacon, barbecued pork and poultry;
- salads such as potato, macaroni and tuna fish;
- bakery products containing custard or cream such as éclairs, filled doughnuts and pies;
- puddings, dressings and sauces; and
- fermented meat and dairy products.

The Disease

The symptoms of staphylococcal food poisoning usually occur from 30 minutes to 8 hours after eating the food containing the bacterial toxin; most symptoms appear within 2 to 4 hours (1,2,4,8). This time period is dose related. The greater the amount of enterotoxin ingested, the shorter the incubation period. The most common symptoms are excessive salivation and nausea followed by a violent onset of vomiting, abdominal cramps and diarrhea. Headache, sweating, chills and prostration may also occur. The duration of the illness is brief, usually 1 to 2 days and recovery is complete. The disease is rarely fatal (1,2,4,8).

Prevention

Due to their close association with animals used for food and with people who handle food during processing and preparation, it is very difficult to keep staphylococci out of foods. The cells of *S. aureus* are killed by normal cooking procedures, but the enterotoxins produced by this organism are relatively heat stable (4). These toxins are not inactivated by normal cooking procedures or pasteurization. To prevent staphylococcal food poisoning, efforts must be directed to inhibiting the organism from growing and producing toxin in foods.

Botulism

Botulism is the most severe of the bacterial foodborne diseases because it is frequently fatal (1). In the U.S., between 1899 and 1977, there were 1,961 cases of botulism resulting in 999 deaths (1). Fortunately, botulism rarely occurs, but this disease attracts much interest due to its severe and life-threatening nature (1).

Botulism is an intoxication caused by ingesting improperly processed (usually home-canned or home-fermented foods) that contain one of several neurotoxins produced by *Clostridium botulinum* (1,12). Although the neurotoxins are preformed in the contaminated food and are ingested, they do not affect the alimentary tract like staphylococcal enterotoxins, but affect the nervous system (1,4).

There are other causes of botulism including wound botulism that results when a wound becomes infected with *C. botulinum* and infant botulism that occurs when the organism grows in the intestinal tract of infants less than one year old (1,4,11,12). This discussion will focus only on adult foodborne botulism.

Nature and Source of the Organism

C. botulinum is widely distributed in nature and is found in soil; water; bottom sediments of marshes, lakes and coastal ocean waters; on plants and in the intestinal tracts of animals and fish (1,4,12). These organisms are also found in honey, feed, manure, sewage, and on fruits and vegetables (1,4,12).

C. botulinum produces spores that can contaminate raw foods during production, harvesting or processing (12). If the foods are not properly processed, the spores will germinate, grow and produce toxin in the food. *C. botulinum* grows in the absence of air and is usually associated with low-acid canned foods that have been improperly processed, stored and consumed without appropriate heating (1). The organism cannot grow below pH 4.6, so foods with a pH higher than this should be thermally processed (at high temperatures and under pressure) for sufficient time to destroy the heat resistant spores. Although the toxin is very potent, it can be inactivated by boiling the food for 10 to 15 minutes (1,4).

Foods Involved

Foods that have been involved in a majority of botulism outbreaks include (1,4,11,12):

- Low acid canned vegetables - green beans, corn, spinach, beets, asparagus, peppers, pimentos, and mushrooms;
- Fish and fishery products - fermented or smoked fish and fish eggs;
- Home-canned fruits like figs, blackberries and peaches; and
- Condiments such as chili peppers, tomato relish, chili sauce and salad dressing.

Meat, poultry and dairy products are rarely involved in outbreaks of botulism because these foods are primarily eaten fresh, but several outbreaks have been reported (4). Recently, several outbreaks of botulism have been reported in "unlikely" foods such as baked potatoes, sauteed onions, potato salad made from leftover baked potatoes and pot pies (13). In each case, the foods were cooked and held at temperatures that allowed the growth of *C. botulinum* and then served. These outbreaks clearly illustrate the importance of appropriate holding temperatures for foods potentially contaminated with *C. botulinum* organisms or spores (13).

From 1899 to 1977, 72% of the botulism outbreaks have been traced to home-processed foods while 9% have been caused by commercially processed foods; 19% of the botulism outbreaks could not be traced (11). When one considers that Americans have consumed the contents of billions of containers of canned foods, the record of

botulism outbreaks show that properly processed canned foods are safe. The botulism outbreaks in home-processed foods are usually due to under-processing - either by not using a high enough temperature, by processing for too short a time or a combination of these conditions. Well informed and knowledgeable home food processors, using up-to-date and accurate time and temperature charts can also produce safe canned foods.

The Disease

Botulinal toxin is one of the most potent poisons known, and small amounts can cause death. Botulism can develop within 2 hours to 14 days after ingesting a food that contains the neurotoxin, but symptoms usually appear within 12 to 36 hours. The signs and symptoms of botulism vary with the type of botulinal toxin (1). In general, the shorter the incubation period, the more severe the disease and the higher the fatality rate (1,2,4).

The earliest symptoms are usually gastrointestinal disturbances sometimes followed by nausea, vomiting and possibly diarrhea (4). Fatigue, weakness, dizziness, headache and occasionally constipation also occur. Blurred or double vision, and difficulty in swallowing and speaking are common symptoms (4). People exhibiting the symptoms of botulism also complain of dryness of the mouth, constriction of the throat and a swollen or "coated" tongue. Involuntary muscles become paralyzed and this paralysis spreads to the respiratory system and heart. Death usually occurs due to respiratory failure (1,2,4).

Successful treatment of botulism requires quick medical attention and diagnosis of the disease, prompt administration of the antitoxin and close medical supervision.

Prevention

Botulism can be prevented by strictly following safe, approved and up-to-date procedures for processing home-canned foods and by thorough heating (boiling for 10 to 15 minutes) of home-processed low-acid foods just before serving (1,4).

Bacillus cereus Gastroenteritis

Since 1950, there has been an increasing number of reports that have established *Bacillus cereus* as a causative agent in foodborne illnesses (1).

B. cereus causes two distinct forms of gastroenteritis that differ in the foods involved, incubation time and symptoms. The two foodborne illness syndromes are caused by toxins that elicit either diarrhea (diarrheal type) or vomiting (emetic type) after the consumption of contaminated foods (1,14,15). Although these diseases are seldom confirmed, they are thought to be an important disease transmitted by food (1,14,15).

Nature and Source of the Organism

B. cereus produces spores and is common in soil, dust, plant products like rice, cereals, flour, starch, bakery products, spices, animal products and in mixtures of in-

redients (puddings, soups and gravy mixes) (4,14,15). It is also present in the feces of about 15% of healthy humans (14). Foods from the soil or ones produced and prepared in dusty environments will contain the organism.

Foods Involved

Foods involved in the diarrheal type *B. cereus* outbreaks are quite varied and have included vegetables, salads, meat dishes, casseroles, puddings, sauces and soups. The vomiting or emetic type of *B. cereus* outbreaks include rice (almost exclusively) and other starchy foods such as macaroni and cheese, and vanilla slices (a product similar to cream puffs) (1,4,14,15).

The Disease

The diarrheal form of the illness is characterized by an incubation period of 6 to 16 hours following the consumption of contaminated foods. The symptoms include abdominal pain and profuse watery diarrhea. Nausea may accompany the diarrhea, but vomiting and fever rarely occur. The symptoms usually persist for less than 24 hours and are very similar to those caused by *Clostridium perfringens* (1,14,15).

The emetic or vomiting form of the illness is characterized by an acute attack of nausea and vomiting from 15 minutes to 11 hours, but usually 30 minutes to 6 hours after ingestion of food containing the toxin. Occasionally, abdominal cramps and/or diarrhea also occur in emetic outbreaks. Duration of symptoms is less than 24 hours. The symptoms closely resemble those of *Staphylococcus aureus* food intoxication (1,14,15).

Prevention

B. cereus can be a problem in food establishments where large batches of food are prepared ahead of time and not properly cooled prior to reheating and serving. Since *B. cereus* is frequently found in or on many foods and because the spores can survive ordinary cooking procedures, steps should be taken to handle foods properly. In particular, cooked rice and other starchy foods should not be stored at room temperature for long periods of time (4).

INFECTIONS

In the broadest sense, foodborne infections are caused by the ingestion of pathogenic microorganisms like bacteria, viruses, parasites and protozoa, that penetrate the intestinal mucosa and multiply or migrate into other tissues where they multiply (1,2,5). This section will describe the important bacterial infections that cause foodborne diseases.

Salmonellosis

Salmonellosis is a term used to describe the illness resulting from the ingestion of one or more of the approximately 2,000 closely related types of salmonellae (16). According to CDC, salmonellosis accounted for 40.1% of the confirmed cases of foodborne illness between 1972 and 1978 (6). Salmonellosis is an infection caused when large numbers of the organism are ingested and affect the small intestine. It continues to be the most frequently occurring foodborne disease in the U.S. (1,4,6).

Nature and Source of the Organism

Salmonellae are very common in nature and are found wherever there are humans and animals (1,4,17). These bacteria frequently occur in the intestinal tracts and fecal matter of animals. Food source animals such as chickens, turkeys, swine and cattle are the most important reservoirs, but dogs, cats, turtles, frogs, birds and many other animals are also infected (1,4,17). Salmonellae have also been isolated from asymptomatic human carriers, and from rodents and insects.

Foods Involved

Foods that have frequently been involved in *Salmonella* outbreaks include (1,4,17):

- meat and meat products such as roast beef, meat pies, hash, sausage, ham, bacon and chili;
- poultry and poultry products;
- milk and dairy products;
- egg products such as custards, cream cakes and egg nog;
- fishery products; and
- meat and vegetable salads.

The Disease

The symptoms of *Salmonella* foodborne disease can appear from 6 to 72 hours, but usually occur 12 to 36 hours after ingesting an infective quantity of the organism (1,2,4). The gastroenteritis is characterized by diarrhea, abdominal cramps and frequently nausea and vomiting the first day of illness. Mild fever sometimes follows and lasts for a few days. Headache, chills, dehydration and prostration sometimes occur. The illness usually lasts from 2 to 6 days and deaths are uncommon except in the very young, very old or persons who are already weakened by illness.

Salmonella can be transmitted in a variety of ways (1,4,18). Since these bacteria occur in the intestinal tract of animals and some humans, they are shed in fecal matter and a cycle of infection is always present in the environment. The disease is usually transmitted from animals to humans by ingestion of foods of animal origin that have been contaminated with these bacteria. There can also be direct transmission from person-to-person and from animal-to-person.

Prevention

While many foods provide an environment that will allow salmonellae to grow, proper care in the processing, preparation, handling and storage of these foods will reduce the chances of a *Salmonella* outbreak.

Shigellosis

Shigellosis or bacillary dysentery is a common enteric infection caused by bacteria of the genus *Shigella* (1,4). This illness is associated with poor personal hygiene and sanitation. Between 1972 and 1978, it accounted for 6.5% of the confirmed cases of foodborne illness in the U.S. (6).

Nature and Source of the Organism

The normal habitat for shigellae are in the intestinal tract of humans and other primates (1,2,4). They are rarely found in other animals. The main source of shigellae involved in outbreaks is humans who are symptomless carriers or persons recovering from the disease. Shigellae often persist in the intestinal tract of about 50% of recovering persons for a month (1). Shigellae can be spread from person-to-person via the fecal-oral route, as well as by water and food.

Foods Involved

Foods that have been involved in outbreaks are foods that receive much handling such as salads; including potato, tuna, shrimp, macaroni and chicken; and cut, diced, chopped and mixed foods that are not subsequently heated (1,2,4). The ingredients may be clean, but during preparation, the food is contaminated by hand manipulation or mixing. The organisms can easily multiply in moist foods held at room temperature and cause an outbreak of shigellosis (4).

The Disease

The symptoms of the disease become apparent in 1 to 7 days, and usually within 1 to 3 days. Shigellosis is characterized by diarrhea, abdominal pain and fever. Vomiting, chills and headache often occur. The fecal material may contain blood, mucus or pus. The duration of the illness may range from 12 hours to 3 weeks, with the average illness lasting 5 to 6 days (1,2,4).

Prevention

Shigellosis can be prevented with a high standard of personal hygiene including washing the hands after using the toilet, not working with food when ill and by practicing good sanitation on the job (1).

Vibrio parahaemolyticus Gastroenteritis

Vibrio parahaemolyticus is a marine organism that can cause gastroenteritis in humans. It is responsible for 50% to 60% of the reported foodborne illness in Japan and

has also been incriminated in an increasing number of outbreaks in the U.S. (1).

Nature and Source of the Organism

V. parahaemolyticus is found in warm coastal waters throughout the world (1,19). It can also be found in brackish fresh water and in fresh water that contains large amounts of organic matter. It contaminates fish and shellfish in their aquatic environment.

Foods Involved

Foods incriminated in outbreaks include raw fish, clams, oysters, raw crab, crab salad, lobster and shrimp. Raw or inadequately cooked seafoods that are contaminated with large numbers of the organism can cause gastroenteritis. The cross-contamination of contaminated raw products with previously cooked foods has also resulted in outbreaks (1,4,19).

The Disease

The symptoms of *V. parahaemolyticus* gastroenteritis occur 2 to 48 hours (usually 10 to 20 hours) after ingesting the contaminated food. Symptoms include severe abdominal cramps, diarrhea, nausea, vomiting, headache, chills and prostration. These symptoms persist from a few hours to 10 days with the usual duration being 2 to 3 days. Recovery is usually complete, but the disease has been fatal to some elderly and already debilitated people (1,2).

Prevention

Since *V. parahaemolyticus* is easily killed by normal cooking temperatures, care should be taken to cook seafood products thoroughly, to eliminate cross-contamination and to properly refrigerate cooked seafoods (1,19).

TO BE CONTINUED NEXT MONTH.

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N.M.C.

NATIONAL MASTITIS COUNCIL

Check Your Mastitis Management

The 5-point plan was developed as a quick and easy method to remember the main components of an effective mastitis control program. It still is valid if each point is evaluated frequently and in depth.

The 5-point plan is:

1. Check milking machines.
2. Dip teats.
3. Treat clinical cases promptly.
4. Use dry cow therapy.
5. Cull chronically infected cows.

First, does the milking system meet functional standards and are the machines being used according to the manufacturer's recommendations? Are good milking procedures being practiced prior to machine attachment and throughout milking?

Second, is proper hygiene being practiced 24 hours a day, with emphasis on dipping each teat after every milking with an effective product?

Third, are clinical cases being treated as soon as they are diagnosed? Are you consulting a veterinarian for advice and is the full series of recommended treatments being administered?

Fourth, is a safe and effective, commercially prepared, single dose, dry cow treatment product being used on each teat of every cow at drying off?

Fifth, are chronically infected cows, that do not respond to the control program, culled on a routine basis? They are a source of new infections for other animals in the herd. Is culling based on economic reasons?

The 5-point mastitis control program is an excellent tool for evaluating the mastitis prevention measures that are in place in any herd. Any component of the 5-point plan that is found inadequate or missing should be upgraded immediately.

An effective mastitis control program is an essential part of management efforts to consistently produce high-quality milk and milk products.

This article is one of a continuing series made available by the National Mastitis Council.

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

FROZEN FOOD CODE

"Frozen Food Handling and Merchandising," a code of recommended practices endorsed by the Frozen Food Roundtable, is available in a revised printing. The code covers the proper handling and merchandising of frozen foods from raw material to ultimate consumer; includes sections on warehousing, transportation, temperature control, and handling in retail food stores and restaurants.

Recognized by both the Federal Trade Commission and the U.S. Department of Agriculture, the code is published by the Frozen Food Roundtable, an alliance of 16 trade associations concerned with proper handling and merchandising of frozen food. A free copy of the code may be obtained from the National Frozen Food Association, P.O. Box 398, Hershey, PA 17033. Telephone: 717-534-1601.

E.N.D./March-April 1986

PIM on Microfiche

The FDA announced recently that its Program Information Manual, a desk reference on food safety and sanitation in the food service, vending, and retail food store industries, is available--on microfiche only. PIM is intended for use by local, state, and federal regulatory officials, corporate sanitarians, and sanitation consultants. It includes organizational charts, the three model codes, all current code interpretations (bulk food, sulfites, dishwasher conversion, etc.); manager training and certification information; a guide to FDA's automated data processing system (SPIF); agency procedures for conducting investigations and evaluating food chains; and a complete course on facilities planning and plan review. To order, contact the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. Telephone: 703-487-4650. Order No. PB85-152767. Price: \$23.50.

E.N.D./March-April 1986

Sanitation For Seniors

Two new training modules on sanitation and safety designed for use in senior citizen centers are available. "Making It Safe: Preparing Food for the Elderly" and "For Safety's Sake--Food Preparation and Accident Prevention at Senior Centers" are being offered in slide/tape cassette and videotape formats. The 10-minute programs were produced by Colorado State University for the North Dakota Department of Human Services. Joanne Pegues, nutritionist for the Administration on Aging, Region VIII, and D.J. Inman, FDA regional food consultant, were technical advisors on the project.

Senior centers, Meals on Wheels, home delivery to shut-ins, and other similar operations are often staffed by volunteers who work on a rotating and very flexible schedule. Because sanitation "horror stories" associated with this activity are not uncommon, the addition of training materials specific to food service for the elderly will be welcome in many quarters. For information on availability and costs, contact: Audio Visual Services, A-69 Clark Bldg., Colorado State University, Fort Collins, CO 80523. Telephone: 303-491-5468.

E.N.D./March-April 1986

Penn State Home Study Course

"Sanitation Certification, HFS 5704" is the name of an independent learning course in food service sanitation being offered by the Hotel, Restaurant, and Institutional Management Department of Penn State

University. The course is designed to provide a basic understanding and knowledge of the skills needed to design, implement, and manage an effective sanitation program in a foodservice operation.

The home study course includes twelve lessons and a comprehensive exam. In each lesson students are asked to answer study questions and submit this homework to their Penn State instructor for grading and recommendations. Upon successful completion of the course, students earn four Continuing Education Units and receive a certificate verifying completion. A registry of certified students is maintained at Penn State.

Cost of the course including all materials is \$93.45. For more information, contact: The Pennsylvania State University Dietetic Extended Degree Program, 20 Human Development Building, University Park, PA 16802. Telephone: 814-863-2676.

E.N.D./March-April 1986

Hazardous Waste Success

The Albuquerque/Bernalillo County household and small quantity hazardous waste collection project held during five days in October was a huge success, according to Alana Rae Eager, Community Development Coordinator of the Albuquerque Environmental Health and Energy Department. The project helped reduce by 118,350 pounds the amount of hazardous wastes that otherwise would have found their way into the area's refuse and sewer systems.

The data supports Ms. Eager's claim of success for the five-day collection project:

- 1005 households and 57 small quantity generators participated;
- 118,950 pounds of hazardous chemicals collected;
- 444 drums contained pesticides, paints, solvents, cleaners, acids, and many more chemicals;
- Over 400 pounds of potential explosive materials were collected for detonation by the Albuquerque Police Department's Bomb Squad;
- Although over 40 gasoline stations around Albuquerque accepted used motor oil for recycling, 750 gallons of oil were collected for recycling during the project.

Residents who participated in the project overwhelmingly felt there is a need for an ongoing program for hazardous waste management through future collection projects and a permanent collection/storage/transfer facility.

For more information on the project, call Donna M. Lacombe at 505-766-7434.

E.N.D./March-April 1986.

Letters/ Environmental News Digest

It was with interest I read your article on page 16 of the September-October magazine on disposal of hazardous household waste.

In rural areas, such as central Kentucky, a different problem exists in the form of old or banned farm chemicals that are still in storage on the farm or in retail outlets. Our local and district health departments held a "Pesticide Roundup" where nearly anyone (except industry) could bring in these old chemicals to a collection point. The county governments paid for the disposal at a hazardous waste landfill and the health department managed the collection and shipping.

Some of the materials disposed of included arsenic, D.D.T., paris green, cyanide, strichnine, and experimental "bug dusts." Over a ton was collected.

Randall Carrier, H.E. III
West Bluegrass Distr. Health Dept.
104 South Campbell
Lancaster, KY 40444
606-792-2462

E.N.D./March-April 1986

Ammonia Contamination in a Milk Processing Plant - Wisconsin

On October 30, 1985, the Wisconsin Division of Health was informed by the state poison control center of two elementary school children who presented with severe burning of the mouth and throat as well as nausea. The symptoms developed within one hour of drinking milk packaged in half-pint containers with an expiration date of 11/9 from a Wisconsin milk processor. An investigation into the source of the milk determined that, five days previously, the milk processor had noted an ammonia leak in one of its cooling chambers, where approximately 250,000 half-pint milk containers with an expiration date of 11/9 were stored. The liquid ammonia, used to cool the tanks and stored under pressure, had sprayed about the storage tank for an undetermined number of hours. On discovery of the leak, the milk processors destroyed those cartons with obvious external damage to the paper and polyethylene containers. After tasting and smelling approximately 75 of the remaining 250,000 cartons, they determined the milk was safe and began distributing the product through the state.

Thirty milk containers with expiration date 11/9 were retrieved from the index elementary school. An analysis of these 30 containers by the Wisconsin Department of Agriculture identified seven (23%) that were contaminated with ammonia at levels ranging from 530 ppm to 1,524 ppm (normal = less than 15 ppm). The pH levels of these contaminated samples ranged from 9.1 to 10.0 (normal milk pH = 6.7-6.9).

On the basis of the initial reports of adverse symptoms associated with ingestion of the implicated milk, a case definition was established: the development of symptoms of irritation of the gastrointestinal tract, including the mouth, throat, or stomach, with onset within one hour of ingesting milk with expiration date 11/9 from the implicated processing plant.

Over the next 24 hours, 268 schools that had received milk with expiration date 11/9 from the implicated plant were contacted and instructed to withdraw these milk products from their schools. Additionally, each school was requested to inform the Wisconsin Division of Health if any child developed symptoms consistent with the case definition.

This surveillance effort identified approximately 520 cartons of milk ingested before notification. Twenty children fulfilling the case definition were identified (attack rate 3.9%). None required hospitalization, and no deaths occurred. Schools were instructed to return the unused cartons to the milk processor, where they were destroyed. This is the first reported incident of acute ammonia poisoning associated with contaminated milk.

Editorial Note: Ammonia (NH₃) is a colorless gas with a characteristic strong, pungent, penetrating odor. It is one of the more common industrial chemicals; an estimated 20-30 million tons are used per year in the United States. It is widely used in fertilizer manufacture; other uses include dye, synthetic fiber, plastic, and nitric acid production, as well as refrigeration. In its aqueous form as ammonium hydroxide (NH₄OH), it is extremely alkaline and can be highly caustic. Aqueous ammonia is 28% (280,000 ppm) ammonia, whereas household ammonia is 10% ammonia (100,000 ppm). Mild to moderate ammonia exposures can produce headaches, salivation, burning of the throat, anosmia, nausea, vomiting and substernal pain. Moderate doses may produce laryngospasm or bronchospasm.

The Occupational Safety and Health Administration standard for ammonia inhalation is 50 ppm as an 8-hour time-weighted average, but the National Institute for Occupational Safety and Health has recommended that 50 ppm be a 5-minute ceiling for exposure. The characteristic ammonia odor is readily perceptible below toxic levels. Most persons can detect an odor at 30 ppm, and eye and nose irritation become more severe as the levels increase to 50 ppm. The students involved in this incident were unable to smell the ammonia probably because the milk cartons were closed. The students first became aware of a problem when they felt burning in their throats.

Outbreaks of ammonia poisoning of milk, other beverages, or food have not been previously documented. The ammonium hydroxide appar-

ently penetrated the milk cartons when the refrigerant leaked. Additional studies need to be done to determine how the ammonia contaminated the milk and criteria need to be established to prevent contaminated milk from being distributed.

Recommendations for ammonia spills are as follows:

1. Following ammonia ingestion, a conscious person should immediately be given large quantities of water to dilute the ammonia.
2. Persons who have inhaled ammonia should be observed closely for visual disturbances, upper airway obstruction, and hypoxia.
3. The area of the ammonia spill or leak should be ventilated to disperse the gas. A flow of gaseous ammonia should be stopped; liquid ammonia should be allowed to vaporize.
4. Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until the clean-up has been completed.

MMWR - 5/2/86

USDA PAMPHLET - SAFE FOOD TO GO

"When you think of summertime activities, you think of warm sunshine, games and good food (with maybe an occasional ant). But a more worrisome "bug" - food poisoning bacteria - is lurking, waiting to pounce on foods that are not prepared and handled properly." So begins a letter from the USDA Public Awareness Branch informing health departments across the country of the availability of their new booklet entitled *Safe Food to Go*.

This 20-page, colorfully illustrated brochure includes practical food safety information for almost every outside eating occasion. It also contains a fold-out chart that lists five basic food safety tips, as well as information about foodborne disease organisms. The brochure will be a welcome addition to consumers planning a picnic, a camping trip, or preparing lunch for school or work. Operators of children's camps or temporary food service operations may find it very useful also. We have reviewed this booklet and it creates a ten on a scale of one to ten - ten being the best!

Bulk copies of *Safe Food to Go* are available by writing or calling:

USDA/FSIS
Public Awareness Branch
Washington, DC 20250
202-447-9351

Food Protection Bulletin - NY State Dept. Health Vol. 2 #4 (1986)

Campylobacter Outbreak Associated with Raw Milk Provided on a Dairy Tour - California

On October 3, 1985, students and teachers from northern California, and some of their family members, made a field trip to a San Joaquin County dairy. Of the 50 attendees from whom information was available, 23 (46%) became ill with *Campylobacter jejuni* infection.

Twenty-three (59%) of the 39 attendees who drank raw milk, and none of the 11 who did not drink it, became ill ($p = 0.0005$). Included among the cases was an infant who had been almost exclusively breastfed and became ill after drinking a bottle filled with raw milk at the dairy. In addition, secondary cases occurred in two women who had not visited the dairy but tended an infant who drank raw milk and developed campylobacter gastroenteritis. Stool cultures from one asymptomatic and eight ill persons grew *C. jejuni*. Neither the cows nor milk were cultured.

Of the 23 ill field-trip attendants, 96% reported diarrhea; 35%, abdominal cramps; 35%, fever; 26%, vomiting; and 22%, bloody diarrhea. Incubation periods ranged from 1 day to 10 days, but were 3 or 4 days in most cases. Symptoms most commonly lasted 5 days.

Editorial Note: Numerous outbreaks of enteric diseases have occurred among school children given raw milk while on field trips to dairies

in the United States. As a result, in January 1985, the U.S. Food and Drug Administration (FDA) issued a "milk advisory" to all state school officers recommending that children not be permitted to sample raw milk on such visits.

Healthy lactating cows can carry *C. jejuni* in the intestinal tract, providing an extrinsic source of contamination. In one study of 193 healthy dairy cows at three dairies, 77 (40%) had positive rectal cultures. In another study of 477 dairy cows, 69 (14%) had *C. jejuni* cultured from bile. In addition, cows with no evidence of illness can excrete *Campylobacter* directly into their milk as a result of mammary infection. Fourteen (61%) of 23 *Campylobacter* outbreaks reported to CDC from 1980 to 1982 were traced to consumption of raw milk. Since culture of diarrheal stools for *C. jejuni* became common, many raw milk associated *Campylobacter* outbreaks involving thousands of cases have been reported.

Milk is an excellent vehicle for infection, because its fat content protects pathogens from gastric acid and because, being fluid, it has a relatively short gastric transit time. Present technology cannot produce raw milk that can be assured to be free of pathogens; only with pasteurization is there this assurance. Since 1983, when Scotland banned the sale of raw milk, milkborne infection has decreased markedly.

MMWR 5-16-86

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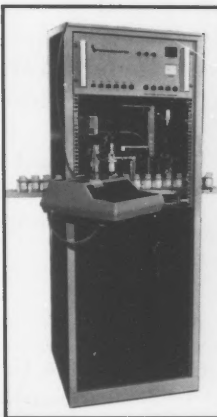


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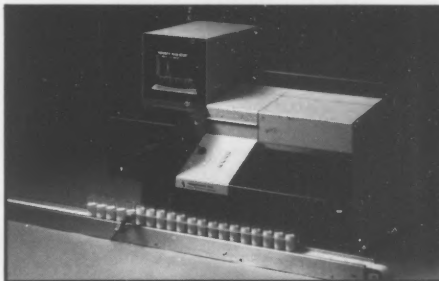


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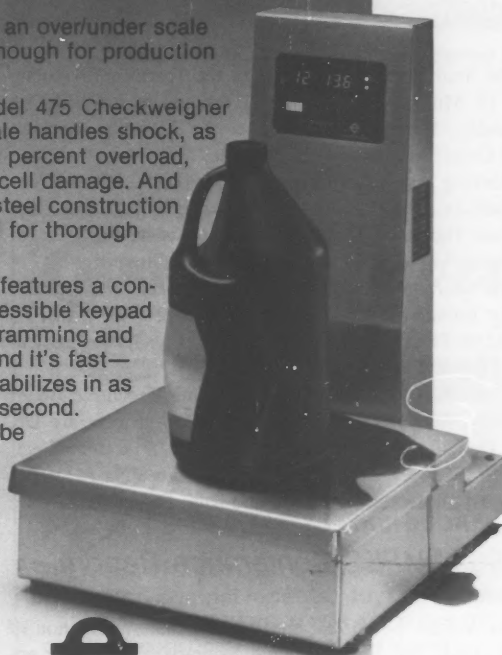
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Enjoying the meeting, Mary Lou Hopper of the Tennessee Department of Agriculture and Herbert Holt, past president of the Tennessee Affiliate.

Tennessee Affiliate Holds Sixth Annual Workshop

The Sixth Annual Workshop of the Tennessee Association of Milk, Water and Food Protection was held on Thursday, November 6, 1986 at the Ellington Agricultural Center in Nashville, Tennessee.

Morning session topics and speakers were: "Cross Connections in Dairy Plants" by Dale Seiberling; "Cross Connection Hazards" by Robert Lashlee; and "Effects of Lowered Somatic Cell Count" by Jimmy Hopper.

The afternoon session topics and speakers were: "FDA Dairy Initiatives 'The Pathogen Problem'" by IAMFES President-Elect Leon Townsend and "Brucellosis Eradication Program" by Alfred Creswell.

A meeting of the Tennessee Affiliate Executive Board was also held. The Tennessee Affiliate Officers are Dr. Bob Demott, President; David Mayfield, President Elect; Mrs. Dempsey Thornton, Vice President; Dennis Lampley, Secretary-Treasurer and Ruth Fuqua, Archivist.

1986 IAMFES Conference Report

On August 3-7, 1986, the International Association of Milk, Food and Environmental Sanitarians held their annual conference in Bloomington, Minnesota. It was attended by over 850 (!) food, dairy, and environmental professionals from all over the world - their largest conference yet. I was impressed by the attendance, the organization involved in such a large event and the professionalism of the people who participated.

During the conference I attended the membership committee meeting, the affiliate council meeting and the annual business meeting. I learned much about the organization in a short time, met many interesting people and enjoyed the opportunity to contribute. There seemed to be much interest in Michigan and our organization - espe-

Affiliate Calendar

1987

February 23-25, KAMFES 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.

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 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 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 Volkens, Environmental Health, Michigan Dept. of Health, 3500 N. Logan, Lansing, MI 48909. 517-335-8268.

April 6-8, FLORIDA ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC. ANNUAL EDUCATIONAL CONFERENCE, to be held at the Gainesville Hilton, Gainesville, FL. For more information contact: Dr. Franklin Barber, 20 Stymie Ln., New Smyrna Beach, FL 32069. 904-428-1628.

April 8-10, MISSOURI MILK, FOOD, AND ENVIRONMENTAL HEALTH ASSOCIATION 1987 ANNUAL EDUCATIONAL CONFERENCE, to be held at the (New) Hilton Inn, Columbia, MO. For more information contact: David Welde, Mid-America Dairymen, P.O. Box 1837, SS Station, Springfield, MO 65805.

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 28, ASSOCIATED ILLINOIS MILK, FOOD AND ENVIRONMENTAL SANITARIANS SPRING EDUCATIONAL SEMINAR, a joint conference with the Chicago Dairy Technology Society, to be held at The Holiday Inn, Rolling Meadows, IL 60008. 312-259-5000. For more information contact: Dr. Clem Honer, Gorman Publishing Company, 8750 West Bryn Mawr Ave., Chicago, IL 60631. 312-693-3200.

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.

September 21-23, NYSAMFS 1987 ANNUAL CONFERENCE, to be held at the Sheraton Inn-Syracuse, Liverpool, NY. For more information contact: Paul J. Dersam, 27 Sullivan Road, Alden, NY 14004. 716-937-3432.

cially in the areas of our CEU program and in our MEHA Newsletter. In talking with representatives from other states, it seems that Michigan is quite well organized in these areas, and I was pleased to be able to share our expertise.

The educational sessions were excellent. I was especially interested in the quality assurance programs in industries such as the airlines, Pillsbury, and General Mills. There was *much* discussion about HACCP (Hazard Analysis Critical Control Point) programs. I was surprised to

find out that most of the above industries have had some form of HACCP programs in place for 10-15 years and that several states have also been implementing similar programs. The people involved in HACCP (or modified HACCP) hold much confidence in the program, and it is an area that I believe Michigan should be taking an interest in. In fact, the conference was followed by a two day HACCP workshop which I unfortunately was unable to attend.

Another interesting session involved the Hill Farm Dairy *Salmonella* outbreak. A microbiologist and representative from FDA discussed their investigation, the specifics of the cross connection problem, and how to manage crisis situations.

Although there was not a specific session devoted to training, there was much discussion about it, and I am more convinced than ever that continuous and effective training is the key to solving many sanitation, quality assurance and environmental issues. In addition to HACCP and training discussions, there were many sessions devoted to the subject of *Listeria*.

The conference was attended by a mix of people from USDA, FDA, state and local governments, education, and industry. There were people there who worked in microbiology, quality assurance, packaging, consulting, engineering, etc. It was exciting for me to meet people with such diverse backgrounds whose professional purpose and interests were so similar to ours as local health department sanitarians. As the local affiliate, we should be seeking the membership and participation of other professionals in Michigan. I feel we have a lot in common and much to offer each other. For sanitarians, participating in IAMFES would be a perfect opportunity to meet other environmental health professionals outside of our usual circles.

The conference was inspiring for me and I have more to tell. If you have specific questions, I would be happy to talk with you. I was proud to represent Michigan and appreciate the opportunity. Thank you.

Submitted by
Susan J. Hibberd, R.S.
1986 IAMFES Delegate

Note: The 1987 IAMFES conference will be held in Anaheim, California, August 2-6.

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DAIRY AND FOOD SANITATION/FEBRUARY 1987 89

Toxigenic Fungi - Their Toxins and Health Hazards edited by Hiroshi Kuata and Yoshio Ueno. Elsevier Science Publishers, Amsterdam and New York.

The book is the Proceedings of the Mycotoxin Symposium held at the Third International Mycological Congress in Tokyo, Japan, August 30 to September 3, 1983. These proceedings contain papers from five symposia on the ecology of mycotoxin producing fungi; the taxonomy of mycotoxin producing fungi; food and feed mycology related to mycotoxicoses and food hygiene; toxicology of mycotoxins; and epidemiological risks to human health from mycotoxins. Each symposium forms a chapter and consists of from five to ten papers from different contributors. Contributors included scientists from the U.S.A., Canada, U.K., West Germany, Italy, Denmark, New Zealand, Thailand, Taiwan, The Netherlands, and Japan.

The papers that are presented in the proceedings are research papers and therefore tend to be rather specialized in subject matter. The papers will be of primary interest to individual researchers who are working in the field, and probably of less interest to sanitarians and food scientists who are not directly involved in active mycotoxin research. This would be particularly true if one is considering purchasing the book for one's personal library, in view of the high cost (\$86.50). While the book will be of primary interest to researchers in the field, other scientists and graduate students in both industry and academia will have need for access to the book. Therefore, company and university libraries may wish to add this book to their holdings. The book was produced by directly reproducing the typed manuscripts of the authors. While organization and style are quite uniform, a number of typographical errors are evident, as are the different sizes and styles of type. For those who have a direct and keen interest in the subject matter, these will be minor disadvantages.

Some of the individual subjects noted in the chapters include the following: distribution of mycotoxin-producing fungi in marketing foods in Japan; ecological approaches to the study of mycotoxic fungi; identity and aflatoxin producing ability of *Aspergillus* reference cultures; the value of physiological characters in the taxonomy of *Penicillium*; toxigenic penicillia occurring in foods and feeds; survey for mycotoxins in commercial foods; the occurrence of vomitoxin (deoxynivalenol, DON) in Canadian grains; immunochemical studies on mycotoxins; synergistic effect of citrinin on hepatorenal carcinogenesis of ochratoxin A in mice; ochratoxin A: on the mechanism of action; an assessment of cancer risk from aflatoxins B₁ and M₁; and cancer risk from aflatoxins in Thailand.

The book is a very good addition to the mycotoxin

literature, and is recommended reading for anyone working in the mycotoxin area, or with an interest in the subject.

Lloyd B. Bullerman

*University of Nebraska
Lincoln, NE*

Quality Control In The Food Industry, Volume Two. Edited by: S.M. Herschdoerfer, Academic Press, London, 522 pages.

This publication is part of a four volume series devoted to quality control in the food industry. With the exception of the first chapter that deals with water and wastewater quality, each chapter focuses on a specific food. Quality control aspects of processing and manufacturing dairy products, meats, fish, and oils and fats are discussed in detail.

One will soon recognize that the text is basically written for a European audience. Many of the quality standards discussed are of importance only for food industries located in the European Economic Community (EEC). Even with the European slant this four volume series can still provide useful information to quality control personnel in the United States. For the field sanitarian in the US, the series would not be an ideal investment.

Contents of the other volumes are outlined in volume two. Volume one presents an introduction and overview of quality control in the food industry. Subjects addressed in volume one include: health and nutritional aspects, statistical methods in quality control, national and international standards, and specifications in the food industry. Like volume two, volumes three and four address quality control in specific food industries. Volume three presents quality control aspects of flour and bread, confectionery, sugar, frozen desserts, fruit and vegetables, canned and bottled foods, and prepared food mixes. Volume four continues with quality control aspects of alcoholic beverages and vinegars, soft drinks, tea, coffee, flavouring materials, food additives, and packing materials.

Quality Control in the Food Industry - Volume Two, would not serve as a ready reference for the public health professional. Individuals engaged in quality control in a specific food industry should check out the volume that addresses their individual concern. All four volumes would be a useful addition in the reference section of libraries supporting schools of food science.

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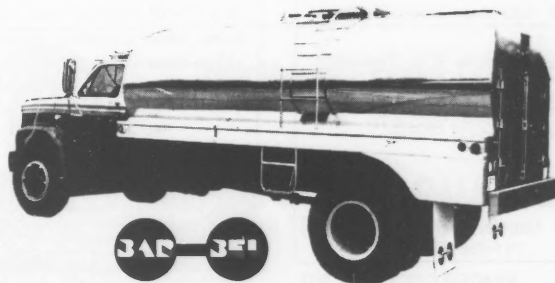
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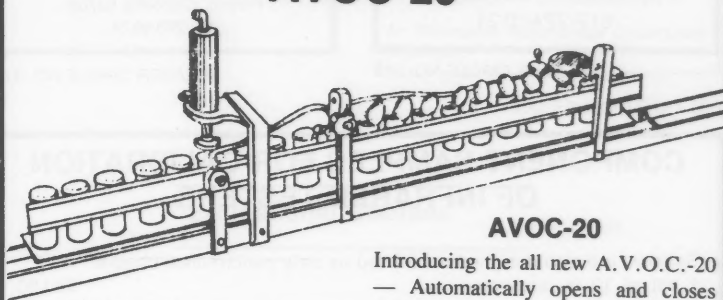
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Richardson, Department of Nutrition
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VERSITY, Logan, Utah 84322 - 8700.

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A course on how to save on refrigeration, energy and equipment maintenance. Learn
by doing and observing (ice cream freezers, packaging, and refrigeration systems).

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and sanitation procedures and waste management.

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A course developed to train the person on the job the skills necessary to operate a
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READER CIRCLE NO. 295

Holders of 3-A Symbol Council Authorization on February 15, 1987

Questions or statements concerning any of the holders authorizations listed below, or the equipment fabricated, should be addressed to: Robert E. Holtgrieve, Sec'y.-Treasurer, W255 N477 Grandview Blvd., Suite 100, Waukesha, Wisconsin 53188

01-06 Storage Tanks for Milk and Milk Products

115 A-L Stainless Inc. (Not available in USA) 113 Park St., South Peterborough, Ontario Canada K9J 3R8	(9/28/58)	377 Energy Service Co. B200 Walker Bldg., 734 15th St., NW Washington, DC 20005	(2/4/83)
2 APV Crepaco, INC. 100 South CP Ave. Lake Mills, Wisconsin 53551	(5/1/56)	462 Enprotech Corporation 335 Madison Avenue New York, New York 10017	(12/5/85)
28 Cherry-Burrell Corporation (A Unit of AMCA Int'l., Inc.) 575 E. Mill St. Little Falls, New York 13365	(10/3/56)	466 Fluid Metering Inc. 29 Orchard St. Oyster Bay, New York 11771	(1/10/86)
102 Chester-Jensen Co., Inc. 5th & Tilghman Sts., P.O. Box 908 Chester, Pennsylvania 19016	(6/6/58)	404 Fullwood-Packo N.V. (Not available in USA) Cardijnlaan 10 8160 Diksmuide, Belgium	(8/25/83)
117 DCI, Inc. P.O. Box 1227, 600 No. 54th Ave. St. Cloud, Minnesota 56301	(10/28/59)	65R G & H Products Corp. 7600-57th Avenue P.O. Box 1199 Kenosha, WI 53141	(5/22/57)
76 Damrow Company (A Div. of DEC Int'l., Inc.) 196 Western Ave., P.O. Box 750 Fond du Lac, Wisconsin 54935-0750	(10/31/57)	145R ITT Jabsco Products 1485 Dale Way Costa Mesa, California 92626	(11/20/63)
127 Paul Mueller Co. P.O. Box 828 Springfield, Missouri 65801	(6/29/60)	314 Len E. Ivarson, Inc. 3100 W. Green Tree Rd. Milwaukee, Wisconsin 53209	(12/22/78)
440 Scherping Systems 801 Kingsley St. Winsted, MN 55395	(3/1/85)	372 The Kontro Co., Inc. 450 W. River St., P.O. Box 30 Orange, Massachusetts 01364	(12/20/82)
432 TCI-Superior Division, Mueller Canada Inc. 6500 Northwest Dr. Mississauga, Ontario, Canada L4V 1K4	(11/9/84)	461 L.A. Liquid Handling Systems for Nakamura Metallic Ind. Co., Ltd. 15411 S. Broadway Gardena, California 90247	(12/5/85)
31 Walker Stainless Equipment Co., Inc. Elroy, Wisconsin 53929	(10/4/56)	26R Ladish Co., Tri-Clover Div. 9201 Wilmot Rd. Kenosha, Wisconsin 53141	(9/29/56)
02-08 Pumps for Milk and Milk Products		373 Luwa Corporation P.O. Box 16348 Charlotte, North Carolina 28297-6348	(12/27/82)
63R APV Crepaco, INC. 100 South CP Ave. Lake Mills, Wisconsin 53551	(4/29/57)	364 M D Pneumatics, Inc. 4840 W. Kearney Springfield, Missouri 65803	(7/28/82)
325 Albin Pump, Inc. 120 Interstate N. Pkwy. E.#208 Atlanta, Georgia 30339-2103	(12/19/79)	319 Mono Group, Inc. 847 Industrial Dr. Bensenville, Illinois 60106	(3/21/79)
214R Ben H. Anderson Manufactures Morrisonville, Wisconsin 53571	(5/20/70)	148R Moyno Industrial Products of Robbins & Meyers, Inc. 1895 Jefferson St. Springfield, OH 45506	(4/22/64)
212R Babson Brothers Co. 2100 S. York Rd. Oak Brook, Illinois 60521	(2/20/70)	400 Netzsch Incorporated 119 Pickering Way Exton, PA 19341-1393	(8/15/83)
29R Cherry-Burrell Corp. (A Unit of AMCA Int'l., Inc.) 2400-6th St. SW, P.O. Box 3000 Cedar Rapids, Iowa 52406	(10/3/56)	375 Niro Atomizer Food & Dairy Inc. 1600 County Road F Hudson, Wisconsin 54016	(1/25/83)
205R Dairy Equipment Co. 1919 S. Stoughton Rd., P.O. Box 8050 Madison, Wisconsin 53716	(5/22/69)	241 Puriti, S.A. de C.V. (not available in USA) Alfredo Nobel 39 Industrial Puente de Vigas Tlalnepantla, Mexico	(9/12/72)
		306 Stamp Corporation	(5/2/78)

- P.O. Box 65
Middleton, Wisconsin 53562
- 332 Superior Stainless, Inc. (12/10/80)
611 Sugar Creek Rd.
Delavan, Wisconsin 53115
- 45I Susquehanna Valley Systems, Inc. (8/28/85)
P.O. Box 804
Berwick, Pennsylvania 18603
- 72R L. C. Thomsen & Sons, Inc. (9/14/57)
1303-43rd St.
Kenosha, Wisconsin 53140
- 219 TCI-Superior Division, (2/15/72)
Mueller Canada Inc.
6500 Northwest Dr.
Mississauga, Ontario, Canada L4V 1K4
- 175R Universal Cooperatives, Dairy (10/25/56)
Dairy Division
U.S. Hwy 33 East/Box 115
Goshen, Indiana 46526
- 47I VNE CORPORATION (4/27/86)
1415 Johnson Street
Janesville, Wisconsin 53545
- 329 Valex Products Corp. (6/10/80)
6080 Leland Street
Ventura, California 93003
- 52R Viking Pump-Houdaille, Inc. (12/31/56)
406 State St.
Cedar Falls, IA 50613
- 5R Waukesha Foundry Division (5/6/56)
Abex Corporation
1300 Lincoln Avenue
Waukesha, Wisconsin 53186
- 408 Westfalia Systemat (10/18/83)
1862 Brummel Drive
Elk Grove Village, IL 60007

**04-03 Homogenizers and High Pressure
Pumps of the Plunger Type**

- 37 APV Crepaco, INC. (10/19/56)
100 South CP Ave.
Lake Mills, Wisconsin 53551
- 75 APV Gaulin, Inc. (9/26/57)
44 Garden St.
Everett, MA 02149
- 390 American Lewa, Inc. (6/9/83)
132 Hopping Brook Road
Holliston, Massachusetts 01760
- 247 Bran & Luebbe, Inc. (4/14/73)
1025 Busch Parkway
Buffalo Grove, Illinois 60015
- 87 Cherry-Burrell Corp. (12/20/57)
(A Unit of AMCA Int'l., Inc.)
2400-6th St., SW, P.O. Box 3000
Cedar Rapids, Iowa 52406
- 486 Kol-Flo Corporation (11/18/86)
320 N. Jensen Road
Vestal, New York 13850
- 256 Liquipak Int'l. Inc. (1/23/74)
2285 University Ave.
St. Paul, Minnesota 55114

- 309 Niro Atomizer Food & Dairy Inc. (7/19/78)
1600 County Road F
Hudson, Wisconsin 54016
- 425 TCI-Superior Division, (8/31/84)
Mueller Canada Inc.
6500 Northwest Dr.
Mississauga, Ontario, Canada L4V 1K4

**05-13 Stainless Steel Automotive Milk Transportation
Tanks for Bulk Delivery and/or Farm
Pick-up Service**

- 379 Bar-Bel Fabricating Co., Inc. (3/15/83)
RR 2
Mauston, Wisconsin 53948
- 70R Brenner Tank, Inc. (8/5/57)
450 Arlington Ave., P.O. Box 670
Fond du Lac, Wisconsin 54935
- 388 Frell, Inc. (5/24/83)
5657 Bear Lane-P.O. Box 4977
Corpus Christi, Texas 78469-4977
- 45 The Heil Company (10/26/56)
1125 Congress Pkwy.
P.O. Box 160
Athens, Tennessee 37303-0160
- 40 Hills Stainless Steel & Equip., Inc. (10/20/56)
405 S. Water
Hills, MN 56138
- 66 Kari-Kool Transports, Inc. (5/29/57)
P.O. Box 538
Beaver Dam, WI 53916
- 201 Paul Krohnert Mfg. Ltd. (4/1/68)
(not available in USA)
811 Steeles Ave., P.O. Box 126
Milton, Ontario Canada L9T 2Y3
- 305 Light Industrial Design Co., Inc. (3/23/78)
963 I-A Depot Rd.
Lynden, Washington 98264
- 85 Polar Tank Trailer, Inc. (12/20/57)
Holdingford, MN 56340
- 189 A & L Tougas, Ltee (10/3/66)
(not available in USA)
1 Tougas St.
Iberville, Quebec, Canada
- 25 Walker Stainless Equipment Co. (9/28/56)
New Lisbon, Wisconsin 53950
- 437 West-Mark (11/30/84)
2704 Railroad Ave., P.O. Box 418
Ceres, CA 95307

**08-17 Fittings Used on Milk and Milk Products
Equipment and Used on Sanitary Lines
Conducting Milk and Milk Products**

- 349 APN, Inc. (12/15/81)
400 W. Lincoln
Caledonia, Minnesota 55921
- 484 APV BEVCO, INC. (10/22/86)
1325 Samuelson Road
Rockford, Illinois 61109
- 260 APV CREPACO, INC. (08-17 A&B) (5/21/75)
100 South CP Avenue
Lake Mills, Wisconsin 53551

- 450 APV International Limited (8/22/85)
(Not available in USA)
P.O. Box 4, Manor Royal
Crawley
West Sussex RH10 2QB
England
- 291 Accurate Metering Systems, Inc. (6/22/77)
1731-33 Carmen Dr.
Elk Grove Village, Illinois 60007
- 470 Advance Stainless Mfg. Corp. (3/30/86)
218 West Centralia Street
Elkhorn, Wisconsin 53121
- 380 Allegheny Bradford Corp. (3/21/83)
P.O. Box 200 Route 219 South
Bradford, PA 16701
- 79R Alloy Products Corp. (11/23/57)
1045 Perkins Ave., P.O. Box 529
Waukesha, Wisconsin 53187
- 422 BS&B Safety Systems, Inc. (6/12/84)
7455 E. 46th St.
Tulsa, OK 74133
- 245 Babson Bros. Company (2/12/73)
2100 So. York Rd.
Oak Brook, Illinois 60521
- 443 Badger Meter, Inc. (5/1/85)
6116 East 15th Street
Tulsa, OK 74158
- 284 Bristol Engineering Co. (08-17D) (11/18/76)
210 Beaver St., P.O. Box 696
Yorkville, Illinois 60560
- 411 Capital Equipment Corp. (11/15/83)
2421 Darwin Road
Madison, WI 53704
- 82R Cherry-Burrell Corp. (12/11/57)
(A Unit of AMCA Int'l. Corp.)
2400-6th St. SW, P.O. Box 3000
Cedar Rapids, Iowa 52406
- 478 CIPRIANA1, INC., Fratelli Tassalini (7/31/86)
21695 Belerma Street
Mission Viejo, California 92695
- 407 Continental Disc Corp. (10/14/83)
4103 Riverside NW
Kansas City, MO 64150
- 376 Defontaine Inc. (1/25/83)
563 A. J. Allen Circle
Wales, WI 53183
- 455 Flowtech Inc. (9/17/85)
120 Interstate N. Pkwy. E. #208
Atlanta, Georgia 30339-2103
- 271 The Foxboro Co. (3/8/76)
38 Neponset Ave.
Foxboro, Massachusetts 02035
- 480 GEA Food and Process Systems Corp. (8/8/86)
8940 Route 108 (08-17A)
Columbia, Maryland 21045
- 67R G & H Products Corp. (6/10/57)
7600-57th Avenue
P.O. Box 1199
Kenosha, WI 53141
- 350 H&K, Inc.-Rosista Div. (1/7/82)
880 Bahcall Court
P.O. Box 1508
Waukesha, Wisconsin 53186
- 287 Hackman Flow Inc. (1/14/77)
Route 3, Box 28
Brunswick, Georgia 31520
- 369 IMEX, Inc. (11/3/82)
4040 Del Rey Ave. Unit 9
Marina del Rey, CA 90292
- 203R ITT Grinnell Valve Co., Inc. (11/27/68)
Dia-Flo Division
33 Centerville Rd.
Lancaster, Pennsylvania 17603
- 454 Jensen Fittings Corp. (9/11/85)
107-111 Goundry St.
North Tonawanda, New York 14120-5998
- 34R Ladish Co., Tri-Clover Div. (10/15/56)
9201 Wilmot Rd.
Kenosha, Wisconsin 53141
- 398 Ladish Co., Tri-Clover Div. (7/29/83)
9201 Wilmot Road
Kenosha, WI 53141
- 389 Lee Industries, Inc. (5/31/83)
P.O. Box 688
Philipsburg, PA 16866
- 239 Lumaco, Inc. (6/30/72)
P.O. Box 688
Teaneck, New Jersey 07666
- 200R Paul Mueller Co. (3/5/68)
1600 W. Phelps St., Box 828
Springfield, Missouri 65801
- 374 Niro Atomizer Food & Dairy Inc. (1/25/83)
1600 County Road F
Hudson, Wisconsin 54016
- 483 On-Line Instrumentation, Inc. (10/15/86)
Rt. 376, P.O. Box 541
Hopewell Junction, New York 12533
- 416 Process Engineers, Inc. (1/11/84)
3329 Baumberg Ave.
Hayward, CA 94545
- 242 Puriti, S.A. de C.V. (9/12/72)
(not available in USA)
Alfredo Nobel 39
Tlalnepantla, Mexico
- 149R Q Controls Subsid. of Cesco Magnetics (5/18/64)
93 Utility Court
Rohnert Park, California 94928
- 424 Robert-James Sales, Inc. (8/31/84)
P.O. Box 1672, 269 Hinman Ave.
Buffalo, NY 14216-0672
- 334 Stainless Products, Inc. (12/18/80)
1649-72nd Ave., Box 169
Somers, Wisconsin 53171
- 391 Stork Food Machinery, Inc. (6/9/83)
P.O. Box 1258/Airport Parkway
Gainesville, Georgia 30503
- 300 Superior Stainless, Inc. (11/22/77)
611 Sugar Creek Rd.
Delavan, Wisconsin 53115
- 357 Tanaco Products (4/16/82)
3860 Loomis Trail Rd.
Blaine, Washington 98230
- 73R L. C. Thomsen & Sons, Inc. (8/31/57)
1303-43rd St.
Kenosha, Wisconsin 53140

- 467 Tuchenhagen North America Inc. (1/13/86)
4119 W. Green Tree Road (08-17A)
Milwaukee, Wisconsin 53209
- 250 Universal Cooperatives, Dairy (6/11/73)
Dairy Division
U.S. Hwy 33 East/Box 115
Goshen, Indiana 46526
- 449 Up-Well Enterprises Co., USA (8/1/85)
P.O. Box 5334
Grants Pass, Oregon 97527
- 304 VNE Corporation (3/16/78)
1415 Johnson St., P.O. Box 187
Janesville, Wisconsin 53547
- 278 Valex Products Corp. (8/30/76)
6080 Leland Street
Ventura, California 93003
- 86R Waukesha Specialty Co., Inc. (12/20/57)
Hwy 14
Darien, Wisconsin 53144

09-07 Instrument Fittings and Connections Used on Milk and Milk Products Equipment

- 428 ARi Industries, Inc. (9/12/84)
381 ARi Court
Addison, IL 60101
- 321 Anderson Instrument Co., Inc. (6/14/79)
RD #1
Fultonville, New York 12072
- 315 Burns Engineering, Inc. (2/5/79)
10201 Bren Rd., East
Minnetonka, Minnesota 55343
- 206 The Foxboro Co. (8/11/69)
38 Neponset Ave.
Foxboro, Massachusetts 02035
- 418 Niro Atomizer Food & Dairy Inc. (4/2/84)
1600 County Road F
Hudson, Wisconsin 54016
- 487 Pyromation, Incorporated (12/16/86)
5211 Industrial Road
Fort Wayne, Indiana 46825
- 367 RdF Corporation (10/2/82)
23 Elm Ave.
Hudson, New Hampshire 03051
- 420 Stork Food Machinery, Inc. (4/17/84)
P.O. Box 1258/Airport Parkway
Gainesville, Georgia 30503
- 32 Taylor Instrument (10/4/56)
Combustion Engineering, Inc.
400 West Avenue, P.O. Box 110
Rochester, New York 14692
- 444 Tuchenhagen North America, Inc. (6/17/85)
4119 Green Tree Road
Milwaukee, WI 53209

10-03 Milk and Milk Products Filters Using Disposable Filter Media, as Amended

- 371 Alloy Products Corp. (12/10/82)
1045 Perkins Ave., P.O. Box 529
Waukesha, Wisconsin 53187

- 35 Ladish Co., Tri-Clover Div. (10/15/56)
9201 Wilmot Rd.
Kenosha, Wisconsin 53141
- 435 Sermia Equipment Limited (11/27/84)
(Not available in USA)
2511 Barbe Avenue
Chomedey, Laval, Quebec, Canada H7T 2A2
- 296 L. C. Thomsen, Inc. (8/25/77)
1303 43rd St.
Kenosha, Wisconsin 53140

11-03 Plate-type Heat Exchangers for Milk and Milk Products

- 38 APV Crepaco, INC. (10/19/56)
100 South CP Ave.
Lake Mills, Wisconsin 53551
- 20 APV Crepaco, INC. (9/4/56)
395 Fillmore Ave.
Tonawanda, New York 14150
- 458 APV International Limited (10/15/85)
(Not available in USA)
P.O. Box 4, Manor Royal
Crawley
West Sussex RH10 2QB
England
- 17 Alfa-Laval, Inc. (8/30/56)
2115 Linwood Ave.
Ft. Lee, New Jersey 07024
- 120 Alfa-Laval, Ltd. (12/3/59)
(DeLaval Agric. Div.)
11100 No. Congress Ave.
Kansas City, Missouri 64153
- 326 American Vicarb Corporation (2/4/80)
89 Pearce Avenue
Tonawanda, New York 14150
- 30 Cherry-Burrell Corp. (10/2/56)
(A Unit of AMCA Int'l. Inc.)
2400-6th St. SW, P.O. Box 3000
Cedar Rapids, Iowa 52406
- 14 Chester-Jensen Co., Inc. (8/15/56)
5th & Tilghman Sts., P.O. Box 908
Chester, Pennsylvania 19016
- 468 GEA Food and Process Systems Corp. (2/2/86)
8940 Route 108
Columbia, Maryland 21045
- 362 Kroeze Dairy Equipment, Inc. (7/20/82)
14393 Euclid Ave.
Chino, California 91710
- 15 Kusel Equipment Co. (8/15/56)
820 West St., P.O. Box 87
Watertown, Wisconsin 53094
- 360 Laffranchi Wholesale Co. (7/12/82)
P.O. Box 698
Ferndale, California 95536
- 414 Paul Mueller Co. (12/13/83)
P.O. Box 828
Springfield, MO 65801
- 365 Niro Atomizer Food & Dairy Inc. (9/8/82)
1600 County Road F
Hudson, Wisconsin 54016
- 279 The Schlueter Co. (8/30/76)
112 E. Centerway
Janesville, Wisconsin 53545

- 472 Schmidt-Bretten Inc. (5/7/86)
1612 Locust Avenue
Bohemia, New York 11716
- 426 TCI-Superior Division, (8/31/84)
Mueller Canada Inc.
6500 Northwest Dr.
Mississauga, Ontario, Canada L4V 1K4

12-05 Tubular Heat Exchangers for Milk and Milk Products

- 438 APV Crepaco, INC. (12/10/84)
395 Fillmore Avenue
Tonawanda, New York 14150
- 248 Allegheny Bradford Corp. (4/16/73)
P.O. Box 200 Route 219 South
Bradford, PA 16701
- 243 Babson Bros. Company (10/31/72)
2100 So. York Rd.
Oak Brook, Illinois 60521
- 103 Chester-Jensen Co., Inc. (6/6/58)
5th & Tilghman Sts., P.O. Box 908
Chester, Pennsylvania 19016
- 307 G & H Products Corp. (5/2/78)
7600-57th Avenue
P.O. Box 1199
Kenosha, WI 53141
- 217 Girton Manufacturing Co. (1/31/71)
Millville, Pennsylvania 17846
- 238 Paul Mueller Co. (6/28/72)
P.O. Box 828
Springfield, Missouri 65801
- 96 C. E. Rogers Co. (3/31/64)
So. Hwy #65, P.O. Box 118
Mora, Minnesota 55051
- 298 Sanitary Processing Equipment Corp. (1/28/85)
P.O. Box 178, Salino Station
Syracuse, NY 13201
- 392 Stork Food Machinery, Inc. (6/9/83)
P.O. Box 1258/Airport Parkway
Gainesville, Georgia 30503

13-08 Farm Milk Cooling and Holding Tanks

- 49R A-L Stainless Inc. (12/5/56)
113 Park St., South
Peterborough, Ontario Canada K9J 3R8
- 240 Babson Bros. Company (9/6/72)
2100 So. York Rd.
Oak Brook, Illinois 60521
- 4R Dairy Equipment Co. (6/15/56)
1919 So. Stoughton Rd.
Madison, Wisconsin 53716
- 179R Heavy Duty Products (Preston) Ltd. (3/8/66)
(not available in USA)
1261 Industrial Rd.
Cambridge (Preston)
Ontario Canada N3H 4W3
- 12R Paul Mueller Co. (7/31/56)
1600 W. Phelps, P.O. Box 828
Springfield, Missouri 65801
- 16R Zero Manufacturing Co. (8/27/56)
811 Duncan Ave.
Washington, Missouri 63090

16-05 Evaporators and Vacuum Pans for Milk and Milk Products

- 254 APV Anhydro, Inc. (1/7/74)
165 John L. Dietsch Square
Attleboro Falls, Massachusetts 02763
- 132 APV Crepaco, INC. (10/26/60)
395 Fillmore Ave.
Tonawanda, New York 14150
- 277 Alfa-Laval, Inc. (8/19/76)
Contherm Division
P.O. Box 352, 111 Parker St.
Newburyport, Massachusetts 01950
- 356 Damrow Co. (3/10/82)
(Div. of DEC Int'l. Inc.)
196 Western Ave., P.O. Box 750
Fond du Lac, Wisconsin 54935-0750
- 311 GEA Food and Process Systems Corp. (8/28/79)
8940 Route 108
Columbia, Maryland 21045
- 273 Niro Atomizer Food & Dairy, Inc. (5/20/76)
1600 County Rd F
Hudson, Wisconsin 54016
- 107R C. E. Rogers Co. (7/31/58)
So. Hwy #65, P.O. Box 118
Mora, Minnesota 55051
- 446 Sterner Industries, Inc. (7/8/85)
P.O. Box 70
Winsted, Minnesota 55395
- 299 Stork Food Machinery, Inc. (11/17/77)
P.O. Box 1258/Airport Parkway
Gainesville, Georgia 30503
- 427 TCI-Superior Division, (8/31/84)
Mueller Canada Inc.
6500 Northwest Dr.
Mississauga, Ontario, Canada L4V 1K4
- 387 Unitech Div. of the Graver Co. (5/13/83)
2720 Hwy. 22
Union, New Jersey 07083
- 186R Marriott Walker Corp. (9/6/66)
925 E. Maple Rd.
Birmingham, Michigan 48011

17-06 Fillers and Sealers of Single Service Containers for Milk and Milk Products

- 366 Autoproduct, Inc. (9/15/82)
12 So. Denton Ave.
New Hyde Park, New York 11040
- 346 B-Bar-B, Inc. (10/21/81)
E. 10th & McBeth, P.O. Box 909
New Albany, New York 47150
- 192 Cherry-Burrell Corp. (1/3/67)
(A Unit of AMCA Int'l., Inc.)
2400-6th St. SW, P.O. Box 3000
Cedar Rapids, Iowa 52406
- 382 Combibloc, Inc. (4/15/83)
4800 Roberts Rd.
Columbus, OH 43228
- 324 Conoffast (11/29/79)
800 Connecticut Avenue
P.O. Box 5410
Norwalk, Connecticut 06856

- 137 Ex-Cell-O Corp. (10/17/62)
850 Ladd Rd., Bldg. "A"
Walled Lake, Michigan 48088
- 352 GMS Engineering (1/12/82)
1936 Sherwood St.
Clearwater, Florida 33515
- 473 International Paper Company (6/12/86)
Extended Shelf Life Division
4020 Stirrup Creed Drive Bldg. 200
P.O. Box 13318
Research Triangle Park, NC 27709
- 452 Jagenberg Inc. (9/3/85)
Freshwater Blvd.
P.O. Box 188
Enfield, Connecticut
- 220 Lquipak International, Inc. (4/24/71)
2285 University Ave.
St. Paul, Minnesota 55114
- 330 Milliken Packaging (8/26/80)
White Stone, South Carolina 29353
- 442 Milliken Packaging (2/21/85)
White Stone, SC 29386
- 281 Purity Packaging Corp. (11/8/76)
800 Kaderly Dr.
Columbus, Ohio 43228
- 482 Serac Inc. (8/25/86)
1209 Capitol Drive
Addison, Illinois
- 351 Tetra Pak Inc. (1/7/82)
889 Bridgeport Ave.
P.O. Box 807
Shelton, Connecticut 06484-0807
- 211 Twinpak, Inc. (Canada) (2/4/70)
2225 Hymus
Dorval, Quebec, Canada H9P 1J8
- 18-00 Multiple-Use Rubber & Rubber-Like Materials Used
as Product Contact Surfaces in Dairy Equipment**
- 429 Bepex Corporation (9/25/84)
P.O. Box 880
Santa Rose, CA 95402
- 19-03 Batch and Continuous Freezers for Ice Cream, Ices,
and Similarly Frozen Dairy Foods, as Amended**
- 141 APV Crepaco, INC. (4/15/63)
100 South CP Ave.
Lake Mills, Wisconsin 53551
- 146 Cherry-Burrell Corp. (12/10/63)
(A Unit of AMCA Int'l., Inc.)
2400-6th St. SW, P.O. Box 3000
Cedar Rapids, Iowa 52406
- 401 Coldelite Corp. of America (8/22/82)
Robinson Rd. & Rt. 17 So.
Lodi, NJ 07644-3897
- 286 O. G. Hoyer, Inc. (12/8/76)
201 Broad St.
Lake Geneva, Wisconsin 53147
- 465 Leon's Frozen Custard (12/17/85)
3131 S. 27th Street
Milwaukee, Wisconsin 53151
- 412 Sani Mark, Inc. (11/28/83)
2020 Production Drive
Indianapolis, Indiana 46241
- 355 Emery Thompson Machine & Supply Co. (3/9/82)
1349 Inwood Ave.
Bronx, New York 10452
- 22-05 Silo-type Storage Tanks for Milk and Milk Products**
- 262 A-L Stainless Inc. (11/11/74)
113 Park St., South
Peterborough, Ontario Canada K9J 3R8
- 154 APV Crepaco, INC. (2/10/65)
100 South CP Ave.
Lake Mills, Wisconsin 53551
- 168 Cherry-Burrell Corp. (6/16/65)
(A Unit of AMCA Int'l., Inc.)
575 E. Mill St.
Little Falls, New York 13365
- 160 DCI, Inc. (4/5/65)
P.O. Box 1227, 600 No. 54th Ave.
St. Cloud, Minnesota 56301
- 181 Damrow Co. (5/18/66)
(Div. of DEC Int'l., Inc.)
196 Western Ave., P.O. Box 750
Fond du Lac, Wisconsin 54935-0750
- 439 JV Northwest Inc. (1/22/85)
28120 SW Boberg Rd.
Wilsonville, Oregon 97070
- 155 Paul Mueller Co. (2/10/65)
1600 W. Phelps, P.O. Box 828
Springfield, Missouri 65801
- 460 Niro Atomizer Food & Dairy Inc. (11/4/85)
1600 County Road F
Hudson, Wisconsin 54016
- 312 Sanitary Processing Equipment Corp. (9/15/78)
P.O. Box 178, Salino Station
Syracuse, New York 13201
- 479 Scherping Systems (8/3/86)
801 Kingsley Street
Winsted, Minnesota 55395
- 434 TCI-Superior Division, (11/9/84)
Mueller Canada Inc.
6500 Northwest Dr.
Mississauga, Ontario, Canada L4V 1K4
- 165 Walker Stainless Equipment Co., Inc. (4/26/65)
Elroy, Wisconsin 53929
- 23-01 Equipment for Packaging Frozen Desserts, Cottage
Cheese, and Similar Milk Products, as Amended**
- 174 APV Anderson Bros. Mfg. Co. (9/28/65)
1303 Samuelson Rd.
Rockford, IL 61109
- 209 Dobby Packaging Machinery Incorp. (7/23/69)
869 S Knowles Ave.
New Richmond, Wisconsin 54017
- 302 Eskimo Pie Corp. (1/26/78)
530 E. Main St.
Richmond, Virginia 23219
- 343 O. G. Hoyer, Inc. (7/6/81)
201 Broad St.
Lake Geneva, Wisconsin 53147
- 222 Maryland Cup Corp. (11/15/71)
Owings Mills, Maryland 21117

447 Mateer-Burt Co., Inc. (7/22/85)
 436 Devon Park Drive
 Wayne, Pennsylvania 19087

P.O. Box 4151
 Los Angeles, California 90051
 176 Sprout-Waldron, Koppers Co., Inc. (1/4/66)
 Muncy, Pennsylvania 17756

24-01 Non-coil Type Batch Pasteurizers

158 APV Crepaco, INC. (3/24/65)
 100 South CP Ave.
 Lake Mills, Wisconsin 53551
 161 Cherry-Burrell Corp. (4/5/65)
 (A Unit of AMCA Int'l., Inc.)
 575 E. Mill St.
 Little Falls, New York 13365
 402 Coldelite Corp. of America (8/22/83)
 Robinson Rd. & Rt. 17 So.
 Lodi, NJ 07644-3897
 187 DCI, Inc. (9/26/66)
 P.O. Box 1227, 600 No. 54th Ave.
 St. Cloud, Minnesota 56301
 166 Paul Mueller Co. (4/26/65)
 P.O. Box 828
 Springfield, Missouri 65801

25-01 Non-coil Type Batch Processors for Milk and Milk Products

159 APV Crepaco, INC. (3/24/65)
 100 South CP Ave.
 Lake Mills, Wisconsin 53551
 162 Cherry-Burrell Corp. (4/5/65)
 (A Unit of AMCA Int'l., Inc.)
 575 E. Mill St.
 Little Falls, New York 13365
 188 DCI, Inc. (9/26/66)
 P.O. Box 1227, 600 No. 54th Ave.
 St. Cloud, Minnesota 56301
 167 Paul Mueller Co. (4/26/65)
 P.O. Box 828
 Springfield, Missouri 65801
 448 Scherping Systems (8/1/85)
 801 Kingsley Street
 Winsted, Minnesota 55395
 202 Walker Stainless Equipment Co. (9/24/68)
 New Lisbon, Wisconsin 53950

26-02 Sifters for Dry Milk and Dry Milk Products

173 Blaw-Knox Food & Chemical Equip. Co. (9/20/65)
 P.O. Box 1041
 Buffalo, New York 14240
 229 Russell Finex, Inc. (3/15/72)
 156 W. Sandford Blvd.
 Mt. Vernon, New York 10550
 363 Kason Corp. (7/28/82)
 1301 East Linden Ave.
 Linden, New Jersey 07036
 430 Midwestern Industries, Inc. (10/11/84)
 915 Oberlin Rd., P.O. Box 810
 Massillon, OH 44648-0810
 185 Rotex, Inc. (8/10/66)
 1230 Knowlton St.
 Cincinnati, Ohio 45223
 172 SWECO, Inc. (9/1/65)
 6033 E. Bandini Blv.

27-01 Equipment for Packaging Dry Milk and Dry Milk Products

353 All-Fill, Inc. (3/2/82)
 40 Great Valley Pkwy.
 Malvern, Pennsylvania 19355
 409 Mateer-Burt Co. (10/31/83)
 436 Devon Park Dr.
 Wayne, PA 19087
 476 Stone Container Corporation (7/17/86)
 1881 West North Temple
 Salt Lake City, Utah 84116-2097

28-00 Flow Meters for Milk and Liquid Milk Products

272 Accurate Metering Systems (4/2/76)
 1731-33 Carmen Dr.
 Elk Grove Village, Illinois 60007
 253 Badger Meter, Inc. (1/2/74)
 4545 W. Brown Deer Rd.
 P.O. Box 23099
 Milwaukee, Wisconsin 53223
 265 Electronic Flo-Meters, Inc. (3/10/75)
 P.O. Box 38269
 Dallas, Texas 75238
 359 Emerson Elec. Co. (6/11/82)
 Brooks Instrument Div.
 P.O. Box 450, North 301
 Statesboro, Georgia 30458
 469 Endress + Hauser, Inc. (3/3/86)
 2350 Endress Place
 Greenwood, Indiana 46142
 226 Fischer & Porter Co. (12/9/71)
 County Line Rd.
 Warminster, Pennsylvania 18974
 477 Flowdata Inc. (7/31/86)
 15510 Wright Bros. Drive
 Dallas, Texas 75244-2137
 224 The Foxboro Co. (11/16/71)
 38 Neponset Ave.
 Foxboro, Massachusetts 02035
 475 Hackman Flow Inc. (7/15/86)
 Route 3, Box 28
 Brunswick, Georgia 31520
 474 Hydrill Products Technology Division (6/30/86)
 P.O. Box 721560
 Houston, Texas 77272-1560
 223 Invalco Measurement & Control (11/15/71)
 P.O. Box 556
 Tulsa, OK 74101
 399 E. Johnson Engineering & Sales (8/3/83)
 11 N. Grant St.
 Hinsdale, IL 60521
 320 Max Machinery, Inc. (3/28/79)
 1420 Healdsburg Ave.
 Healdsburg, California 95448
 378 Micro Motion, Inc. (2/16/83)
 7070 Winchester Circle
 Boulder, Colorado 80301

- 431 Niro Atomizer Food & Dairy Inc. (10/11/84)
1600 County Road F
Hudson, Wisconsin 54016
- 270 Taylor Instrument (2/9/76)
Combustion Engineering, Inc.
400 West Avenue, P.O. Box 110
Rochester, New York 14692
- 386 Turbo Instruments Inc. (5/11/83)
4 Vashell Way
Orinda, California 94563

29-00 Air Eliminators for Milk and Fluid Milk Products

- 340 Accurate Metering Systems, Inc. (6/2/81)
1731-33 Carmen Dr.
Elk Grove Village, Illinois 60007
- 485 Hackman Flow Inc. (11/18/86)
Route 3, Box 28
Brunswick, Georgia 31520
- 436 Scherping Systems (11/27/84)
801 Kingsley Street
Winsted, MN 55395

30-01 Farm Milk Storage Tanks

- 421 Paul Mueller Co. (4/17/84)
P.O. Box 828
Springfield, MO 65801

31-01 Scraped Surface Heat Exchangers, as Amended

- 290 APV Crepaco, INC. (6/15/77)
100 South CP Ave.
Lake Mills, Wisconsin 53551
- 274 Alfa-Laval, Inc. (6/25/76)
Contherm Div.
P.O. Box 352, 111 Parker St.
Newburyport, Massachusetts 01950
- 361 BFM Machinery Corp. (7/12/82)
P.O. Box 117
Fall River, Wisconsin 53932
- 323 Cherry-Burrell Corp. (7/26/79)
(A Unit of AMCA Int'l., Inc.)
2400-6th St., SW, P.O. Box 3000
Cedar Rapids, Iowa 52406

32-00 Uninsulated Tanks for Milk and Milk Products

- 397 APV Crepaco, INC. (6/21/83)
100 South CP Ave.
Lake Mills, Wisconsin 53551
- 264 Cherry-Burrell Corp. (1/27/75)
(A Unit of AMCA Int'l., Inc.)
575 E. Mill St.
Little Falls, New York 13365
- 268 DCI, Inc. (11/21/75)
600 No. 54th Ave., P.O. Box 1227
St. Cloud, Minnesota 56301
- 354 C. E. Rogers Co. (3/3/82)
So. Hwy #65, P.O. Box 118
Mora, Minnesota 55051
- 441 Scherping Systems (3/1/85)
801 Kingsley St.
Winsted, MN 55395

- 433 TCI-Superior Division, (11/9/84)
Mueller Canada Inc.
6500 Northwest Dr.
Mississauga, Ontario, Canada L4V 1K4
- 339 Walker Stainless Equipment Co., Inc. (6/2/81)
601 State St.
New Lisbon, Wisconsin 53950

33-00 Polished Metal Tubing for Dairy Products

- 310 Allegheny Bradford Corp. (7/19/78)
P.O. Box 200 Route 219 South
Bradford, PA 16701
- 413 Azco, Inc. (12/8/83)
P.O. Box 567
Appleton, WI 54912
- 289 Ladish Co., Tri-Clover Div. (1/21/77)
9201 Wilmot Rd.
Kenosha, Wisconsin 53141
- 308 Rath Manufacturing Co., Inc. (6/20/78)
2505 Foster Ave.
Janesville, Wisconsin 53545
- 368 Gordon J. Rodger & Sons Ltd. (10/7/82)
P.O. Box 186
Blenheim, Ontario Canada NOP 1A0
- 335 Stainless Products, Inc. (12/18/80)
1649-72nd Ave., Box 169
Somers, Wisconsin 53171
- 331 United Industries, Inc. (10/23/80)
1546 Henry Ave.
Beloit, Wisconsin 53511

35-00 Continuous Blenders

- 417 Cherry-Burrell (2/7/84)
Anco/Votator Division
P.O. Box 35600
Louisville, KY 40232
- 464 Dairy Service Mfg., Inc. (12/12/85)
4630 W. Florissant Ave.
St. Louis, Missouri 63115
- 415 Luwa Corporation (1/5/84)
P.O. Box 16348
Charlotte, North Carolina 28297-6348

36-00 Colloid Mills

- 293 Waukesha Div., Abex Corp. (8/25/77)
1300 Lincoln Ave.
Waukesha, Wisconsin 53186

37-00 Pressure and Level Sensing Devices

- 318 Anderson Instrument Co., Inc. (4/9/79)
R.D. #1
Fultonville, New York 12072
- 481 Control Systems Design, Inc. (8/14/86)
P.O. Box 1689
Manchester, Missouri 63011
- 405 Drexelbrook Engineering Co. (9/27/83)
205 Keith Valley Rd.
Horsham, PA 19044

- | | | | |
|--|------------|---|-----------|
| 423 Dynisco
Ten Oceana Way
Norwood, MA 02062 | (6/15/84) | 410 Viatran Corporation
300 Industrial Drive
Grand Island, NY 14072 | (11/1/83) |
| 459 Endress + Hauser, Inc.
2350 Endress Place
Greenwood, Indiana 46142 | (10/17/85) | | |
| 463 The Foxboro Company
38 Neponset Avenue
Foxboro, Massachusetts 02035 | (12/6/85) | 38-00 Cottage Cheese Vats (In Press) | |
| 317 Invalco Measurement & Control
P.O. Box 556
Tulsa, OK 74101 | (2/26/79) | 385 Stoelting, Inc.
P.O. Box 127
Kiel, Wisconsin 53042-0127 | (5/5/83) |
| 396 King Engineering Corp.
P.O. Box 1228
Ann Arbor, Michigan 48106 | (6/13/83) | 40-01 Bag Collectors for Dry Milk and Dry Milk Products | |
| 457 Moore Technologies Inc.
P.O. Box 258
Klamath Falls, Oregon 97601 | (10/17/85) | 406 Chicago Conveyor Corporation
330 LaLonde Avenue
Addison, IL 60101 | (10/5/83) |
| 419 Niro Atomizer Food & Dairy Inc.
1600 County Road F
Hudson, Wisconsin 54016 | (4/2/84) | 381 Marriott Walker Corp.
925 E. Maple Rd.
Birmingham, Michigan 48011 | (4/12/83) |
| 328 Rosemount, Inc.
12001 W. 78th St.
Eden Prairie, Minnesota 55344 | (5/22/80) | 453 MikroPul Corporation
10 Chatham Road
Summit, New Jersey 07901 | (9/4/85) |
| 285 Tank Mate Div/Monitor Mfg. Co.
P.O. Box AL
Elburn, IL 60119 | (12/7/76) | 456 C. E. Rogers Company
P.O. Box 118
Mora, Minnesota 55051 | (9/25/85) |



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Abstracts of papers in the February Journal of Food Protection

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

Microbiological Quality of Commercial Tempeh in The Netherlands, R. A. Samson, J. A. Van Kooij and E. De Boer, Centraalbureau voor Schimmelcultures, P.O. Box 273, 3740 AG Baarn, Food Inspection Service (FIS), Prinsegracht 50, 2512 GA The Hague and Food Inspection Service (FIS), De Stoven 17, 7206 AZ Zutphen, The Netherlands

J. Food Prot. 50:92-94

A survey of the microbiological quality of commercial tempeh was done in The Netherlands. A total of 110 samples were examined. Most (98%) of the samples had an aerobic plate count above 10^7 CFU/g. Numbers of *Enterobacteriaceae* exceeded 10^5 CFU/g in 67% of the samples, whereas numbers of lactic acid bacteria exceeded 10^7 CFU/g in 81% of the samples. *Staphylococcus aureus* was found in 13%, *Bacillus cereus* in 11% and *Escherichia coli* in 3% of the samples at levels of 10^5 CFU/g. *Yersinia enterocolitica* was found in six samples, whereas *Salmonella* was absent in 25 g of all the samples examined. Many (69%) of the samples had a yeast count above 10^5 CFU/g. *Trichosporon beigeli* was the most frequent yeast species. Besides *Rhizopus oryzae* and *Rizopus oligosporus*, which obviously represent the mold species responsible for the fermentation, *Mucor indicus* was often associated with the mycoflora of the tempeh. The reasons for the poor microbiological quality are discussed and some recommendations are proposed.

Thermal Resistance of Disease-Associated *Salmonella typhimurium* in Milk, J. G. Bradshaw, J. T. Peeler, J. J. Corwin, J. E. Barnett and R. M. Twedt, Division of Microbiology, Food and Drug Administration, 1090 Tusculum Avenue, Cincinnati, Ohio 45226

J. Food Prot. 50:95-96

The thermal resistance of *Salmonella typhimurium* cultures that had been associated with a major milkborne outbreak of salmonellosis was determined in raw whole milk. Thirteen patient stool isolates and 24 implicated pasteurized milk isolates at concentrations of 1×10^5 /ml were screened for heat resistance at 51.8°C. A representative milk strain was heated in replicate at four temperatures from 51.8 to 68.3°C. The z_D value was calculated to be 5.3°C. Mean D-value estimates at 51.8°C were 24.0 and 22.8 min for patient and milk isolates, respectively. Extrapolated $D_{71.7^\circ\text{C}}$ values were 0.24 and 0.22 s, and did not differ significantly ($\alpha=0.05$). These isolates would not survive proper pasteurization.

Microbiological Screening Tests to Detect Antibiotic Residues in Cull Dairy Cows, Joseph P. Tritschler II, Robert T. Doby, Stephen P. Oliver and Robert W. Prange, Department of Veterinary and Animal Sciences, University of Massachusetts, Amherst, Massachusetts 01003

J. Food Prot. 50:97-102

Two microbiological procedures were evaluated to detect antibiotic residues in dairy cows at slaughter. Inhibition of *Bacillus subtilis* growth was used for determining the presence or absence of antibiotic residues. The two tests differed only in the concentration of *B. subtilis* used. The Swab Test on Premises (STOP) was used to detect antibiotic residues in kidney and muscle tissue and the Live Animal Swab Test (LAST) was used to detect residues in urine of cull dairy cows. Kidney samples from 3% of cull dairy cows were positive. Confirmation by standard reference procedures and a subsequent investigation on antibiotic residues in urine from 317 cows and heifers with known antibiotic treatment histories suggest that a high percentage of false-positive readings occurred in urine. In addition, 23% of urine samples were difficult to interpret in that *B. subtilis* growth surrounding Swabs dipped in urine was reduced. While producer response was generally favorable for an on-farm screening test for antibiotic residues detection in cows going to slaughter, interpretation problems, difficulty in collecting urine samples, and concerns over the complexity and sensitivity make it unlikely that the acceptance of the LAST will be widespread on dairy farms.

Survival and Growth of *Yersinia enterocolitica* in Egg Washwater, Gordon Southam, Jane Pearson and Richard A. Holley, University of Guelph, Department of Microbiology, Guelph, Ontario, N1G 2W1; London Regional Cancer Centre, Ontario Cancer Treatment and Research Foundation, London, Ontario N6A 4G5; and Food Research Centre, Research Branch, Agriculture Canada, Ottawa, Ontario, K1A 0C6, Canada

J. Food Prot. 50:103-107

Two serotypes of *Yersinia enterocolitica* (0:3 and 0:8) were added to a 1% (w/v) whole egg suspension and their survival was followed during exposure to conditions which reflected those used during commercial egg washing. Trials were conducted over a range of pH (7.9, 5.10 and 10.5) at 38 and 42°C. The potential for *Yersinia* growth during transport of samples from grading stations to the laboratory at a number of storage temperatures (6, 10, 12 and 15°C) was also examined. *Y. enterocolitica* strain 125 (serotype 0:3) was able to grow in synthetic egg washwater at pH 10 and 38°C (conditions frequently found at egg grading stations). Both *Yersinia* strains were able to grow at refrigerator temperatures when the pH was ≤ 10 . Recommendations concerning the conditions of egg washing were made in view of the potential for *Yersinia* growth in washwater during the period of its transportation to the laboratory for analysis and in view of *Yersinia* survival in the recycled washwater.

Ultraviolet Radiation — An Effective Bactericide for Fresh Meat, Raymond A. Stermer, Margaret Lasater-Smith and Clayton F. Brasington, U.S. Department of Agriculture, Agricultural Research Service, Pest Control Engineering Research Unit, Room 231 — Agricultural Engineering Building, Texas A&M University, College Station, Texas 77843

J. Food Prot. 50:108-111

Ultraviolet radiation (UV), with principal energy at a wavelength of 253.7 nm, was effective in destroying bacteria on the surface of fresh meat. A radiation dose of 150 mW/cm² (275 uW/cm² for 550 s) reduced bacteria on smooth surface meat (beef plate) about 2 log cycles (99% "kill"). Further increases in dose level to 500 mW/cm² (275 uW/cm² for 1800 s) reduced the bacteria level one additional log cycle. Since UV radiation does not penetrate most opaque materials, it was less effective on rough surface cuts of meat such as round steak because bacteria were partly shielded from the radiation. Unlike gamma (ionizing) radiation, UV had no deleterious effects on color (Hunter "a", redness) or general appearance. UV treatment chambers could be easily installed in new or existing meat processing facilities at relatively low cost. Experimental results indicate that UV irradiation of meat carcasses could effectively increase the lag phase of bacteria multiplication until adequate cooling had occurred.

Effect of Acetic Acid on the Microbiological Quality of Scalded Picked and Unpicked Broiler Carcasses, H. S. Lillard, L. C. Blankenship, J. A. Dickens, S. E. Craven and A. D. Shackelford, United States Department of Agriculture, Agricultural Research Service, R. B. Russell Agricultural Research Center, P.O. Box 5677, Athens, Georgia 30613

J. Food Prot. 50:112-114

Reductions in the levels and incidence of salmonellae in poultry scald water by the addition of acetic acid have been reported previously. Hence, acid treatment of scald water may help control cross-contamination of carcasses in the scald tank. However, the effect of acid-treated scald water on microbial levels of scalded carcasses has not been addressed. This study confirmed reductions in levels of total aerobic bacteria and *Enterobacteriaceae* in scald water containing 0.2 and 0.5% acetic acid; salmonellae were not detected. No significant reductions occurred in levels and/or incidence of salmonellae, total aerobic bacteria and *Enterobacteriaceae* on unpicked carcasses sampled after scalding in 0.5% acetic acid-treated scald water or on picked carcasses that were acid scalded and sprayed with 0.5% acetic acid water during picking.

Serum and Urine as Predictors of Sulfamethazine Levels in Swine Muscle, Liver and Kidney, Victor W. Randecker, James A. Reagan, Ronald E. Engel, David L. Soderberg and Jon E. McNeal, U.S. Department of Agriculture, Food Safety and Inspection Service, Science, Washington, D.C. 20250, U.S. Environmental Protection Agency, Atmospheric Sciences Research Laboratory, Research Triangle Park, North Carolina 27711 and U.S. Department of Agriculture, Food Safety and Inspection Service, Midwestern Laboratory, St. Louis, Missouri 63115

J. Food Prot. 50:115-122

Three field studies were done to determine the relationship between sulfamethazine levels in swine serum and urine, and those in swine muscle, liver and kidney. The 119 animals used in these studies were crossbreed Landrace, Yorkshire, White and Chester White pigs. The medication, Aureo-SP-250, was added to the ration to achieve a sulfamethazine feed concentration of 110 ppm. The swine were divided into groups, with the treatment groups receiving feed containing no medication for 0 to 8 d after being on the medicated feed for 19 to 20 d. Control groups also received nonmedicated feed. Results from the three studies were pooled and predictive relationships were developed in the form: Tissue Concentration = Ratio × Fluid Concentration. For serum, the mean tissue-fluid ratios in muscle, liver and kidney were 0.24, 0.90 and 0.53, respectively; the ratios for urine were 0.08, 0.27 and 0.16, respectively. Previous reports indicate serum can be used to predict sulfamethazine levels in muscle, liver and kidney. No reports concerning tissue-urine data have been published; however, the three studies reported here indicate that the tissue-urine relationship, although more variable, can also be used as a predictor. The observed variability caused by biological, analytical or other factors must be considered when using either urine or serum to predict muscle, liver or kidney sulfamethazine levels. These studies show promise for quality control or regulatory use by the slaughter plant, farm or laboratory as a predictor of sulfamethazine levels in tissues.

Shelf Life of Plain Liquid Yogurt Manufactured in Saudi Arabia, Joseph P. Salji, Suhayl R. Saadi and Ahmad Mashhadi, Regional Agriculture and Water Research Centre, Food Science and Nutrition Section, Ministry of Agriculture and Water, P.O. Box 17285, Riyadh, Saudi Arabia 11484

J. Food Prot. 50:123-126

The shelf life of plain liquid yogurt under local conditions of manufacture and handling has been investigated. Initial coliform counts of <1 cfu/ml in the product remained constant throughout 14 d of storage at 7, 10 or 15°C. With initial counts of mold and yeast not exceeding 1 cfu/ml, growth of these microorganisms was nominal (22 cfu/ml) after 14 d of storage at 7°C. At 10 and 15°C storage, however mold and yeast increased substantially from initial levels not exceeding 1 cfu/ml to 2 × 10³ cfu/ml and 3 × 10³ cfu/ml after 5 and 10 d of storage respectively. The high initial quality of the product, with ≤10 cfu/ml coliform, ≤10 cfu/ml mold and yeast and a hedonic score of 8 (like very much), was maintained for 5 d at 7°C storage. After 5 d of storage at 7°C, the mold and yeast count and organoleptic property of the product became unacceptable. The organoleptic quality deteriorated irrespective of the microbial contamination of the product. Quality assessment of the product before expiration (4 d) and under prevailing commercial conditions of manufacture, handling and storage revealed acceptable sensory and microbial quality. The possible causes of product sensory deterioration irrespective of growth of mold and yeast are discussed.

Effect of Methanol-Acetone Extract of Skim Milk Fermented by *Streptococcus thermophilus* on Color, Microbial Counts, and pH of Fresh Beef, A. Sikes and G. E. Rolle, Department of Food Science and Animal Industries, Alabama A&M University, P.O. Box 264, Normal, Alabama 35762

J. Food Prot. 50:127-131

Fresh beef steaks were treated with two concentrations of a methanol-acetone (MA) extract (*Streptococcus thermophilus*-fermented skim milk) for color stability, pH change, and microbial growth at storage temperatures of 0 and 10°C. Beef color was measured by a color difference meter (Gardner) and a sensory panel. The Gardner "a/b" values for the untreated samples (control) were significantly higher ($P < 0.05$) than values for treated samples (500 and 1000 ppm MA) through 9 d of storage (0°C). At 15 d of storage (0°C) there were no significant differences between treatments ($P > 0.05$). The "a/b" values at 10°C indicated a significant difference ($P < 0.05$) after 3 d of storage between untreated and treated samples. After 6 d of storage (10°C), no significant difference ($P < 0.05$) was found between untreated and treated meat. Sensory panel scores indicated that both untreated and treated samples were of an acceptable quality through 9 d of storage (0°C); however, the untreated samples were of inferior color quality compared to treated ($P < 0.05$). All samples stored at 10°C deteriorated to an unacceptable color quality between 3 and 6 d. The growth of *Pseudomonas fluorescens* on beef steaks was significantly higher ($P < 0.05$) in the untreated samples (by 1 to 2 log₁₀ cycles) than the treated (0°C, 15-d storage). The same pattern was observed at 10°C; however, spoilage was apparent after 6 d of storage while spoilage was apparent after 9 d at 0°C. The pH change, between 0 and 3 d of storage, was not significant ($P > 0.05$) at either storage temperature (0°C and 10°C). From 3 through 15 d, the pH increased from 5.3 to 6.1, with no significant difference ($P > 0.05$) between treatments (after 15 d of storage, 0°C). At 10°C, no significant difference ($P > 0.05$) was observed between treatments (after 6-d storage). Results from this experiment indicate that the MA extract may have some practical use in extending the shelf life of fresh beef by reducing factors that are responsible for color deterioration, e.g., microbial activity. However, it seems likely that higher concentrations of the MA extract would be necessary to control microbial activity at higher storage temperatures.

Preparation and Use of Somatic Cell Count Samples (SCCS) for Comparison of Milk Somatic Cell Counting Methods, T. J. Lintner, A. L. Lange, C. W. Heald and R. J. Eberhart, The Pennsylvania State University, Department of Veterinary Science and Dairy Science Extension, University Park, Pennsylvania 16802

J. Food Prot. 50:132-135

Somatic cell count samples (SCCS) for use in comparison of milk somatic cell counting methods were prepared from the cell sediment deposited in a creamery milk separator. Bovine milk somatic cells were resuspended from the sediment, and serial cell dilutions were prepared in bronopol-preserved milk diluent. Over a 1-year period, sets of SCCS were prepared each month and sent to milk-testing laboratories in the U.S.A., Canada and Europe, and counted by the methods in use at those laboratories: (a) direct microscopic somatic cell count (DMSCC), (b) Fossomatic counter and (c) Coulter counter. Cell counts were normalized to eliminate the effect of month to month variation in the cell content of the SCCS. Counts obtained by the three methods were similar, although Coulter counter results tended to be lower, and significantly lower ($P < 0.05$) in SCCS with cell counts greater than 700,000 cells/ml than those counts by the other two methods. The effect of ship-

ping on SCCS stability was assessed for SCCS samples sent to and returned from other laboratories, and counted by the Fossomatic method on their return. Counts were similar before and after shipping, except that results for SCCS with cell counts greater than 1,000,000 cells/ml were significantly higher ($P < 0.05$) after their return.

Microbiological Quality of Dry Dessert Mixes Sold in Canada, D. W. Warburton, P. I. Peterkin, G. A. Jarvis, K. F. Weiss and G. Riedel, Food Directorate and Field Operations Directorate, Health Protection Branch, Health and Welfare Canada, Tunney's Pasture, Ottawa, Ontario, Canada K1A 0L2

J. Food Prot. 50:136-140

A study done in 1977-1978, assessed the bacteriological quality of five types of dry desserts including starch-, gelatin- and rennet-based products. One hundred and ninety-seven lots were randomly selected across Canada and analyzed for aerobic colony count, aerobic sporeformers, *Bacillus cereus*, coliforms, *Escherichia coli*, *Staphylococcus aureus* and *Salmonella*. Microbiological and practical consideration do not warrant the establishment of standards or guidelines for such products at this time.

Incidence of Potential Pathogens on Raw Pork, Beef and Chicken in Sweden, with Special Reference to *Erysipelothrix rhusiopathiae*, Anders Ternström and Göran Molin, Swedish Meat Research Institute, P.O. Box 504, S-244 00 Kävlinge, Sweden

J. Food Prot. 50:141-146

In total, 135 samples divided between pork, beef and chicken were examined for the presence of *Aeromonas hydrophila*, *Bacillus cereus*, *Campylobacter jejuni*, *Clostridium perfringens*, *Erysipelothrix rhusiopathiae*, *Escherichia coli*, *Listeria monocytogenes*, *Pseudomonas aeruginosa*, *Salmonella* spp., *Staphylococcus aureus*, *Streptococcus* spp., and *Yersinia enterocolitica*. No *Salmonella* spp., *Listeria monocytogenes* or *Pseudomonas aeruginosa* could be detected. The following bacteria were found at various incidences from all types of meat; *A. hydrophila* (24-33% of the samples were positive); *E. coli* (62-100%); *S. aureus* (13-73%); only two isolates produced enterotoxin; hemolytic streptococci (7-29%; Lancefield groups C, D and G); and *Y. enterocolitica* (2-24%); none of the isolates was considered as virulent when tested by the magnesium oxalate inhibition test). *B. cereus* and *C. perfringens* were found only on beef and pork (7 and 11%; and 2 and 22%, respectively); and *C. jejuni* only on chicken. *E. rhusiopathiae* was found on pork (36%) and chicken (13%). In a subsequent study, 196 pork loins and 73 samples of sausage obtained from two different slaughter houses were analyzed for *E. rhusiopathiae*. In one plant, 54% of the loins harbored the bacterium while only 4% of the samples were positive from the other plant. None of the sausage samples contained *E. rhusiopathiae*. Thirty-seven isolates were tested on mice; all died within 48 h.

Ineffectiveness of Crystal Violet Tetrazolium Agar for Determining Psychrotrophic Gram-Negative Bacteria, James M. Jay and May E. Buc, Department of Biological Sciences, Wayne State University, Detroit, Michigan 48202

J. Food Prot. 50:147-149

Gram-negative psychrotrophic and nonpsychrotrophic mesophiles grew equally well on crystal violet tetrazolium (CVT) agar at 30°C in 48 h, hence this medium is not suitable for enumerating or recognizing psychrotrophic bacteria.

Wholesomeness of Irradiated Foods, J. H. Skala, E. L. McGown and P. P. Waring, Letterman Army Institute of Research, Presidio of San Francisco, California 94129

J. Food Prot. 50:150-160

The history and applications of food irradiation are reviewed. The term wholesomeness when applied to food irradiation, embodies the concepts of microbiological and toxicological safety, and nutritional adequacy. The status of these areas of concern is reviewed. Nutritional studies have addressed the effects of irradiation on nutrient content and bioavailability, and evaluation of potential consequences of changes in either. Results of rat studies are presented in which we tested for the presence of anti-thiamin and anti-pyridoxine activity in radappertized chicken and beef. Test meats were analyzed for thiamin and pyridoxine to establish a basis for incorporation into repletion diets. Thiamin levels in gamma- and electron-irradiated, and thermally processed (commercial canning) chicken were 74, 34 and 78%, respectively, of the vitamin level in a frozen meat reference; the levels in beef were 77, 56 and 79%, respectively. Pyridoxine levels in chicken were 50, 38 and 17%, respectively, of the reference level. Rats were depleted in each vitamin, then repleted at two vitamin levels with diets containing test meats. Activities of transketolase, aspartate aminotransferase and alanine aminotransferase in erythrocytes from these rats provided no consistent evidence of antivitamin presence. It was concluded that these irradiated meats pose no problem regarding vitamins B₁ and B₆ if part of a complete diet.

Protease Inhibitors in Processed Plant Foods, Robert A. Burns, Department of Nutritional Science, Mead Johnson Nutritional Group, Evansville, Indiana 47721

J. Food Prot. 50:161-166

Plants contain a wide variety of protein protease inhibitors. However, most is known about the serine protease (trypsin and chymotrypsin) inhibitors found in legumes, particularly soybeans. These inhibitors in unheated legume protein (a) impair the protein's nutritional quality, (b) induce pancreatic hypertrophy in some but not all experimental animals, (c) enhance the action of chemical pancreatic carcinogens in Wistar rats but not hamsters or mice, (d) are reported to be carcinogenic to the pancreas of Wistar rats and (e) inhibit certain experimental tumors in rats, mice and hamsters. The physiological significance of the low residual protease inhibitor levels in commercially processed plant proteins and human foods prepared from such proteins remains to be resolved. Plant proteins prepared for human consumption, however, contain low levels of protease inhibitor activity which are of no nutritional concern in animals or humans.

Commercial Food Processing Operations and Mutagen Formation, Cheryl A. Krone and Wayne T. Iwaoka, Institute for

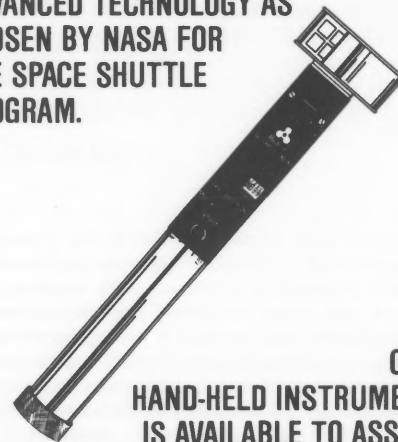
Food Science and Technology, University of Washington, Seattle, Washington 98195

J. Food Prot. 50:167-174

Thermally-induced bacterial mutagens are formed when foods are processed by some commercial food preservation techniques. The processes which involve longer times and higher temperatures are most likely to produce mutagens (e.g., canning and evaporative concentration). Pasteurization and spray drying processes possess a low potential for creation of mutagens. The types of food products with the greatest tendency to contain mutagens following heat treatments are muscle foods such as canned meats and fish. Canned beef broth, chili, hash, roast beef, pink and red salmon, and mackerel contain substances which induce mutation rates up to 20 times higher than spontaneous revertant colonies in the Ames *Salmonella* mutagenicity assay. Using canned pink salmon as a representative product, reprocessing increased mutagen content, whereas addition of Maillard-browning reaction inhibitors led to significant decreases in mutagen formation. Even though thermally-induced mutagens can arise during household cooking (e.g., frying and charcoal grilling), the consumer can choose to minimize their production through use of lower temperature methods such as boiling, steaming or microwave heating. This option is not available to the consumer of commercially canned foods. Hence, further research into the reduction of mutagen formation during thermal processing is needed.

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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 23-26, 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 2-4, PRINCIPLES OF SENSORY EVALUATION, to be held in Palo Alto, California. Pre-registration required. For more information contact: Herbert Stone, President, Tragon Corporation, 365 Convention Way, Redwood City, CA 94063. 415-365-1833 or Telex WUI 6502215776 (access MCI).

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 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 9-10, PRINCIPLES OF SANITATION FOR WAREHOUSEMEN, Manhattan, Kansas. For more information contact: The Registrar, Sanitation Education Department, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502. 913-537-4750 or 1-800-633-5137.

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 10-13, WORKSHOP IN INSTRUMENT SERVICE AND REPAIR, to be held

at the Anderson training facility and dairy processing plant in Fultonville, NY. For more information contact: Michael D. Cunningham, Anderson Instrument Company, Inc., R.D. #1, Fultonville, NY 12072. Telephone: 518-922-5315

March 15-18, AMERICAN CULTURED DAIRY PRODUCTS INSTITUTE ANNUAL MEETING AND CONFERENCE/CULTURES AND CURDS CLINIC/INTERNATIONAL CULTURED DAIRY PRODUCTS EVALUATION SESSIONS, Nashville, Tennessee. For more information contact: Dr. C. Bronson Lane, ACDPI, P.O. Box 7813, Orlando, Florida 32854. 305-628-1266.

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 25-26, THE FOURTH ANNUAL CHEESE RESEARCH AND TECHNOLOGY CONFERENCE, to be held at the Dane County Forum and Sheraton Inn and Conference Center, Madison, Wisconsin. For program information contact: Mark E. Johnson, Department of Food Science, UW-Madison, 226 Babcock Hall, 1605 Linden Drive, Madison, WI 53706. 608-262-0275. For enrollment information contact: Agricultural Conference Office, Jorns Hall, 650 Babcock Drive, Madison, WI 53706. 608-263-1672.

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 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.

April 29, FOOD SAFETY AND SANITATION WORKSHOP FOR THE FOOD PROCESSING AND FOOD SERVICE INDUSTRIES, to be held at the Inn at the Park, Anaheim, CA. For more information contact: Kathryn Boor, Food Science and Technology, UCD, Davis, CA 95616. 916-752-1478.

April 29, CORNELL'S INSTITUTE OF FOOD SCIENCE SPRING CONFERENCE, to be held at the White Plains Hotel in White Plains, NY. For more information contact: Dr. John Kinsella, Chairman, Institute of Food Science, Dept. of Food Science, Stocking Hall, Ithaca, NY 14853. 607-255-7616.

May 4-6, TECHNIQUES IN MEASUREMENT, to be held in Palo Alto, California. Pre-registration required. For more information contact: Herbert Stone, President, Tragon Corporation, 365 Convention Way, Redwood City, CA 94063. 415-365-1833 or Telex WUI 6502215776 (access MCI).

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 14456. 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 12-15, WORKSHOP IN INSTRUMENT SERVICE AND REPAIR, to be held at the Anderson training facility and dairy processing plant in Fultonville, NY. For more information contact: Michael D. Cunningham, Anderson Instrument Company, Inc., R.D. #1, Fultonville, NY 12072. Telephone: 518-922-5315.

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 31-June 4, AMERICAN SOCIETY OF BREWING CHEMISTS 53RD ANNUAL MEETING, to be held at the Hyatt Regency in Cincinnati, Ohio. For more information contact: ASBC Headquarters, 3340 Pilot Knob Road, St. Paul, MN 55121. 612-454-7250 or Telex (MCI/WUI) 6502439657.

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.

August 9-14, ANNUAL MEETING OF THE SOCIETY FOR INDUSTRIAL MICROBIOLOGY, to be held at The Hyatt Regency Hotel, Baltimore, Maryland. For more information contact: Mrs. Ann Kulback, SIM, P.O. Box 12534, Arlington, VA 22209. 703-941-5373.

September 1-2, FOOD PROCESSING WASTE CONFERENCE, Radisson Hotel, Atlanta, GA. For more information contact: Edd Valentine or Chuck Ross, Georgia Tech Research Inst., Economic Development Laboratory, Environmental, Health and Safety Division, O'Keefe Building, Atlanta, GA 30332. 404-894-3412.

September 14-17, AOAC TO HOLD 101ST ANNUAL INTERNATIONAL MEETING, to be held at The Cathedral Hill Hotel, in San Francisco. For more information contact: the AAOAC office at 1111 N. 19th St., Suite 210, Arlington, VA 22209. 703-522-3032.

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.

October 5-9, 13TH INTERNATIONAL SYMPOSIUM OF THE IUMS-ICFMH & FECS-WPFC, "Toxins in Foodborne Disease" and "Microbiology of Drinking Water," to be held in Halkidiki, Greece. For more information contact: Prof. J. A. Papadakis, Omirou 24, 10672 Athens, Greece.

October 19-21, DESCRIPTIVE ANALYSIS, to be held in Palo Alto, California. Pre-

registration required. For more information contact: Herbert Stone, President, Tragon Corporation, 365 Convention Way, Redwood City, CA 94063. 415-365-1833 or Telex WUI 6502215776 (access MCI).

December 8-11, WORKSHOP IN INSTRUMENT SERVICE AND REPAIR, to be held at the Anderson training facility and dairy processing plant in Fultonville, NY. For more information contact: Michael D. Cunningham, Anderson Instrument Company, Inc., R.D. #1, Fultonville, NY 12072. Telephone: 518-922-5315.

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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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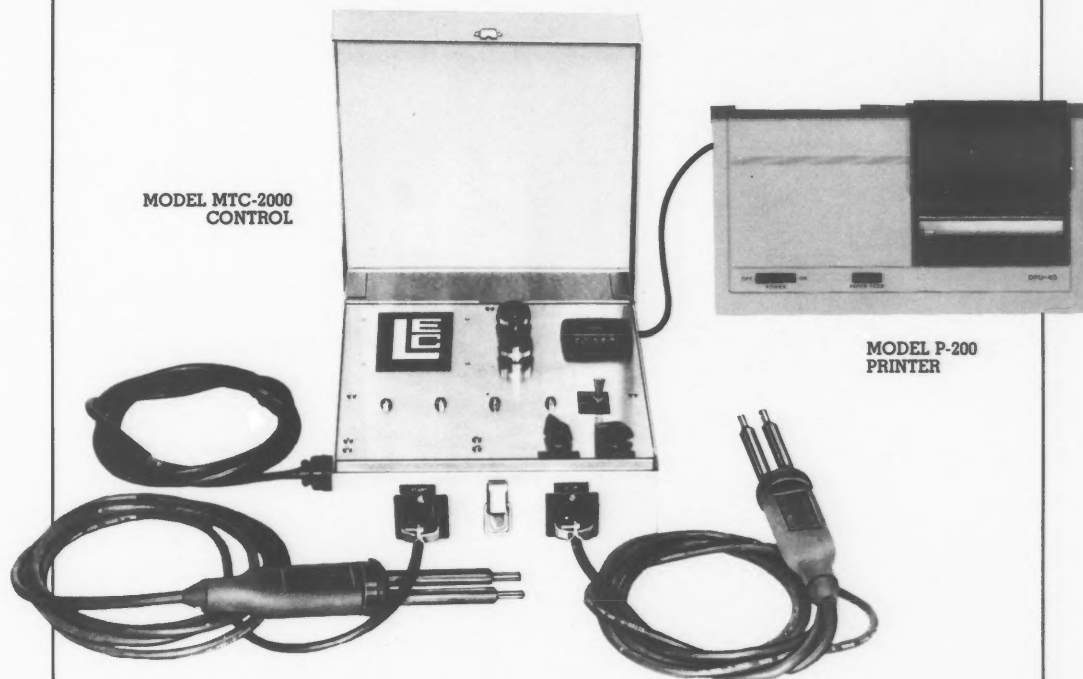
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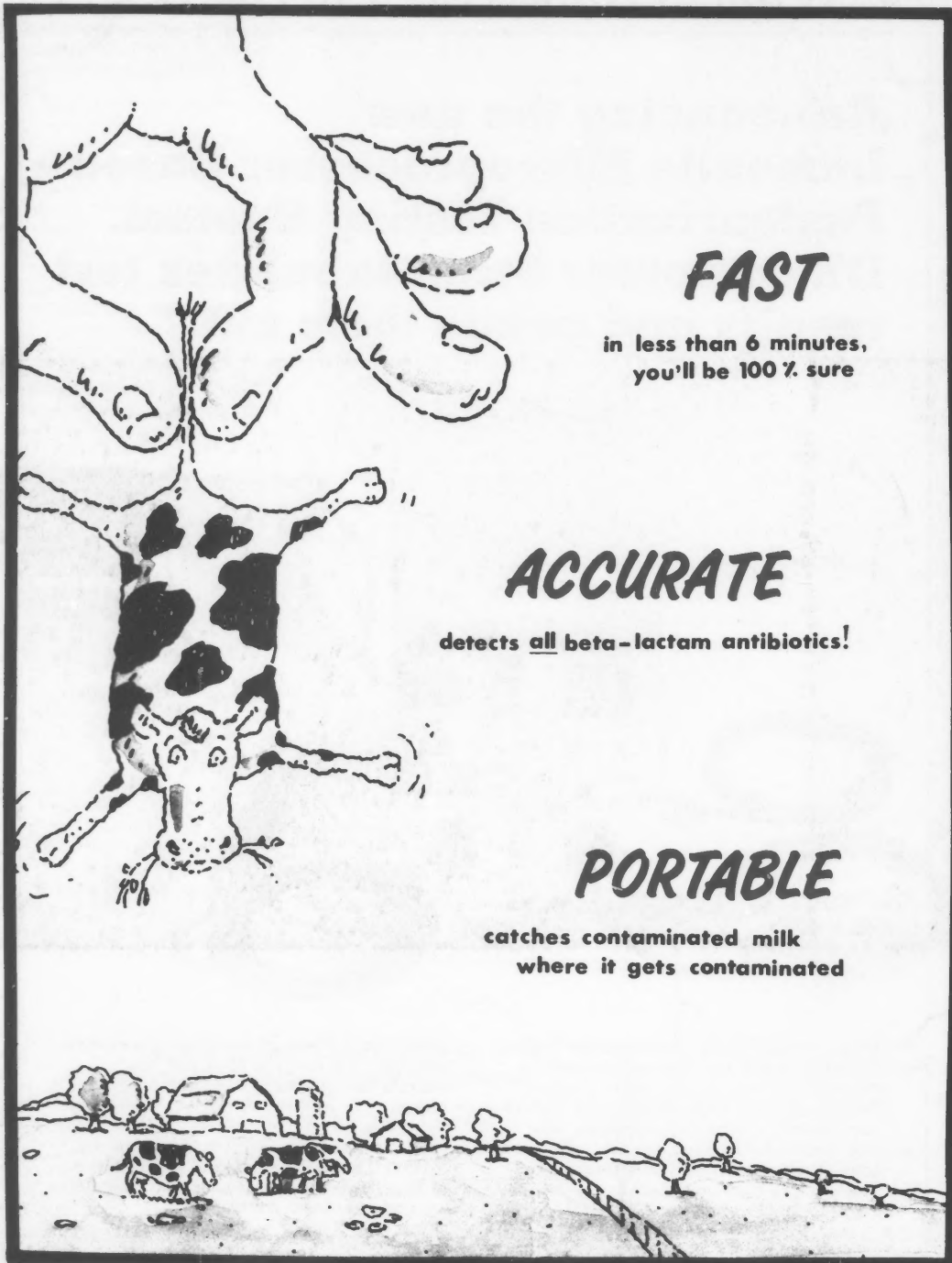
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