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60TH ANNUAL MEETING
FLAGSHIP MOTOR HOTEL
August 13, 14, 15, 16
Rochester, New York

NOTICE
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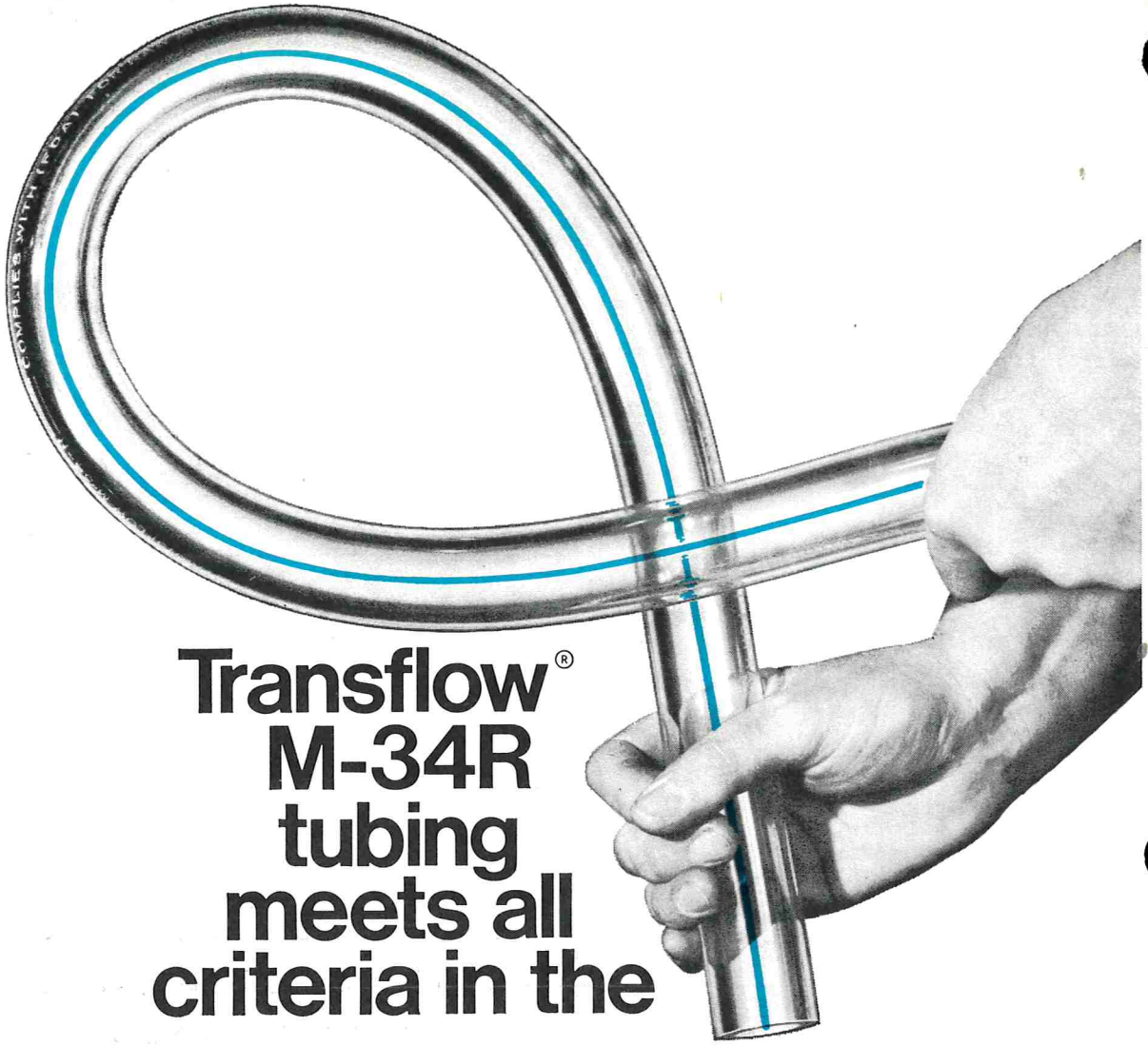
National Mastitis Council Meeting

Official  **Publication**



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NATIONAL MASTITIS COUNCIL ANNUAL MEETING

EXECUTIVE INN — LOUISVILLE, KENTUCKY

February 6-7, 1973

Everyone interested in prevention and control of bovine mastitis is cordially invited to attend the 12th Annual Meeting of the National Mastitis Council.

The meeting is scheduled on February 6-7, 1973, at the Executive Inn, Louisville, Kentucky. For your pleasure we have moved out of the Chicago blizzard area.

An excellent program will concentrate on subjects and speakers requested by popular demand. Current progress and problems in mastitis control will be covered.

Dr. F. H. Dodd of the University of Reading, England, and the National Institute for Research in Dairying, will keynote the meeting on the "Strategy of Mastitis Control." Dr. Dodd is recognized as an international authority on research in hygiene and dry cow therapy. He will also present valuable information on the effect of a mastitis control system on the prevention and elimination of infection.

Lloyd P. Duncan, Zero Manufacturing Company, prominent in the milking machine industry, will discuss concepts of machine milking in the future. The Milking Machine Manufacturers Council will present a panel discussion on automated milking systems.

Dr. W. Nelson Philpot, Louisiana State University, will review the latest information on mastitis research.

A panel on coliform mastitis will be presented by Dr D. E. Jasper, University of California, Dr. R. J. Eberhart, Pennsylvania State University, and Dr. Ben D. Harrington, Raleigh, North Carolina.

Dr. Dodd, Dr. Harrington, and Dr. R. B. Bushnell, University of California, will conduct a symposium on how to approach the problem herd. This session should answer many questions of current concern.

Plan now to attend this meeting. It will start at 8:45 a.m. on February 6 and will adjourn at noon on February 7. Request advance registration form from National Mastitis Council, 910 - 17th Street, N.W., Washington, D. C. 20006.

Send request for room reservation directly to the Executive Inn, Louisville, Ky. 40213. Ask for special NMC rates: Single — 16.00 per day; Twin — $22.00 per day.

D. E. JASPER, President
National Mastitis Council

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THE USE OF INHIBITORY MEDIA TO SCREEN SOUTH DAKOTA BULK TANK MILK FOR *STREPTOCOCCUS AGALACTIAE*

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(Received for publication May 17, 1972)

Abstract

Edward's medium with red blood cells, staphylococcus *beta* toxin, and ferric citrate (TKT medium) was used to culture 4189 bulk tank milk samples from herds supplying seven dairy plants in South Dakota. Identity of organisms with characteristics of *Streptococcus agalactiae* on TKT was tested by biochemical means. The incidence of *S. agalactiae* infected herds supplying the seven milk plants ranged from 0% to 66.6% and averaged 4.03%.

Difficulty was encountered in identifying *S. agalactiae* by its characteristics on TKT alone so that only about one out of ten colonies picked as *S. agalactiae* from TKT had all the characteristics of this organism. Some limitation of the method for use in *S. agalactiae* eradication is thus indicated. Modified KF Agar was found unsuitable for the direct isolation and identification of *S. agalactiae* from bulk tank milk.

For several years it has been recognized that bovine mastitis caused by *Streptococcus agalactiae* is rather unique when compared to other forms of the disease. For practical purposes, in bovine mastitis the only source of *S. agalactiae* is an infected cow's udder. The organism is infrequently isolated from other animate sources and its ability to exist outside the host animal is apparently limited *(8, 9)*. In addition, *S. agalactiae* can frequently be eliminated from infected glands by intramammary antibiotic infusions *(3, 9)*. Because of these factors, *S. agalactiae* mastitis is theoretically eradicable.

Although *S. agalactiae* mastitis is universally recognized as an economically important disease, its incidence apparently varies considerably from one region of the US to another. The highest reported incidence of herd infection with *S. agalactiae* is from Wisconsin and Pennsylvania north and eastward. The incidence in the plains states is apparently lowest while that on the west coast and in the Southeast is between these extremes *(10, 11, 13, 14, 16)*.

Some of the original area-mastitis control plans have been based on the control or eradication of *S. agalactiae (14)*, and at one time or another, nationwide *S. agalactiae* eradication has been proposed *(15)*. Recently it has been suggested that action be taken to control interstate movement of *S. agalactiae* infected cattle over 18 months of age *(7)*. The effectiveness of any mastitis control program which relies greatly on treatment with antibiotics will be determined to some extent by the incidence of *S. agalactiae* since this infection responds better to this type of therapy than do other common infections of the mammary gland. Because of the above factors it is important to know the approximate incidence of *S. agalactiae* in an area.

Numerous attempts have been made to develop a successful one-step method for the recognition of *S. agalactiae* in milk samples *(2, 4, 6, 21)*. These methods differ in complexity and efficacy. One of the most recently proposed methods involves the use of Edward's medium with red blood cells, staphylococcus *beta* toxin and ferric citrate (TKT medium) *(5, 12, 13, 18)*.

The following study was undertaken with three objectives: *(a)* to determine the approximate incidence of *S. agalactiae* infection in South Dakota dairy herds, *(b)* to assess the efficacy of TKT culture of bulk tank milk samples for identifying *S. agalactiae* infected herds, and *(c)* to test modified KF Streptococcus Agar (KFT) (Difco, Detroit, Mich.) as a selective medium to isolate and identify *S. agalactiae* from bulk tank milk samples.

Materials and Methods

A total of 4,189 bulk tank samples was examined over a two-year period. Seven milk plants cooperated in the trial. Six of these plants received milk from herds east of the Missouri River in South Dakota. Plant 5 received milk from herds in the Black Hills region of western South Dakota. Samples were collected three times from Plant 4, twice from Plants 6 and 7, and once from each of the other plants. More than 90% of the milk was of manufacturing grade.

Five to 10-ml portions of the bulk tank milk were secured in sterile vials from samples used by the milk plant for determining bacteria numbers. Each vial was marked with the producer's number and transported to the laboratory under refrigeration. One loopful, approximately 0.01 ml, was streaked onto 1/2 plate of medium and the plates incubated at 37 C. Plates were examined after 24, 48, and 72 hr incubation. When growth was judged optimal, colonies with characteristics of *S. agalactiae* were streaked on blood agar. Then isolated colonies were transferred to differential media to determine the organisms' biochemical activity.

Streptococci and other organisms picked because of their resemblance to *S. agalactiae* on TKT medium were gram stain-

[1]Present address: Chemagro Corp., Kansas City, Missouri.

ed and examined microscopically. The streptococci isolated were tested for their CAMP reaction, ability to hydrolyse hippurate, produce NH_3 from arginine, and split esculin. The latter three reactions were determined by incubation in a single medium *(17)*. The CAMP test was performed as described elsewhere *(1)*, and its results were the main basis for identity of the organism. The results of the hippurate, arginine, and esculin tests were used as a double check.

KFT medium was prepared by adding 76.4 g KF Streptococcus Agar, 1 g esculin, and 0.05 g ferric citrate to 1000 ml distilled water. The mixture was steamed to dissolve the solids and then autoclaved at 121 C for 10 min. The medium was cooled to 50 C in a water bath and 50 ml sheep blood and crude staphylococcal *beta* hemolysin as titrated for TKT *(5, 20)* were added.

Five milliliters of non-sterile milk was inoculated with S. *agalactiae* and incubated 24 hr at 37 C. A plate count at this time indicated the milk contained 4×10^{11} bacteria/ml. Examination of colonies produced when this milk was cultured on TKT and blood agar revealed that approximately 35% of the bacteria in the sample were S. *agalactiae*. A loopful (0.01 ml) of the milk and of the milk diluted with sterile physiological saline 10^{-2} through 10^{-6} were each plated on TKT and KFT media and the plates were incubated 72 hr at 37 C.

RESULTS

Results from culturing 4,189 bulk tank milk samples on TKT medium are summarized in Table 1.

TABLE 1. RESULTS OF CULTURING 4,189 BULK TANK MILK SAMPLES ON TKT MEDIUM. THE NUMBER POSITIVE FOR S. *agalactiae* INCLUDES ONLY THOSE ISOLATES WHOSE IDENTITY WAS CONFIRMED ON THE BASIS OF BIOCHEMICAL CHARACTERISTICS.

Plant number	Number of samples	Number positive for S. *agalactiae*	Per cent positive for S. *agalactiae*
1	106	0	0.0
2	370	40	10.81
3	9	6	66.66
4	1457	41	2.81
5	139	30	21.58
6	1333	17	1.28
7	775	35	4.52
	Total 4189	Total 169	Average 4.03

Only the isolates which conformed to the morphological and biochemical characteristics of S. *agalactiae* are listed. These results indicate the incidence of herds infected with S. *agalactiae* in South Dakota averages approximately 4% and ranged from 0.0% to 66.6% in different areas. The highest incidence was in 9 herds supplying a small grade A distributor. Six of these herds were infected with S. *agalactiae*.

The portion of S. *agalactiae*-infected herds supplying each milk plant at different times varied. The incidence of infection in herds supplying Plant 4 was 0.90, 2.4, and 4.8% when samples were taken at about six-month intervals. Cultures of samples taken about one year apart at Plant 6 revealed 0.81% and 1.8% were infected with S. *agalactiae*, whereas 6.13% and 2.3% of the herds supplying Plant 7 were found infected.

When 0.01 ml of undiluted milk known to contain approximately 4×10^{11} total organisms and 1.4×10^{11} S. *agalactiae* organisms/ml was plated on KFT medium and incubated 72 hr at 37 C, only a few colonies grew. None of these had the characteristic hemolytic pattern which would distinguish it as S. *agalactiae*.

DISCUSSION

Two technicians performed the culturing procedures. Each worked part time at the project over a period of about a year and each performed over 2,000 individual TKT cultures of bulk tank samples. Only 5 to 10% of the colonies selected from TKT by these technicians proved to be S. *agalactiae*, and the technicians did not increase their accuracy with experience. As an example, 106 milk samples were received from Plant 1. After culture on TKT, 17 isolates were picked which resembled S. *agalactiae*. Further examination of these isolates proved that none of them was S. *agalactiae*. Three were identified as CAMP-positive S. *uberis*. The others were mostly *alpha*- or *delta*-hemolytic staphylococci.

When S. *agalactiae* predominated in the milk sample, there was little problem in making a presumptive identification on TKT without further examination. When there were large numbers of contaminants such as fecal streptococci and staphylococci in the specimen, increased difficulty was encountered in deciding whether the hemolytic organisms were S. *agalactiae*. Esculin-splitting organisms often present in bulk tank milk samples frequently turned the medium dark over the entire plate and made it impossible to pick colonies on the basis of their ability to split esculin.

Undoubtedly fewer non-S. *agalactiae* organisms would have been selected had the object of the study been to see how often this organism could be picked from a mixed culture on TKT without selecting any other organisms. In this instance the operator would merely pick only those colonies obviously identifiable as S. *agalactiae*. However, the object of screening bulk tank milk on TKT is to identify all the S. *agalactiae* infected herds possible. Therefore, when a colony bore any resemblance to S. *agalactiae* on TKT, i.e. surrounded by a zone of clear hemolysis, it was isolated and identified further. As the incidence of S. *agalactiae* decreases, the relative incidence of other organisms resembling it on TKT increases and the accuracy of the selective process, in turn, decreases. Reports are given of accuracy greater than 90% in selecting S. *agalactiae* from cultures of bulk tank milk on TKT *(12, 13, 18)*. However, in these instances the indicated incidence of S. *agalactiae* infected herds was much higher (87%) than is indicated by this survey (4.0%).

Attempts were made to utilize media more inhibitory than Edward's medium to non-streptococcus organisms. KF medium was found to be too inhibitory to S. *agalactiae* so that when a small number was present in the milk sample it was often overlooked.

It is generally recognized that in an eradication program the accuracy of the diagnostic procedures used becomes more critical as the incidence of the disease decreases. Our results indicate that TKT screening of bulk tank milk samples for a S. *agalactiae* eradication program has limitations where the incidence of infection is below 10%. There is no indication of the number of false-negative results produced although other work has indicated that if over 5% of the quarters contributing to the bulk tank milk were infected with S. *agalactiae*, the organism would be isolated on TKT from over 80% of samples taken from the tank *(12, 13)*. There are indications that if no criteria other than the characteristics on TKT were used to confirm the identity of S. *agalactiae*, numerous false-positive results would occur where the incidence of infected herds is low.

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EMERGING FOODBORNE DISEASES

II. FACTORS THAT CONTRIBUTE TO OUTBREAKS AND THEIR CONTROL

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(Received for publication January 31, 1972)

ABSTRACT

A review of the impact of change in food production, processing, and preparation on emerging foodborne disease problems is followed by the results of a survey which disclosed factors that contributed to 493 foodborne disease outbreaks during the last 10 years. The most significant of 18 identified factors were: failure to properly refrigerate foods; failure to thoroughly heat process foods; infected employees who practice poor personal hygiene; preparing foods a day or more before they are served; incorporating raw (contaminated) ingredients into foods that receive no further cooking; allowing foods to remain at warm (bacterial incubating) temperatures; failure to reheat cooked foods to temperatures that kill vegetative bacteria; cross contamination; and failure to clean and disinfect kitchen or processing plant equipment. The relationships of the identified factors to transmission of specific diseases are also discussed. Effective control of foodborne diseases must be based upon preventing the factors that contribute to foodborne disease outbreaks.

FACTORS THAT CONTRIBUTE TO OUTBREAKS

Factors that contribute to foodborne disease outbreaks can occur at any point along the food chain—during production, processing, transportation, storage, preparation, or service. Some of these factors encourage contamination of foods with pathogens or toxic agents; others permit multiplication of bacteria. Also, precautions which are designed to kill pathogens sometimes fail in their purpose.

Changes in food production, processing, and preparation

Changes that have occurred or are occurring in agricultural, food processing, food distribution, and food service practices have an impact on the foodborne disease problem. On farms, public health problems still center around the production of animals and their products. Animal feeds contain rendered animal byproducts which for a decade and a half have been known to be contaminated with salmonellae. These organisms can also survive for a long time in litter, soil, animal feces, trough water, and other places in a farm environment. Flocks or herds that are maintained in the same environment can become infected from these sources. Feed lot and brooder operations, where concentrations of animals are kept in confined areas, contribute to the problem of animal-to-animal transmission of diseases.

In agricultural practices today, pesticides, fungicides, plant growth regulators, animal growth promoters, and antibiotics become incidental food additives when they are applied to plants or animals or used in their environment. Spraying is an obvious source of pesticides for plants. Animals acquire pesticides when they eat forage contaminated with pesticide residue and when they are dipped in, or sprayed with, pesticides. The use of antibiotics for therapy or growth promotion has led to the emergence of strains of salmonellae and staphylococci that are resistant to these antibiotics. Other organisms, such as *Escherichia coli*, can acquire resistance, and at some later time transfer a resistant factor to other bacteria, such as *Salmonella*, in the intestines.

Changes are continual in the food-processing industries. These changes include development of new food products and new equipment which processes the new products or which automates processing of foods that have for years been processed in other ways. They include new methods of processing to permit longer shelf life or better quality and new packaging materials and procedures. All this leads to expanding markets and a larger population at risk if contaminated foods are distributed. Many food processing methods such as freezing, dehydrofreezing, spray drying, hot-air drying, and freeze drying cannot be relied upon to destroy significant numbers of bacteria or viruses. Microbial inhibitors (chemicals and antibiotics), mild heat treatments, salting, smoking, irradiation pasteurization, and vacuum packaging act selectively against certain microorganisms. These processes change the distribution of organisms in a food so new kinds predominate. Pathogens may be encouraged by some of these processes.

Potential or actual foodborne disease problems emerge when new foods, processed by new or modified methods, are marketed in increased quantity. Some examples of such new or modified food processes leading to outbreaks of human diseases are: botulism from smoked and vacuum packed fish *(6)*;

TABLE 1. FACTORS CONTRIBUTING TO OUTBREAKS

DISEASE	TOTAL OUTBREAKS	Incubation					Process failure		Contamination							Chemical				
									Person	Source			Cross	Cleaning						
		Inadequate cooling[a]	Warming	Prepared far in advance	Use of leftovers	Selective environment	Inadequate cooking	Inadequate reheating	Infected person, poor hygiene	Unsafe source	Contaminated raw ingredient	Mistaken for food	Cross contamination	Inadequate cleaning of equipment	Inadequate dishwashing	Poor dry storage practices	Toxic containers	Incidental additives	Intentional additives
Salmonellosis	151	77	22	24	5		38	15	16	2	51		34	23					
Staphylococcal intoxication	99	74	16	48	3	1	3	6	54				3	9					
Clostridium perfringens foodborne illness	59	46	27	26	6		4	23					1	1					
Botulism	42	8				36	37												
Shigellosis	17	13		3					14										
Typhoid fever	9								8	2									
Enterococcal foodborne illness	1	1					1	1											
Beta-hemolytic streptococcal infection	3	2		1			1		3										
Bacillus cereus foodborne illness	1		1				1												
Vibrio parahaemolyticus infection	2									1	1								
Scombroid (fish) poisoning	4	4																	
(Sub-totals) Bacterial diseases	388	225	66	102	14	37	85	45	95	5	52		38	33					
Infectious hepatitis	23								11	12					1(?)				
Trichinosis	37						31				17		5	5					
Toxoplasmosis	1						1												
Metallic poisoning	13																13		
Chemical poisoning	18															4		5	12
Mushroom poisoning	7									7									
Plant poisoning	3									1		2							
Shellfish poisoning	3									3									
Fish poisoning	1									1									
Total	493	225	66	102	14	37	117	45	106	29	69	2	43	38	1	4	13	5	12
(Group totals)		444					162		106	100			43	39		34			

[a]See text for complete description of each factor.

salmonellosis from cake mixes containing unpasteurized dried eggs *(8);* salmonellosis from turkey rolls and pork rolls *(4);* salmonellosis from instantized dry milk *(2);* salmonellosis from artificial ice cream containing unpasteurized eggs *(1); Clostridium perfringens* foodborne illness from freeze-dried chicken *(5);* salmonellosis from a food supplement containing yeast and cottonseed protein *(7);* and staphylococcal intoxication from Genoa salami.

Animals may harbor salmonellae, *C. perfringens,* or other foodborne pathogens, and bring these organisms into abattoirs or poultry processing plants. An infected organ, a contaminated carcass, or animal feces contaminate equipment that they touch or workers' hands. From these workers and equipment surfaces, pathogens may be transferred to other carcasses or processed foods. As plants process a greater volume of animals, the likelihood of entry of an infected animal, subsequent cross contamination, and eventual contamination of finished products becomes greater. Raw products of animal origin, such as dried eggs and milk, can be the source of pathogens for processing plants that do not slaughter animals. Once in a plant, even long after an original source of contamination is gone, pathogens may survive on equipment or on other features of plant environment and contaminate foods at some later time.

With the efficiency of modern food distribution, widespread disease could result before any attempt to recall a food could prevent it. In 14 or more outbreaks stemming from artificial ice cream manufactured in one plant, for instance, it was estimated that over 9,000 cases of salmonellosis occurred in four eastern states within a period of 13 days *(1).*

Supermarkets are beginning to prepare salads and sandwiches, to roast meats, and to barbecue poultry. Inadequate cooking, cross contamination, and storage in warming ovens for long periods of time have incubated pathogens and led to outbreaks.

The food service industry, including food operations at hotels, colleges, hospitals, and similar institutions, ranks fourth in retail sales in the United States. Over one-half million food service establishments employing approximately 3.4 million workers serve over 145 million meals each day. A variety of dishes and types of meals are prepared in these establishments. As the number of dishes and meals that are eaten away from home increases, the problem of prevention of foodborne disease grows more complex.

Fast food-service restaurants that prepare foods in advance and hold them for sale throughout the day are becoming very popular. Numerous outbreaks have resulted when food items (such as roast beef, gravy, and fried chicken) have been either inadequately cooked or held for long periods of time at temperatures that permit bacterial multiplication. If these products are left over from one day to the next, they are seldom reheated to a temperature that is lethal to vegetative bacterial pathogens.

Foodborne disease hazards commence when foods enter the kitchen. Some foods, particularly those of animal origin, may contain pathogens such as *Salmonella* and *C. perfringens.* As the foods are prepared, additional contamination occurs either from workers (staphylococci, shigellae, or infectious hepatitis viruses) or as a result of cross contamination. Foods prepared in food service establishments are handled by numerous workers, many of whom are not aware of safe-handling and cooking techniques. Bacterial spores are not killed by ordinary cooking procedures. Foods prepared in these establishments are usually held for some time between preparation and serving—sometimes at temperatures that permit bacterial multiplication.

Evaluation of reported outbreaks

A survey of reported and published foodborne disease outbreaks covering the period 1961 through 1970 has been made by the author. Details on operational or constructional factors that contributed to the outbreaks were gathered. Information was sought from periodic surveillance reports that are published by the Center for Disease Control (CDC); articles in journals; reports of outbreaks that have been sent to CDC from states, local health departments, or Federal agencies; and reports from CDC's Epidemic Intelligence Service officers. The surveillance reports used were *Morbidity and Mortality Weekly Reports (14), Salmonella Surveillance Reports (15), Shigella Surveillance Reports (16), Hepatitis Surveillance Reports (13),* and *Trichinosis Surveillance Reports (17).* Besides journal articles that would routinely reach the attention of the author, *Index Medicus* (1961-1971), *Excepta Medica* (1961-1971), and *Archives of Hygiene* (*Bulletin of Hygiene,* 1961-1971) were reviewed for listings of outbreaks that occurred in the United States. Only those outbreaks that contained some mention of a food production, processing, or preparation history were included in the report. Approximately one-third of the number of outbreaks of known etiology that were reported from 1961-1970 are included in the report. Outbreaks cited by one source were checked against the other sources to avoid duplication.

This survey, although pointing out many important factors that contribute to outbreaks, suffers from certain shortcomings, which include: *(a)* inadequate investigations of factors that contribute to outbreaks *(b)* incomplete reporting, write-up, or abstracting; *(c)* incomplete and nonrepresentative search of literature;

and *(d)* misinterpretation of the reported information. The first two of these shortcomings were noted in many of the reports. The investigators, at the time of the investigation or write-up, frequently did not put much emphasis on the factors other than the etiologic agent and the vehicle that contributed to the outbreak. Some diseases — salmonellosis, botulism, trichinosis, and infectious hepatitis — are more frequently reported in detail to CDC than are other diseases. Thus, the more commonly reported staphylococcal intoxications and *C. perfringens* foodborne illness are represented in the total figures at an extent disproportionate to their reported frequency. Results of the survey are listed in Table 1. Factors that contribute to foodborne disease outbreaks, in order of frequency of findings of the survey, are as follows:[a]

1.[1][b] Failure to properly refrigerate foods.
2.[5] Failure to thoroughly heat process or cook foods.
3.[4] Infected employees who practice poor personal hygiene.
4.[3] Preparing foods a day or more before they are served.
5.[7] Incorporating raw (contaminated) ingredients into foods that receive no further cooking.
6.[2] Allowing foods to remain at warm (bacterial incubating) temperatures.
7.[6] Failure to reheat cooked foods to temperatures that kill vegetative bacteria.

[a]This list is based on all reviewed foodborne disease outbreaks that included sufficient information on factors that contributed to the outbreaks. Because of the nature of the review, more data came from outbreaks of diseases in which there are active surveillance programs (salmonellosis, botulism, and trichinosis) than from outbreaks of diseases which are commonly reported (staphylococcal intoxication and *C. perfringens* foodborne illness).

[b]If weight is given to diseases in proportion to the frequency with which they were reported in the United States during the last ten years, factors that contribute to staphylococcal intoxication and *C. perfringens* foodborne illness would be given more emphasis. The revised order is in brackets after the initial number.

8.[9] Raw foods of animal origin bring foodborne bacteria into kitchen or processing plant environments, and cross contamination occurs after workers touch contaminated raw foods and then touch cooked foods, or after equipment is used for contaminated raw foods and is then used for cooked or prepared foods.
9[8] Failure to clean and disinfect kitchen or processing plant equipment.
10.[10] Establishing environmental conditions that selectively permit pathogens to grow but inhibits competing organisms.
11.[11] Obtaining foods from unsafe sources.
12.[12] Serving foods that were left over from a previous meal.
13.[13] Using utensils or piping that contains toxic metals.
14.[14] Using excessive amounts of intentional additives of poisonous chemicals.
15.[15] Incidental or accidental addition of poisonous chemicals to foods.
16.[16] Mistaking poisonous plants or fish for edible varieties.
17.[17] Poor dry storage practices.
18.[18] Inadequate dishwashing.

Occasionally only one factor was involved in the outbreaks surveyed, but frequently two or more factors combined to allow contamination, survival, and multiplication of pathogens. When weight based upon reported frequency was given to each disease, there was little change in the order of the factors. The most significant change is that factor 6, "Allowing foods to remain at warm (bacterial incubating) temperatures," would move to second place. This was caused by giving greater weight to the rapidly emerging *C. perfringens* foodborne illness. Dishwashing was listed only once as a contributing factor, and certainty that this factor was involved in the outbreak of infectious hepatitis can be questioned *(3)*.

Staphylococcal intoxication. The most significant factors that contribute to staphylococcal intoxications are as follows: Failure to properly refrigerate foods, preparing foods a day or more in advance of serving, and an infected person who handles and thus contaminates food. If more complete information had been obtained in the investigation or cited in the report and if more intensive laboratory work had been conducted, there is little doubt that two factors—inadequate refrigeration and contamination by workers—would appear in nearly all outbreaks. Two other factors that contribute significantly to staphylococcal intoxications are holding foods at warm (bacterial incubating) temperatures and inadequate cleaning of kitchen or processing equipment. Another possible factor, seldom investigated, is that foods of animal origin may harbor *Staphylococcus aureus* when they arrive in a kitchen. In this instance, either inadequate cooking or cross contamination may explain the presence of staphylococci on the incriminated foods.

Clostridium perfringens foodborne illness. The most important factors that contribute to *C. perfringens* foodborne illness outbreaks are failure to properly refrigerate cooked meat or poultry or to allow these foods to stay at warm (bacterial incubating) temperatures for long periods of time. Either or both inadequate refrigeration or warm holding was reported in every investigation. These two factors were usually coupled with preparing foods a day or more in advance of serving or with using leftovers. After these foods were prepared on one day and held at bacterial incubating temperatures or inadequately chilled, which permits germination of spores and multiplication of vegetative bacteria and may result

in development of high numbers of vegetative cells of *C. perfringens*, the foods were frequently reheated under time-temperature conditions that did not kill the vegetative cells. Although not reported in the data, cooking may contribute to outbreaks of *C. perfringens* foodborne illness in an indirect way. Cooking temperatures kill competing vegetative bacteria but allow heat resistant spores of *C. perfringens* to survive. The temperatures generated during cooking heat shock (activate) spores which increases the percentage of spores that are able to germinate. Cooking also drives off oxygen and aids in establishing anaerobic conditions in meats and gravies.

Salmonellosis. A multitude of factors contribute to outbreaks of salmonellosis. Once again, failure to properly refrigerate contaminated foods heads the list. Other important factors that related to bacterial incubation were preparation of foods a day ahead of serving and holding foods at warm (bacterial incubating) temperatures. Factors that were involved in initial contamination or in recontamination of food were the presence of salmonellae on raw foods of animal origin (not reported), the use of contaminated raw products (such as raw eggs) in prepared foods which received no further heat treatment or which were inadequately heated, cross contamination from raw foods to cooked foods by hands of workers or surfaces of equipment, inadequate cleaning and disinfecting of kitchen or processing equipment, and, to a lesser extent, contamination by a human carrier. Factors that allowed the survival of salmonellae in contaminated products were inadequate cooking or heat processing and inadequate reheating of leftover or prepared foods.

Shigellosis and typhoid fever. In outbreaks of shigellosis and typhoid fever, investigations disclosed that food was contaminated by an infected worker who practiced poor personal hygiene. In outbreaks of shigellosis (also possibly in typhoid fever, but not reported), inadequate refrigeration was also frequently mentioned as a contributory factor. Occasionally, the practice of obtaining foods from unsafe sources, such as shellfish from contaminated bays, contributed to outbreaks of typhoid fever.

Botulism. Outbreaks of botulism occurred after foods were packed in an anaerobic environment (a can, jar, plastic bag, or food in bulk) and inadequately heat processed. Inadequate refrigeration practices contributed to type E botulism outbreaks in Eskimo and Indian groups who stored seal and whale flippers and salmon eggs at ambient temperatures to promote fermentation.

Infectious hepatitis. Either one of two practices contributed to outbreaks of infectious hepatitis—obtaining foods from an unsafe source, as with shellfish from contaminated bays, or contamination of food by an infected worker who practices poor personal hygiene.

Trichinosis. As expected, outbreaks of trichinosis occurred after either raw pork or inadequately cooked pork or bear meat was ingested. Occasionally, there were reports of cross contamination from pork to beef when a grinder or similar piece of equipment was not cleaned between processing pork and then processing beef.

CONTROL

From a detailed review of the factors that contribute to foodborne disease outbreaks, it becomes apparent that their control must be based on inhibiting bacterial growth, preventing or limiting contamination by pathogens or by toxic substances, and by destroying pathogens. Bacterial diseases can be prevented by application of any of these principles. Viral and parasitic diseases can be controlled by preventing contamination and by destroying pathogens; chemical poisonings are controlled only by preventing contamination. The three principles, when applicable, must be applied at all stages of food and feed chains —production, distribution, processing, storage, preparation, and service.

Production

Zoonoses, such as salmonellosis, that are transmitted by foods can be controlled at the farm by preventing infection of animals. This can be accomplished by feeding animals a ration that is free of *Salmonella;* acquiring disease-free stock; acquiring chicks or poultry from hatcheries that receive eggs from hens that have been tested and found to be free of *Salmonella pullorum, Salmonella gallinarum,* and *Salmonella typhimurium;* fumigating eggs; and by practicing sanitation on farms. Sewage-transmitted organisms (such as *Salmonella typhi,* taeniae, and infectious hepatitis virus) can be prevented from contaminating foods either by isolating sewage from food-growing areas or pastures or by treating sewage before it is used for irrigating crops or before it reaches tributaries and finally water courses that are used for growing shellfish, watercress, or other water-grown foods. Shellfish growing waters should be periodically sampled, and areas found contaminated should be closed and patrolled to prevent shellfish harvesting. Chemical contamination of foods can be prevented only by careful choice and application of pesticides and other farm chemicals. Antibiotics should not be used indiscriminately.

Processing

In general, to ensure destruction of vegetative bacteria, foods must be heated to internal temperatures

of 165 F; but if these temperatures cause undesirable changes in products, lower temperatures for longer periods of time can be effective, as in pasteurizing milk *(12)* or eggs *(9)*. If spores are to be destroyed, higher time-temperature values must be used—usually the product has to be heated under pressure. Precooked foods which are not ordinarily cooked before serving require measures such as proper packaging to prevent recontamination. Processing plants should be designed and equipment utilized so that raw food operations are physically separated from finished products. Potentially hazardous foods that are not processed to a point of commercial sterility should be chilled as fast as possible and held at temperatures of 40 F or below. Processing, whenever possible, should also be effected within the bacterial lag period (2 to 3 hr) to prevent bacterial multiplication during the processing period. Although freezing is detrimental to some bacteria, it cannot be relied upon to destroy viruses or most types of bacteria. Freezing, however, is an effective means of killing parasites such as *Trichinella spiralis, Toxoplasma gondii, Taenia solium*, and *Taenia saginata*.

As a result of outbreaks that have occurred in the last decade, various control measures have been developed or intensified. For instance, after the occurrence of outbreaks of salmonellosis from cake mixes, cream pies, and other products containing dried or frozen eggs, laws were passed to require the pasteurization of all liquid eggs that are dried or frozen and shipped interstate *(10)*. After dried milk was associated with human salmonellosis, dry milk plant operations were changed so that milk was pasteurized before drying was commenced. After the occurrence of botulism from vacuum-packed smoked fish, heat processing procedures were changed to ensure destruction of *Clostridium botulinum* type *E*. Sanitation control programs in shellfish and fish meal industries were intensified after outbreaks pointed out that these products were vehicles for infectious hepatitis virus and salmonellae, respectively.

Preparation and service

The measures discussed in this section are crucial in preventing the occurrence of the more frequently reported factors that contribute to foodborne disease outbreaks. Opportunities for foods to become contaminated with foodborne pathogens are great. It is virtually impossible to keep *C. perfringens* out of foods. With the handling that foods frequently receive after they are cooked, low numbers of staphylococci can be expected in these foods. With present practices of giving animals feed that contain *Salmonella* and with the present technology of slaughtering, dressing, and evisceration operations, it is difficult to keep salmonellae out of raw meats and poultry. On the other hand, infectious hepatitis and other viral infections, beta-hemolytic streptococcal infections, enteropathogenic *E. coli* infections, typhoid fever, and shigellosis can be prevented by food workers who practice personal hygiene. Cross contamination from raw to prepared foods, which is important in the spread of salmonellae, *C. perfringens*, and certain other pathogens, can be prevented if workers wash their hands after handling raw products of animal origin and if processing and preparation equipment is thoroughly cleaned and disinfected after contacting raw foods. Equipment sanitation is more effective if a cleaning schedule (which defines cleaning responsibility, frequency, time, and method) is followed. Layout and operational flow should be designed to segregate raw food and prepared food operations. Chemical contamination can be controlled by the proper storage of poisonous substances, by discontinuing use of chemicals to mask spoiled or inferior products, and by conservative use of chemicals, such as nitrites and MSG, in foods.

The mere presence of pathogenic bacteria on foods is usually not enough to cause illness; they must multiply to significant numbers or produce significant amounts of toxin in foods before danger develops. Adequate refrigeration of foods that are prepared a day or more in advance of serving or that are leftover after serving is crucial in preventing bacterial foodborne diseases, such as those diseases which are reported most frequently in the United States — staphylococcal intoxication, *C. perfringens* foodborne illness, and salmonellosis. Adequate refrigeration consists of rapidly chilling foods through the incubation temperature range for foodborne pathogens (approximately 125 to 45 F) and holding foods at 45 F or below — at <38 F or frozen to prevent growth of *C. botulinum* type E. Ideally, the period of chilling should be within the bacterial lag period — 2 to 3 hr. Unfortunately, many foods (roasts, batches of gravy, turkeys) do not cool rapidly when simply put in a refrigerator. To cool rapidly, the foods must be put in 4-inch deep rectangular pans in thin layers. When this is not practicable because of the nature or form of the food or the quantity of food to be cooled, other methods which allow rapid cooling, such as chilling in ice or water baths, mixing, cutting large chunks of meat into smaller portions, must be used.

Temperature control of foods that are held for long periods in warmers is crucial to the prevention of *C. perfringens* foodborne disease, as well as other bacterial foodborne diseases. The internal and surface temperature of foods should be kept above

the highest temperature (126 F) that allows incubation of foodborne pathogens, but 140 F is recommended by the U. S. Public Health Service *(11)*. To maintain this temperature, foods must come to the warmer at a temperature higher than the minimum holding temperature, and the air temperature in the warmer must be higher than the desired food-holding temperature. Preferably, the product should be kept in the warmer for only a short period of time.

Although equipment limitations, work schedules, and the nature of certain food service operations necessitates some types of foods being prepared a day or more before they are served, this practice should be limited to the times that are absolutely necessary. And when it is required that foods be prepared in advance, critical temperature control should be maintained at all times so that bacterial growth will be held to a minimum during warm holding and refrigerated storage.

Addition of mayonnaise, vinegar, or citric acid to foods to reduce the pH below 4.5 will inhibit growth of foodborne pathogens. In most dishes, however, this pH is undesirable or hard to attain. Such a pH requires a relatively large proportion of acid ingredients and the food must be finely divided to allow the acid to penetrate.

An internal food temperature of 165 F will readily destroy vegetative bacteria; however, bacterial spores and staphylococcal enterotoxins will survive this temperature. Cooked, leftover foods and foods that have been cooked on a previous day and which have been held in storage devices should be reheated to internal temperatures of 165 F. This is of particular importance when there is a likelihood that raw foods might be contaminated with spores of *C. perfringens*, as with meat and poultry, or when there has been an opportunity for contamination after cooking. The newly inoculated vegetative cells or the vegetative cells which germinate from heated spores can multiply rapidly and attain large numbers during inadequate storage. Reheating to internal temperatures of 165 F assures the destruction of these vegetative cells.

CONCLUSION

Effective control of foodborne diseases depends on prevention of those factors that contribute to occurrence of foodborne disease outbreaks. Prevention, however, will not be achieved until supervisors of food production, processing, and service operations become cognizant of these factors and are motivated to require that appropriate control measures are routinely practiced in the operations they supervise.

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COLLABORATIVE STUDY OF SOME SCREENING TESTS FOR DETECTION OF ABNORMAL MILK[1]

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Abstract

The California Mastitis Test, Modified Whiteside Test, Wisconsin Mastitis Test, tube Catalase Test, Milk Gel Index, and Direct Microscopic Somatic Cell Count (NMC Method) were done according to a detailed protocol in five laboratories. Each laboratory tested about 250 bulk tank milk samples in blind duplicate. Screening tests were compared at various critical scores with respect to their identification of milk samples with cell concentration above (positive) and below (negative) 1.0 and 1.5 million/ml. The percent of positive samples correctly identified is the *Utility* of the screening test; the percent of negative samples mis-identified is the *Cost*.

At the 1.5 million cells per milliliter limit, and using U.S.P.H.S. recommended critical scores, the mean Cost/Utility estimates were: CMT 68/98, MWT 64/97, WMT 13/84, and CAT 38/94. Lowering the critical score for WMT to > 20 increased its Utility to an acceptable 89% at 17% Cost. At the 1.0 million/ml cell concentration limit the ranking of tests did not change materially. Laboratories varied widely in Cost of screening with all tests, and, particularly for subjectively-scored tests, in the critical score required for equivalent Utility. In all comparisons, the MGI was the test of choice, with the WMT ranking next.

The Subcommittee on Screening Tests was charged by the National Mastitis Council to investigate currently used indirect tests for screening milk for excessive concentration of somatic cells, and to report its conclusions. The results of our studies of five indirect tests in each of five laboratories are reported here.

Materials and Methods

Testing procedures

Five indirect tests were selected for study. The California Mastitis Test (CMT) was conducted as specified by the originators *(8)* with the additional precautions that 2.0 ml volumes of milk and reagent were delivered by automatic syringe and cannula, and reactions were graded with reference to color photographic reproductions supplied by Dr. Schalm. The Modified Whiteside Test (MWT) was conducted according to Temple's procedure *(13)*. The Wisconsin Mastitis Test (WMT) was performed according to the brochure written by D. I. Thompson[8], which does not differ significantly from the procedure recommended by the U.S. Public Health Service *(13)*. Our only procedural variation was that both milk samples and reagent were brought to room temperature before mixing. The Milk Gel Index (MGI) was done according to the method specified for its official use in the Province of Ontario, Canada *(7)*. The method is similar to the WMT with respect to reaction mixture and measurement of height of residual liquid column after timed outflow through a small orifice. It differs in that milk and reagent are mixed in one vessel and then transferred to a viscosity tube, a 5 ml plastic syringe barrel marked at intervals of 0.2 ml. Outflow time is 10 sec. Equipment for the MGI was loaned to each participating laboratory by the Laboratories Division, Ontario Department of Health. The Catalase Test (CAT) procedure was provided by Postle *(4)* and deviated from the published method in that 2 ml of hydrogen peroxide were used. The reference method for somatic cell concentration was the Direct Microscopic Somatic Cell Count *(3)* (DMSCC).

The test protocol called for each laboratory to test 250 samples of milk from farm bulk tanks. Fifty samples were to fall within each of five cell concentration ranges, clustering around 0.5, 0.75, 1.0, 1.5, and 2.0 million/ml, respectively. Two to four ounces of well-mixed, unfiltered milk were collected from full tanks (usually the composite of four successive milkings of the herd) after at least 3 min agitation. Samples were immediately subdivided among four screw-capped tubes and refrigerated overnight. Tests were done the next morning after bringing subsamples to room temperature: one milk film for DMSCC, one CMT, and one MWT on each subsample A; then one WMT, CAT, and MGI on each subsample B; the first series of tests repeated on subsamples C; and finally the second series repeated on subsamples D. CMT and MWT reactions were coded and recorded as 1 through 5, CAT scores as percent 0_2, MGI scores as (20 $\times$ height of residual reaction mixture to nearest 0.1 ml), and WMT to nearest millimeter. The DMSCC was performed using the wide band of the original Subcommittee reticle *(10)*. Since, in a preliminary study, we had experienced difficulty in assuring ourselves of the equivalence of reagents used in the several laboratories, we this time secured a single batch of each reagent and distributed portions of

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[7]Laboratory Division, State Department of Health, P. O. Box 1689, Hartford, Connecticut 06101.

[8]Available from Z. D. Roundy, 725 South 600 West, Orem, Utah 84057.

TABLE 1. SOURCES AND DISTRIBUTIONS OF CELL CONCENTRATION OF SAMPLES USED IN EVALUATING SCREENING TESTS

Lab	Number	Somatic cell concentration		Distribution of cell concentrations (millions/ml)						
		Mean	Median	.25	.25-.49	.50-.74	.75-.99	1.0-1.49	1.5-1.99	2.0-2.49
				(%)						
A	260	.941	.850	2	15	21	23	25	12	3
B[1]	321	1.040	.950	0	3	21	29	31	12	3
B[2]	288	1.058	.977	0	3	19	29	34	11	3
C	220	.627	.561	4	36	33	15	11	1	0
D	250	.591	.558	8	33	35	16	8	0	0
E[3]	240	1.068	.980	0	12	22	19	26	12	9

[1]Not used for WMT (non-standard caps used in tests of early samples)
[2]Used for WMT only
[3]Not used for MGI (test not performed)

TABLE 2. COMPILATION OF A COST-UTILITY TABLE FOR WMT SCORES ON BULK TANK MILK SAMPLES[1]

WMT score	Cell concentration categories (millions/ml)			Screening at 1.0 million/ml				Screening at 1.5 million/ml			
	<1.0	1.0-1.5	>1.5	True positive	Utility[2]	False positive	Cost[3]	True positive	Utility[2]	False positive	Cost[3]
	(No. samples)			(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)
< 4	5	0	0	206	100	314	100	78	100	442	100
4	16	1	0	206	100	309	98	78	100	437	99
5	17	0	0	205	100	293	93	78	100	420	95
6	20	1	0	205	100	276	88	78	100	403	91
7	26	0	0	204	99	256	82	78	100	382	86
8	22	0	0	204	99	230	73	78	100	356	81
9	19	0	0	204	99	208	66	78	100	334	76
10	32	0	0	204	99	189	60	78	100	315	71
11	25	0	0	204	99	157	50	78	100	283	64
12	20	0	0	204	99	132	42	78	100	258	58
13	23	1	0	204	99	112	36	78	100	238	54
14	24	7	0	203	99	89	28	78	100	214	48
15	14	5	0	196	95	65	21	78	100	183	41
16	16	4	0	191	93	51	16	78	100	164	37
17	15	6	1	187	91	35	11	78	100	144	33
18	6	12	0	180	87	20	6	77	99	123	28
19	6	27	1	168	82	14	4	77	99	105	24
20	3	22	1	140	68	8	3	76	97	72	16
21	2	8	7	117	57	5	2	75	96	47	11
22	2	14	8	102	50	3	1	68	87	37	8
23	1	11	3	80	39	1	0	60	77	21	5
24	0	7	12	66	32	0	0	57	73	9	2
25	0	1	11	47	23	0	0	45	58	2	0
26	0	1	14	35	17	0	0	34	44	1	0
≤27	0	0	20	20	10	0	0	20	26	0	0
Total	314	128	78								

[1]Data from laboratory A
[2]Numbers and percentages indicate the samples correctly judged as positive if screening were at indicated level.
[3]Numbers and percentages indicate the samples incorrectly judged as positive if screening were at indicated level.

these to each participating laboratory.

The laboratories found it impossible to adhere to the planned distribution of cell concentrations during sample collection. Table 1 shows the numbers and distributions of cell concentrations of samples from which screening test results were actually submitted. As may be seen from Fig. 1, the sample population available to a given laboratory may be characterized as low-skewed, high-skewed, or symmetrical.

Cost-utility analysis

In a program for control of abnormal milk, screening tests are used to identify positive milk samples, i.e. those with a content of somatic cells in excess of a specified maximum concentration. Berkson's Cost-Utility analysis *(1)* fits these circumstances, for it was designed for situations in which "a test result or measure X applying to an individual is used to 'predict' . . . whether the individual belongs to A or B of two mutually exclusive categories." We here define Utility as the effectiveness of a screening test in indicating which milk samples are positive, and we measure it as the percent of true positives which are correctly identified. Two categories of Cost can be described: *(a)* the cost to the laboratory, and eventually to the producer, in time and ma-

terials of carrying out the confirmatory procedure on milk samples falsely identified as positive by the screening procedure (Type I error); and *(b)* the cost to equitable and effective functioning of the control program of missing milk samples in violation of the standard (Type II error, consisting of false negatives). We consider the first category of greater importance. The second cost is impossible to quantify, and its urgency is mitigated by the fact that our purpose in abnormal milk control is to monitor sources of milk rather than discrete batches of milk. Cost, then, for this analysis is defined as the extent to which a screening test falsely identifies negative milk samples as positive, and is measured as the percent of true negative samples which are so misidentified.

For a given screening test, Cost and Utility estimates are positively related and are contingent upon the critical score at which they are measured. As the critical score is lowered, both statistics increase in numerical value. Optimum use of this analytical method for choosing among screening tests entails *(a)* determination for each test of that critical score at which the Utility estimate approximates some predetermined standard, and *(b)* comparison of Cost estimate for each test at the point of equivalent Utility. We have chosen 90% Utility (i.e. 10% false negatives) as an appropriate criterion for screening test performance. Because critical scores have been established for official use of these tests *(14)* without regard to this criterion, we have made Cost-Utility comparisons at these specified scores also.

RESULTS AND DISCUSSION

The bulk tank sample data from each laboratory were categorized on the basis of DMSCC results as follows: $\leq$ 1.0 million cells/ml; $>$ 1.0 million and $\leq$ 1.5 million cells/ml; and $>$ 1.5 million cells/ml. For each screening test we tabulated the distribution among the three cell concentration categories of samples which yielded each test score. Progressing from the highest score to the lowest, we then listed the cumulative sum of true positive samples and of false positive samples at each test scoring level. These sample sums were converted to percent of total positive or false positive samples and listed as the Utility and Cost estimates, respectively, relevant to the use of that scoring level as the critical score for the test. A sample compilation of Cost-Utility data, for one laboratory's study of the WMT, is shown in Table 2. In the analysis, duplicate screening test scores were treated as independent observations, and both were related to the single DMSCC made on the milk sample. Because of increasing demand that the limiting cell concentration for the national abnormal milk control program be lowered from 1.5 to 1.0 million somatic cells per milliliter, we have applied the analysis of Utility and Cost to simulated screening of milk samples against both concentration limits.

The information in Table 2 is interpreted in the following manner. At the 1.0 million/ml cell concentration limit (shown in the middle columns) there was a total of 206 (128 + 78) positive milk samples. All of them yielded WMT scores of $\geq$ 4. Thus, the choice of WMT $>$ 3 as the critical score would result in detection of all the over-limit samples, for a Utility estimate of 100%. Only 140 of the positive samples yielded WMT scores of $\geq$ 20, so the choice of WMT $>$ 19 as critical score would result in only 68% Utility. Similarly, 309 of the 314 negative samples yielded WMT scores $\geq$ 4. Thus, 98% of the total would be considered positive (requiring confirmation) by mistake if WMT $>$ 3 were accepted as the critical score. Using a critical score of WMT $>$ 19, the Cost would drop to only 3%. These results are unusually good, with fairly sharp separation of WMT scores between the three cell concentration categories. Other participating laboratories experienced less favorable relationships between test scores and cell counts. The Cost-Utility analyses of all five screening tests are shown for each laboratory in Tables 3 through 7.

To compare the various screening tests we averaged the Costs estimated for equivalent Utility in the participating laboratories. The critical test score was not necessarily the same for all laboratories. Selecting the 1.5 million cells/ml concentration limit and demanding 90% Utility, the average Costs of the tests were: CMT = 68%, MWT = 53%, WMT = 17%, CAT = 39%, and MGI = 10%. Because of the limited number of high cell count samples available to laboratories C and D, their results could not be included. Since laboratory E did not perform the MGI, the average given is for laboratories A and B only. Possibly more extensive testing would have caused an increase in our estimate of its Cost. The significance of these large values for Cost is more apparent if one considers the absolute numbers of samples involved. Thus, in identifying 100 of the total 102 positive samples by the WMT, laboratory B also misidentified 464 of the total 548 samples with cell concentration not in excess of 1.5 million cells/ml.

Although the percentage Costs determined in this study are free from bias because of the proportion of positive samples in the population, they do reflect the distribution of cell concentrations within the negative sample group. Our sample populations were accumulated in a conscious attempt to achieve a rather flat distribution across the cell concentration range studied. In a field situation we would expect all percentage Costs to be lower because of a marked skewing of sample distribution toward the lower cell concentrations. The relative values, however, are valid for comparing tests. Excluding the MGI, which is not used in the United States to our knowledge and for which equipment is difficult to obtain, the advantage among the tests studied lies clearly with the WMT.

TABLE 3. UTILITY AND COST ESTIMATES USING THE CMT TO SCREEN BULK TANK MILK SAMPLES

a) Screening at 1.0 million somatic cells/ml

CMT score	Lab A		Lab B		Lab C		Lab D		Lab E	
	Util.	Cost	Util.	Cost	Util.	Cost	Util.	Cost	Util.	Cost
	(%)									
3	14	0	71	18	90	43	0	1	3	0
2	92	21	94	59	100	85	33	14	100	90
1	100	93	99	88	100	98	90	56	100	100
tr	100	98	100	99	100	100	95	85	100	100

b) Screening at 1.5 million somatic cells/ml

CMT score	Lab A		Lab B		Lab E	
	Util.	Cost	Util.	Cost	Util.	Cost
	(%)					
3	27	2	79	36	5	0
2	100	40	93	72	100	93
1	100	95	96	93	100	100

TABLE 4. UTILITY AND COST ESTIMATES USING THE MWT TO SCREEN BULK TANK MILK SAMPLES

a) Screening at 1.0 million somatic cells/ml

MWT score	Lab A		Lab B		Lab C		Lab D		Lab E	
	Util.	Cost	Util.	Cost	Util.	Cost	Util.	Cost	Util.	Cost
	(%)									
3 +	17	0	82	37	38	12	18	3	2	0
2 +	87	18	98	77	90	46	58	18	88	60
1 +	100	89	100	96	100	75	88	49	99	97
tr	100	99	100	100	100	94	100	78	100	100

b) Screening at 1.5 million somatic cells/ml

MWT score	Lab A		Lab B		Lab E	
	Util.	Cost	Util.	Cost	Util.	Cost
	(%)					
3 +	27	2	98	51	4	0
2 +	100	40	100	85	92	68
1 +	100	95	100	97	100	98
tr	100	99	100	100	100	100

Under the national abnormal milk control program, the critical score to be used for each screening test is constant, derived from a national survey by the U. S. Public Health Service *(13)*. If each laboratory used these scores rather than its own best determination, the Utility of the tests ranged as follows: CMT (>1) = 93 to 100%; MWT ($> +1$) = 92 to 100%; WMT (>21) = 77 to 87%; and CAT ($>30\%$ 0_2) = 91 to 96%. The lowered Utility of the WMT at that critical score was accompanied by a decrease in its Cost to 13%. To the extent that assignment of uniform critical scores for use in all laboratories is justified at all, our results support those currently specified, with the exception that the score for the WMT should be lowered to >20 to achieve equivalent recovery of positive samples. This conclusion is, of course, contingent upon exercise of similar care in collection and storage of bulk tank samples and upon their testing within 24 hr. Analysis of milk samples after greater delay or less careful handling may be expected to further reduce the Utility and magnify the Cost estimate for each screening test.

Our data are useful in predicting the efficiency of operation of these screening tests at a somatic cell concentration limit of 1.0 million/ml. Determined as before at that test score which in each laboratory yielded at least 90% Utility, the average Costs of the tests were: CMT = 54%;MWT = 77%; WMT = 45%; CAT = 47%; and MGI = 31%. The increase in proportion of false positive determinations for the WMT and MGI at this lower concentration limit reflects both a real increase in Cost determined for

TABLE 5. UTILITY AND COST ESTIMATES USING THE WMT TO SCREEN BULK TANK MILK SAMPLES

a) Screening at 1.0 million somatic cells/ml

WMT score	Lab A		Lab B		Lab C		Lab D		Lab E	
	Util.	Cost	Util.	Cost	Util.	Cost	Util.	Cost	Util.	Cost
	(%)									
18	87	6	77	34	85	41	83	48	81	20
17	91	11	82	39	92	50	83	51	84	25
16	93	16	87	50	94	57	85	53	87	29
15	95	21	94	63	98	65	90	56	88	36
14	99	28	97	71	100	71	90	60	90	44

b) Screening at 1.5 million somatic cells/ml

score	Lab A		Lab B		Lab E	
	Util.	Cost	Util.	Cost	Util.	Cost
	(%)					
22	87	8	77	16	87	14
21	96	11	83	23	88	17
20	97	16	94	36	93	23
19	99	24	98	41	95	29
18	99	28	98	47	97	41

TABLE 6. UTILITY AND COST ESTIMATES USING THE CAT TO SCREEN BULK TANK MILK SAMPLES

a) Screening at 1.0 million somatic cells/ml

CAT score	Lab A		Lab B		Lab C		Lab D		Lab E		CAT score
	Util.	Cost	Util.	Cost	Util.	Cost	Util.	Cost	Util.	Cost	
	(%)										
37-38	45	3	59	23	58	12	80	23	55	12	50
35-36	56	5	69	31	62	17	90	32	67	20	45
33-34	67	8	72	37	69	19	90	35	77	37	40
31-32	75	16	80	44	85	24	95	41	83	54	35
29-30	84	23	87	55	96	32	98	49	90	75	30
27-28	90	32	90	66	100	37			95	85	25
25-26	92	46	95	77							

b) Screening at 1.5 million somatic cells/ml

CAT score	Lab A		Lab B		Lab E		CAT score
	Util.	Cost	Util.	Cost	Util.	Cost	
	(%)						
39-40	63	7	81	26	73	22	50
37-38	77	10	84	31	83	32	45
35-36	83	15	90	41	90	47	40
33-34	87	21	91	47	93	61	35
31-32	91	30	95	55	96	79	30

the laboratories and also the participation in the averages of two additional laboratories. These two tests would still be the preferred choices for screening at 1.0 million cells/ml.

Although Read et al. *(5)* approached the analysis of screening test performance in a somewhat similar manner, and apparently balanced their sample population similarly to ours both in range and symmetry, the form of their data presentation precludes direct comparison of the results. Data presented by Smith and Schultze *(10)* and Schultze and Smith *(8)* in earlier studies of the CMT match closely the results of their laboratory in the present study. In the three separate studies, using CMT at >1 to screen for milks in excess of 1.0 million cells/ml, they achieved between 90 and 95% Utility at a Cost of 28, 21, and 21%, respectively. Results of Kowalczyk *(1)* can be expressed in this form, assuming a cell concentration

limit of 1.0 million/ml. Excluding samples with concentrations greater than 5 million/ml, he found CMT scores of ≥1 to detect 94% of positive samples at a Cost of 57% false positives, and MWT scores of ≥1+ to detect 88% of positives at a Cost of 52% false positives. His sample distribution was also unlike that to be expected in the field, with 0.5 to 1.0 million cells/ml the most frequent subclass. Data of Postle *(4)* can be recalculated to provide information on screening bulk tank samples at 0.5 million cells/ml. The Utility and Cost, respectively, were 83% and 37% for the CAT at ≥ 30% 0_2, and 91% and 22% for the WMT at ≥15. These results, although fragmentary, support our conclusion as to the relative superiority of the objectively-scored tests based on the gel reaction. The fact that the scoring level of 30% 0_2 in the CAT has been treated as equivalent to either 0.5 or 1.5 million cells/ml by different experimenters without much difference in Cost or Utility speaks clearly of the extreme imprecision of this test for estimating cell concentration.

The general superiority of results from the MGI, coupled with the fact that it really differs only in hardware from the runner-up WMT, tempts us to call for development of a new screening test, based on the same principle as these but with mechanical improvements to make the advantages of the MGI more readily accessible. If an indirect screening test is to be employed for routine milk monitoring, the potential saving in operating cost offered by the WMT and MGI should be maximized.

Differences in the performance and calibration of the various screening tests are apparent in our results. Laboratory A, for example, used the WMT (Table 5) to achieve greater than 90% Utility at either cell concentration level at a Cost of only 11%. The Cost among the other laboratories ranged from 23 to 63%, despite the more favorable sample distributions for laboratories C and D. Laboratory A performed each of the screening tests at the lowest Cost, and in most instances laboratory E at the highest Cost. Since the relative ranking of Cost for the tests was similar among the laboratories, it is tempting to conclude that a major cause of the disparity was differences in magnitude of random error in DMSCC performance. We computed for each laboratory's DMSCC data the mean value for relative variance of sample means according to the method of Smith *(11)*. For laboratories A, B, C, D, and E, respectively, the computed values for $s^2\bar{y}$ were .436 $\bar{y}$, .552 $\bar{y}$, .445 $\bar{y}$, .225 $\bar{y}$, and .919 $\bar{y}$. The high variance found for laboratory E is consonant with its relatively high Cost estimates for the screening tests. The variance estimated for laboratory D is sufficiently smaller than the expected .4 $\bar{y}$ to alert one to the possibility that the technician performing the DMSCC tended to smooth the differences among individual strip counts.

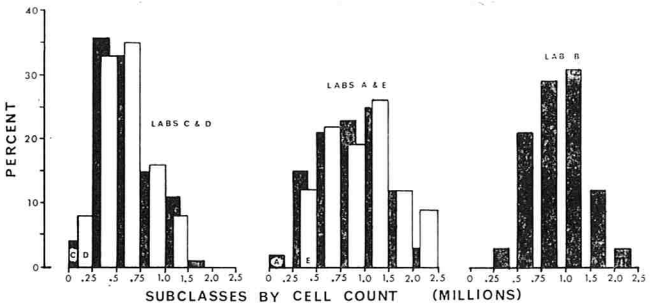
TABLE 7. UTILITY AND COST ESTIMATES USING THE MGI TO SCREEN BULK TANK MILK SAMPLES

a) Screening at 1.0 million somatic cells/ml

MGI score	Lab A		Lab B		Lab C		Lab D	
	Util.	Cost	Util.	Cost	Util.	Cost	Util.	Cost
	(%)							
32-33	89	10	62	8	42	19	88	26
30-31	92	13	65	9	42	20	88	26
28-29	93	16	71	14	46	23	95	31
26-27	95	20	73	18	56	24	95	32
24-25	98	24	81	26	65	28	95	40
22-23			86	30	73	28		
20-21			90	38	77	34		
18-19			93	45	87	36		
16-17			96	57	90	42		

b) Screening at 1.5 million somatic cells/ml

MGI score	Lab A		Lab B	
	Util.	Cost	Util.	Cost
	(%)			
48-49	92	4	42	2
46-47	94	7	47	2
44-45	95	9	59	3
42-43	96	11	62	4
40-41	100	16	72	7
38-39			75	9
36-37			87	14
34-35			90	16



Figule 1. Distributions by cell concentration of milk samples used to evaluate screening tests.

Another aspect of the problem of interlaboratory differences is illustrated by the variation in scoring level required to achieve equivalent Utility. This variation is apparently systematic, and could reflect bias in performance of either the screening test or the DMSCC, or both. An example can been seen in the MGI results, for which critical scores (90% Utility) against 1.0 million cells/ml were, respectively, 30, 20, 16, and 28. The two subjectively read screening tests yielded extreme illustrations of this problem. When the CMT was used to screen against the 1.0 million cells/ml level, a score of 3 as assigned in the respective laboratories resulted in Utility estimates of 14, 71, 90, 0, and 2%. The MWT was not much better, achieving 17, 82, 38, 18, and 2% Utility, respectively. Clearly, scoring judgements were not equivalent, for we cannot conceive of such an extreme bias in cell counting. Distributions of high cell count samples among laboratories would lead us to expect a different ranking of percentages, namely mid, high, low, low, and high, for the respective laboratories, if distribution were the controlling factor.

In this collaborative study we exercised extreme care to achieve uniformity both in collection and storage of relatively fresh samples and in the details of testing procedure. Despite our efforts, large differences appeared in the relation between screening test scores and cell counts for the several laboratories. Since even greater discrepancies are likely to obtain among the many dairy laboratories engaged in abnormal milk control testing, we strongly believe that each laboratory should develop control data required to establish and justify a working critical score based on its own circumstances of milk supply and laboratory performance.

On the basis of these studies, the Subcommittee on Screening Tests has come to the following conclusions:

(a) That all the indirect screening tests included in this investigation may be expected to identify an inconveniently large proportion of false positives when used to screen milk samples for cell concentration above or below a limiting somatic cell concentration.

(b) That among the tests investigated, the WMT and MGI can be so used with the least Cost.

(c) That these two tests would still be the methods of choice if the limiting cell concentration for the national abnormal milk control program were lowered to 1.0 million/ml.

(d) That individual laboratories may be expected to vary widely in the efficiency with which they operate any screening test, and to a lesser degree in the test score required to detect a similar proportion of over-limit samples.

(e) That the currently-accepted test scores for screening milks against 1.5 million somatic cells/ml are valid generalizations, except that the WMT score should be lowered to > 20 to make its Utility equivalent to that achieved with the other indirect tests.

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EXAMINATION OF FOOD AND WATER FOR CHOLERA VIBRIOS

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ABSTRACT

A procedure to detect cholera vibrios in food and water, consisting of the examination of large samples, using pre-enrichment, concentration by micropore filtration, and enrichment in alkaline peptone broth is described. This method was used to examine ten types of foodstuffs exported from countries invaded by cholera. No cholera vibrios were found in these 435 samples, whereas 37 of 964 specimens collected in households of cholera patients harbored these organisms. It appeared that the risk of transmission of cholera by uncooked cereals, legumes, acidic produces, properly canned food, and dried fruits and cereal products is negligible. A search for salmonellae and shigellae was carried out simultaneously. One of the 10 exported smoked fish samples yielded *Salmonella typhimurium*. Of the 964 samples collected in homes, 10 harbored salmonellae, and 11 shigellae. Food from cholera-infested areas also should be examined for these organisms.

The exact time of the beginning of the present cholera pandemic has not been determined but it probably started in 1960. This outbreak is caused by the El Tor biotype of *Vibrio cholerae*. The infection spread first over the southern part of Asia, lost some of its momentum in 1967 and 1968, then rapidly involved also Africa, the Iberian Peninsula and large areas in East Europe. Endemic foci developed in Southeast Asia and the Middle East. It is a matter of conjecture if and when cholera will invade the Americas, the smaller islands of the Pacific Region, and additional areas in South Africa and Europe.

The infection is often water-borne but symptomless carriers and patients not presenting the typical clinical picture of classical, grave cholera seem to play a significant role in the propagation of the present pandemic *(9)*. Flies have been found infected only in a few instances *(2, 13)*. Cholera vibrios do not appear to have any other natural host than man *(22)*. Nevertheless food, water, and fomites may become contaminated with the vomitus of cholera patients and with the feces of carriers as well as patients. Therefore Public Health authorities have been greatly concerned with the possible transmission of cholera by this route *(3, 9, 24)*. Hence, food and beverages originating from cholera-infected regions often have been rejected by other countries during the present pandemic even though many such products have been prepared in properly supervised and inspected establishments, and by procedures that destroy cholera vibrios. Even cereals, acidic fruits, factory-made carbonated beverages, and dried fruits which do not support survival and multiplication of cholera vibrios were rejected by some prospective recipients *(5, 8, 13, 17, 21 - 24, 29)*. The resulting economic loss seriously affected agriculturists, fishermen, processors, shippers, exporters, and importers. This induced the World Health Assembly in 1971 to call for further studies on the survival time of cholera vibrios, particularly in food destined for export. Such a reappraisal of available data appeared necessary because the hitherto published investigations did not yield uniform results *(8)*.

Several authors studied the survival of cholera vibrios outside the human body on artificially infected food, water, and fomites *(1–8, 13, 15, 17, 19, 21, 22, 24, 25)*. However only selected food items, often only locally consumed products, were examined. The investigators worked with different strains and used diverse numbers of organisms to infect the food samples which were then incubated at selected temperatures and pH. Moisture content and osmolarity were seldom considered *(17)*. A variety of methods was used to recover the vibrois (reviewed in *1, 8, 9, 17, 22, 24)*. These incongruencies impaired evaluation of results and vitiated their application to estimate the risk of spreading cholera by naturally infected edibles. Moreover, only few investigations of the survival period of cholera vibrios in the environment, on food, and in water naturally infected with *V. cholerae* biotype El Tor have been reported to date during the present pandemic *(3, 12, 16, 26, 29)*. However a review of the results presented by various authors reveals certain general patterns repeatedly observed by several investigators. The El Tor biotype causing the present pandemic is more resistant to adverse environmental factors, as lowering of the pH, changes in osmolarity, and in its ability to compete for basic nutritional factors than the "classical" cholera vibrio which was considered the only microorganism able to produce cholera epidemics between 1906 and 1960. All choleragenic vibrios appear to survive on food, in milk and milk products, water, and

TABLE 1. MEAN SURVIVAL TIME OF EL TOR VIBRIOS IN WATER AND SOME FOODS

Item	Incubation temperature		
	20 to 40 C	2 to 5 C	<1 C
Shallow well water	8 ± 2[a]	10 ± 3	
Deep well water	4 ± 2	6 ± 1	
Seawater	11 ± 3	15 ± 2	
Ice			20 ± 2
Carbonated beverages	<1	<1	
Milk and ice cream	10 ± 2	18 ± 3	14 ± 1
Acidic fruit juices, beer, wine	<1	<1	
Uncooked rice, wheat, barley, corn, legumes	2 ± 1	2 ± 1	
Fresh tomatoes	1 ± 1	5 ± 2	
Fresh potatoes	1 ± 1	4 ± 2	
Citrus fruits	1	1	
Bananas	2 ± 1	3 ± 1	
Dried figs and dates	<1	<1	
Fish and shrimp	2 ± 2	10 ± 5	18 ± 3[b]
Beef	1 ± 1	7 ± 4	
Kitchen utensils	1 ± 1		

[a]Mean ± standard deviation, in days.
[b]Deep-frozen

on fomites for a longer time at 2 to 5 C than at 20 to 30 C. Table 1 shows the reported survival time of freshly isolated El Tor vibrios in water and such selected food samples which frequently have been supposed to convey cholera infection from one country to another *(4, 5, 13, 15, 16, 19, 21, 24, 25)*.

This communication is primarily concerned with a reproducible laboratory procedure that permits recovery of cholera vibrios from food and beverages and a comparison between food contaminated by improper handling during processing, storage, distribution, and in households on one hand, and of a number of food items collected, processed and shipped from cholera-infested areas under appropriate precautions on the other.

MATERIALS AND METHODS

Nine hundred sixty-four samples of food, milk, ice, and water were collected aseptically in Thailand in 1960 to 1962 and studied in the laboratory by the methods described below within 4 hr after collection. Four hundred thirty-five samples of uncooked cereals, fruits, canned food, and dried cereal products imported from cholera-infected areas were collected in retail outlet stores in Thailand, Switzerland, England, and the United States. The samples were examined with the aid of the procedures listed in sections A to D below.

Methods used to detect cholera vibrios in food and water may be divided into two groups. One of them advocates washing solid food samples with alkaline peptone water and adding double-strength alkaline peptone broth to water and other liquids. The fluids are incubated at 37 C, then plated to selective cholera media. This method was employed by the coworkers of Robert Koch *(23)*. The other procedure uses the membrane filter technic with subsequent culture of the growth collected on the filter *(7-10, 24)*.

An attempt to recover salmonellae and shigellae was also included in the present studies. This required additional materials and effort but offered a broader insight into the status of the contaminated food samples.

Food samples were prepared for examination according to generally recommended methods *(14, 18, 27, 28)* with modifications that were found suitable for detection of cholera vibrios:

A. Solid and semisolid foods

1. *General preparatory measures.* All phases of the food examination were carried out under rigid aseptic conditions using sterile instruments, apparatus, containers, glassware, disposables, solutions, and media. Samples weighing 10 to 50 g were examined. If the food was frozen, thawing at room temperature (18 to 20 C) was necessary. Heating was avoided. Samples were processed immediately after thawing was completed.

Packaged food was opened using aseptic conditions with sterile instruments. The container or wrapping was cleansed with cotton soaked in 70% alcohol, and washed with sterile distilled water before opening.

2. *Pre-enrichment.* This step was necessary particularly for the "resuscitation" of organisms exposed to sublethal stress by ionic radiation, heat, freezing, or dehydration during processing and/or storage of food. This procedure also contributed to the maintenance of the pH of the medium into which the microbes were placed in subsequent steps.

i. If only cholera vibrios were sought, nine volumes of a solution of 0.1% peptone and 0.8% NaCl in water, pH 7.8 to 8.0 after autoclaving, were added to the sample.

ii. If the examination included also a search for shigellae and salmonellae, nine volumes of sterile PBS containing 0.1% peptone, 0.76% NaCl, 0.13% Na_2HPO_4, 0.03% NaH_2PO_4, pH 7.3 after autoclaving, were added.

3. *Blending.* After pre-enrichment for 12 to 15 min at room temperature, blending at 8,000 to 10,000 r.p.m. was carried out for 2 to 3 min. Hand-shaking of the mixture appeared feasible when only the surface of the food was expected to be contaminated, and for fomites. Emulsification was necessary when the sample was rich on fat. The procedure had to be carried out with cooling if the temperature of the contents of the mixer increased by more than 5 C during the blending.

4. *Separation of the supernate.* If the solid particles did not settle out immediately:

i. The mixture was rapidly filtered through a Buchner funnel with a coarse pad of filter paper or a micropore prefilter, using suction. Cotton and gauze frequently retained considerable amounts of the supernate and were not used for that reason.

ii. An alternate method was centrifugation at 800 to 1,000 r.p.m. for not longer than 5 minutes.

5. *Qualitative procedure.*

i. a. If *only cholera vibrios* were sought, the supernate was filtered through a micropore filter with an average pore size of 0.22 μ (Gelman, Schleicher and Schüll, or Millipore). Then the filter membrane was dropped into an Erlenmeyer flask with a narrow neck, containing 200 to 250 ml of alkaline peptone water made with 1% peptone and 1% NaCl, pH 7.8 to 8.0. The medium filled part of the narrow portion of the flask because cholera vibrios, particularly the El Tor biotype, tend to accumulate near the surface of the nutrient fluid.

b. After 6 and 16 to 18 hr incubation at 37 C, plates suitable for growth of cholera vibrios were streaked from the upper part of the medium. We have been using tellurite-lauryl sulfate (Cholera Medium, Oxoid) and Husain-Burrows plates (alkaline agar with 1% NaCl, 0.2% glycerol, and 0.1%

thionin; pH 8.4 to 8.6), later also T.C.B.S. [(thiosulfate-citrate-bile salt-sucrose (Baltimore Biological Laboratory, Difco or Eiken)] medium. Duplicate plates were streaked in all instances.

ii. If *V. cholerae, Salmonella,* and *Shigella* were studied simultaneously, the supernate prepared with buffered peptone-saline (A.2.ii.) was divided into two equal portions. Both were filtered through separate membrane filters with an average pore size of 0.22 μ. One of them was immersed into alkaline peptone broth, incubated, and the growth streaked to plates as under A.5.i. for isolation of cholera vibrio colonies.

The other filter membrane was dropped into 100 ml Selenite-F broth in the first tests. Later the same amount of Hajna GN broth (B.B.L. or Difco) was used. Duplicate MacConkey, Shigella-Salmonella and/or Desoxycholate-Citrate plates (B.B.L. or Difco) were streaked after 6 to 12 hr incubation of the enrichment broth at 37 C to culture salmonellae and shigellae.

The Hynes plate (Oxoid) and the D.E.C. medium of Panja and Ghosh *(20)* appeared feasible for the simultaneous isolation of cholera vibrios as well as of salmonellae and shigellae *(7, 9, 12)*. Unfortunately, the D.E.C. medium is not available commercially and its preparation is laborious.

6. *Quantitative estimation of cholera vibrios.* Steps A.1 to A.3. were carried out, followed by centrifugation as described in A.4.ii. Then:

i. Ten-fold dilutions to 10^4 of the supernate were prepared. Ten-milliliter aliquots of the undiluted and diluted supernate were inoculated into test tubes containing 10 ml of medium with 2% peptone and 2% NaCl, pH 7.8 to 8.0. The tubes were incubated for 16 to 18 hr at 37 C, then streaked to a selective medium for cholera vibrios as under A.5.i.b. The number of viable *V. cholerae* per gram of food was estimated from the number of discrete colonies appearing on the plates, multiplied by the dilution factor(s), and divided by the weight of the sample.

ii. An alternate method consisted of micropore filtration of the supernate as outlined in A.4.ii. The filter was placed on the surface of a selective cholera medium such as T.C.B.S., the plate incubated for 22 to 24 and 48 hr at 37 C, then the vibrio colonies that grew on the plate were counted.

B. Beverages including water

1. *General preparatory measures.* Carried out as under A.1. The amount of examined fluid was at least 100 ml. Whenever possible, at least 1 liter of water was examined.

2. *Examination.*

i. The fluid was treated as the supernate of solid food after blending. Microporé filtration was carried out, the filter incubated in alkaline peptone water, then plates streaked as described in paragraph A.5.

ii. Milk, milk products, fruit juices, and carbonated beverages were diluted with 10 volumes of alkaline peptone water before micropore filtration. If a sediment was formed, it was centrifuged off at 1,000 r.p.m. for 5 min. The examination was continued as above.

3. *Quantitative estimation.* Vibrios were enumerated as described in A.6.i. for solid food. The liquid was prepared according to the procedure B.2.

C. Direct culture method

This procedure consisted of washing the surface of solid food with alkaline peptone water without pre-enrichment, incubating the washing fluid for 6 and 16 to 18 hr at 37 C, then streaking selective cholera vibrio plates as in A.5.i.b. from the growth in the alkaline peptone water.

Water, other beverages, and melted ice were diluted with an equal amount of double-strength alkaline peptone water (2% peptone, 2% NaCl, pH 7.8 to 8.0), incubated, and streaked to plates as under A.5.i.b.

D. Identification of the isolates

Colonies showing characteristics of cholera vibrios on the selective plates, namely, with brownish-black centers on tellurite media; yellow on the T.C.B.S. plates but colorless on the Husein-Burrows, D.E.C., and Hynes media, were selected. The "suspicious" colonies were usually translucent, relatively large, with smooth edges, but rough colonies were not infrequent. The colonies were inoculated into Kligler medium. Cholera vibrios do not form H_2S and gas but produce an acid butt and an alkaline slant in this medium. Slide-agglutination with bivalent, then Inaba and Ogawa commercial sera (Difco or Burrows-Welcome) permitted a preliminary diagnosis.

Cross-reactions with other organisms and the necessity to distinguish the El Tor biotype as well as so-called nonagglutinable vibrios (NAG) required further tests.

El Tor organisms should give positive hemolysin and V. P. tests but aberrant types are not rare. Phage susceptibility and vibriocin testing should be carried out in specialized reference laboratories.

For rapid orientation, one drop of a heavy suspension of the growth on the slant of the Kligler medium was mixed with one drop of a 2.5% chicken red blood cell suspension in PBS. El Tor (and many "water" vibrios) show hemagglutination, whereas the "classical" cholera vibrios do not. Numerous other tests devised to differenciate El Tor and "classical" cholera vibrios are based on the lesser susceptibility of the El Tor biotype to unfavorable environmental factors, including some antibiotics *(5, 9)*.

Tubes with semisolid mannitol (0.4 to 0.5% agar, 0.5% NaCl, 1% peptone, 1% mannitol, 1% Andrade indicator, 0.4% of a 0.4% aqueous solution of brom thymol blue) were inoculated by stabbing. Cholera vibrios form acid (red color) and show motility. These vibrios also give a positive indol test and utilize arginine but not lysine and ornithine. Most cholera vibrios, including the El Tor biotype, decompose mannose and sucrose but not arabinose. The last three carbohydrate fermentation tests permit classification of NAG vibrios into groups according to Heiberg.

Growth of the vibrios in 3 and 6% NaCl helps to distinguish the halophilic *Vibrio parahaemolyticus. Aeromonas* decomposes arginine but not lysine and ornithine. *Plesiomonas* and most *Proteus* strains do not ferment mannitol. *Proteus* strains also break down urea. *Pseudomonas* does not split dextrose and, therefore, the butt of the Kligler medium remains unchanged.

Results and Discussion

Table 2 shows the results of the examination of the samples collected in not inspected establishments and in households where infections with cholera occurred during the beginning of the present cholera pandemic. The number of samples harboring cholera vibrios varied. Approximately 7.5% of the samples of cooked rice in homes were found infected by these organisms. This probably resulted from contamination by soiled hands because rice in the hot areas of the Far East is frequently cooked only once a day, and then kept in the house for later consumption. Water harboring cholera vibrios was

TABLE 2. RESULTS OF THE EXAMINATION OF FOOD AND WATER SAMPLES COLLECTED IN THAILAND

Samples	No. samples tested	No. samples found to harbor: *V. cholerae*					*Salmonella*	*Shigella*
		Pre-enrichment at pH 7.9	7.3	Washing or dilution with alk. pept. water	No. organisms, by tube dilution[1]	Filter pad put on media[1]	Pre-enrichment at pH 7.3	
Water containers in front of homes	33	4	3	2	$3.1 \pm 1.2 \times 10^2$	$1.8 \pm 0.9 \times 10^2$	2	1
Ice from unapproved factories	128	4	3	2	$1.9 \pm 0.7 \times 10^2$	$1.0 \pm 0.3 \times 10^2$	3	2
Milk from unapproved dealers, kept in homes	318	7	6	1	$1.1 \pm 0.2 \times 10^3$	$6.7 \pm 0.3 \times 10^3$	2	4
Cooked rice in homes	239	18	15	7	$8.2 \pm 0.7 \times 10^2$	$1.2 \pm 0.2 \times 10^2$	2	4
Fresh fish and shellfish, from homes	246	4	5	1	$2.7 \pm 0.3 \times 10^2$	$2.8 \pm 0.4 \times 10^2$	1	0

[1]Mean and standard deviation of No. of vibrios per g or ml in samples positive by the pre-enrichment method.

probably the principal cause of the presence of these microbes in milk and ice not approved by the proper authorities. Contamination by soiled hands and containers may account for the finding of vibrios in water containers and in milk. The positive vibrio cultures from not cleaned or cut and uncooked fish and shellfish confirm former observations which demonstrated that these bacteria may survive for several weeks in some species of fish and shellfish which live in contaminated water *(3, 9, 15, 21, 23, 25)*. The role of soiled hands and other means of admixture of fecal matters to food is borne out also by the finding of shigellae and salmonellae in some of these samples.

The larger number of specimens harboring shigellae than salmonellae emphasizes the importance of food contamination by man and his excreta because in nature only primates including man harbor shigellae.

No cholera vibrios, salmonellae, or shigellae were isolated from 85 samples of uncooked rice from Thailand, Taiwan, and Korea; 25 samples of uncooked legumes from India; 46 samples of uncooked grain from Iran; 50 boxes of preserved export dates from Iraq; 51 packages of rice noodles from Taiwan and Japan; and in 39 cans of smoked oysters and shrimps from Japan. Neither were cholera vibrios found in 59 cans of fruit from Hong Kong, on 47 hands of bananas from the Philippines, and on 23 grapefruits from Israel. Of 10 samples of smoked whole fish from Taiwan, one contained *Salmonella typhimurium*. Except for the cereals, untreated fruits, legumes and whole smoked fish, all samples came from establishments inspected and approved by the appropriate Public Health authorities, and have been passed for import to Europe and the United States. These results were gratifying. The viability of the El Tor biotype is greater than that of the "classical" cholera vibrios encountered in former cholera epidemics. Nevertheless, the survival time of these organisms on certain foods was limited. The findings confirmed the value of proper inspection and supervision of food processing establishments. Unfortunately, no raw vegetables and only few fruits were available for this part of the study.

Since the examined samples were collected 4 to 8 weeks after cholera was reported from the country of origin of these foods and only products considered "recently arrived" were tested, it appears that properly grown, collected, processed, stored, and distributed food generally does not convey cholera. Exceptions may include unheated fish and other waterlife with alkaline stomach contents *(3, 5, 21)*, milk and milk products not exposed to temperatures that destroy cholera vibrios, contaminated ice used to preserve unprocessed food *(5, 8)*, and also some vegetables that are shipped without cleaning and then eaten raw *(5, 21, 23, 24, 26)*. If the results of the study of artificially contaminated food samples can be used to draw some conclusions, cholera vibrios may be expected to die off within 3 to 4 weeks even in food favoring their survival, except in milk and milk products, ice and deep-frozen food.

Comparison of the methods used in these studies demonstrated the efficacy of the micropore filter technic after pre-enrichment for the detection of cholera vibrios. There appear to be several avenues permitting further development of the quantitative methods, for instance addition of tellurite and sodium lauryl sulfate or bile salts to the diluting fluids, and the use of radioactive isotope immunoprecipitation test. Additional studies of plating media favoring simultaneously the growth of vibrios, shigellae and salmonellae are also desirable.

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COLIFORMS AND KEEPING QUALITY OF A *STREPTOCOCCUS LACTIS* BASED CULTURED MILK PRODUCT[1]

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ABSTRACT

Coliform bacteria counts, pH, titratable acidity, and keeping quality were determined for a *Streptococcus lactis* based cultured milk product, stored at 4, 19, 37, and 43 C. Coliform counts decreased rapidly at 43 and 37 C, usually disappearing completely within 24 hr. Coliform counts generally decreased on storage at 19 C, although some samples showed increases in coliforms, whereas slight decreases were found during storage at 4 C. The keeping quality was related to initial coliform counts but not to changes in acidity or in coliform population.

The presence of coliform bacteria in milk products is generally regarded as providing an index of the hygienic standard of the product and also of its keeping quality. Many public health authorities set down maxima for the density of coliforms in milk and its products. Dahlberg *(3)* reported that storage of milk at temperatures above 7 C results in a considerable rise in coliform counts. Schultze and Olson *(7)* isolated coliforms as the dominant psychrotrophic bacterial type from dairy products after storage at 4 C for one week. Fermented milk products based on thermophilic cultures of *Lactobacillus* and *Streptococcus thermophilus* seem to inhibit coliform bacteria *(4, 5)* and cause their complete disappearance within 6 hr *(10)*. In fermented milk products based on mesophilic cultures, such as *Streptococcus lactis*, the behavior of coliforms is less clearly defined. Overcast and Britton *(6)* report little change in coliform counts during storage of cottage cheese at 5 C but Skelton and Harmon *(8)* found considerable increases in coliforms in cottage cheese stored at 13 C. Goel et al. *(4)* found decreases in coliform counts in buttermilk and cottage cheese stored at 7 C, although in some instances coliform counts did increase in cottage cheese.

The present study was undertaken to determine the fate of coliform bacteria in a local cultured milk product based on *Streptococcus lactis* and to ascertain the correlation between coliform counts and keeping quality.

METHODS

The cultured milk product (a variety of Leban) was obtained from five different commercial dairies. The product was prepared by pasteurization of whole milk at 80-90 C for 1-1.5 min, cooling, addition of a commercial starter containing a mixture of *Streptococcus lactis* and aroma bacteria, and ripening at 25-30 C for 8-15 hr. Samples were transferred to the laboratory where they were maintained at 4±1, 19±2, 37±1, and 43±1 C. Each test lasted 9 days and involved daily duplicate examination of two samples at each temperature. Seven coliform levels were examined and results were analyzed by accepted statistical methods *(9)*. Acidity was determined according to *Standard Methods (1)*, and pH was measured on a Radiometer Copenhagen pH meter. Coliform bacteria were counted on violet red bile agar as described in *Standard Methods (2)*. Organoleptic testing was carried out by a trained panel of five dairy technologists. The cultured milk product was assessed on the basis of the following criteria: separation of curd from the container, cracks, wheying-off, gas production, bitterness, atypical flavors, acidity, and the presence of yeast, molds or chromogenic organisms on the surface. The excessive occurrence of one or more of the listed criteria resulted in rejection of the sample.

RESULTS

Acidity and pH

Figures 1 and 2 show the mean changes in pH and acidity observed at the various temperatures of incubation. Acidity and pH changed little at 4 C, acidity increased and pH decreased at 19, 37, and 43 C, changes of the largest magnitude being observed at 37 C.

Coliform bacteria

Samples incubated at 4 C showed very slight decreases in coliform counts. At 19 C most samples tested showed a decline in the number of coliforms; however, two samples which contained higher initial coliform counts did support extensive coliform increases. Incubation of the samples at 37 and 43 C resulted in a rapid decrease in the coliform population, resulting in almost complete disappearance within 24 hr (Fig. 3).

Keeping quality

Two samples were rejected after 26 hr at all temperatures. Otherwise samples incubated at 4 C showed good keeping qualities, one being rejected after 120 hr due to mold and the remainder still being edible after 170 hr. Two samples stored at 19 C

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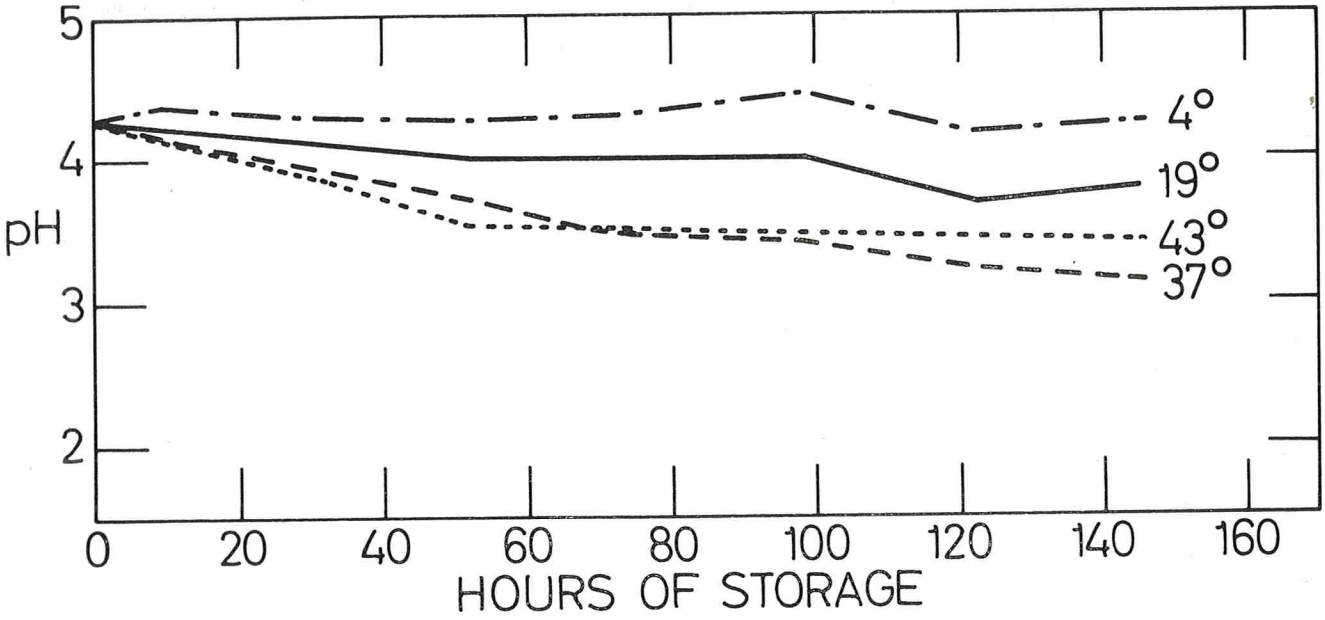

Figure 1. Mean changes in pH of the cultured milk product with time of storage at 4, 19, 37 and 43 C.

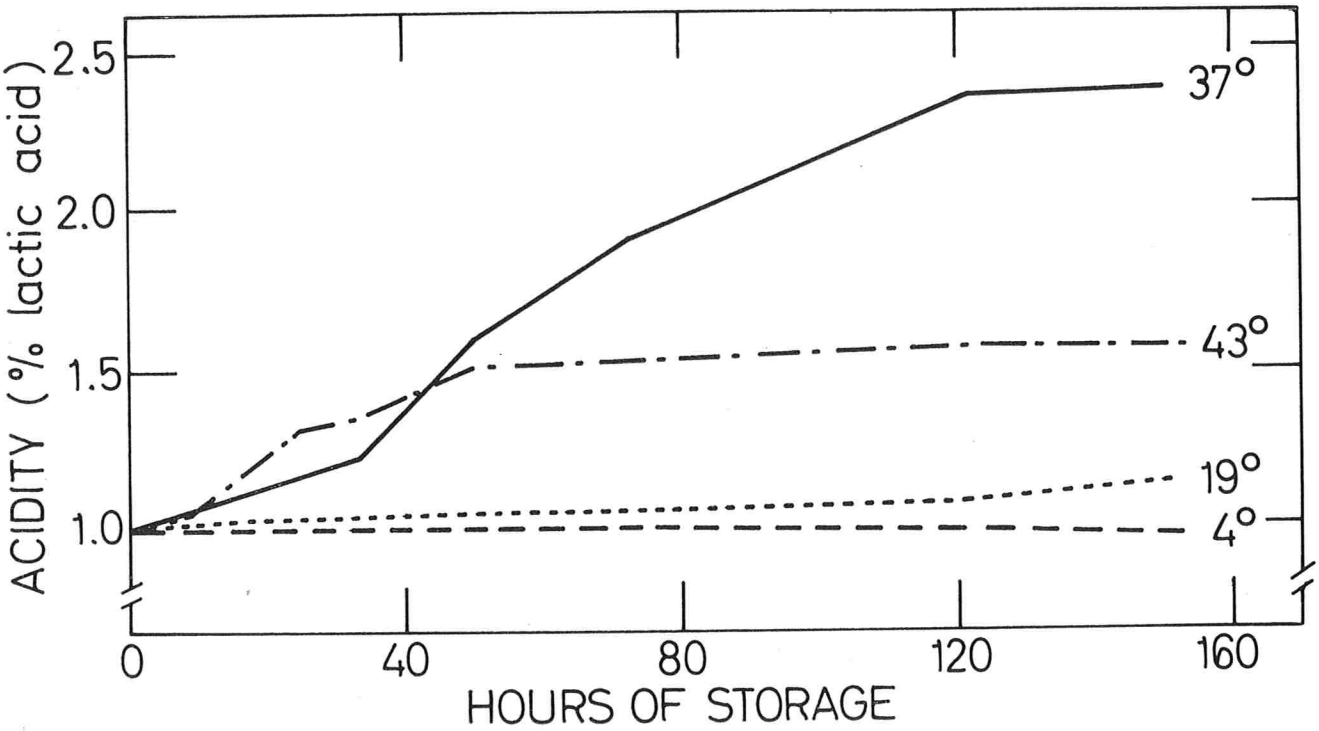

Figure 2. Mean changes in titratable acidity of the cultured milk product time of storage at 4, 19, 37 and 43 C.

were rejected after 75 hr because of the growth of yellow colonies (small gram-negative rods) on the surface and the remainder developed an unidentified mold growth on the surface. Storage of the samples at 37 C resulted in excessive off-flavors after 33 and 52 hr. One sample however, lasted 75 hr before development of excessive off-flavors and mold on the surface.

Storage at 43 C resulted in rejection of all samples within 33 hr due to textural faults and off-flavors.

Figure 4 plots initial coliform counts against shelf life. A statistically significant correlation was found between the initial coliform counts and the shelf life at the various temperatures.

Statistical analysis of the data from which Fig. 1, 2, 3, and 4 are composed shows no apparent correlation (r approximately 0.1) between changes in acidity and changes in the coliform population, or between either of these two factors and the time of storage until rejection of the samples.

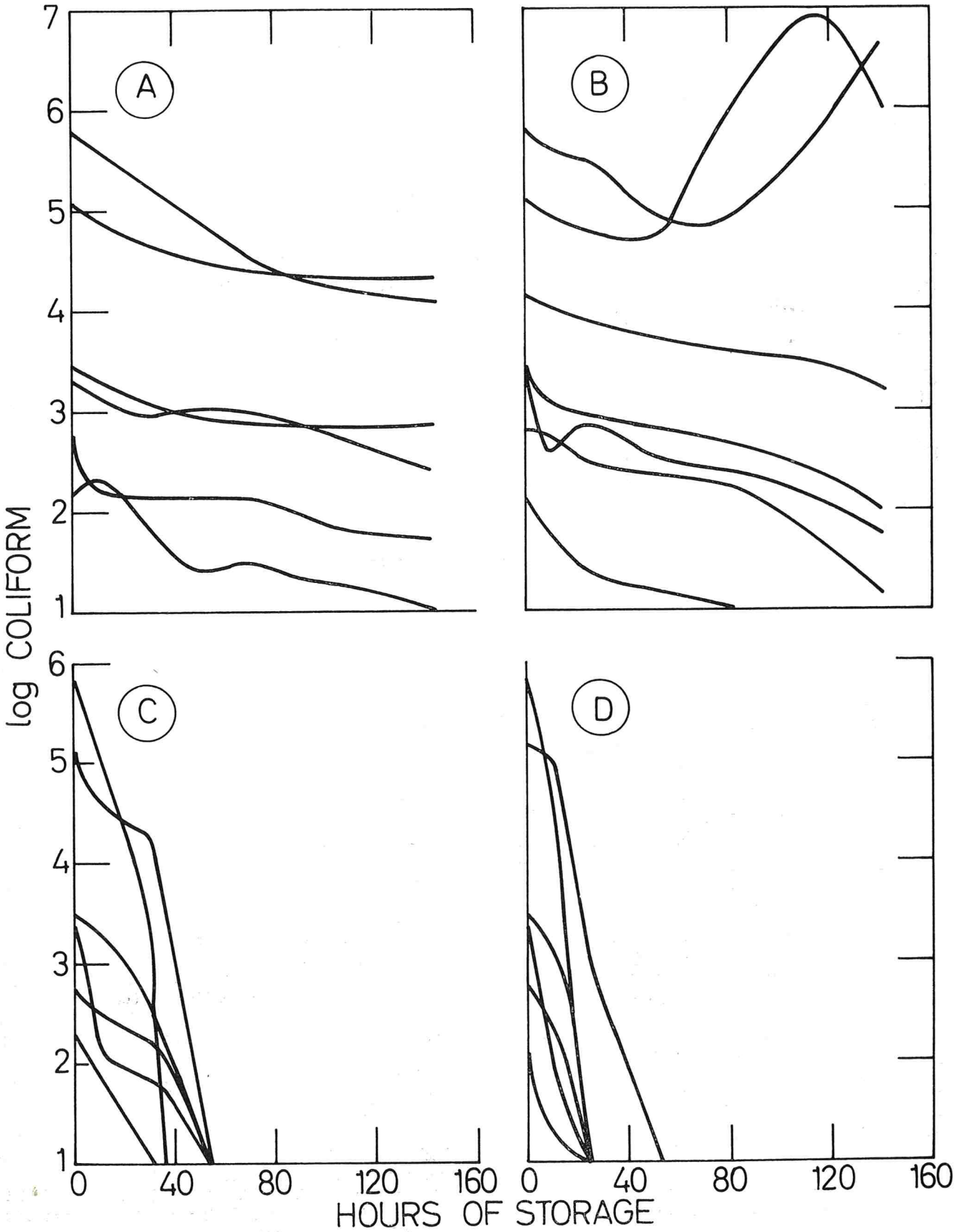

Figure 3. Changes in coliform counts of the cultured milk product with time of storage. A, incubation at 4 C; B, incubation at 19 C; C, incubation at 37 C; D, incubation at 43 C.

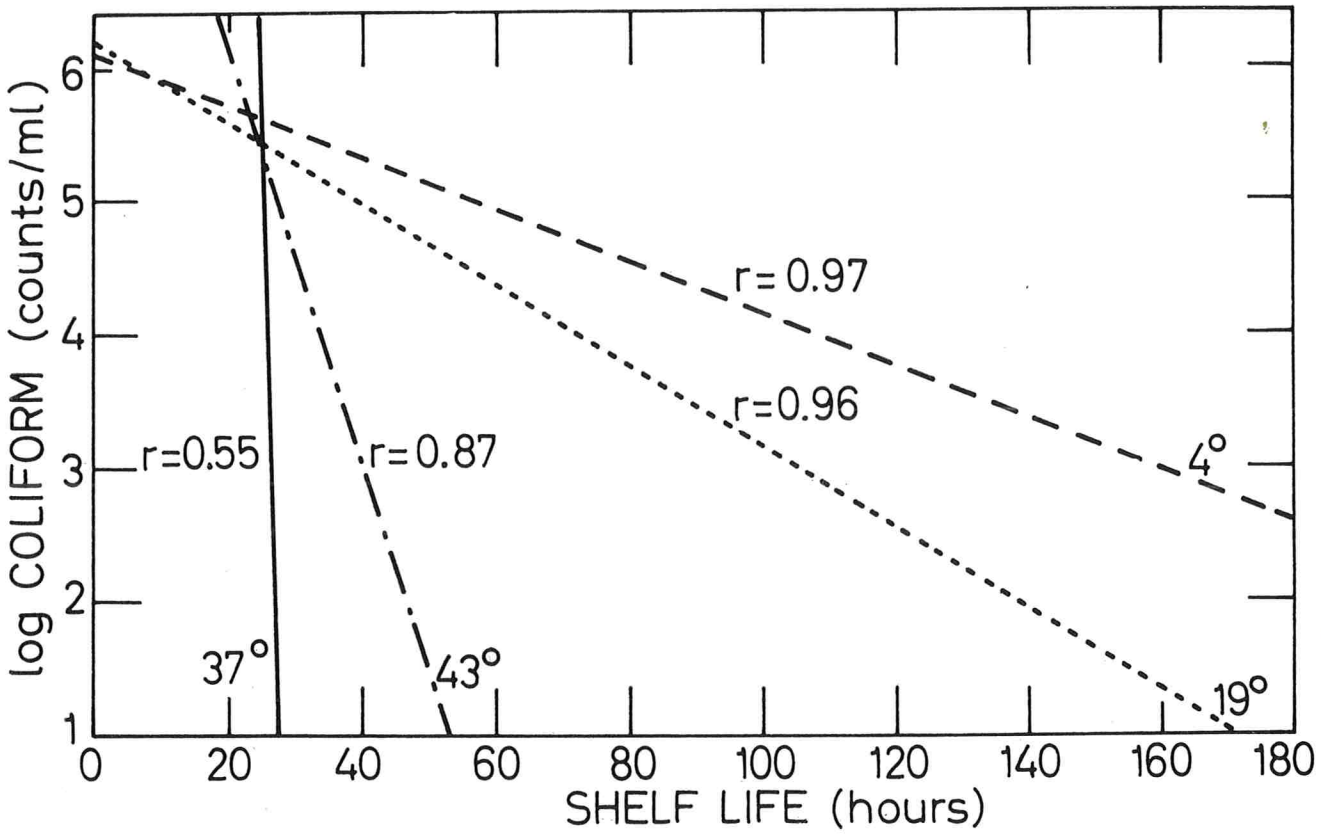

Figure 4. Initial coliform counts of the cultured milk product plotted against shelf life.

DISCUSSION

While no correlation was found between the rate of acid accumulation and the rate of change in the coliform population, or, between either of these two parameters and the shelf life of the product; a good correlation was found between initial coliform counts and the keeping quality of the product. Coliform counts generally decreased during storage, and, in several instances, no coliforms were detectable at the point of organoleptic rejection. Samples were rejected for reasons that do not seem to be associated with active growth of coliform bacteria. However, the correlation between initial coliform counts and shelf life could indicate a residual activity of the non-proliferating coliform bacterial cells, or more probably other hygenic parameters. The results reinforce the recommendation of Goel et al. *(4)* that coliform counts are only valid on the fresh product and underline the variability of coliform behavior in *Streptococcus lactis* based cultured dairy products.

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EFFECT OF DIELDRIN ON BACTERIA PRODUCING LACTIC ACID[1]

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Abstract

All lactic organisms tested produced acid slowly in lactose broth contaminated with 5 ppm dieldrin. Inhibition of acid production was greater than in milk where lipophilic milk constituents exerted a protective effect. Milk proteins added to lactose broth decreased inhibition by dieldrin, with α-lactalbumin being most effective. Moreover, lactic organisms can adsorb dieldrin making metabolic interference possible.

Lactic acid producing bacteria used to manufacture cheese and fermented milk products have shown variable acid production in the presence of organochlorine pesticides. Collins and Langlois *(3)* reported that growth and survival of *Escherichia coli, Pseudomonas fluorescens,* and *Staphylococcus aureus* were affected differently by organochlorine pesticides, depending on the medium and chemical. Kim and Harmon *(8)* concluded that pesticide levels at or below tolerances established by the Food and Drug Administration would not interfere with normal growth and fermentation of lactic organisms. They used dieldrin, heptachlor, methoxychlor, and the organophosphate, Malathion[R] with different lactic bacteria. Bradley and Li *(1)* and Li, Bradley, and Schultz *(12)* reported that cyclodiene residues, such as dieldrin and heptachlor epoxide, interfered with acid production by some *Streptococcus* species when approximately 2 ppm of the chemicals occurred in milk fat of naturally and artificially contaminated milks used to manufacture Cheddar cheese.

Since acid production is necessary in the manufacture and quality of fermented milk products, the study reported herein was made to ascertain the effect of dieldrin and its mode of action on selected lactic acid bacteria.

Methods and Materials

Preparation of cultures and media

Single strains of *Streptococcus cremoris, Streptococcus lactis,* and a mixed strain commercial culture were used. Frozen cultures were activated by transferring 4 times in 16 × 125 mm screw cap test tubes containing 10 ml sterilized Marstar[R] (Bacteriophage resistant medium—Marschall Div., Miles Laboratories, Inc., Elkhart, Ind.). The inoculated medium was held at 22.2 C for 15 hr, then refrigerated until further use. Before an experiment, the activity was increased by transferring 1 ml of the refrigerated culture two times into sterilized reconstituted nonfat dry milk (NDM) containing approximately 10% solids, incubated for 15 hr at 22.2 C, and a second transfer was used to inoculate the samples at a 1% level.

Elliker broth *(6)* and lactose broth *(5)* were prepared according to instructions. NDM was reconstituted to approximately 10% solids, sterilized, and refrigerated until needed. Raw skimmilk obtained from the University Dairy Plant was pasteurized at 63 C and held at that temperature for 30 min, followed by immediate cooling and storage overnight at 5 C.

The effect of added dieldrin was determined in the presence of milk protein components (Nutritional Biochemicals Corporation, Cleveland, Ohio) which were added to lactose broth with the aid of a magnetic stirrer as follows: 2.8 g Hammersten casein/100 ml, 0.155 g α-lactalbumin/100 ml, or 0.145 g β-lactoglobulin/100 ml.

Contamination of samples with dieldrin

Dieldrin, a representative of the highly toxic cyclodiene pesticides, was prepared as a stock solution in 95% ethanol. Samples were artificially contaminated by adding sufficient stock solution to give levels of 0.5 and 5 ppm based on a total volume basis. Control samples were prepared with no added dieldrin. Other control samples were prepared with only 95% ethanol added at a rate equal to that added as a carrier for dieldrin.

Acidity development

Samples (100 ml) of media (lactose broth, skim and whole milk) in 250-ml Erlenmeyer flasks were tempered in a water bath at 32 C for 30 min. An additional 15 min was allowed for equilibration after addition of ethanol or dieldrin. Samples were inoculated with 1% of an active lactic culture, mixed well, and incubated. After 5 hr each sample was placed on a magnetic stirrer set at medium speed and the pH change determined using a single glass electrode with an expanded scale Beckman Zeromatic pH meter. Each sample was titrated back to the same pH. The pH and milliliters of 0.1 N NaOH required were recorded, with the control sample being used as 100% for acid production.

Sonication

Elliker broth containing 5 ppm added dieldrin was used as the medium for this work. The procedure used is described in Fig. 1. Three liters of medium were inoculated with 1% active culture and incubated at 22.2 C for 24 hr. Cells were collected by centrifugation in 250-ml glass centrifuge bottles at 2000 rpm for 30 min in an International centrifuge model SBV. Cells were washed with 1 liter of distilled water, shaken vigorously for 5 min, recentrifuged, and then collected. To the combined supernatants was added 1 liter of petroleum ether. This mixture was placed on an Eberbach mechanical platform shaker for 60 min at high speed, followed by centrifugation. The solvent layer was removed by siphon. Bacterial cells were mixed with 1 liter of petroleum ether, shaken mechanically for 60 min, and collected by centrifugation. Both ether extracts were saved for further analysis.

Cells collected by centrifugation were ruptured in a specially designed sonication vessel using a Branson sonifier model LS-75 for 60 min. Fractured cells and 1 liter of petroleum

[1]Research supported by the College of Agricultural and Life Sciences, University of Wisconsin—Madison.

[2]Present address: Del Monte Corp. Research Center, 205 Wiget Lane, Walnut Creek, California 94598.

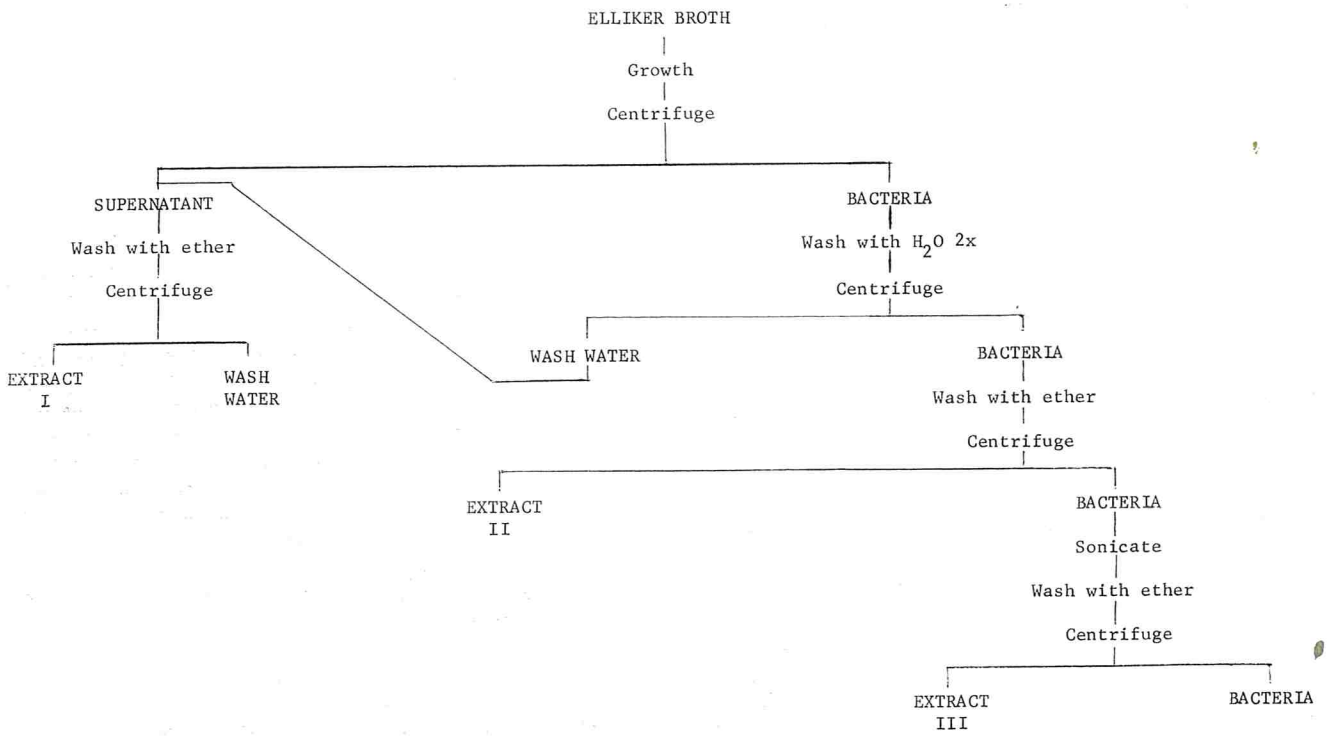

Figure 1. Diagram of the extraction of added dieldrin from lactic organisms grown in Elliker broth.

ether were placed on the shaker for 60 min. The petroleum ether was separated centrifugally and collected by siphoning.

Residue analysis

The three petroleum ether extracts were passed through a 25 × 300 mm glass chromatography column packed with Florisil[R] to remove any possible interfering compounds before injection into the gas chromatograph. An F and M model 810 gas chromatograph equipped with a ^{63}Ni electron capture detector was used. The glass column was 6 mm × 1.1 m and packed with 4% SE-30 on 60-80 mesh Anakrom ABS. The operating parameters were: temperature, oven 200 C, injection port 215 C, EC detector 205 C; pulse interval 5 μsec; 95% argon in 5% methane, the carrier gas, was flowing at 60 ml/min.

Results and Discussion

Since lactic organisms produced less acid in the presence of dieldrin, an attempt was made to define factors involved in inhibition of acid production using lactose broth as the model system. To this model system were added milk proteins to ascertain their effect on acid production. Also, pure cultures used to determine tolerance to dieldrin were compared to a mixed strain lactic culture. Similar reductions in acid development were observed (Fig. 2).

Since dieldrin is a lipophilic organochlorine pesticide, there could be less inhibition in a solution containing more fat. Results in Fig. 3 indicate that fat in the solution does not appear to be important since inhibition was similar in skimmilk as in whole milk. No inhibition was observed in the control samples that contained only 0.1% ethanol, however,

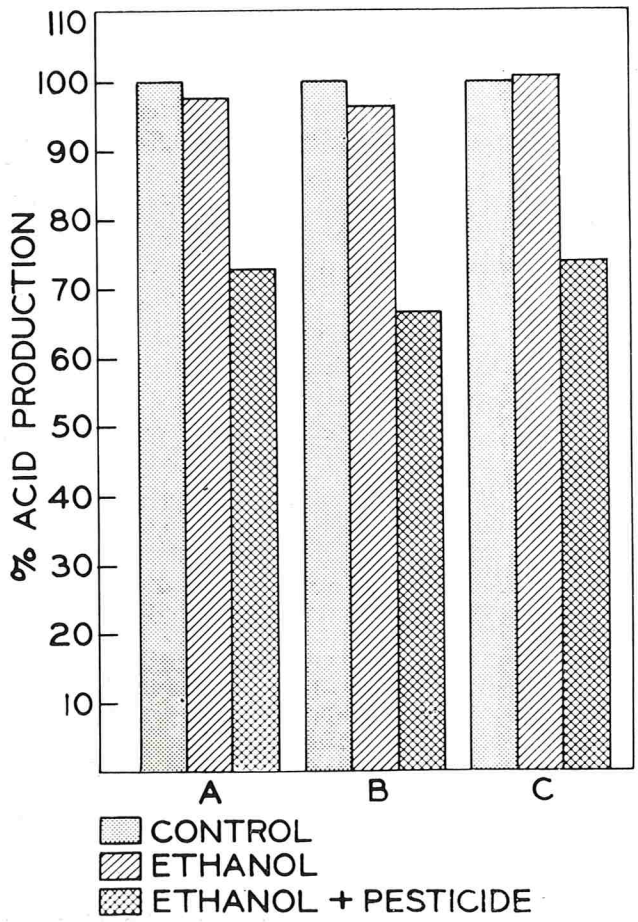

Figure 2. Lactic organism tolerance to 0.5 ppm dieldrin measured by acid production in lactose broth. A, *S. cremoris;* B, *S. lactis;* and C, mixed commercial culture.

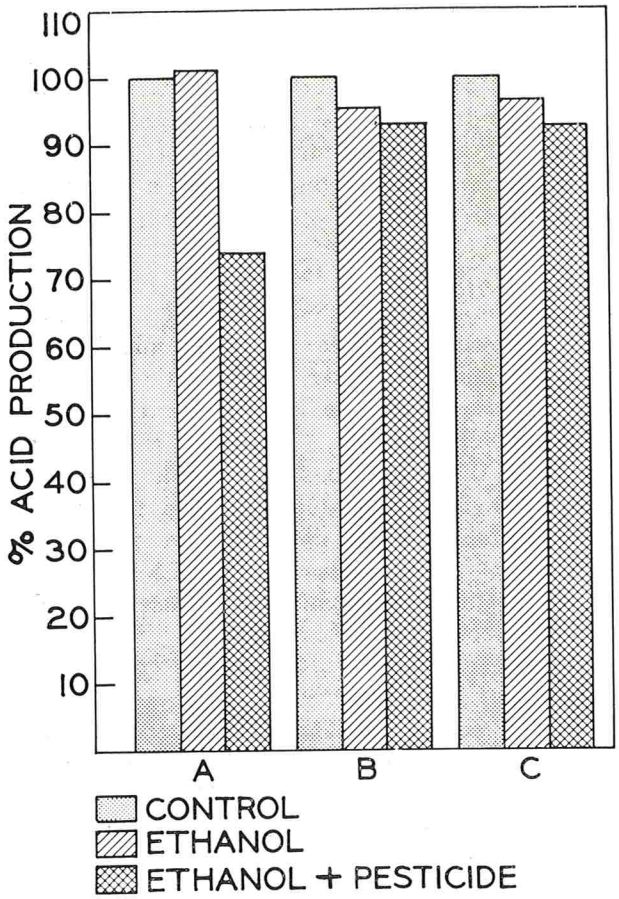

Figure 3. Effect of lipophilic material on inhibition of acid production with 0.5 ppm dieldrin added. A, lactose broth; B, whole milk; and C, skimmilk.

some occurred in milk samples, suggesting some interference between ethanol and the acid producing organisms in milk. Moreover, greater inhibition was observed in the presence of dieldrin.

Milk fat and protein appeared to minimize the effect of dieldrin. Apparently the pesticide is adsorbed to the milk fat or the proteins thereby preventing interference with acid production. This was demonstrated by Langlois and Collins *(10)* with the use of Trypticase Soy Broth (TSB) and skimmilk. They showed that DDT was able to inhibit growth of *Pseudomonas fluorescens* and *Staphylococcus aureus* in TSB but no effects were apparent in skimmilk containing added DDT, heptachlor, or dieldrin. Since the effect of milk fat was negligible, various milk protein components were added to lactose broth in concentrations equal to those found in milk. Hugunin and Bradley *(7)* demonstrated that significant amounts of residue were associated with the serum protein fraction in skimmilk. Data in Fig. 4 show that when α-lactalbumin was added to lactose broth containing 0.5 ppm added dieldrin, acid production increased more than in samples containing either added β-lactoglobulin or casein. This demonstrates the apparent adsorption of dieldrin with the added α-lactalbumin producing the greater effect. However, in lactose broth containing 5 ppm dieldrin (Fig. 5), similar acid production was found in the presence of dieldrin in all samples containing added milk proteins. This can be attributed to the excess of residue, greater than the amount with which the protein can react and therefore allowing the excess dieldrin to interfere with acid production. Working with casein and some of its fractions, Langlois and Collins *(10)* found that as little as 1.5% whole casein allowed growth of *S. aureus* in the presence of heptachlor. They concluded that whole casein and its fractions interacted with heptachlor, thus preventing interference with the metabolism of the bacteria.

The bacterial cell wall is high in proteinaceous material and so may adsorb organochlorine residues which would interfere with cellular metabolism. Chacko *(2)* found that bacterial cells can accumulate pesticides. Kim and Harmon *(9)* suggested that small amounts of dieldrin are adsorbed or incorporated by the cells. Wedemeyer *(14)* identi-

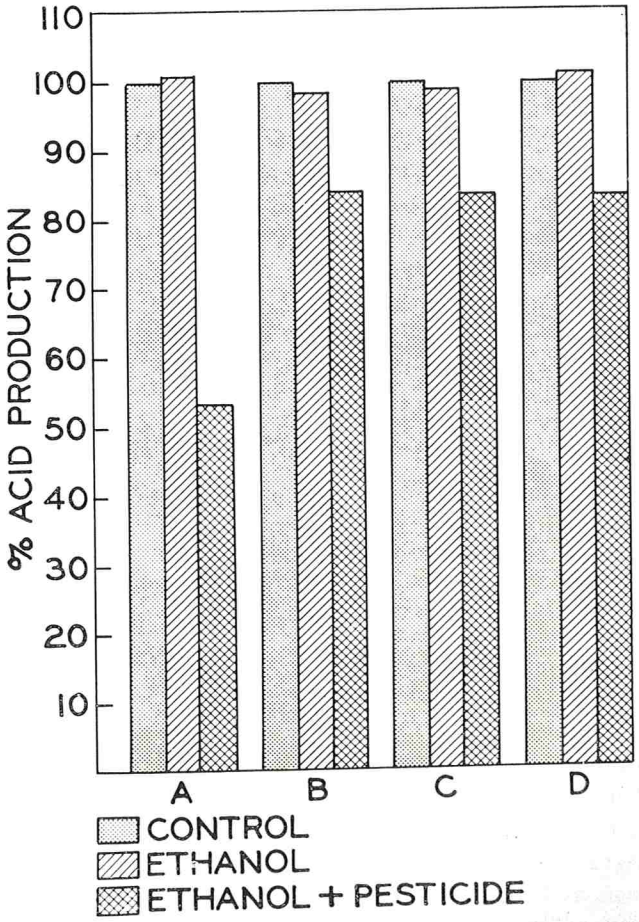

Figure 4. Effect of milk proteins on inhibition of acid production in lactose broth with 0.5 ppm dieldrin added. A, control; B, α-lactalbumin; C, β-lactoglobulin; and D, Hammersten casein.

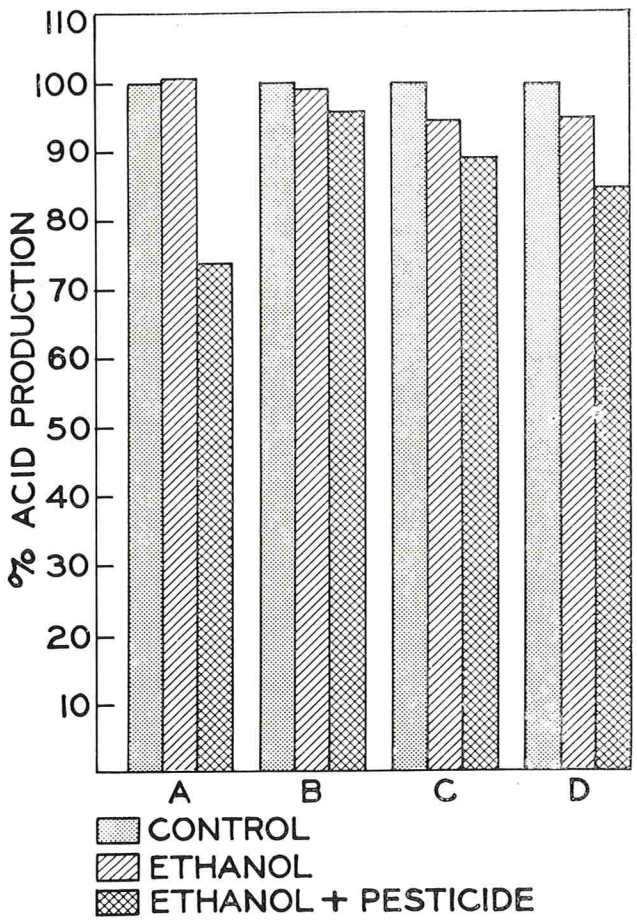

Figure 5. Effect of milk proteins on inhibition of acid production in lactose broth with 5.0 ppm dieldrin added. A, control; B, α-lactalbumin; C, β-lactoglobulin; and D, Hammersten casein.

fied metabolites of dieldrin after sonically rupturing cells of *Enterobacter aerogenes*. Our data show that a large portion of dieldrin was tightly bound to the surface or adsorbed into the cells. Washing with petroleum ether removed only 30% of the pesticide associated with the cells. With sonication, the cell walls were disrupted thereby allowing 65% of the associated pesticide to be extracted with petroleum ether, while only 5% was found in the supernatant following centrifugation and cell removal. Since cells adsorbed dieldrin, their metabolic processes were subjected to possible inhibitory action from the dieldrin.

Dikshith and Vasuki *(4)* concluded that the organochlorine pesticide, endrin, has inhibitory effects on the acid and alkaline phosphatases. With *S. lactis* possessing both the Embden-Meyerhof and hexosemonophosphate shunt enzyme systems *(13)*, it is possible that these enzymes are inhibited by dieldrin. This may explain the mode of action causing inhibition of acid production by lactic streptococci exposed to dieldrin.

Some researchers have concluded that insecticides have little or no effect on the ability of the organism to produce acid; however, their conclusions were based on 0-, 24-, and 48-hr, or longer, incubations *(8, 11)*. Results presented herein are based on a 5-h period, during which time much of the acid is produced in the manufacture of certain fermented milk products.

Summary

All lactic organisms tested produced acid slowly in the presence of dieldrin. Greater inhibition of acid production was shown when lactic organisms grew in lactose broth than in milk where the presence of lipophilic material appeared to minimize the effect of dieldrin. Addition of milk proteins to lactose broth reduced inhibition of acid production, with α-lactalbumin being most effective when concentrations of dieldrin were low. Lactic organisms can adsorb dieldrin which may cause metabolic interference.

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A Research Note

FUNGI IN FOODS

IV. EFFECT OF PLATING MEDIUM pH ON COUNTS[1]

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ABSTRACT

Yeasts and molds in 25 retail food samples were enumerated by plating with antibiotic potato-dextrose agar adjusted to pH values in the range of 2 to 10. In general, counts for a given sample were similar in the pH range of 4 to 7; however, most samples showed maximum counts at pH 8. The effectiveness of antibiotics used to suppress bacteria diminished at pH 8 and above, which may account for some of the high counts obtained. Consequently, for routine laboratory analysis, adjustment of the medium to pH 5 to 6 is recommended.

Nelson *(7)* reported that pure cultures of 10 unstressed yeasts grew equally well over the pH range of 3 to 9.5. However, when the cultures were heat stressed, the maximum count occurred at a pH of 8 or above. The one important fact emerging from this and other studies *(2, 3, 4, 5, 8)* is that with natural or stressed populations a low pH medium *(1, 6)* has an inhibitory effect on outgrowth of yeasts and molds and, therefore, should not be used for their enumeration. In spite of existing knowledge, there is no indication in the literature as to the proper pH of the medium for enumerating fungi in foods. The purpose of this study was to determine the optimum pH or pH range of the medium for outgrowth of fungi from food samples.

MATERIALS AND METHODS

Sterile Potato Dextrose Agar was adjusted to the desired pH with tartaric acid (10%) or 1 N NaOH. After pH adjustment 100 mg per liter each of chloramphenicol and chlortetracycline HCl were added to the medium *(5)*.

Samples of food were obtained from retail outlets in the Gainesville, Florida area. Dilutions of 1:10 were prepared by blending 50 g of sample in 450 ml phosphate buffer for 2 min *(1)*. Further dilutions were prepared as needed. Incubation was for 5 days at 22 C. Suspect colonies, those that did not appear as typical yeasts or molds, were picked and gram stained to confirm their morphology.

RESULTS AND DISCUSSION

Differences in total fungal counts were not great within the range of pH 4 - 7. Most of the samples gave a maximum count at a single pH; however, six of the samples exhibited maxima at two pH values. The significance of these maxima is not clear. It is of greater importance to know the acceptable working range within which most organisms will produce countable colonies in an enumeration medium. Undoubtedly a number of selective and debilitating forces are exerted on the population of a particular sample. These may be agronomic, climatic, substrate associated, or caused by handling and storage, and it is not possible to predict how those forces will specifically affect the total population present within a sample.

It is also of interest that the maximum average counts occurred at pH 7 or below. It had been expected that a maximum would occur close to neutrality, particularly since Nelson *(7)* found a marked shift and more narrow recovery range as the yeast cultures were stressed. These findings again point out the difficulty in trying to extrapolate from data obtained with laboratory cultures to natural populations.

While maximum recovery occurred below a pH of 7, use of media at pH 8 resulted in the largest number of samples exhibiting their maximum total count. This may have resulted from growth of bacteria at the higher pH. Early in this study it was observed that colony formation by bacteria occurred at pH 8 and above. This was attributed to inactivation of the chloramphenicol at the high pH. Once this observation was made, plates were screened as thoroughly as possible for bacterial colonies, and counts were either adjusted or the results discarded if differentiation was impossible. However, if any value can be attached to the pH 8 results, it would support the findings of Nelson *(7)* which described the shift to a higher pH with stress.

On the basis of these results, it appears that a plating medium within the range of pH 4 - 7 would give substantially the same count. However, from the standpoint of controlling bacteria a pH between 5 and 6 is to be preferred for routine laboratory analysis.

[1]Florida Agricultural Experiment Station Journal Series No. 4477.

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TABLE 1. FUNGAL COUNTS AS AFFECTED BY MEDIUM pH

Sample	pH 2	3	4	5	6	7	8	9	10
Ground beef	1,800	14,000	14,000	15,000	15,000	14,000	14,000	11,000	4,700
Chicken liver	400	3,000	3,800	3,500	3,400	2,200	3,600	3,000	1,900
Chicken	<100[1]	6,000	6,600	5,700	6,600	6,000	5,800	2,100	1,500
Sausage	<100	2,200	3,200	3,800	3,900	4,500	4,000	1,300	1,000
Pork chop	<100	1,400	7,500	16,000	11,000	14,000	8,600	5,900	1,500
Beef pattie	<100	11,000	23,000	27,000	29,000	26,000	28,000	24,000	14,000
Veal steak	200	12,000	19,000	22,000	24,000	22,000	23,000	19,000	11,000
Pork tenderloin	<100	1,500	2,800	3,100	2,900	1,700	3,400	2,800	1,400
Country ham	<100	19,000	38,000	36,000	30,000	31,000	31,000	22,000	12,000
Veal stew	<100	2,800	8,000	7,200	8,400	10,000	10,000	4,800	1,600
Ground pork	<100	62,000	110,000	110,000	100,000	96,000	86,000	53,000	23,000
Cheddar cheese	<100	1,500	1,200	1,400	1,300	2,100	1,500	1,100	< 100
Pizza	<100	1,800	2,400	1,900	2,200	2,700	3,000	1,900	1,500
Cottage cheese	< 10	400	800	1,000	1,000	1,000	1,400	800	300
Mozzarella	< 10	500	600	900	900	800	800	700	700
Catfish	150	800	4,500	5,100	4,900	3,700	4,000	2,800	1,900
Green beans	4,000	34,000	46,000	52,000	53,000	53,000	55,000	25,000	18,000
Yellow squash	3,900	18,000	24,000	22,000	28,000	29,000	31,000	29,000	30,000
Cabbage	350	42,000	46,000	50,000	51,000	52,000	45,000	50,000	49,000
Cranberries	3,200	4,100	4,500	4,400	4,300	4,200	3,400	1,500	1,000
Broccoli	200	1,600	7,000	5,700	4,700	6,200	11,000	9,000	5,000
Carrot	100	9,700	16,000	15,000	14,000	17,000	14,000	10,000	8,500
Avocado	1,200	31,000	43,000	35,000	37,000	43,000	31,000	18,000	16,000
Tomato	200	2,500	3,000	4,000	2,700	3,300	3,600	1,300	600
Grapefruit	500	4,600	7,000	6,600	7,800	6,800	8,600	4,400	1,100
Average	700	11,000	18,000	18,000	18,000	18,000	17,000	12,000	8,300

[1]Values of <100 are used in averaging as 100

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SOME OBSERVATIONS OF MILKING EQUIPMENT STATUS AND MILKING PROCEDURE ON DAIRY FARMS EXPERIENCING HIGH SOMATIC CELL COUNT LEVELS[1]

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Abstract

During an evaluation of the Abnormal Milk Control Program *(1)*, 162 milking-time farm calls were made specifically to evaluate milking equipment installation and operation and milking practices on farms experiencing high somatic cell counts. A summary of these findings is presented herein.

Using generally recognized guidelines as acceptance criteria for both equipment factors and milking practices, the percentage of satisfactory compliance was: for operating vacuum, 34.0%; stall size (stanchion barns), 37.3%; use of strip cup, 11.1%; use of individual towels for udder wash, 12.3%; temperature of udder wash at completion of milking, 14.8%; and use of teat dip, 19.1%. Relatively high compliance was noted for: vacuum controller location, 64.8%; pulsator speed, 72.2%; presence of sanitizer in udder wash, 87.0%; and equipment sanitization before milking, 60.5%. About 47% of the dairymen held milking-time-per-cow to 5 1/2 min or less.

Over the years, several milking equipment factors and milking practices have been implicated as potential predisposing conditions for mastitis infections in dairy herds. Numerous investigations have resulted in development of milking management guidelines designed to reduce infections to a minimum. While it is difficult to assess the significance of these factors individually, their interaction on the dairy farm determines the extent and seriousness of mastitis infections.

Under the Abnormal Milk Control Program (AMCP) of the U. S. Public Health Service, a fieldman is required to assist those dairymen whose milk supplies are found to contain abnormally high somatic cell counts. At present, cell counts of $>$ 1.5 million per milliliter are considered abnormally high. During the fieldman's work, an inspection is made of milking equipment condition and milking practices are observed. The fieldman evaluates conditions and makes suggestions based on guidelines generally accepted as approved practice.

Recent work *(3, 6)* indicated that the relationship between bulk milk cell count and percent infected quarters was not well correlated. Nevertheless, the AMCP, as currently constituted, uses a somatic cell level of $>$ 1.5 million per milliliter as cause for action to be taken. The work of Postle et al. *(3)* also indicated three management practices that seemed to be related to low bulk milk cell count. These were: *(a)* farm-raised herd replacements, *(b)* post-milking teat dipping, and *(c)* treatment of milking inflations by boiling in lye solution before storage.

During a study to evaluate effectiveness of the AMCP *(1)*, milking time calls were made on 162 dairy farms where microscopic analyses confirmed somatic cell counts at 1.5 million per milliliter or higher. Observations were made, a questionnaire completed, and a record kept of all findings. Without attempting to draw specific conclusions, we wish to report these findings as being indicative of the conditions found to exist on dairy farms experiencing high somatic cell counts.

Materials and Methods

Between August 1969 and February 1971, 2,673 dairy herds supplying milk to the Minneapolis-St. Paul market were involved in an evaluation of the Abnormal Milk Control Program. These herds were divided into three study groups consisting of 681, 684, and 1,308 herds, Study Groups I, II, and III, respectively. The experimental conditions imposed on the three groups were described in an earlier paper *(1)*.

During the investigation, a fieldman assigned to the project made farm calls and milking time calls on the Group III farms whenever the somatic cell count reached 1.5 million per milliliter or higher. Return visits (recalls) were made when, upon resampling and testing, somatic cell counts were found to persist at 1.5 million per milliliter or higher. At the conclusion of the study period, selected farms known to have had somatic cell counts of 1.5 million per milliliter or higher in both Groups I and II were visited by the same fieldman. In all instances, milking equipment condition and milking practices were noted. The number of farms visited were, for groups I, II, and III respectively, 18, 13, and 131.

At each farm visited, a work-sheet report was completed concerning various aspects of milking management. Wherever possible, questions were designed so that simple yes or no answers could be reported. Generally approved milking management guidelines as outlined below were used as ac-

[1]Funding of this work was provided in part by the Agricultural Research Service of the U. S. Department of Agriculture, Washington, D. C.

TABLE 1. STATUS OF SELECTED COMPONENTS OF MILKING EQUIPMENT AND MILKING PROCEDURE FOR DAIRY HERDS EXPERIENCING HIGH SOMATIC CELL COUNTS[1] BY STUDY GROUP[2]

Item	Study group I Percent satisfactory[3]	II Percent satisfactory	III Percent satisfactory	Percent satisfactory, All farms[4]
Milking equipment:				
1. Vacuum pump capacity	72.2	76.9	49.6	54.3
2. Operating vacuum	44.4	38.8	32.8	34.0
3. Vacuum line				
a. Size, looped	64.7	53.8	47.3	49.4
b. No. of risers and/or tightness of fittings	64.7	61.5	37.4	42.0
4. Vacuum controller				
a. Location	77.8	76.9	61.8	64.8
b. Operation	64.7	38.5	43.5	45.1
5. Pulsator speed	77.8	69.2	71.8	72.2
6. Stall size (stanchion)[2]	35.7	27.3	38.5	37.3
Milking procedures:				
1. Use of strip cup	11.1	7.7	11.5	11.1
2. Use of individual towels	16.7	15.4	11.5	12.3
3. Sanitizer in udder wash	88.9	92.3	86.3	87.0
4. Udder wash temperature at end of milking 90 F or higher	5.6	15.4	16.0	14.8
5. Equipment sanitization before milking	72.2	76.9	57.3	60.5
6. Use of teat dip	33.3	15.4	17.6	19.1
7. Milking Time, 5.5 min or less	44.4	46.2	47.3	46.9

[1]Data were collected on herds in which bulk milk had been found to contain 1.5 million per milliliter or higher somatic cell count, as confirmed by the microscope.
[2]There were 18, 13, and 131 dairy farm observations made in Study Groups I, II, and III, respectively. Of these, respectively, 14, 11, and 117 were stanchion barn installations.
[3]Consult Materials and Methods section for an explanation of factors used in determining satisfactory compliance.
[4]These percentages are inclusive of the three study groups taken together, involving a total of 162 dairy farm observations.

ceptance criteria.

For milking equipment

(a) Vacuum pump capacity—considered satisfactory if the Milking Machine Manufacturers Council *(2)* standards were met. These standards call for 4 ft³/min available capacity American standard or 8 ft³/min New Zealand standard for each long tube milker unit (claw-type, floor unit) up to two units (3 and 6 ft³/min, respectively, for suspended milkers) and a somewhat lower per-unit capacity for systems of three or more milker units.

(b) Operating vacuum-manufacturer's recommendations for operating level were used and operation was considered satisfactory if, during the addition of milker units to the milking line, the drop in vacuum was 2 inches or less, with a 3-sec or less recovery rate.

(c) Vacuum line—a one-inch diameter vacuum line was considered satisfactory (though not necessarily desirable) when two milker units were used, a 1 1/4-inch diameter line for three or four units. The Milking Machine Manufacturers Council *(2)* recommends a 1 1/4 inch vacuum line for use by two to four milker units in a pipeline system. Vacuum lines were not considered properly installed unless they were looped in a continuous circuit. Vacuum lines were considered to be operating properly if no stall outlet fittings or other fittings were found to be leaking air when checked with a vacuum gauge while the system was operating. Acceptance criteria also included a minimum number of risers and a reasonable slope toward the vacuum reserve tank.

(d) Vacuum controller—considered satisfactory if positioned between the vacuum pump and first stall outlet or, in pipeline milker installations, between the milk releaser mechanism and the vacuum pump. The vacuum controller was considered operating satisfactorily if the operating vacuum did not exceed the level recommended by the manufacturer.

(e) Pulsator speed—considered satisfactory if operating at the rate recommended by the equipment manufacturer.

(f) Stall size—considered satisfactory if, for Holstein cows, stalls were a minimum of 62 inches long and 44 inches wide. This was considered a lenient standard, and certainly a minimum for stall size.

For milking procedure

(a) Strip cup—considered satisfactory if a strip cup was used at least once each week on all milking animals.

(b) Use of individual towels—considered satisfactory if a clean cloth towel or paper towel was used on each cow in preparation for milking.

(c) Sanitizer in udder wash—considered satisfactory if sanitizer of any kind and concentration was used in the udder wash water.

(d) Udder wash water temperature at end of milking—considered satisfactory if the solution temperature was no lower than 90 F.

(e) Sanitization of equipment before milking—considered satisfactory if the operator circulated or vacuum-flushed all milk contact surfaces with a sanitizer before each milking.

(f) Use of teat dip—considered satisfactory if a teat dip was being applied either by immersion or in a teat spray.

(g) Milking time—considered satisfactory if milking time per cow did not exceed 5 1/2 min. This is somewhat lenient compared to the 3 1/2 to 4 min suggested by the Milking

Machine Manufacturers Council *(2)*.

RESULTS AND DISCUSSION

Table 1 lists a summary of findings of milking management status on farms having high somatic cell counts by study group and for all farms as a whole. Data for group III were collected during the period between August 1969 and February 1971. By nature of the experimental design, data for groups I and II were collected at the completion of the evaluation period. There were 18, 13, and 131 farms studied in groups I, II, and III respectively. All had one or more confirmed somatic cell count of 1.5 million per milliliter or higher.

There was no reason to expect that differences between study groups would be very great, and in fact the similarities in percentage of satisfactory practices seem to imply that the selection process (high somatic cell count) isolated similar kinds of dairy farm operations.

Because of the numbers involved, the percentage of satisfactory responses for all farms is perhaps the most meaningful of the data presented. In total, 162 farms are represented by these figures. The lowest percentage of satisfactory compliance was: for operating vacuum, 34.0%; stall size (stanchion barns), 37.3%; use of strip cup, 11.1%; use of individual towels for udder wash, 12.3%; temperature of udder wash at completion of milking, 14.8%; and use of teat dip, 19.1%. A relatively high percentage of satisfactory responses was noted for vacuum controller location, 64.8%; pulsator speed, 72.2%; presence of sanitizer in udder wash, 87.0%; and equipment sanitization before milking, 60.5%.

Only one-half (46.9%) of the dairymen were milking cows at a rate of 5 1/2 min per cow or less. Slightly over one-half (54.3%) had adequate vacuum pump capacity, and just under one-half had looped vacuum lines and lines of proper size, properly functioning. The vacuum controller was located satisfactorily in about 45% of the installations.

It seems apparent that, on dairy farms experiencing high somatic cell counts, several milking management practices generally considered important to mastitis control are not being followed.

ACKNOWLEDGMENTS

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EVALUATION OF SCALLOP MEAT QUALITY BY THE RESAZURIN REDUCTION TECHNIQUE[1]

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Abstract

Experiments were conducted on calico and bay scallop meats in the fresh, frozen, and thawed states and with two modifications of the resazurin technique. Results indicated that the resazurin reduction test was a relatively rapid, objective technique to determine the shelf-life of scallop meats as compared with total bacteria numbers and sensory ratings for aroma by a trained panel. Agreement between these three criteria for determining shelf-life quality improved with storage time; which apparently was related to changes associated with the log phase of bacterial growth. The resazurin test was found to be a simple, relatively rapid, inexpensive, and objective technique for determining quality of fresh scallop meats.

The shellfish industry is characterized by numerous relatively small operations. Objective methods to evaluate quality are extremely limited. Thus, an objective method which is rapid, inexpensive, and simple for determining the organoleptic and bacteriological qualities of shellfish would be valuable.

The resazurin reduction test has been used as an objective test of milk quality by the dairy industry *(1)*. Proctor and Greenlie *(7)* suggested that modifications of the resazurin procedure could make this technique an accurate approximation of the quality of other classes of foods. Subsequently, modifications were made in the technique for suggested applications to precooked frozen meat pies *(10)*, frozen vegetables *(5)*, poultry products *(12, 14)*, and meat products *(8)*. However, the relationship between resazurin reduction time and microbiological numbers was relatively poor in several non-dairy foods. Preliminary work in this laboratory indicated that scallop meat spoilage rate and resazurin reduction time were related to a fairly high degree *(13)*.

Previous work in our laboratory, using crab meat *(4)* and scallop meat *(11)*, has indicated that trypticase soy agar (TSA, BBL) with the addition of NaCl, resulted in the enumeration of a higher number of bacteria than presently accepted standard plate count methods *(1)*. The value of added NaCl in media used to test the microbiological level in seafoods has been confirmed by Lee and Harward *(6)*.

The objective of this investigation was to determine the applicability of the resazurin reduction test as a rapid and reliable method for evaluating the shelf-life quality of scallop meats.

Experimental Procedure

Sample preparation

Bay *(Aequipectin irradians)* and calico *(Aequipectin gibbus)* scallops were used for this experiment. The bay scallops were harvested from Bogue Sound, N. C. (34° 15′ N, 81° 30′ W), and calico scallops from the North Carolina and Florida coastal waters of the Atlantic Ocean. The scallops were harvested with commercial dredges, hand shucked, rinsed, placed in Whirl-Pak bags, iced, and transferred to the laboratory. Samples used for fresh storage were maintained at 3 C, and those for frozen storage were frozen and held at −20 C. After thawing (overnight at 3 C), previously frozen scallops were stored the same as the fresh samples (3 C) for the time of the study.

Analytical methods

The scallop meats were analyzed, at selected intervals throughout storage, for total bacterial colony counts, resazurin reduction time, and aroma (sensory evaluation).

The resazurin reduction method of the American Public Health Association *(1)* was used with slight modifications. The Munsell system of color notation (7/4 point scale) was used to determine the end point. Samples were prepared by either blending or surface rinsing the meats. Blending the meats was accomplished by adding 25 g scallop meat and 225 ml of 3% NaCl solution to a standard pint jar and blending for 1 min with a Sunbeam blender. A 5-ml aliquot of the sample blend, 5 ml of trypticase soy broth (TSB, BBL) containing 2% NaCl, and 0.5 ml of resazurin solution were added to a 70 ml test tube. Triplicate tubes were prepared, stoppered, shaken, and incubated in a covered 37 C water bath. The samples were checked for color change every 15 min (maximum of 6 hr) until the 7/4 end-point was observed.

The surface rinsing procedure was accomplished by thoroughly shaking (25 times in a 1-ft arc) 25 g of scallops in 225 ml of 3% NaCl. Aliquots of the rinse were analyzed the same as for the blended samples.

Total aerobic bacterial colonies were enumerated by taking

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[1]Paper No. 3452 of the Journal Series of the North Carolina State University Agricultural Experiment Station, Raleigh, N. C. This study was conducted in cooperation with the U. S. Department of the Interior, Bureau of Commercial Fisheries, under Public Law 88-309. Use of trade names in this publication does not imply endorsement by the North Carolina Agricultural Experiment Station of the products named, nor criticism of similar ones not mentioned.

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TABLE 1. SENSORY EVALUATION SCALE FOR RATING THE AROMA OF RAW SCALLOP MEATS

Score	Description
1	Putrid, ammoniacal
2	Strong musty, acrid, sour
3	Musty, acrid, sour
4	Slight musty, acrid, sour
5	Sweet, neutral

aliquots of the meat sample blend or rinse mixture used for the resazurin test and preparing appropriate serial dilutions in a 3% NaCl solution. The samples were plated on TSA containing 2% NaCl, incubated at 23 C for 72 hr and counted.

A 5-7 member panel rated the fresh scallop meats for their sensory characteristic (aroma) on a five-point descriptive scale; with 5 indicating the maximum attribute and 1 indicating the minimum attribute (Table 1).

Commercial plant procedures

A resazurin test kit which was suitable for transport to various plants for testing microbial quality of scallops was developed. The kit contained 0.5 ml and 5 ml disposable pipettes, Whirl-Pak bags, dilution bottles, sterile trypticase soy broth, resazurin solution, disposable test tubes, 100 ml graduated cylinder, and a small electric water bath. The procedure was conducted as described for the surface rinsing procedure, except that five scallop meats were placed in a Whirl-Pak bag in place of weighing 25 g.

Calico scallops were analyzed for resazurin reduction time by using the test kit under field (plant) conditions at various storage intervals up to 17 days. Samples were observed for color change every 30 min (5 hr maximum) until the reduction end point was observed.

Aliquots were taken from the rinse mixture, iced, transferred to the laboratory, and plated within 2 hr on TSA containing 2% NaCl to determine total bacterial numbers. Plates were incubated at 35 C for 24 hr and counted.

Several methods for reading resazurin reduction were investigated in an attempt to read the color change more accurately using the Munsell system under field conditions. Black background, white background, and direct sunlight were tested. Direct sunlight was most suitable for observing the color changes when a blank tube containing 0.5 ml resazurin solution and 5 ml TSB plus 2% NaCl was used as a comparison. However, it was concluded that direct sunlight was too inconsistent, and a direct artificial light rather than background materials (white or black) was most suitable for test conditions.

Data tabulation

The means of results for resazurin reduction time, total bacteria count, and aroma ratings were graphed against time to indicate the relative, progressive changes throughout storage. Individual points of observation were not plotted on the graphs because each sampling of scallops varied greatly in initial bacterial counts. This initial variation in bacterial counts resulted from natural conditions of the scallop meats and does not invalidate the results. However, it is not possible to use individual observations in a meaningful manner under these population parameters.

RESULTS

Calico scallops (fresh, blended)

Data in Fig. 1 show the averages of three trials for total bacteria numbers, panel aroma scores, and resazurin reduction times on fresh blended calico scallop meat samples stored for 12 days. Due to distances of transportation involved in this experiment, the evaluation could not be made before 6 days after harvesting. Total bacterial levels were characterized by a slight drop in the initial growth phase with rapid population increases beginning 7-8 days post-harvest.

Panel aroma ratings indicated a steady decrease in quality with time of storage. Since products of relatively high quality are expected to have extended resazurin reduction times, the reason for the lack of a close correlation between the reduction time and the other two quality indices is not evident. However, the general trend for reduction time was to decrease similar to the panel ratings. The abnormally abrupt decrease in reduction time between 6 and 7 days post-harvest storage probably was caused by the change in bacterial growth at that time as indicated by the growth curve. It is possible that the type of bacterial flora was sufficiently different after 7 days storage to cause a change in the oxidation-reduction potential of the system and thereby prevented further reduction of the resazurin compound between the 7 and 11 days storage times.

Bay scallops (fresh, blended)

The averages of six trials for total bacterial numbers, panel aroma scores, and resazurin reduction time which were conducted on the blended, fresh bay scallop meats during a 10 day storage period

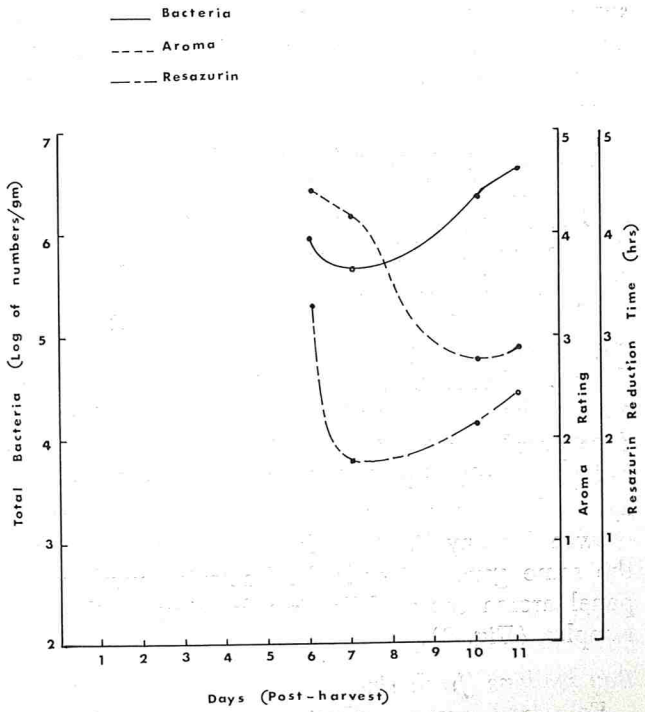

Figure 1. The relationship between various quality indices during fresh storage (3 C) of calico scallop meats (blended).

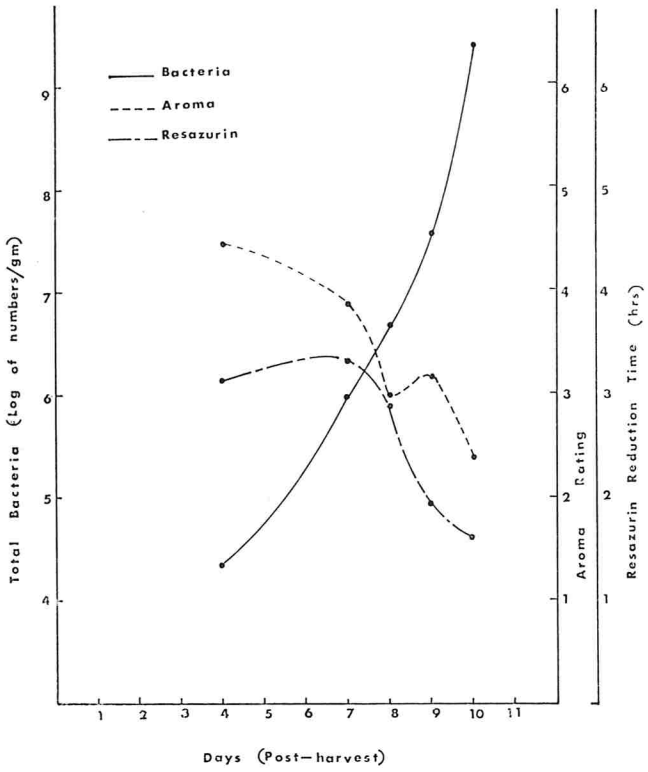

Figure 2. The relationships between various quality indices during fresh storage (3 C) of bay scallop meats (blended).

are presented in Fig. 2. The same general pattern observed for the calico scallops was found for the fresh bay scallops, except that better agreement was observed among the three quality indices for this experiment. The rate of decrease in panel aroma scores and resazurin reduction time after 7 days agreed closely and both evaluations were inversely related to the rate of increase for bacterial numbers.

Bay scallops (frozen and thawed, blended)

Data in Fig. 3 are for bay scallop meats held at 3 C following frozen storage (–27C for 90 days). Samples were held in fresh storage 4 days before freezing and 6 days after thawing. Four trials were conducted in this experiment. The effect of freezing on bacterial growth and on possible changes in the oxidation-reduction potential of the meats may explain the constancy of the reduction time for 4 to 7 days post-harvest. This condition may have occurred as a result of sublethal injury during frozen storage with subsequent recovery of bacteria to normal growth by day 7. The frozen scallop meats gave the same general trends for bacterial numbers and panel aroma scores following freezing as the fresh samples (Fig. 2).

Bay scallops (fresh rinsed)

Four trials were conducted using the surface rinsing procedures and the averages for the data are in Fig. 4. The trend for bacterial numbers closely paralleled that of the blended samples but total numbers were generally lower when compared with those in Fig. 2. Generally, reduction times of rinsed samples followed the trend of the blended samples except that little change was found between 4 to 8 days of storage. Data on resazurin reduction time obtained by surface rinsing had less variation within treatments than occurred for the blending procedure. Even though little change in reduction time was observed during the 4-8 day storage period, bacterial numbers and panel aroma scores showed an inverse relationship and agreement was satisfactory for practical consideration.

Commercial plant studies

Figure 5 shows the averages of 4 trials made under field (commercial plant) conditions after 3, 4, 6, 7, and 12 days post-harvest storage times. The bacterial growth curve was characterized by an initial reduction in numbers, which was interpreted as the lag phase, with the log phase starting on storage day 6. The resazurin reduction time tended to increase between the third and fourth day post-harvest storage and to begin a sharp decline thereafter, which coincided with the log growth phase of the bacteria. The two curves showed an inverse relationship whereby bacterial numbers increased and the resazurin reduction time decreased. Because of the commercial environ-

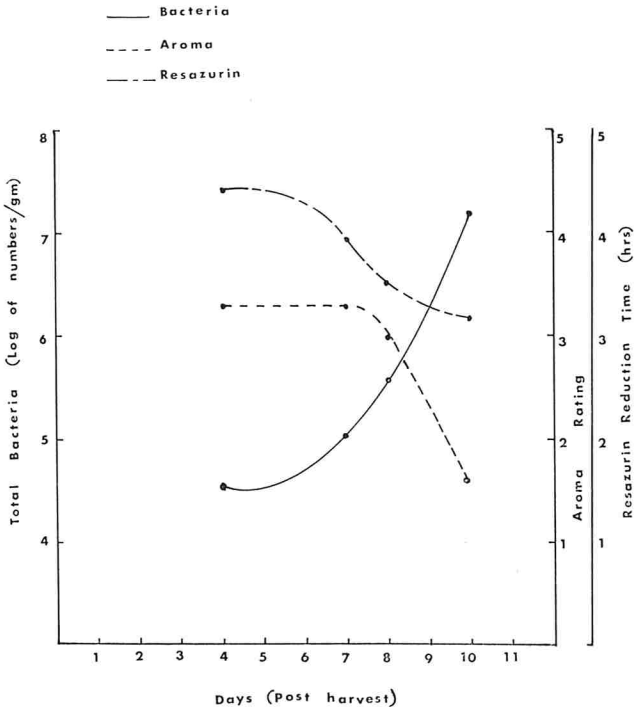

Figure 3. Relationships between various quality indices for storage at 3 C following frozen storage (–27 C) of bay scallop meats (blended).

ment, no rating was made for aroma in this experiment.

DISCUSSION

The resazurin reduction technique described in this paper has potential as a rapid, simple, and relatively reliable test for approximating the bacterial quality of scallop meats. The surface rinsing technique, in particular, has special value in that it is easily performed with a minimum of equipment under commercial plant conditions. Even though the resazurin method did not correlate precisely with bacterial numbers and panel aroma scores, agreement was considered to be sufficient for a practical method for in-plant testing of fresh scallop meat quality. On the basis of these studies, the researchers recommend that a reduction time of greater than 3 hr be used as an acceptable quality standard. This recommendation is primarily based on the data for bacterial counts as the latter was considered to be the test most closely related to reduction time, rather than aroma ratings. Further work is needed to determine the cause of the slow rate of decrease in reduction time during the early part of the storage time for fresh bay scallop meats. It is proposed that these conditions occurred because of a change in the type of bacteria, formation of chemical breakdown components, or developments associated with the bacterial lag phase. It is evident that the sensory evaluation of aroma is approximately as sensitive as the resazurin test However, since sensory judgments vary with individuals and are difficult to control under plant conditions, use of an objective test such as the resazurin technique has the advantages of preciseness and uniformity of performance.

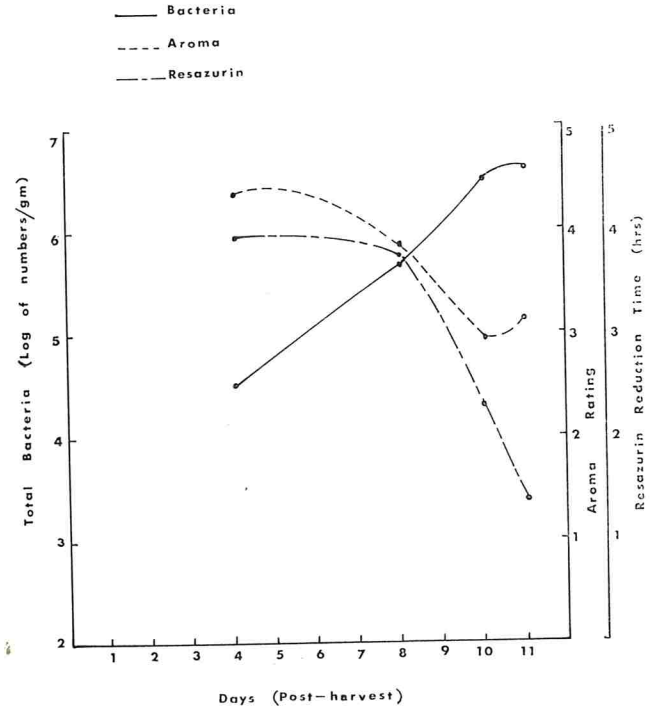

Figure 4. The relationships between various quality indices during fresh storage (3 C) of bay scallop meats (rinsed).

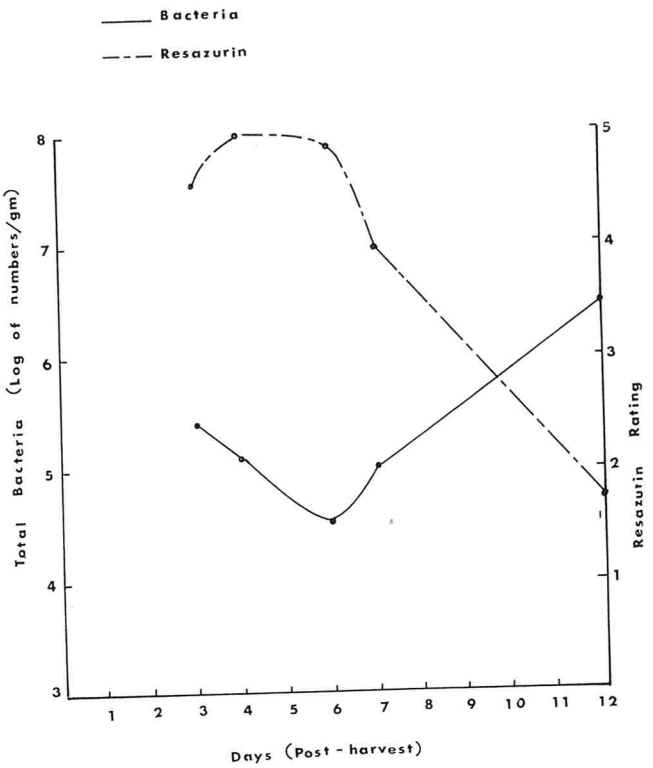

Figure 5. The relationship of bacterial numbers to resazurin reduction time during storage (3 C) of scallop meats (rinsed) under field conditions.

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HEALTH AND FOOD SERVICE OFFICIALS MEET TO ESTABLISH SANITATION CODE

A national sanitation code for Canada's food service industry, including the establishment of standards of cleanliness for the nation's food service establishments, will be discussed and approved at a joint meeting of health and food service officials to be held in Ottawa.

The Department of National Health and Welfare has joined with the Canadian Restaurant Association to sponsor a three-day conference starting September 20 to study and finalize the code. The conference will be attended by representatives from federal, provincial and municipal health agencies as well as delegates from the food service industry.

"I consider the joint sponsoring of this conference and the code itself a reflection of the importance being given in developing higher levels of co-operation between government and industry to further protect the health and well-being of the Canadian public," said Health Minister Munro.

"The Canadian Restaurant Association, through its national, provincial and territorial organizations, has been most diligent in developing the code in co-operation with their respective health departments. Expert advice has gone into the preparation of the draft code, and I am sure in its final form it will be of great benefit to all concerned."

This is the first time that a national sanitation code has been proposed for Canada's food service industry. The objective of its proponents is to establish even higher standards than are now required under federal and provincial health regulations.

The Code is aimed at ensuring consumers the highest level of health protection in all establishments where food is prepared and served. The project has been in the research and development stage for the past 5 years by a Steering Committee of the Canadian Restaurant Association and there has been continual study and revision prior to the official introduction at the conference.

Throughout preparation of the code, opinions and advice have been solicited from government health officials, public health inspectors, foodservice educators, industry leaders and equipment manufacturers.

Dr. A. B. Morrison, Assistant Deputy Minister, Health Protection Branch, Department of National Health and Welfare, has commended the association for the initiative it has taken in proposing and developing the code.

"The Code reflects the Industry's increased sense of public responsibility," said Vincent C. Kennedy, Chairman of the Steering Committee for the CRA Sanitation Code. "By finalizing a Sanitation Code for Canada's Foodservice Industry, we will bring to the attention of the public the fact that association members regard most seriously their responsibility to provide safe food. Hopefully, this Code will bring us closer to the day when proof of technical know-how and qualifications will be mandatory in order to obtain a license to operate a foodservice outlet."

More than 150 delegates will spend two days in study groups before meeting on the third day to evaluate recommendations and discuss printing and distribution of the Code. The Conference will be held at the Holiday Inn of Ottawa-Centre.

Mr. J. D. Rae, Vice President, Canadian Restaurant Association, will be conference chairman, Dr. A. B. Morrison will welcome delegates.

The agenda for the session includes a tour of the Food Research Laboratories of the Health Protection Branch.

ORGANIC FOODS–ANOTHER CONSUMER HOAX?[1]

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ABSTRACT

Today's food industry is under great consumer attack. Consumer demands have served to increase the number of food products to 7,800; about 3,300-3,500 new products are introduced annually. Nearly all new products can be classified as convenience foods. With such a rapidly changing market, consumer confidence in the food industry has been lost and, because of confusion created, the consumer has become increasingly fearful of chemically contaminated foods. This fear is substantiated by increased public interest in so-called organic foods or organically-grown foods, proliferation of health food stores, and introduction of health food sections into supermarket chains. It is estimated that there are some 7 million organic food consumers, and that sales of natural foods (organic) will reach $500 million in 1972. Today only a limited number of organic farms and wholesalers of organic foods exist. The opportunity for fraud is great. A sign over an organic food section, or a label claiming "organic," does not guarantee that the food was produced by organic methods. Since there is nothing unique about organic foods that differentiates them from products grown by conventional means, governmental agencies are reluctant to issue standards controlling movement of these products.

Today's food industry, institutions concerned with food research, as well as government agencies are under great consumer attack and pressure. This pressure has resulted because in recent years changes in our society have placed a heavy burden on the food industry to produce an adequate, nutritious, safe, economical, and convenient food supply. That this challenge to the food industry has been met can easily be documented. The American consumer has an abundant food supply, nutritious products if properly chosen, and the foods are the safest and most economical products in the world. As an example, a consumer in Taiwan spends 48% of his total expenditures on food; in the Federal Republic of Germany, 33%; in the United Kingdom or Sweden, approximately 20%; while the American consumer spends <20%. No one will argue that the ultimate in this challenge has not been reached. In the rapidly changing efforts to meet consumer demands, the number of food products has increased to 7,800. About 3 300-3,500 new products are introduced annually. Nearly all of the new products can be classified as convenience foods. With such a changing market, consumer confidence in the food industry has been lost, basically because of the confusion created by the great choice in products, misinterpretation of functional properties of ingredients, and a misunderstanding of the regulatory process that controls the industry.

The consumer has become increasingly fearful of chemically contaminated food, a fear which is substantiated by increased public interest in the so-called organic or organically-grown foods, proliferation of health food stores, and introduction of health food sections in supermarkets.

It is difficult for the consumer to recognize the need for antioxidants, emulsifiers, stabilizers, etc. It is difficult for the average consumer to understand that Grade A milk refers to a sanitary quality which starts with inspections on the farm, while in vegetables Grade A is concerned with such quality attributes as texture, color, flavor, uniformity in size, and absence of defects. Why should the top grade in one product be designated by Grade A, prime, or fancy while in another the highest grade is designated by Grade AA when there is already a bias toward the letter A? Why should the ingredients in one jelly be listed if the ingredients in another are not? With this confusion and misunderstanding is it then surprising that consumers have created a new meaning for the word organic?

WHAT IS ORGANIC FOOD?

There is no legal definition or standard that defines organic foods. *Organic Food Marketing*, a Rodale Press publication, gives the following definition:

"Organically-grown food is food grown without pesticides; grown without artificial fertilizers; grown in soil whose humus content is increased by the additions of organic matter; grown in soil whose mineral content is increased with applications of natural mineral fertilizers; has not been treated with preservatives, hormones, antibiotics, etc." *(3)*.

The definition clearly indicates that no man-made chemicals can be used during production, harvesting, handling, transportation, storage, and preservation of food products.

HOW BIG IS THE ORGANIC FOOD MARKET?

It is estimated that today there are some 7 million organic food consumers. Sales of natural or organic foods reached $170 million in 1970, $250-$300 million in 1971, and it is estimated to reach $500 million in

[1]Presented at the 59th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, Milwaukee, Wisconsin, August 21-24, 1972.

1972. Projecting such growth, it is easy to visualize a $1 billion market in a few years *(6)*. This is still a small part of the total food market but a significant one. The number of stores specializing in organically grown foods has reached 3,000 in the United States and may major food chains have added natural food sections in their supermarkets.

Why Organic Foods?

Consumer advocates claim that organic foods, because they are grown without agricultural chemicals, contain no residues, are therefore not "poisonous" and present no hazard to health; and are more nutritious, taste better and, since they contain no additives, are not synthetic.

Widespread elimination of agricultural chemicals would result in decreased food production through lower yields, plant diseases, and insect infestations. Much of our abundant food supply must be attributed to proper application of agricultural chemicals. Elimination of such practices would bring about hunger and malnutrition. Although farming the organic way is possible on a small scale, large operations will not survive. Demonstration plots in various parts of the country indicate that without chemical treatments reduction in yield ranges from 70% to total crop failure. Weeds, diseases, and insects simply take over. To meet the demands for foods, agricultural chemicals are needed; we must continue to use them wisely and with the greatest safety precautions.

It is argued that foods grown with organic fertilizers are more nutritious than are those grown with chemical fertilizers. It should be pointed out that green plants synthesize all their necessary constituents from elements. Minerals are absorbed by plants in the ionic and not the organic form. Organic fertilizers, before being utilized by the plant, are degraded by microorganisms in the soil and the released elements are absorbed by the plant. Thus, the elements released are no different from those obtained from chemical fertilizers, and if a proper amount and balance of nutrients is supplied, nutritive value should be equal for plants grown with the two fertilizers. There have been few controlled experiments conducted to determine the effect on nutrients in plants when produced with organic versus chemical fertilizers. Those that have been carried out showed no measurable differences in nutritional value attributable to use of organic or inorganic fertilizers. Claims that organic foods result in better health are probably real because consumers are more aware of nutrition and ingest a more balanced diet.

Food additives improve color, texture, flavor, and often extend the shelf life of processed foods. To do without them would simply mean a return to total food preparation in the kitchen. It is doubtful that this is the wish of a homemaker in the 1970's. Additives are needed to assure an adequate food supply and a variety of food products. What the food industry must continue to do is to scrutinize all additives to assure their safety. In addition, increased effort must be expended so the consumer understands the function of additives and the regulations presently enforced to assure their proper use and safety.

Who Joins the Organic Movement?

There are three distinct categories: *(a)* Those consumers fearful of the food supply and who believe that today's foods are poisonous and the only purpose of food additives is to make someone rich. It is doubtful that any amount of explanation or education will cause them to have confidence in today's food supply. They are the faddists. *(b)* There are those, and by far the largest number, who join the movement to champion a cause. They are going to change society; they are going to change the food industry despite its obvious accomplishments in providing an adequate food supply. It is a group that only an affluent society with a highly technical agriculture can afford. *(c)* There are a few who see a huge profit potential from organic foods. Today only a limited number of organic farms and wholesalers of organic foods exist. Therefore, the price is high and the opportunity for fraud is great.

At present, according to Rodale Press, there are 200 certified organic farms. A recently published list contained 38 certified growers who operated 1,642 acres; 27 of the farms comprised < 50 acres *(1)*. With the obviously limited supply, it is difficult to visualize who fills the organic food shelves.

Regulation of Organic Foods

That the possibility of fraud is recognized by those who advocate organic food is clear since a program to certify organic farms has been initiated by Rodale Press through its publication, *Organic Gardening and Farming (2, 4)*. The program is intended to identify the organic farmer. It emphasizes the small farmer, and the heart of the program is a commitment to maintain or rebuild the soil to contain 3% humus and eliminate all agricultural chemicals. Compliance is verified through *(a)* questionnaires to growers on methods of farming, *(b)* soil sampling for residues, and *(c)* a personal visit. Foods produced on certified farms may carry the organic seal.

Inspection or certification of organic foods has found support among legislators and some government officials. The Pennsylvania Department of Agriculture has expressed support for effective organic marketing procedures and certification of growers *(5)*. Justification for this is based on the

premise that Pennsylvania farms are small and diversified and therefore adaptable to organic farming. A bill in Congress would require organic farmers to register with the government each year, pay an inspection fee, and be inspected at least twice a year. Another bill defines organically grown and processed foods and, if passed, would require the FDA to set standards for labeling, advertising, and distributing organic foods.

Should such measures become law, an army of inspectors would be required to certify farms and even if, as suggested, the cost be borne by growers and processors, it would really add to the already inflated prices for organic foods. There is also no doubt that fees charged would not cover the cost of inspection and so it would eventually be borne by the taxpayer. Furthermore, since methods of inspection and testing cannot be made foolproof or even meaningful, legislative bills as proposed are not in the best interest of the consumer. Since there is no scientific evidence of major benefits to the consumer of organic food, legislation beyond a definition is meaningless and not justified. If American consumers want to maintain the great variety of food they enjoy, at low costs, safe use of agricultural chemicals and food preservatives must continue.

NOT A HOAX BUT A CHALLENGE

Organic food is not a consumer hoax but a challenge. It is a challenge to the food industry to rebuild confidence in today's food supply. The industry must not join the organic movement, for to join the movement is to admit that today's products are unsatisfactory. Rather the food industry should embark on a new program that emphasizes the need for and the safety of agricultural chemicals and food additives. We also must work toward a more simple regulatory process, one that every consumer can understand and trust. It is with such efforts that the consumer now fearful of foods can be reassured that America's food supply is now, and will continue to be nutritious, wholesome, economical, safe and convenient. A total commitment to organic farming will result in famine!

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ANTIBIOTICS MAY POSE HAZARD IN MILK PRODUCTS

Results of a study by University of Wisconsin food microbiologists underscore the need to use antibiotic-free milk when making cultured dairy products to make sure these foods are safe from hazardous salmonella organisms.

H. S. Park and E. H. Marth found that antibiotic concentrations which inhibit or inatcivate useful milk bacteria do not affect salmonellae. This tips the balance of microbial life in milk in favor of salmonellae because the milk bacteria cannot manufacture lactic acid which prevents salmonellae from multiplying.

The food microbiologists warn that a public health hazard could result if ripened or rennet-type cheeses, in particular, are made from milk containing both antibiotics and salmonellae. This situation may occur if milk is inadequately heated or somehow contaminated with these organisms after pasteurization.

The level of antibiotics in milk remains a matter of concern because some 2.7 million pounds of these drugs are annually administered to livestock on U. S. farms either to treat diseases or to stimulate growth. For example, antibiotics are widely used to treat mastitis and other diseases of dairy cattle. It is, therefore, likely that occasionally the drugs find their way into milk.

In their experiment, Park and Marth used skim milk with three levels each of penicillin, streptomycin and tetracycline. The antibiotic doses selected were known to inhibit growth of milk starter bacteria. Milk samples were then inoculated with various species of salmonella and incubated for 18 hours.

Bacterial counts every three hours showed that concentrations of any of the three antibiotics tested that can inhibit starter bacteria had no effect on salmonellae.

Earlier work by Park and his colleagues had shown that salmonellae grew in both milk and cheese curd when cheese was made with a starter culture that produced insufficient acid. Also, salmonellae survived longer in low-acid cheese than when the acid content was normal.

ADDRESS OF WELCOME: FIFTY-NINTH ANNUAL IAMFES MEETING

DONALD E. WILKINSON
Wisconsin Department of Agriculture
Madison, Wisconsin 53713

Wisconsin is honored by the presence of the distinguished international and national associations. We welcome you enthusiastically and extend our best wishes for a successful convention here in Milwaukee.

As one long interested in the continuing supply of quality foods for this nation and world, I am impressed with the caliber of representation at this meeting and also the diversity of interests represented. I readily recognize, however, that the common bond which brings together this vast group of dedicated men and women is the desire to upgrade the quality of our food supply, even though it is already the highest of any country in this world.

As we welcome you to Wisconsin, may we also compliment you who represent these various important organizations for joining together in the common cause of food quality and more particularly in this convention where you are approaching common areas of concern with the benefit of differing areas of experience. Here in this gathering we have professionally trained sanitarians who make up the membership of The International Association of Milk, Food and Environmental Sanitarians. Here also we have fieldmen from various parts of this nation that comprise the membership of the National Association of Dairy Fieldmen.

In addition to the state counterparts of these two associations, we have been privileged to have representatives of the National Mastitis Council and the Interstate Milk Shippers Executive Board. I understand also that there are other similar important boards and committees meeting during this event.

EARLIER MILWAUKEE MEETINGS

There is a special reason why we are pleased that you have chosen Wisconsin as the site of your 59th meeting, for it was in 1911 that the very first meeting of the Sanitarians was organized and held in Milwaukee. It was under a different name; there were 35 men present, including one Canadian and one Australian. Today your membership numbers over 3,000 representing many nations of the world and many different interests.

You met again in Wisconsin at two critical periods, one during the mid-depression era of 1935 and again in the postwar period of 1947, each with its peculiar national food problems.

You especially honored Wisconsin by electing as your president one of our distinguished food scientists, Dr. Kenneth Weckel, of the University of Wisconsin.

For your contributions as sanitarians and as fieldmen we commend you and wish you success as we face the challenges before us.

FOOD PRODUCTION IN WISCONSIN

An individual who is honored by being invited to extend a word of welcome to a convention is usually expected to proclaim the merits of the host city or state. How unnecessary for me to remind you that you are truly in "America's Dairyland" for many of you have been working so closely with the milk supply of this nation in one way or another for many years and know of Wisconsin's leadership. You may not know, however, that it is not dairying alone which places Wisconsin as one of the top 10 agricultural states of this nation for it is also a leader in the production and processing of canning crops, in the livestock and poultry industry, and in other commodities of importance in providing a balanced food supply, commodities which have benefited from your scientific input over the years.

THE MEETING PROGRAM

A study of your convention program certainly indicates the wide scope of interest and concern facing the food industry of this nation today and, in turn, the challenges before those agencies of government which work with that industry. I note for example papers and panel discussions dealing with milk and food production and processing, environmental concerns, solid waste control, residues, abnormal milk, natural and organic foods, and regulatory activities.

Each and every one of these, plus many others, warrants in-depth discussion and evaluation.

FUTURE CHALLENGES

But there are, in addition to these specific items, some general challenges which lie ahead and which I wish to delineate for your consideration.

1. The food industry and government at all levels must continue to work closely together. Wherever possible, government's designated regulatory activi-

ties must compliment industry's program of self-accountability.

2. Consumer interests must be recognized. They are dynamic. They are demanding. Nutritional labeling is just one of many significant new programs facing industry and government food specialists.

3. Federal, state, and local governmental activities must be better coordinated. The American public, through its duly elected representative, has designated various types of food quality authority to the several jurisdictions of government, from municipal to state and federal. No longer can we afford the luxury of duplication of effort; instead there is a demand for each effort and each jurisdiction to compliment another.

4. FDA's expanding policy of decentralization with state and municipal cooperation warrants commendation. How pleased I was to hear Commissioner Charles Edwards of FDA speak with enthusiasm regarding new contractual agreements with states as he met with members of the FDA-NASDA (National Association of State Departments of Agriculture) Task Force recently in Washington. He informed us of the new congressional authority in four areas of food inspection, medicated feeds, laboratory services, and restaurant inspection and the funding which will be available to the states in carrying out this work of federal-state concern.

In Conclusion

Today's consumer is fortunate indeed that concerned men and women, members of your important associations, have for so many years contributed to the well-being of the people of this nation and in turn to the world as the quantity and quality of foods have continued to improve.

As the head of a state regulatory agency, may I also acknowledge and thank you for the scientific resources made available to us from your associations and your members as we attempt to effectively administer the food laws of our various states and nation.

FIFTY-NINTH ANNUAL MEETING OF IAMFES

MILWAUKEE, WISCONSIN, AUGUST 21-24, 1972

The 59th Annual Meeting of IAMFES was one of the most successful held in recent years. Approximately 450 members and guests registered for the meeting which was held on August 21-24, 1972 in cooperation with the National Association of Dairy Fieldmen. The Summer meeting of the National Mastitis Council was held on August 21 and attracted approximately 300 participants. All sessions were at the Pfister Hotel in Milwaukee, Wisconsin. The Wisconsin Association of Milk and Food Sanitarians and the Wisconsin Association of Dairy Fieldmen were co-hosts for the meeting.

Executive Board Meetings

The IAMFES Executive Board met Sunday afternoon, August 20th; all day on Monday, August 21st; and completed deliberations on Thursday afternoon, August 24th. President Orlowe M. Osten presided at all of the sessions.

Deliberations of the Board began with a report from Harold Y. Heiskell, Chairman of the newly formed Membership Committee. Heiskell described procedures to be implemented for promoting membership in IAMFES. Initial efforts will be directed toward those affiliates that have many members who do not belong to IAMFES. Thirteen state chairmen have been appointed and more will be added as activities of the Committee are expanded. A new brochure giving information about IAMFES will be developed for use in the membership campaign. Signs for use at affiliate meetings also will be prepared. The Executive Board agree to provide up to $1200 for use by the Membership Committee.

Other reports heard by the Executive Board included those of: *(a)* Robert Anderson, Chairman of the local arrangements committee (arrangements for the meeting are in good order, funds are adequate, a press conference is scheduled for August 22); *(b)* Dr. E. H. Marth, Editor of the *Journal of Milk and Food Technology* (the report will appear in a future issue of the *Journal*); *(c)* H. L. Thomasson, Executive Secretary of IAMFES (the society continues to be financially sound).

The Committee on Awards and Recognition, through its chairman Milton E. Held, recommended that the Citation Award be presented to Ben Luce and that Honorary Life Memberships be granted to Professor Evert Wallenfeldt and Mr. Clarence W. Dromgold. These recommendations were confirmed by the Executive Board. Held also reported that the Sanitarian's Award will go to Mr. A. P. Bell and that the newly created Shogren Award for outstanding accomplishments by an affiliate will be presented to the group in Iowa. Decisions on these two awards (Sanitarians and Shogren) are the sole responsibility of the Committee on Recognition and Awards.

Held reported further that the Committee recom-

An excursion around the meeting. Top row, left: George Zaichek (left), president of the National Association of Dairy Fieldmen, greets Orlowe Osten, president of IAMFES; top row, center: a welcome message appears on the Milwaukee City Hall; top row, right: a view of the speaker's table at the Awards Banquet, Prof. Myron P. Dean at the lectern served as master of ceremonies; bottom row, left: some advanced publicity for the 1973 Annual Meeting; bottom row, right: three former IAMFES presidents visit at the meeting, Dr. C. K. Johns on the left, H. J. Barnum in the center, and Dr. K. G. Weckel on the right.

mended establishment of a new award to recognize meritorious contributions to food safety and sanitation by persons in academic institutions or industry. Mr. P. J. Skulborstad was requested to explore possibilities for funding this award. Later during the sessions, Skulborstad reported that the Milking Machine Manufacturers of the Farm and Industrial Equipment Institute agreed to provide $1000 annually for the new award.

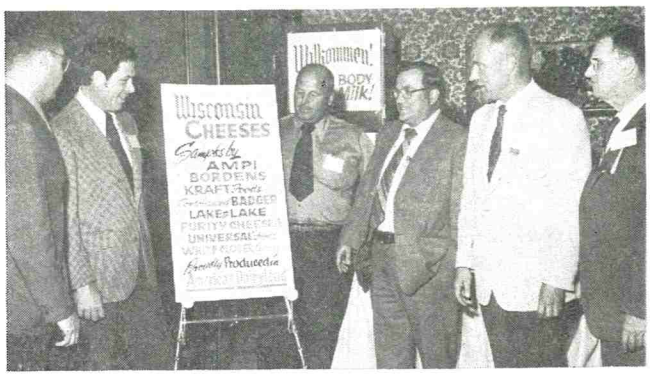
The Executive Board heard the following committee reports: *(a)* Dairy Farm Methods by A. K. Saunders, A. E. Parker, and J. B. Smathers (the entire report will appear in a future issue of the *Journal;* new leaders for the committee will be needed in the near future to replace those who will be retiring); *(b)* Sanitary Procedures by Clarence Luchterhand (new committee members with expertise in the food field are being sought); *(c)* Applied Laboratory Methods by Dr. A. R. Brazis (the subcommittee on laboratory methods for foods is being reactivated); *(d)* Journal Management by Dr. W. C. Lawton (advertising should be limited to the front and back of the *Journal,* news and events should be identified better, lists of up-coming events and of new publications should be included, informative advertising should be sought); and *(e)* Food Equipment Standards by Karl Jones (guidelines are being developed for bulk milk dispenser cabinets, NAMA is planning a seal-of-approval program).

Some IAMFES representatives to other organizations also made reports to the Executive Board. Included were: *(a)* representative to the National Mas-

Orlowe Osten (left), out-going IAMFES president, offers some advice to the incoming president, Walter Wilson.

titis Council, A. E. Parker (the Council plans to hold its 1973 Summer Meeting in conjunction with the IAMFES Annual Meeting in Rochester, New York), *(b)* representative to the Committee to Study U. S. Participation in the International Dairy Federation, Harold Wainess (IDF has been developing standards for dairy products, testing, and packaging; the group will meet in Japan in October, 1972); *(c)* representative to the Sanitarian's Joint Council, Ray Belknap (the position of sanitarian has not yet been defined, Harry Haverland will be the new IAMFES representative to the Council, the Council continues to suffer from lack of cooperation among the representatives).

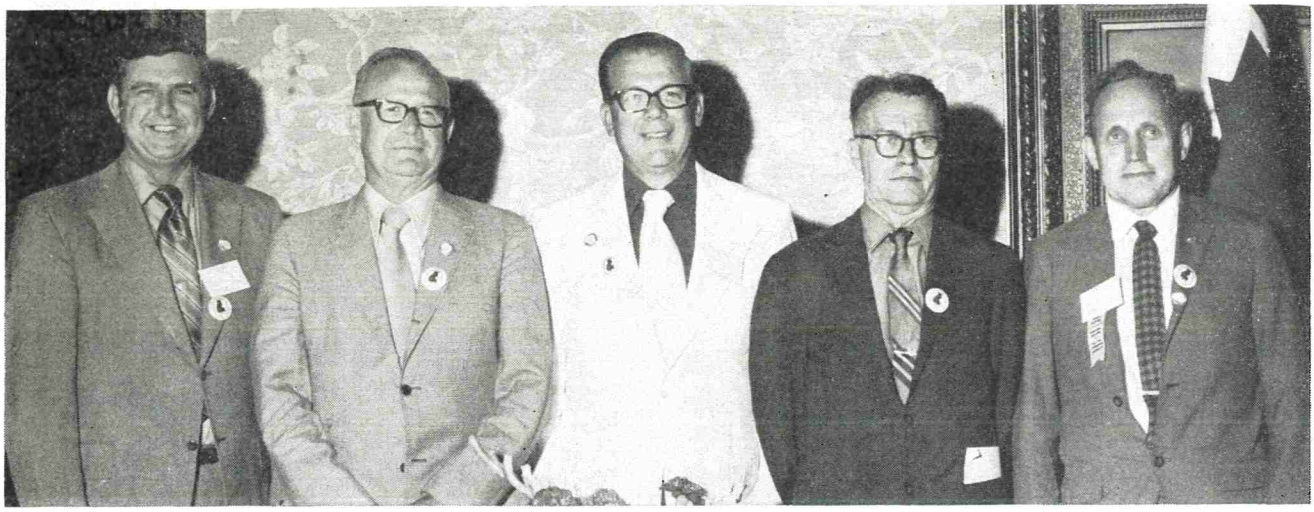
The Executive Board made the following plans for future IAMFES meetings: *(a)* the 1973 Annual Meeting will be held on August 12-16 in Rochester, New York and plans for the meeting are progressing satisfactorily; *(b)* accepted the invitation of the Florida affiliate to host the meeting in 1974; *(c)* requested H. L. Thomasson to contact members of the Washington State affiliate to determine if the Annual Meeting might be held there in 1975; *(d)* tentatively accepted the invitation from the Ontario (Canada) affiliate to host the Annual Meeting in 1976; *(e)* declined with thanks the invitation from the National Environmental Health Association to participate in a joint annual meeting in 1973; this was necessitated by committments already made for 1973, and *(f)* agreed to meet near Chicago on December 6 and 7, 1972 to finalize plans for the 1973 meeting.



Some members of the local arrangements committee are checking to insure that refreshments will be available when needed.

Professor R. P. March, in response to Board action in 1971, prepared a document which described the duties of all officers. The Executive Board reviewed the document and revised it where necessary. Professor March will supply a revised copy to each Board member.

Some "gemuetlichkeit" in Milwaukee.



The new Executive Board of IAMFES. Left to right: Walter F. Wilson, president; Earl O. Wright, president-elect; Parnell J. Skulborstad, first vice president; Harold E. Thompson, Jr., second vice-president; and Richard P. March, secretary-treasurer. Absent when the picture was taken were: Orlowe M. Osten, junior past-president; and Dick B. Whitehead, senior past-president.

AFFILIATE COUNCIL

The annual business meeting of the Affiliate Council, with 16 representatives in attendance, was held Monday evening, August 21. Chairman Ben Luce presided and Dr. L. Wayne Brown, secretary, read minutes of the 1971 meeting.

Luce urged more nominations for the Sanitarian's Award. The Council agreed that appropriate nomination forms for all awards should be prepared and sent out to all members, perhaps with the ballot for election of officers.

The Affiliate Council heard: *(a)* Dr. Brown describe how the Wisconsin group finances its operations, *(b)* several representatives express the need for greater involvement by IAMFES in the food (other than dairy foods) field, and *(c)* a report on the *Journal of Milk and Food Technology* by the Editor, Dr. E. H. Marth.

Officers elected for 1972-1973 are: Chairman, Robert Coe of Illinois; and Secretary, Leon Townsend of Kentucky.

TECHNICAL SESSIONS

Numerous timely subjects in the food, dairy, and environmental fields were discussed by authoritative speakers. Six papers given in the general sessions considered: *(a)* the food industry in the seventies, *(b)* food regulatory activities, *(c)* the Occupational Safety and Health Act, *(d)* organic foods, *(e)* food distribution in today's consumer climate, and *(f)* transportation of refrigerated foods.

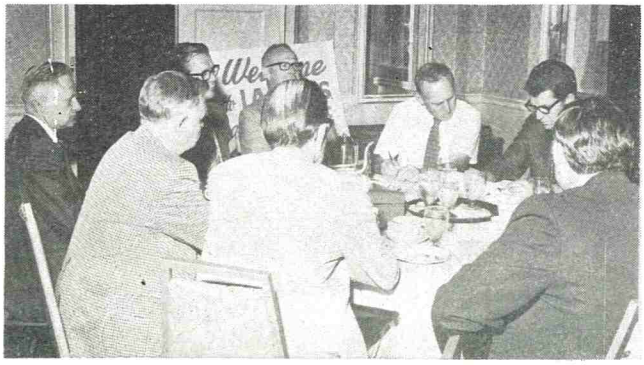
Eight papers given in the milk sanitation sessions were concerned with: the abnormal milk program, reverse osmosis whey treatment, lagoons to treat milking center wastes, recycling of cattle wastes, new dairy products, milk allergy, use of dairy ingredients in other foods, and the Wisconsin dairy industry.

The four papers presented in the food industry sanitation session dealt with: the flour milling industry, pesticides for the food industry, microbiology of shellfish, and microbiology in red meat and poultry inspection.

Topics covered by the eight papers given in the food and environmental sanitation sessions included: polychlorinated biphenyls in food and the environment, consumer concerns, quality control in poultry processing, quality control in the brewing industry, floor coverings and sanitary practices, recycling food cans, botulism and smoked fish, and noise pollution. Most of the papers given at the Annual Meeting will appear in future issues of the *Journal of Milk and Food Technology.*

BUSINESS MEETING

President Orlowe M. Osten presided at the annual business meeting on Wednesday, August 23. After



The Executive Board at one of its sessions.

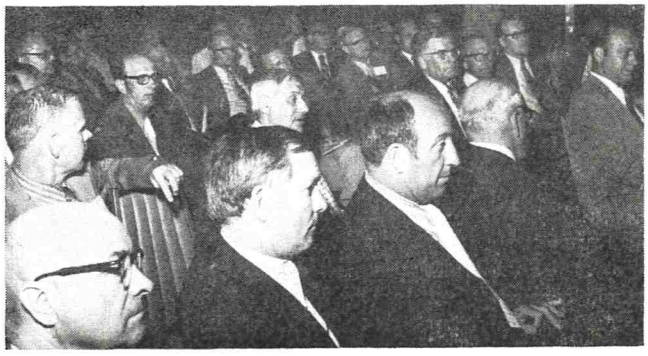
minutes of the 1971 meeting were accepted, H. L. Thomasson, Executive Secretary of IAMFES, gave his annual report. Thomasson indicated: *(a)* receipts for the last year exceeded $73,000 and the net income exceeded $7,000, *(b)* the increase in dues caused no appreciable loss of membership, *(c)* H. Y. Heiskell is heading up a committee on membership and George Willits is working on advertising for the *Journal*, *(d)* over 80,000 copies of the publication on investigating foodborne illness have been sold, and *(e)* a new publication on methods for production of high quality raw milk is now available for sale. Thomasson then gave the detailed financial report and this was followed by a report on the *Journal of Milk and Food Technology* by the Editor, Dr. E. H. Marth. The report on the Affiliate Council was given by Robert Coe, newly elected Chairman of the Council.

Committee reports at the business meeting were given by: A. K. Saunders (Dairy Farm Methods), Dr. A. R. Brazis (Applied Laboratory Methods), C. K. Luchterhand (Sanitary Procedures), R. Belknap (Sanitarian's Joint Council), K. Jones (Food Equipment Sanitary Standards), C. Felix (Food Protection), H. Wainess (Baking Industry), H. Y. Heiskell (Membership), Prof. E. O. Wright (3-A Symbol Council), and D. B. Whitehead (Resolutions). President Osten announced that Harold E. Thompson, Jr. and Professor R. P. March were elected as second vice-president and secretary-treasurer, respectively.

The following resolutions were adopted by the membership at the business meeting.

Some of the reports at the annual business meeting were given by, top row, left: Prof. R. P. March, center: C. K. Luchterhand, right: H. Y. Heiskell; bottom row, left: A. K. Saunders, center: Robert Coe, and right: Dr. A. R. Brazis.

Keynote speakers at opening session were: William O. Beers, left, chairman of the board and president of Kraftco Corporation, and Dr. Virgil O. Wodicka, Director of the Bureau of Foods, Food and Drug Administration.



An attentive audience at one of the technical sessions at the Annual Meeting.

Resolution No. 1

WHEREAS: The Wisconsin Association of Milk and Food Sanitarians and the Wisconsin Association of Dairy Fieldmen co-hosted in cooperation with the National Association of Dairy Fieldmen, the 59th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, Inc. held at the Pfister Hotel, Milwaukee, Wisconsin, August 21-24, 1972, and

WHEREAS: The Local Arrangements Committee, so effectively chaired by Robert T. Anderson, and the management of the Pfister Hotel provided the excellent facilities for the conduct of the meetings and entertainment for the members and their families, and

WHEREAS: The contributors have so generously provided for ladies tours, entertainment, and social gatherings;

THEREFORE, BE IT RESOLVED: That we, the members of the International Association of Milk, Food, and Environmental Sanitarians, Inc., express our gratitude and appreciation to the Wisconsin Sanitarians and to the National and Wisconsin Dairy Fieldmen's Associations, officers, committees, members and friends who have contributed so unselfishly of their time and individual efforts and to the management of the Pfister Hotel who

helped make the Annual Meeting an outstanding success.

BE IT FURTHER RESOLVED: That copies of this resolution be forwarded to the Presidents of the National and Wisconsin Dairy Fieldmen's Associations, to the President of the Wisconsin Association of Milk and Food Sanitarians and to the Chairman of the Local Arrangements Committee as well as to the management of the Pfister Hotel.

Resolution No. 2

WHEREAS: The National Mastitis Council was initiated through the efforts of the International Association of Milk, Food, and Environmental Sanitarians, Inc. and

WHEREAS: The activities and efforts of this Council are interrelated with the interest of this Association; and

WHEREAS: The National Mastitis Council has held several of its regional meetings in conjunction with the International Association of Milk, Food, and Environmental Sanitarians, Inc. annual meetings;

THEREFORE, BE IT RESOLVED: That the International Association of Milk, Food, and Environmental Sanitarians, Inc. pledge its continued assistance to and support of the National Mastitis Council and urge that it continue to hold its Regional Meetings in conjunction with the annual meetings of this Association; and that a copy of this Resolution be forwarded to the President of the National Mastitis Council.

Resolution No. 3

WHEREAS: There is need for revision of the 1962 Food Service Sanitation Manual, PHS Publication No. 934, and

WHEREAS: The U.S.P.H.S. Food and Drug Administration and other official agencies have recognized this need now:

THEREFORE, BE IT RESOLVED: That the International Association of Milk, Food, and Environmental Sanitarians, Inc. strongly recommend and support this revision of the Food Service Sanitation Manual—Model Ordinance and Code, and

BE IT FURTHER RESOLVED: That the Food and Drug Administration give proper consideration to a more effective method of enforcing provisions of the code.

Resolution No. 4

WHEREAS: The proceedings of the First National Conference on Food Protection have been published and distributed to conference participants and other interested parties, and

WHEREAS: Implementation of the recommendations of the the conference is vital to the well being of the consuming public, now:

THEREFORE, BE IT RESOLVED: That the International Association of Milk, Food, and Environmental Sanitarians, Inc., as a sponsoring agency of the conference, recommend the immediate implementation of the recommendations of the conference, and

BE IT FURTHER RESOLVED: That particular emphasis be placed upon the recommendation for the establishment of a *single* Federal Food Protection Agency, and that copies of this resolution be sent to the following persons: The Secretary of the Dept. of Health, Education, and Welfare, The Secretary of the Dept. of Agriculture, The Secretary of the Dept. of Interior, The Office of Consumer Affairs, The Executive Director of the American Public Health Association, and to a select list of congressmen who have food protection bills pending in Congress.

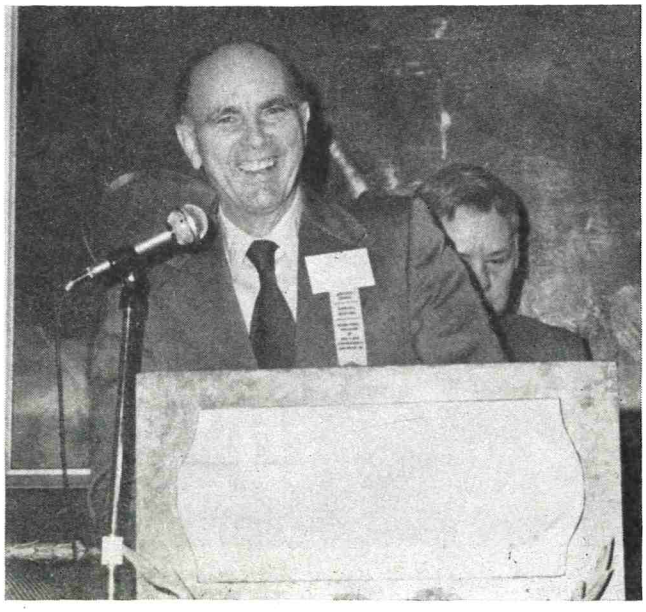
AWARDS GIVEN TO LUCE, DROMGOLD, WALLENFELDT, BELL, AND THE IOWA AFFILIATE

The Awards Banquet is a delightful tradition at the Annual Meeting of IAMFES. This year the banquet was held on Wednesday evening, August 23rd, and featured a review of the history of IAMFES given by Dr. K. G. Weckel. This presentation served to commemorate the founding of IAMFES in Milwaukee in 1911. A hospitality hour, complete with many Wisconsin cheeses available as snacks, preceded the banquet. Awards presented at the banquet went to: Ben Luce, Clarence W. Dromgold, Professor Evert Wallenfeldt, Ambrose P. Bell, and the Iowa affiliate of IAMFES.

CITATION AWARD TO BEN LUCE

The IAMFES Citation Award is given annually to a member who has contributed substantially to the growth, advancement, and status of the Association. This year's recipient was Mr. Ben Luce.

Ben obtained his degree in Dairy Science from the University of Idaho. After graduating he spent



Ben Luce (front) after receiving the 1972 Citation Award from Milton Held (back).

a few years as plant superintendent with the dairy industry. Ben then became associated with the Washington State Department of Agriculture. He now is Chief of the Dairy Inspection Section. He has lectured for several years at Washington State University and the University of Idaho to dairy classes on dairy farm and dairy plant sanitation. He has written articles for the *Washington Quarterly News Letter* and the *Journal of Milk and Food Technology*.

Ben has served 6 years as secretary-treasurer of the Washington Milk Sanitarian's Association. He has served as Chairman of the Examiners, Washington State Registered Sanitarians Board. He is a past-president of the Washington State Dairy Institute Alumni, and has served on numerous committees.

Ben commands the respect and admiration of his fellow sanitarians, not only locally, but nationally. For many years he has been active in the affairs of IAMFES. He served on several subcommittees of the Farm Methods Committee, the Committee on Sanitary Procedures, and the Committee on Recognition and Awards. Ben distinguished himself primarily by his accomplishments with the Affiliate Council, serving as Chairman for the past 4 years. He has served as a member of the Interstate Milk Shippers Conference Task Committee, the National Labeling Committee on milk and dairy products, and the advisory committee of the National Mastitis Council. Ben Luce has become well known by many sanitarians and others not only from the magnitude of his commitments, but from his ability and knowledge and willingness to help his fellowman.

HONORARY LIFE MEMBERS—C. W. DROMGOLD AND E. WALLENFELDT

The Honorary Life Membership Award is presented annually to one or several IAMFES members who have given long and faithful service to the Association. Honorary Life Members have all distinguished themselves by the very substantial contributions they have made to further the objectives of IAMFES. This year Honorary Life Membership Awards went to Clarence W. Dromgold and Professor Evert Wallenfeldt.

Clarence W. Dromgold

Mr. C. W. Dromgold made a career of Milk Sanitation, having served with the Philadelphia Dairy council on raw milk quality control after graduation from the Pennsylvania State University in 1928 until 1935 when he joined the Milk Control Section, St. Louis Health Division. With the St. Louis Health Division, Mr. Dromgold has served as Dairy Sanitarian, Dairy Sanitarian Supervisor, and was appointed Acting Administrative Chief of the Milk Control Service in 1971.

Milton Held (left) presents Honorary Life Memberships to Clarence W. Dromgold (center) and Professor Evert Wallenfeldt (right, standing).

In 1960, Mr. Dromgold received the Sanitarian Service Award for 25 years of membership in the Missouri Association of Milk and Food Sanitarians, and in 1971 the same organization presented Mr. Dromgold with its "Sanitation Citation Award" for outstanding work in the field of sanitation. A native of New Bloomfield, Pennsylvania, Mr. Dromgold now makes his home in Centralia, Illinois.

Professor Evert Wallenfeldt

Evert Wallenfeldt was born in Stanton, Iowa and received the B.S. degree in Agriculture from Iowa State University in 1926. He then taught agriculture and chemistry for 2 years at the Bloomer (Wisconsin) High School. Evert then moved on to Cornell University for graduate study and in 1929 obtained the M.S. degree in Dairy Industry. From 1929 to 1938 he served the Borden Company as a dairy fieldman, supervisor of the special products and technical problems section, and research bacteriologist. In 1938 Wallenfeldt became an Extension Specialist at the University of Wisconsin in Madison. He now is Emeritus Professor of Food Science at the same institution. Although officially retired, Evert remains active professionally and continues to teach in the Farm and Industry Short Course at the Madison campus of the University of Wisconsin.

Wallenfeldt's professional career was largely devoted to improving milk quality, achieving uniformity in field work and dairy inspection procedures, assisting dairy plants to develop effective quality control programs, improving the quality of dairy products, and improving design and construction of equipment used to handle and process milk.

Evert served on numerous University, state-wide,

and national committees. Many of these activities were directly related to problems confronting the dairy industry. In addition he was and continues to be active in numerous professional societies including IAMFES, the American Dairy Science Association, and the American Public Health Association.

A. P. Bell (left) receives the 1972 Sanitarian's Award from Milton Held.

SANITARIANS AWARD TO AMBROSE P. BELL

This award is given annually to a member of IAMFES who, in the opinion of the Committee on Awards and Recognition, has contributed greatly to the field of public health during the preceding 7 years. The award consists of a plaque and $1,000. The Sanitarians Award is sponsored jointly by the Pennwalt Corporation, Klenzade Products (Economics Laboratory), and the Diversey Corporation. Although these companies are sponsors, the award is administered by IAMFES.

Selected as the 1972 recipient was Mr. Ambrose P. Bell, Director of the Division of Environmental Health Service, Louisville and Jefferson County Department of Public Health, Louisville, Kentucky. Bell, a native of Colorado, received the B.S. degree in Civil Engineering (with an option in Sanitary Science) from Colorado A and M University in 1940. He began his career in 1941 as a public health engineer in the District of Columbia Health Department. The last 24 years have been spent with the Louisville and Jefferson County Department of Public Health.

Mr. Bell's foresight and leadership together with untiring efforts enabled development of comprehensive milk, food, and environmental programs for the residents of Louisville and of Jefferson County. The accomplishments of "A.P." are legion and only a few will be cited here.

Bell saw that the Health Department needed new facilities and for more than 10 years he promoted and sought funds for a new building. In 1969 the present $2 million building was dedicated. Mr. Bell was heavily involved in planning, designing, financing, and furnishing the building.

When Bell came to Louisville there was no Sanitary Code. He began to develop and administer programs to enforce rules and regulations governing sewage disposal, water supplies, food service, retail bakeries, poultry processing, retail grocery stores, food warehouses, milk supplies, trailer parks, swimming pools, nursing and personal care homes, child care facilities, schools, slaughter houses and meat processors, nuisance control, solid waste disposal, rabies control, rodent control, insecticide vaporizing devices, residential housing, and blood banks. Nearly all of the programs are operable today.

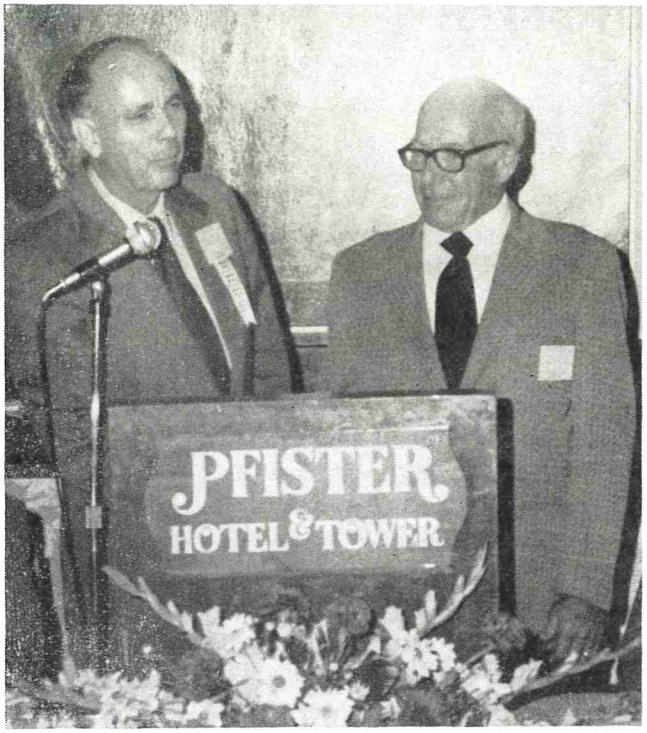
Bell has served as president of each of the following organizations: Kentucky Association of Milk, Food, and Environmental Sanitarians, Kentucky Public Health Association, Ohio Valley Conference of Food and Drug Officials, and the Maryland-Delaware Food and Drug Association. "A.P." presently holds membership in: IAMFES, the American Public Health Association, Ohio Valley Conference of Food and Drug Officials, Conference of Food and Drug Officials of the Southern States, Conference of Local Environmental Administrators, and he is a Diplomat of the American Academy of Environmental Engineers. Bell has lectured on Environmental Health at the University of Louisville Medical School and has served on numerous local, regional, and national committees.

SHOGREN AWARD GOES TO IOWA AFFILIATE

The Shogren Award was developed by the Affiliate Council to give annual recognition to the affiliate organization with the most outstanding program. A questionnaire is submitted annually to the secretary of each affiliate. Completion of the questionnaire serves to enter the affiliate in the competition and provides the information used by the Committee on Recognition and Awards to select the winner. This year the Award went to the Iowa Association of Milk, Food, and Environmental Sanitarians and was accepted by Mr. Glenn Cavin. Ben Luce, retiring chairman of the Affiliate Council, made the presentation.

A NEW AWARD FOR 1973

The Sanitarians Award has long served as a means



Ben Luce (left), chairman of the Affiliate Council for 1972, presents the Shogren Award to Mr. Glenn Cavin of the Iowa affiliate. This new award will be presented annually to the affiliate with most outstanding record of achievement.

whereby IAMFES could recognize members who made exceptional contributions to food and/or environmental safety and sanitation. Although not restricted to persons employed by regulatory agencies, in practice the award has always been won by such individuals. Persons in industry, however, have not been eligible for the award.

The Committee on Recognition and Awards believed that significant contributions to food and/or environmental safety and sanitation also are being made by persons in UNIVERSITIES and INDUSTRY and that such efforts should be recognized by IAMFES. Consequently, the Committee recommended and the Executive Board concurred that a new award be established specifically to recognize outstanding performance by persons in these two groups. The Milking Machine Manufacturers Council of the Farm and Industrial Equipment Institute agreed to provide $1,000 annually so that the award can become possible. Further details about the new award will be provided later.

OTHER AWARDS

Several other awards are traditionally given at the Awards Banquet. Charles W. Felix, editor of *Environment News Digest,* awarded the president's gavel to incoming President Walter F. Wilson. The Past-President's Award went to Dick B. Whitehead and was presented to him by Milton E. Held. George Zaichek, president of the National Association of Dairy Fieldmen, presented a plaque to Professor M. P. Dean in recognition of his efforts on behalf of the dairy industry. J. B. Smathers, on behalf of the National Mastitis Council, presented its past president's award to Mr. William Arledge.

Dick B. Whitehead (right) receives the past president's award from Milton Held.

Prof. M. P. Dean, at the lectern, just received an award from George Zaichek.

PRESIDENTIAL ADDRESS[1]

ORLOWE M. OSTEN
Division of Dairy Industries
Minnesota Department of Agriculture
Saint Paul, Minnesota 55155

Orlowe M. Osten gives the presidential address.

It is a great pleasure for me to greet so many of you at this 59th Annual Meeting of our Association. We are very grateful to the Wisconsin Association of Milk and Food Sanitarians and to the Wisconsin Association of Dairy Fieldmen for the invitation to meet here in Milwaukee in cooperation with the National Association of Dairy Fieldmen. We are indebted to and especially appreciative for the time and effort spent by your local arrangement committees, particularly Mr. Robert Anderson, General Arrangements Chairman, in planning for the care of our needs and desires. Please accept our sincere thanks.

I should also like to express the thanks of the Officers and Executive Board members to Mr. Walter Wilson, Chairman of the Program Committee, who has done such an outstanding job in developing, coordinating, and completing the program, which you have before you.

In addition, we are deeply appreciative of the speakers who are giving of their time and talent to bring us current and useful information, which will assist all of us to further develop our individual and association objectives.

A special "thank you" is always in order to our esteemed Executive Secretary, Mr. H. L. "Red" Thomasson, for his continuing dedication to our Association, and from a personal standpoint, "Red," may I thank you for the guidance you have provided me in my attempt to carry out the various tasks and responsibilities of this office.

In addition, we direct our gratitude to Dr. Elmer Marth, Editor of our official publication, the *Journal of Milk and Food Technology*. We are extremely proud of this journal, which is acknowledged throughout the nation and internationally as one of the outstanding scientific journals on milk and food sanitation. To Dr. Marth and his editorial board, we say thanks to all of you.

Finally, I must add a very personal thank you to all officers and members of the Executive Board for their assistance and cooperation. It has been a happy experience and privilege for me to be associated with these extraordinary gentlemen.

Last, but most important, my sincere appreciation to each one of you—the members of I.A.M.F.E.S.—who have contributed to the success of "International" this past year. It has been a distinct honor to serve as your President.

SPECIAL ACKNOWLEDGMENT

So that you may be aware of it, I call to your attention that our meeting this year carries a special significance because it was here in Milwaukee, Wisconsin, in the year 1911, that "International" was born. As we look back to our humble beginning, when 35 dedicated sanitarians, representing the United States, Canada, and Australia, organized this association and then recognize the status of I.A.M.F.E.S. today—a 59th Annual Meeting—think about all of "International's" accomplishments—the numerous and varied activities in which our members are involved —the fact that today we have approximately 3000 members, 25 state affiliate associations, and some 70 countries represented in membership and/or journal subscriptions—altogether it represents an almost incredible achievement. It well explains, I think, why we as members of "International" are so proud of the heritage and accomplishments of this association and why we have aways had a unique *esprit de*

[1]Presented at the 59th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, Milwaukee, Wisconsin, August 21-24, 1972.

corps, with a display of dedication and cooperation among our members. At our Awards Banquet on Wednesday evening, Dr. K. G. Weckel will elaborate and give due recognition to this special occasion. I hope each of you will find it possible to attend and share in the event.

COMMITTEES AND REPRESENTATIVES

The backbone of any association such as ours is made up of the various committees and representatives who support and enable us to carry out the objectives and responsibilities of "International." Time does not permit us to properly acknowledge and give the credit deserved to all of the people who serve and contribute so much in these activities. I do feel, however, that we should all recognize and appreciate just how extensive the affairs of "International" reach out and relate to fulfilling our reason for existing as an association.

This year, perhaps more than any other, I have been made acutely aware of the magnitude of these activities. To refresh your memory, may I quickly convey the current areas of committee and association representation.

I.A.M.F.E.S. committees

Applied Laboratory Methods, Food Equipment Sanitary Standards, Professional and Educational Development, Journal Management, Sanitary Procedures, Baking Industry Equipment, Environmental Health, Membership, Farm Methods, Awards and Recognition, and Nominations.

Representatives to other agencies

In addition to the committees just mentioned, I.A.M.F.E.S. representatives have been appointed to the following: Sanitarians Joint Council, National Mastitis Council, Third International Conference on Trichinellosis, National Conference of Environmental Organizations, Committee to Study United States Participation in the International Dairy Federation, Keep America Beautiful, Incorporated, Conference of State Sanitary Engineers, C.S.S.E.-N.S.F. Potable Water Committee, and Intersociety Council on Standard Methods.

We are deeply indebted to the individuals who contribute their time and talent, who serve and represent our Association in all of these endeavors.

When we recognize that the strength of our organization is developed through the activities of these committees and representatives and realize the great potential impact they possess for making meaningful contributions, I would suggest that it is extremely important for these activities to be critically reviewed each year by your Executive Board. Where changes for strengthening, eliminating, or appointing new committees would appear desirable, they should be implemented as quickly as possible.

AFFILIATE COUNCIL

It seems most appropriate that we should again recognize and give credit to the important function of our Affiliate Council and its members. As you may recall, Article IV, Section 3 of the constitution specifically provides: "There shall be created a council, which shall consist of the Secretary or other authorized delegate from each affiliate association and the immediate two Past Presidents of the Association. Each affiliate association shall have one vote at council meetings. The council shall select its chairman and secretary, shall keep a record of its proceedings, and shall, at each Annual Meeting of the Association submit its recommendations to the Executive Board." Section 4 further provides, "It shall be the duty of the council to recommend to the Executive Board programs or activities for the Association, provided that no recommendation of the council is binding upon the Executive Board."

We on the Executive Board are more than pleased to acknowledge that our affiliate council continues to provide us with meaningful recommendations, constructive criticisms, and is fulfilling its responsibilities in an effective manner. The council is to be commended for this and it is our hope we can further strengthen these relationships. For it is only through these activities that our association can move forward in an orderly and mutually acceptable way.

EXECUTIVE BOARD NOTES

Even though the past year has not brought about any spectacular changes or proposals as regards the workings of our association, your Executive Board has diligently considered and acted upon all of the business items requiring its attention.

As in any organization, we must acknowledge and consider the merits or disadvantages of change. Routine business must be pursued and resolved to the best interest of the majority concerned, but always with the thought in mind as to what our basic objective is.

After last year's meeting, there was some concern expressed as to the legality of our association's dues increase for 1972 because of possible conflict with the federal wage-price freeze, which was announced by the President just following the Executive Board's dues increase approval. The question was pursued by submitting it to professional legal council, who was of the opinion that our dues increase did not constitute a violation of wage-price controls under the circumstances.

It was also our understanding that Phase II of the wage-price freeze program did, in fact, resolve any possible problem which may have existed at the time the dues increase was made.

As was expected, because of the dues increase, we did experience a net loss in total membership this year. It was, however, considerably less than we had anticipated. Mr. Thomasson will provide us with more complete and detailed membership and financial statistics on this in his annual report.

This year, incidentally, will represent two firsts for "International." We had our largest income and the largest volume (34) of the *Journal* was published. If you haven't noticed, take a look at the new redesigned cover on the Journal. Most would agree it is a definite improvement over the old one.

We are happy to report that only one payment remains on the deferred compensation agreement retirement plan for our Executive-Secretary. As you may recall, this agreement, through the Participating Annuity Life Insurance Company, a subsidiary of Aetna Life Insurance Company, required four annual payments of $6,120.00 and will provide monthly payments of approximately $250.00 upon the Executive-Secretary's retirement.

A new membership committee was formed this year under the chairmanship of Harold Heiskell. While the committee is still in the organizational stage, we have great hopes that this will result in a truly effective membership program, which will reach out to the many additional areas of activity and people who could contribute, as well as benefit, from what our association and the *Journal* have to offer.

FUTURE ROLE OF INTERNATIONAL — WHAT AND HOW

None of us can predict with absolute assurance what tomorrow may bring or what our individual and collective responsibilities may require or how they should be carried out. We can only reflect on the past and, hopefully, recognize those events, activities, philosophies, and human traits, which provide the necessary ingredients that make real progress and understanding possible.

Those of us who have been privileged to serve on your Executive Board may have had a somewhat greater opportunity to witness and appreciate these principles. It is with this in mind that I have tried to identify some of the characteristics of "International" and its membership, which in my opinion, are responsible for bringing our association to its present status. I would suggest these same ideals must be maintained and practiced in any future endeavors if we are to succeed in our objectives.

As one serves in I.A.M.F.E.S., one cannot help but be impressed with the variety of professional abilities, attitudes of genuine dedication, friendly and helpful cooperation, which exists among members of "International." This, I believe, exists primarily because our association is organized and operates to allow maximum recognition of the individual's own personal worth. Each of us is an individual — *you* are an important individual with special talents, and only *you* can make your particular contribution. It would seem to me, therefore, that the most important consideration we have relative to the future role of our association and how we go about accomplishing it depends entirely on our ability to provide the means whereby we can fully utilize our members' talents and fulfill their individual needs.

As we move toward the future, we should keep in mind that no organization can be everything to everyone. There is danger in over-extension of our activities and programs, which may well result in a weakening of our effectiveness. Adjustments undoubtedly will be necessary to cope with rapidly changing technology, but we should be willing to recognize that there are limits to the capabilities of our association. Having recognized those limitations, we can proceed with confidence to act in an appropriate and responsible manner to all of our membership and to accomplishing the present and future needs of "International."

PROGRAM

The program for the next three days has been designed to provide each of us with current information in areas of personal interest. In addition, the agenda gives opportunity for you to express your viewpoints and exchange ideas, both of which are such an important part of our Annual Meeting. With the knowledge that a man rarely succeeds at anything unless he has fun doing it, your Arrangements Committee has wisely provided numerous events to enhance your social pleasures.

As we partake of this program and its' activities, let us keep in mind our obligation as a Sanitarian. This is well described in a statement I once saw a long time ago, which said in effect, "No matter how great your knowledge of a subject may be, you can be no more effective than your ability to communicate that information to others".

I trust our meeting this year will provide each of you with new motivation and increased ability to communicate to others the special knowledge you as a Sanitarian possess. For it is mainly through the understanding and efforts of others that our objectives are accomplished.

ABSTRACTS OF PAPERS PRESENTED AT THE 59TH ANNUAL MEETING OF IAMFES

Abstracts of most papers presented in Milwaukee at the 59th Annual Meeting of IAMFES appear below. Complete papers will be published in later issues of the *Journal of Milk and Food Technology*.

NEW DEVELOPMENTS IN WHEY UTILIZATION. *C. H. Amundson,* Department of Food Science, University of Wisconsin-Madison, Madison, Wisconsin 53706.

New and improved technologies for concentrating, dehydrating, fractionating, and modifying whey and its constituents are providing the industry with an ever increasing potential for the utilization of this by-product of cheese manufacture. Membrane systems, electrodialysis, reverse osmosis, and ultrafiltration make it possible to remove minerals, concentrate whey, or separate out the protein fraction without the use of heat. As a result, a variety of new products can be produced from whey and the functional properties of the whey proteins can be retained. In addition, increasing interest in enzyme modification of whey promises the development of yet another variety of products that will have greater potential for use in frozen desserts and confections. Finally, development of plastics from whey opens the possibility for industrial utilization.

FOOD AND THE SURVIVAL EQUATION. *William O. Beers,* Kraftco Corporation, Kraftco Court, Glenview, Illinois 60025.

More than any other, the food industry is extensively and inextricably involved in the "growth/zero growth" or "quantity/quality" dilemma. For food, as man's own source of energy, is the determinative element in mankind's formula for survival. As the apparatus for supplying this source of energy, the food industry thus plays a crucial role in the resolution of the crisis that could eventually determine the fate of mankind. The food industry, both in regard to the individual consumer in the store, and the world population as a whole, will have to give even greater attention to the quality of its overall contribution in terms of the ends achieved by its products. Such a change in emphasis implies a greater degree of social purpose and accomplishment, but does not mean an erosion of the profit factor. For without profits, private business—the food industry included—cannot continue to function as the most effective means of allocating resources that man has yet developed.

QUALITY CONTROL IN BREWING INDUSTRY. *Donald G. Berger,* Jos. Schlitz Brewing Company, 205 West Galena Street, Milwaukee, Wisconsin 53201.

The history of brewing and the technology of quality areas are reviewed. Emphasis is placed upon the control of microbiology, cereal development, advancement in brewing chemistry, and packaging improvements. The current industry trend toward lighter brewing is discussed and related to flavor technology and product stability. Modern processing equipment and increased knowledge in the field of sanitation microbiology has resulted in sensitive quality control parameters. Included in sanitation consideration is the impact of the good manufacturing practices section of the food and drug regulations. The quality control of brewing is presented as a dynamic, well-organized technology.

Speakers at the 59th annual meeting included, top row left to right, Dr. K. G. Weckel, Dr. H. J. Buyens, Dr. W. C. Lawton, Prof. W. Kempa, and Dr. J. Jonas; bottom row left to right, Dr. R. R. Zall, Dr. R. L. Bradley, Jr., H. N. Couden, Dr. J. R. Spies, and Dr. E. Heath.

Papers at the technical sessions included those given by, top row, left: Dr. J. H. von Elbe, center: Dr. J. O. Young, right: L. King; bottom row, left: Dr. C. Vanderzant, center: P. J. Pace, and right: R. P. Elliott.

POLYCHLORINATED BIPHENYLS IN MAN'S FOOD AND ENVIRONMENT. *R. L. Bradley, Jr.,* Department of Food Science, University of Wisconsin-Madison, Madison, Wisconsin 53706.

Among environmental contaminants, polychlorinated biphenyls (PCBs) are similar to DDT in persistence, biological magnification through food chains, chemical inertness, and hydrophobic character. While toxicity to lower vertebrates and invertebrates is less than DDT, mammals are much more susceptible to the toxic effects. PCB have been implicated in egg shell thinning in some predacious birds, failure to reproduce and deaths in mink, and economic losses in both the dairy and poultry industries. A wide variety of pathologic changes have been observed—teratogenesis, edema, damage to liver and kidneys, and retarded growth and development of sex characteristics. Growth retardation was temporary in chicks fed less than 40 ppm PCBs in a ration and permanently impaired above this concentration. A by-product, tetrachloroparadibenzofuran (dioxin) found in trace quantities in PCBs of European manufacture, has much greater toxicity than PCBs but similar biological effects. Considerable national research emphasis is being directed toward full resolution of PCB-associated problems.

AN EXAMINATION OF THE ABILITY OF THE WESTINGHOUSE MEMBRANE SYSTEM TO MEET CIP AND SANITATION STANDARDS FOR DAIRY PROCESSING. *J. R. Bruce,* Westinghouse Electric Corp., Heat Transfer Division, Lester, Pa.; *Benjamin Mosier,* Institute for Research, 1714 Rice Blvd., Houston, Texas; and *Dan E. Posey,* Institute for Research, 1714 Rice Blvd., Houston, Texas.

Results of studies designed to examine the ability of the Westinghouse membrane system to meet CIP and sanitation standards for dairy processing are discussed. Acid (cottage cheese) whey was utilized as the basic feed to the system. Flux rates across the membrane and bacterial plate counts of the feed, concentrate, and permeate demonstrate CIP and sanitation capabilities. Recent in-plant operations have confirmed the earlier laboratory results.

CONSUMER CONCERNS. *John C. Bruhn,* Department of Food Science & Technology, University of California, 209 Roadhouse Hall, Davis, California 95616.

Consumers today express more concern about the products they purchase than at any other time in our history. The consumer raises questions with regard to the safety, quality, value, and utility of products that are designed to meet his personal needs and desires. This presentation will deal with a number of the present concerns expressed by consumers and discuss their meaning to the food industries. The issues of ingredient and nutritional labeling, and product freshness will be evaluated and an interpretation attempted of what the consumer is really asking from the food industries.

MAGNETIC SEPARATION OF STEEL CANS—AN ADVANCE IN SOLID WASTE MANAGEMENT. *J. Robert Cherneff,* Hill and Knowlton, Inc., American Iron and Steel Institute.

A growing number of communities are finding that the municipal magnetic separation of steel cans is an ecological, economic, and technological solution to part of their solid waste problem. Steel's unique magnetic property permits large-scale efficient reclamation of steel cans from collected municipal garbage. Magnetic separation enables municipalities to extend the life of scarce landfill sites, produces revenues from the sale of scrap cans, lowers the cost of waste disposal, and helps conserve a valuable resource through recycling. It also leads to salvaging vastly greater numbers of used cans than do the volunteer collection programs. Successful recycling programs require that economically viable markets be maintained for reclaimed materials. America's steel industry is actively developing uses for reclaimed steel cans. Steel producers have agreed to accept all reclaimed steel cans for remelting into new steel products. Also, the copper mining industry uses salvaged cans to produce copper from low grade ore. Detinners and ferroalloy plants offer additional markets for salvaged steel cans.

FOOD DISTRIBUTION IN TODAY'S CONSUMER CLIMATE. *Henry N. Couden,* Safeway Brands Buying Division, Safeway Stores, Incorporated, Oakland, California 94660.

"The old order changeth and yieldeth place to new." Today's consumer climate is not just one of change, but of revolutionary change. The supermarket is on the front line of the consumer battle-ground for full disclosure labeling, food purity, and weights and measures. Demands under these headings include unit pricing, open-date coding, nutrition information, ingredient disclosure, chemical additives, grade labeling, protection and safety, visibility of contents, and container fill. In addition we are where the battle is on inflation, pollution, recycling, and the sale of biodegradable materials. Some food distribution practices, once unwanted or regarded as unsuccessful, have now become opportunities. To meet the public needs is our first order of business. We will identify the most immediate needs and tell how we are meeting them.

SOLIDS-LIQUID SEPARATION—AN IMPORTANT STEP IN THE RECYCLING OF DAIRY CATTLE WASTES. *A. C. Dale and Lee G. Carlson,* Dept. of Agricultural Engineering, Purdue Univ., Lafayette, Ind., 47907; and Babson Bros. Co., 2100 S. York Rd., Oak Brook, Illinois 60521.

Dairy cattle waste management systems now in use are described and discussed. Shortcomings and problems in using the various systems to recycle such wastes are enumerated. The main problem of treating and handling the solids and liquids together is discussed. Solids-liquid separation is defined. It is also shown how much a technique may appreci-

ably improve present methods of dairy cattle waste management and particularly how it makes recycling more feasible and acceptable. Byproducts of solids-liquid separation are discussed. Some acceptable methods of the solids-liquid separation process are given.

RED MEAT AND POULTRY INSPECTION: THE MICROBIOLOGY OF EQUIPMENT AND PROCESSING. *R. Paul Elliott,* U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Meat and Poultry Inspection, Scientific Services, Chemistry & Microbiology Staff, Washington, D. C. 20250.

The Federal Meat and Poultry Inspection Program (MPIP) requires that equipment be properly designed and cleaned frequently. Cooked ready-to-eat foods must be physically separated from raw foods and held below 40 F or above 120 F except for short periods. Microbiological plant inspections form the basis for microbiological criteria which MPIP is now considering for several commodities. Final product objective surveillance has recently begun on these. Sampling and analysis of final product as a means of protecting the consumer against an infrequent hazard is not feasible. Even hundreds of determinations give unacceptable low protection when the hazard is severe. Control at the source—i.e., at the processing plant—is the practical way to protect consumers with the limited resources available in laboratory programs. The MPIP microbiological sanitation program is a combination of investigation, surveillance, and correction. For example, the 1971 investigations of staphylococcal food poisonings from fermented sausages developed rapidly from final product tests, to investigations of cause, and to bacteriological inspections and corrections.

THE WILLIAMS-STEIGER OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970. *Earl D. Heath,* Occupational Safety and Health Administration, U. S. Department of Labor, Washington, D. C. 20210.

On December 29, 1970, the President signed the Williams-Steiger Occupational Safety and Health Act of 1970, the most comprehensive law ever designed for ensuring safe and healthful working conditions. The Act, which applies to virtually the entire Nation's workforce, is the result of more than 60 years of involvement by the Federal and State governments, by employers, and by employees in an effort to assure American workers a safe and healthful job environment. The Congress has presented each of us with both a great potential and a great challenge. The essence of the Act is cooperation, for only by working together can we ensure worker protection and eliminate the needless waste that accompanies occupational deaths, injuries, and illnesses. Past accomplishments to safeguard the worker have not been adequate. Each year, more than 14,000 workers continue to die as the result of occupationally-induced injuries. Another two million suffer disabling injuries. And, according to an estimate by the Surgeon General of the United States, some 400,000 are stricken by occupationally-related illnesses. Today, when National concern is focused on all phases of the environment, it is only natural that we give special consideration to the job site where American workers spend an estimated one-quarter of their time.

UTILIZATION OF DAIRY INGREDIENTS IN OTHER FOODS. *John J. Jonas,* Research and Development, Kraftco Corporation, Glenview, Illinois 60025.

Use of dairy ingredients in formulated foods enhances consumer appeal, improves the nutritional value, and supplies important functionality features. Modified dairy ingredients, when designed to meet specific functionality requirements of the food manufactures, could supply not only the inherent benefits of the dairy raw materials, but also improved economy and convenience. Introduction of these new dairy ingredients into the international trade tends to reduce accumulation of surplus dairy products in dairy production areas and be of the benefit to food industries in non-dairying countries. This paper will survey the rationale of using various dairy proteins, fats, and carbohydrates in solid, liquid, frozen, and emulsified food systems. Special emphasis will be given to sectors of the food industry which offer the best novel opportunities for the functionally designed dairy ingredients. The dairy ingredients to be discussed are classified according to their chemical nature in three groups: dairy proteins, fats, and carbohydrates.

FOOD STANDARDS AND CONTROLS IN CANADA. *William Kempa,* Ryerson Polytechnical Institute, Public Health Inspection Department, 50 Gould Street, Toronto 2, Ontario.

The organization and administration of food controls in Canada are reviewed briefly. Due to increasing consumer demands in recent years, more attention is being given to food protection by the federal, provincial, and municipal governmental agencies and by the voluntary associations. There are relatively few microbiological standards established. A number of unpublished microbiological standards are used as guidelines in enforcement programs. Current trends are to transfer more responsibility to the food industry to develop its own quality assurance programs and compliance.

AN EVALUATION OF THE ABNORMAL MILK CONTROL PROGRAM. *W. C. Lawton,* Mid-America Dairymen, Inc., St. Paul, Minn. and *V. S. Packard,* Dept. of Food Science and Nutrition, Univ. of Minnesota, St. Paul.

Milk from three groups of producers was studied for abnormal cell counts for a period of 18 months. One group was a control; one was tested and reports made only to the producers; and the third had a full program of testing and follow up of the abnormal milk control program. Direct microscopic counts were done on all samples having 20% or more gas by catalase test. Of those having over 1.5 million cells, 1.2% came from the control group, 1.4% from the group where tests only were done, and 1.5% from the group where a full program was in force. Considering three out of five counts over 1.5 million as a basis for degrade, 0.14, 0.73, and 0.91% respectively, would have been degraded from the three groups. It is questioned whether or not the cost of running an abnormal milk control program as now constituted can be justified in terms of benefits either to the dairyman or to the consumer.

Clostridium botulinum AND SMOKED FISH PRODUCTION 1963-1972. *Paul J. Pace and Edward R. Krumbiegel,* City of Milwaukee Health Department, 841 No. Broadway, Milwaukee, Wisconsin 53202.

The occurrence of *Clostridium botulinum* in fish of the Great Lakes was not generally suspected until 1963. Surveillance studies conducted since then have revealed type E to be the most prevalent toxin type in fish and environmental samples of the area. Toxin types A and C, as well as non-proteolytic type B, have been detected only occasionally in Great Lakes fish.

Research performed at a variety of laboratories, much of it since the human botulism outbreak traced to smoked fish in 1963, has provided insight into the physiology of *C. botulinum* type E and its spore form. Inoculated pack studies have elucidated conditions of storage which lead to elaboration of toxin. These data have been reviewed and collated with

those derived from studies designated to evaluate the Milwaukee Smoked Fish Ordinance. Processing and handling requirements of the ordinance are delineated; the importance of limiting the time and temperature allowed for distribution of this mildly cooked product is emphasized.

NOISE POLLUTION EVALUATION. *W. Steve Shepard,* Mississippi State University, Drawer A, State College, Mississippi 39762.

Noise, in the sense of "unwanted sound," has become such a problem it is a special type of air pollution. It is difficult to evaluate noise objectively since the human sensation to sound involves complicated physiological and psychological mechanisms. The human response to sound is discussed in detail. Consideration is given to the effects of the physical quantities of a noise source on the subjective loudness evaluation. Reasons are given for lack of agreement on how much noise, what type of noise, and what duration of exposure to noise constitutes a health hazard. A legal definition of excessive noise from the Walsh-Healy Act is discussed in detail. Loudness scales for noise evaluation are also discussed.

DAIRY FOOD ALLERGENS AND ALLERGY. *Joseph R. Spies,* Dairy Products Laboratory, Eastern Marketing & Nutrition Research Division, Agricultural Research Service, U. S. Department of Agriculture, Washington, D. C. 20250.

A general review of milk allergy and a summary of current research on milk at Eastern Marketing and Nutrition Research Division (EMN) will be presented. Milk allergy occurs primarily in infants and children under 2 years of age. It became more prevalent in the U. S. as breast feeding declined and feeding of cow's milk increased. Milk allergy (atopic and anaphylactic) has an immunological basis as distinguished from such diseases as lactose intolerance and galactosemia. The reported incidence of milk allergy varies widely from 30% in allergic children to 0.1 to 1% in nonallergic children. Symptoms of milk allergy are asthma, rhinitis, vomiting, abdominal pain, diarrhea, urticaria, and anaphylaxis. Crib deaths have been attributed to milk allergy. Prognosis is that milk allergy usually disappears by age 2. Milk proteins are the etiological agents in milk allergy. Milk contains from 12-14 immunologically distinguishable proteins, all of which are potential allergens. EMN is doing basic research on milk allergens in an attempt to elucidate the mechanism of the allergic response to ingested milk. Demonstration of new antigens (potential allergens) generated by brief pepsin hydrolysis of four milk proteins—casein, α-lactalbumin, β-lactoglobulin, and bovine serum albumin, is the basis for a new concept of the role of digestion products in immediate type milk and food allergy.

MICROBIOLOGY OF GULF COAST AND POND-REARED SHELLFISH. *C. Vanderzant and R. Nickelson,* Animal Science Department, Texas A & M University, College Station, Texas 77843.

Bacterial counts of freshly harvested Gulf shrimp handled under aseptic conditions ranged from a few hundred to a few thousand bacteria per gram. Under these conditions, coryneform bacteria and *Moraxella* species were predominant. Counts of shrimp delivered by boats to processing plants ranged from less than 1000 to over one million per gram. The predominant microbial flora of this shrimp consisted of coryneform bacteria and species of *Pseudomonas, Moraxella,* and *Micrococcus.* The number and types of microorganisms on shrimp depended upon species, season, fishing grounds, handling on board, and time and temperature of storage on the boat. With shrimp cultivated in natural or artificial ponds, coryneform bacteria and *Vibrio* species predominated. Bacterial counts of pond shrimp were lowest in the middle of summer when water temperature and salinity were high. *Pseudomonas* species which are important in the quality deterioration of Gulf Coast shrimp did not cause serious problems in pond-reared shrimp. With the aid of numerical taxonomy, coryneform bacteria isolated from pond shrimp were placed into six groups based upon biochemical and physiological characteristics. The isolates of two groups grew at 3 C. The coryneform isolates could not be related to a specific genus of the *Corynebacteriaceae.*

ORGANIC FOODS—ANOTHER CONSUMER HOAX? *J. H. von Elbe,* Department of Food Science, University of Wisconsin-Madison, Madison, Wisconsin 53706.

Today's food industry is under great consumer attack. Consumer demands have increased the number of food products to 7,800; about 3,300-3,500 new products are introduced annually. Most of the new products can be classified as convenience foods. With such a rapidly changing market, consumer confidence in the food industry has been lost and, because of confusion created, the consumer has become increasingly fearful of chemically contaminated foods. This fear is substantiated by increased public interest in so-called organic foods or organically-grown foods, proliferation of health food stores, and introduction of health food sections into supermarket chains. It is estimated that there are some 7 million organic food consumers, and that sales of natural foods (organic) will reach $400 million in 1972. Today only a limited number of organic farms and wholesalers of organic foods exist. The opportunity for fraud is great. A sign over an organic food section, or a label claiming "organic," does not guarantee that the food was produced by organic methods. Since there is nothing unique about organic foods that differentiate them from products grown by artificial means, government agencies are reluctant to issue standards controlling the movement of these products.

FOOD REGULATORY ACTIVITIES. *Virgil O. Wodicka,* Food and Drug Administration, 200 C Street S. W., Washington, D. C. 20204.

Current regulatory activities at the Food and Drug Administration cluster about several main lines of thrust. *(a)* More informative labeling. Examples are nutrient labeling, ingredient labeling on standardized foods, percentage declaration of characterizing ingredients, and on new foods, the definition of generic names. *(b)* Increasing emphasis on effective cooperation between State and Federal authorities. *(c)* Increased emphasis on food plant inspection. *(d)* More emphasis on inspection of quality assurance instead of only production. This includes quality assurance procedures applied to plant sanitation. *(e)* Increased attention to environmental contaminants, such as toxic metals and industrial organic chemicals. *(f)* Review of the safety of food ingredients with initial emphasis on the GRAS list.

NEW DAIRY PRODUCTS. *J. O. Young,* South Dakota State University, Brookings, S. D. 57006.

Dairy products that are truely "new" are rare. Most reflect changes in processing methods, alterations in ingredients, form, or packaging. Products undergoing such changes, however, are considered new. It is difficult to build in new conveniences; most dairy products are already convenient. Standards of identity, labeling requirements, and various other regulations often hamper new developments. Despite these deterrents, sterile products, particularly those where the cooked flavor can be masked, hold promise. Low-fat spreads (including cheese spreads) have been developed. Their po-

tential remains unknown because of legal deterrents to marketing. Various blends of dry products (dairy and non-dairy ingredients) are gaining use; their potential is good. Direct acidulation for sterile sour creams and cheese curd formation will expand. Whey products have good potential, particularly whey protein concentrates.

LAGOONS: A TREATMENT FOR MILKING CENTER WASTE. *R. R. Zall,* Department of Food Science, Cornell University, Ithaca, NY; *R. W. Guest,* Department of Agricultural Engineering, Cornell University, Ithaca, NY; and *D. E. Weaver,* Cooperative Extension Service, Batavia, NY.

Operational data from six lagoons treating milking center (milkhouse and milking parlor) waste were collected in New York State during a 1971-72 period. Few advantages occur from using settling basins or expensive out fall structures. Design criteria fail to recognize that individual site geography can appreciably vary a pond's winter snow load from those projected from regional averages. Individual farm management practices make the difference for success or failure of a milk waste system. Dairymen can capture the resources currently being misplaced from milking center effluents by seasonally applying them to crops and land.

ROBERT G. WHITE OF HENDRIES, INC. ELECTED PRESIDENT OF IAICM

Robert G. White, of Milton, Ma. has been elected president of the International Association of Ice Cream Manufacturers (IAICM), it was announced recently. He is president of Hendrie's Inc., headquartered in Milton. The company is the third largest ice cream manufacturer in New England and the largest distributor of nationally branded frozen foods in the six-state region. He has been president of Hendrie's Inc. since 1962.

Other officers elected are: J. Lloyd Langdon, Pet Inc., Dairy Div., Johnson City, Tenn., vice president; W. Fred Atkinsin, Ideal Pure Milk Co., Evansville, Ind., treasurer; James D. Kilgore, Pine State Creamery Co., Raleigh, N. C., secretary; and Ruth B. Stafford, IAICM, Washington, D. C., assistant treasurer.

A director of IAICM for several years, Mr. White served as vice president of the group from 1970 to 1972. He is also president of the 200-member All Star Dairy Association and a vice president and director of the New England Association of Ice Cream Manufacturers. He is a director and member of the executive committee of the Milton Hospital, an incorporator and trustee of the Milton Savings Bank, and a Town Meeting member in Milton.

He is a graduate of the Georgetown University (Washington D. C.) School of Foreign Service and the Wharton School of Finance, University of Pennsylvania.

Mr. White and his wife Barbara have three daughters and one son.

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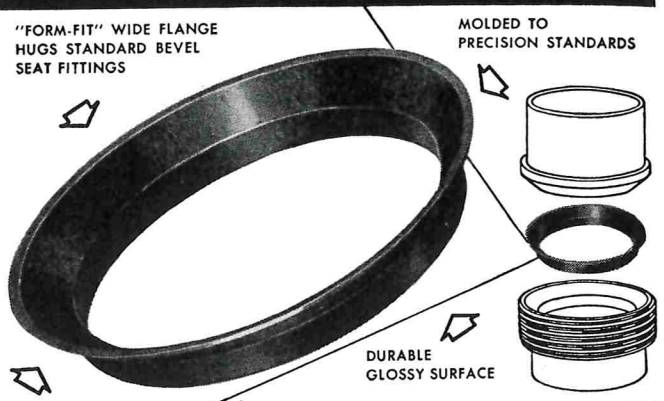

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Dairy authorities speak out
on better cow milking.

W. Nelson Philpot/Louisiana State University
North Louisiana Hill Farm Experiment Station/Homer

Mastitis Detection and Control

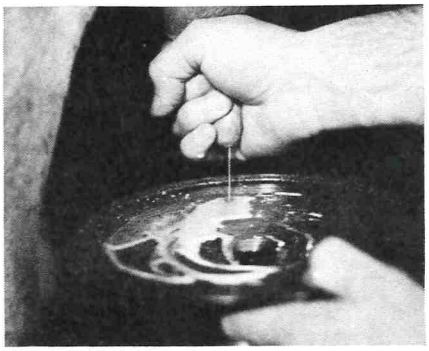
The term "mastitis" generally refers to the clinical form of the disease which occurs relatively infrequently in most herds and is characterized by swelling, redness, heat, and soreness of the udder, and an altered secretion. Research has revealed that for every individual case of clinical mastitis in a herd there are usually 25 to 40 subclinical cases. The subclinical form is important because it usually precedes the clinical form, constitutes a reservoir of organisms that may prompt new infections, reduces milk production, and lowers the quality of milk.

DETECTION

Strip Cup. The strip cup test should be conducted on the fore-milk from each quarter of every cow in the milking string before each milking to detect any prevailing abnormalities such as flakes, clots, pus, or wateriness.

California Mastitis Test. The CMT is conducted by drawing foremilk from each quarter of the udder into shallow cups of a special paddle and adding a test solution that reacts with body cells in the milk to form a gelatinous complex. The amount of gel formed is related to the number of cells present (principally white blood cells) which are, in turn, related to the presence and degree of mastitis. The CMT should be conducted at regular intervals and the scores recorded for current and future reference.

Microbiological Tests. Laboratory culturing of milk samples from individual quarters is necessary to identify the organisms involved in clinical cases of mastitis and, also, to distinguish disease-free animals from those with subclinical infections. These services are available through producer associations, milk plants, veterinarians, or private, state, or institutional laboratories.



More than 20 types of microorganisms may cause mastitis, but two types—Streptococcus agalactiae and Staphylococcus aureus—account for at least 90% of all mastitis.

PREVENTION

Good milking practices are vitally important in maintaining overall udder health. But infections of the udder can still occur. They are the result of bacteria passing through the teat canal and multiplying inside the udder. Research has shown that this usually occurs during the interval between milkings and the rate of infection is related to the number of mastitis organisms present on the end of the teat. The most effective way to reduce the number of prevailing organisms on the teat is by dipping the teats after each milking in a disinfectant teat dip that is formulated to provide an effective residue between milkings. It is also important that the dip be nonirritating and, preferably, possess tissue-toning qualities. Research has shown that the regular use of such teat dips will reduce new infections by at least 50%.

THERAPY

Clinical Mastitis. The treatment of mastitis at the clinical level requires decisive management. Such treatment, though necessary, is less than desirably effective for restoring the gland to normal function; thus, every effort should be made to prevent the disease from progressing to the clinical stage.

Subclinical Mastitis. Mastitis in the subclinical form among a few animals may spread to other animals and evolve into a general herd problem. The most effective therapeutic approach to subclinical mastitis is via a dry cow treatment program. In herds with a high level of infection each quarter of every cow should be treated at drying off. Only selected quarters of individual animals should be treated in other herds.

Drug therapy has been found to be effective in eliminating streptococcus bacteria, but generally ineffective against staphylococcus bacteria. Animals with well established staphylococcus infections often should be removed from the herd.

The level of mastitis infection in a herd can be reduced approximately 50% within 1 year when teats are dipped following milking and all quarters of each cow are treated at the time of drying off.