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Journal of

MILK and FOOD TECHNOLOGY

58TH ANNUAL MEETING
August 16, 17, 18, 19, 1971
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(Program Page 268)

Official Publication

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

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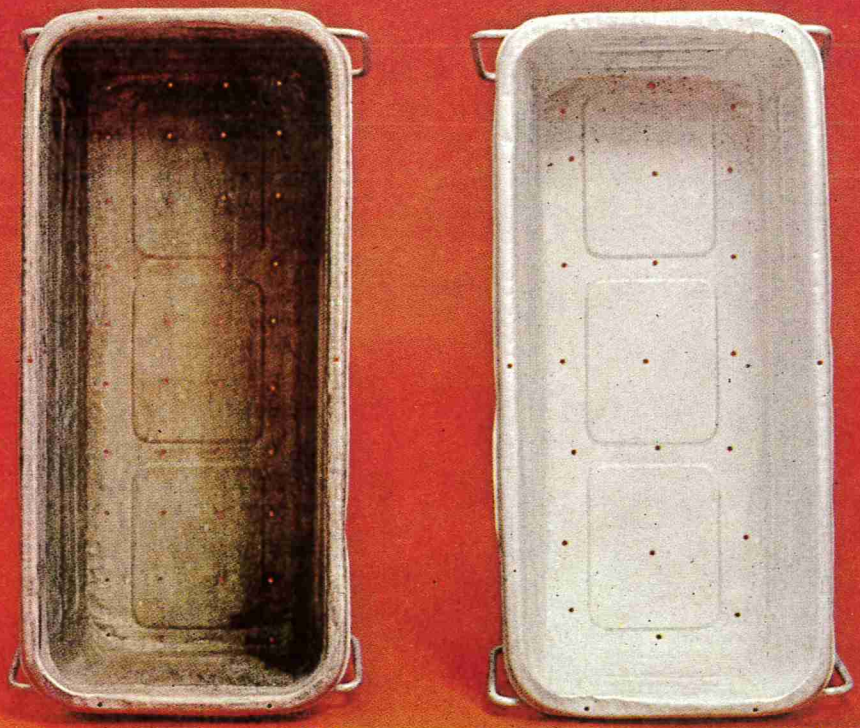

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INCLUDING MILK AND FOOD SANITATION

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

Reg. U. S. Pat. Off.

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CATERED CONVENIENCE FOODS—PRODUCTION AND DISTRIBUTION PROBLEMS AND MICROBIOLOGICAL STANDARDS[1]

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Division of Microbiology
Food and Drug Administration
Washington, D. C. 20204

(Received for publication November 16, 1970)

ABSTRACT

Microbiological standards for foods are being proposed as a means to control transmission of foodborne disease and as a means to assure maintenance of good sanitary practices during their processing, distribution, and preparation for service. The incidence of foodborne disease in the United States remains high and the microorganisms most often incriminated are *Clostridium perfringens,* toxigenic staphylococci, salmonellae, and shigellae. Foods most frequently involved include poultry, beef, pork, bakery products, and shellfish, and the most frequent sites at which the foods involved in outbreaks are mishandled are food service establishments and the home. Microbiological guidelines are a part of the control and enforcement procedures of Federal, State, and local regulatory agencies. They are applied to factory processed foods and have contributed to the excellent safety record of such foods. Similar guidelines and intensified control and regulatory programs are required for restaurant prepared meals, machine vended foods, catered and convenience foods, and foods served aboard interstate conveyances. The Food and Drug Administration is conducting microbiological surveys of these types of foods for the purpose of establishing recommended microbiological guidelines that may be applied nationally by Federal, State, and local food control agencies.

Microbiological standards are being proposed for foods because certain foods have been consistently associated with foodborne disease and because advances in the technology of food processing and preparation result in changes of the normal or historical microbial ecology of a food that may potentiate a new health hazard.

It is the proper responsibility of food control and public health agencies to be interested in the microbial quality of foods marketed in large volume, particularly when such foods receive excessive handling during processing or preparation and are capable of supporting microbial growth. Centralization of food processing in which ingredients from widely separated geographic areas are made up into perishable convenience foods has resulted in placement of responsibility for control of wholesomeness and safety in the hands of the processor—a responsibility that formerly was that of the individual consumer. This responsibility has been taken seriously by many manufacturers as evidenced by the quality control programs of the more reputable processors. Others because of ignorance, lack of technological sophistication, or greed have ignored the responsibility and it is to these groups that most health and control agencies are directing their attention.

That control of microorganisms in foods must be accomplished is no longer argued. It is recognized and widely accepted that the microbial quality of raw materials that make up a finished product affect palatability and shelf life and that good in-plant sanitation must be practiced to insure consistent high quality. If this were not true, industry would not have found it necessary to establish microbiological standards of its own in the form of purchase specifications or to maintain costly quality control programs.

FOODS NOT ALWAYS SAFE

The consuming public, generally, has the impression that any food obtained commercially and consumed is inherently safe and that everything that can be done is being done both by industry and by health and regulatory agencies to insure that it is safe. Unfortunately, this is not true, as may be attested by the incidence of foodborne disease that occurs annually in the United States (Table 1). When one considers that the incidence of foodborne disease is grossly under-reported among the States, one can understand why public health agencies are concerned about food quality and safety and wish to achieve better control (Table 2). The primary concern of the health worker is protecting the health of the consumer. The health worker, therefore, is interested in the presence in foods of pathogenic microorganisms and their toxins or in certain groups of organisms that indicate that the products may have been subjected to insanitary practices which may have permitted entry and development of pathogenic microorganisms. The harmful microorganisms of primary concern are those with which the highest disease incidence is associated. As noted in the first table, these are *Clostridium perfringens,* toxigenic staphylococci, salmonellae, and

[1]Presented at the Annual Meeting of the New York State Association of Milk and Food Sanitarians, Syracuse, New York, September 24, 1970.

TABLE 1. FOODBORNE DISEASE. CDC ANNUAL SUMMARY - 1969

Type of disease	Outbreaks No.	Outbreaks %	Cases No.	Cases %
Bacterial	243	65.5	25,911	90.7
B. cereus	3	0.8	14	0.05
C. botulinum	10	2.7	17	0.1
C. perfringens	65	17.5	18,527	64.9
E. coli	5	1.3	398	1.4
Salmonella	49	13.2	1,892	6.6
Shigella	10	2.7	1,444	5.1
Staphylococcus	94	25.3	3,481	12.2
Streptococcus	4	1.1	37	0.1
Vibrio parahemolyticus	2	0.5	71	0.2
Multiple etiologies	1	0.3	30	0.1
Parasitic	12	3.3	54	0.2
Viral (Hepatitis)	9	2.4	116	0.4
Chemical	27	7.3	172	0.5
Unknown	80	21.6	2,310	8.1
Total	371	100.0	28,563	100.0

TABLE 2. REPORTING OF FOODBORNE DISEASE. CDC ANNUAL SUMMARY - 1969

Reporting area	Number of outbreaks reported
Washington	62
California	40
New York City	22
New Jersey	18
South Carolina	15
2 States	12 (each)
5 States	11 (each)
1 State	10
11 States	5 to 9 (each)
17 States and Guam, Puerto Rico and Washington, D. C.	1 to 4 (each)
10 States	0 (each)

shigellae. Those tests most frequently used for determining sanitary quality are coliform organisms, *Escherichia coli*, and a total aerobic plate count.

STANDARDS FOR FOODS

What are the foods against which standards should be applied? The public health worker's reply to this question is those foods most frequently involved in disease outbreaks and those foods considered potentially hazardous because they support microbial growth. Foods and microorganisms most often involved in foodborne disease outbreaks are shown in Table 3. Note that poultry, beef, and pork are incriminated most often. Vegetables and fruits, bakery products, and shellfish occupy an intermediate position, and eggs and dairy products account for most of the remainder. All of these products are capable of supporting microbial growth.

It is of additional interest to note the places where foodborne illness were acquired and sites at which the foods involved in outbreaks are mishandled (Tables 4 and 5). These data indicate that most illnesses are associated with restaurant-or home-prepared foods and that most of the mishandling of food occurs in these same types of locations. The record of factory processed foods, on the other hand, appears good on the basis of reported illness.

It is noteworthy that active enforcement and control programs have been directed to food processing establishments by Federal, State, and local control and health agencies for many years and that microbial guidelines are a part of the enforcement and control procedures. Can similar control of catered convenience foods be implemented and microbiological guidelines developed for these products? The responsibility for administering the Public Health Service's food service sanitation program was recently transferred to the Food and Drug Administration (FDA). In part, this responsibility is concerned with food service operations and the safety of prepared meals, machine vended foods, catered foods, and foods served aboard common carriers. Though much has been accomplished in the past relative to establishment of sanitation, proper storage and holding of foods, and personnel hygienic practices as they affect food service operations, little to date has been done about microbiological standards for foods prepared and/or served by food service establishments.

MICROBIOLOGICAL CRITERIA

As you are probably aware, specific microbiological administrative guidelines often are used to guide FDA administrative personnel. These guidelines specify microbial levels which, when coupled with factory inspection showing substantial insanitary conditions, provide a basis for subsequent actions by the Agency. Microbiological guidelines presently exist for 59 products. Thirty-one of these specify mold count or mold fragment limits and Table 6 is a listing of foods for which such limits have been developed. Twenty-eight specify count levels singly or in combination, depending upon product, for coliform organisms, *E. coli*, *Staphylococcus aureus*, and total viable bacteria (Table 7). Numerous others exist concerning decomposition and various forms of filth and other extraneous materials. An example of guidelines for a familiar product—crab cakes or crabs; deviled, cooked, frozen—is shown in Table 8.

The Food Protection Committee of the Food and Nutrition Board, NAS-NRC, in a report titled *An Evaluation of Public Health Hazards From Micro-*

TABLE 3. VEHICLES ASSOCIATED WITH FOODBORNE ILLNESS. CDC ANNUAL SUMMARY - 1969

Type of illness	Turkey*	Chicken*	Beef*	Pork*	Other meat*	Egg	Milk	Cheese	Other dairy products	Shellfish	Other fish	Vegetables and fruit	Mushrooms	Bakery products	Chinese food	Water	Other	Unknown	Total
Bacterial																			
B. cereus										1				1				1	3
C. botulinum												6	1					3	10
C. perfringens	16	4	34	3			1	4		1		7						2	72
E. coli	1		1							1						2			5
Salmonella	11	7	6	2		3			1		1	4		5		1	1	11	53
Shigella												2				4		4	10
Staphylococcus	12	7	16	31		3	1		1	5	2	8		9	1		3	5	104
Streptococcus			2	1						1									4
Vibrio parahemolyticus										2									2
Multiple etiologies				1															1
Parasitic				11												1			12
Viral (Hepatitis)	1		2							1						5		2	11
Chemical			1	3						2	2	8	4		3		4	1	28
Unknown	6	5	10	11				2		4	2	6		6	2	2	3	24	83
Total	47	23	72	63		6	2	6	2	18	7	41	5	21	6	15	11	53	398

*Includes some outbreaks due to meat and/or gravy and/or dressing

TABLE 4. PLACE OF ACQUISITION OF FOODBORNE ILLNESS. CDC ANNUAL SUMMARY - 1969

	Restaurant	Delicatessen	Cafeteria	Home	Picnic	School	Church	Camp	Other	Total
Bacterial										
B. cereus	2			1						3
C. botulinum	1			8					1	10
C. perfringens	30	1	3	8		17		1	5	65
E. coli	3		1			1				5
Salmonella	7			26		3	3	2	8	49
Shigella	1			4		2	1		2	10
Staphylococcus	26		1	39	3	5	2	2	16	94
Streptococcus	2			2						4
V. parahemolyticus								2		2
Multiple etiologies				1						1
Parasitic	2			10						12
Viral (Hepatitis)				7		1		1		9
Chemical	6			17		1			3	27
Unknown	24		1	34		8	2	3	8	80
Total 1969	104	1	6	157	3	38	8	11	43	371
Number of persons ill - 1969	2,922	6	982	1,373	681	19,842	527	416	1,814	28,563

biological Contamination of Foods and published in 1964 defined three microbiological criteria for foods. These criteria are as follows:

1. A *microbiological specification* is the maximum acceptable number of microorganisms or of specific types of microorganisms, as determined by prescribed methods, in a food being purchased by a firm or agency for its own use.
2. A *recommended microbiological* limit is the suggested maximum acceptable number of microorganisms or of specific types of microorganisms, as determined by prescribed methods, in a food.
3. A *microbiological standard* is that part of a law or administrative regulation designating the maximum acceptable number of microorganisms or of specific types of microorganisms, as determined by prescribed methods, in a food produced, packed, or stored, or imported into the area of jurisdiction of an enforcement agency.

The microbiological criteria presently used by the FDA most closely resemble the second of these. The microbiological administrative guidelines of the FDA are not a part of a law or a regulation; hence, they

TABLE 5. PLACE WHERE FOOD WAS MISHANDLED IN FOODBORNE DISEASE OUTBREAKS. CDC ANNUAL SUMMARY - 1969

Type of illness	Food processing establishments	Food service establishments	Homes	Unknown-Unspecified	Total
Bacterial					
B. cereus		1		2	3
C. botulinum			7	3	10
C. perfringens	5	28	1	31	65
E. coli	2	2		1	5
Salmonella	4	20	6	19	49
Shigella	1	4	1	4	10
Staphylococcus	3	42	11	38	94
Streptococcus	1	1		2	4
V. parahemolyticus			2		2
Multiple etiologies			1		1
Parasitic	10	1		1	12
Viral (Hepatitis)		3	4	2	9
Chemical	5	5	11	6	27
Unknown		7	4	69	80
Total 1969	31	114	48	178	371

do not contain microbiological standards within the meaning of the Committee's definition; rather, they contain limits "recommended" for use with other evidence in reaching regulatory decisions.

Thus, the use of microbiological criteria for foods by the FDA is not new, nor is it likely to decline. Studies directed toward the development of microbiological criteria for foods are continuing.

LIMITS WHICH CAN BE ACHIEVED

Limits, when set, must take into account the factor of technical achievability under good manufacturing practices. With this in mind, we recently made operational within FDA the National Center for Microbiological Analysis which is located in Minneapolis. One of the functions of this Center is to obtain baseline data on microbiological quality of categories of foods for which no data or incomplete data exist. Not only are types and numbers of organisms in a finished product determined, but also, those critical points in a processing line are identified that contribute significantly to the microbial load. Microbiological data are correlated to manufacturing practices and plants are evaluated in terms of adherence to good manufacturing practices. One program under way in the National Center for Microbiological Analysis (NCMA) is a survey undertaken jointly by the FDA and U. S. Air Force on prepared, ready-to-eat salads. The quality of prepared salads purchased by the consumer often leaves much to be desired and some question remains concerning the safety of these foods. We are performing microbiological analyses on meat, fish, poultry, potato, and egg salads and coleslaw for coliform organisms, *E. coli,* coagulase positive staphylococci, and total aerobic plate count. In addition, examinations for salmonellae will be performed on poultry salads and egg salads. The salads are obtained from commissary outlets on military bases and are shipped to NCMA for analysis. Correlations will be developed between processing practices and microbial quality. This survey should provide the basis for microbiological guidelines of the type previously indicated and it is anticipated that these guidelines may serve the industry and the local and State regulatory agencies as well as the FDA.

CATERED FOODS

With time it is proposed that guidelines will be developed for other types of catered foods. Emphasis shall remain on those organisms most frequently as-

TABLE 6. PRODUCTS FOR WHICH MOLD COUNT OR MOLD FRAGMENT LIMITS HAVE BEEN ESTABLISHED

Food product	Food product
All spice	Greens, canned
Apple butter	Mace
Black cherry jam	Nutmegs
Black current jam	Nuts, tree
Black pepper, whole	Peaches, canned
Black rasberries, frozen	Pepper, whole, black
Caneberries, canned and frozen	Pineapple, crushed, canned
Capsicum	Plums, canned
Cassia, whole	Potato chips
Cinnamon, whole	Prunes, dried
Citrus fruit juices, canned	Raisins
Cocoa beans	Rasberries, canned and frozen
Coffee beans, green	Spinach - canned or frozen
Fruit, cut, dried	Strawberries - frozen, whole or sliced
Fruit juices - citrus, canned	
Ginger, whole	Tomato products

TABLE 7. PRODUCTS FOR WHICH BACTERIAL COUNT LIMITS HAVE BEEN ESTABLISHED

Food product	Food product
Clams - frozen, fried	Gelatin, edible
Clams, mussels and oysters, fresh or frozen	Hash browns and potato patties, frozen
Crab cakes - cooked, frozen; crabs - deviled, cooked, frozen	Langostinos, frozen, cooked
	Mussels, fresh or frozen
	Nuts, tree
Crab cakes - uncooked, frozen; crabs - deviled, uncooked, frozen	Onion rings - breaded, frozen
	Oysters, fresh or frozen
	Pies, cream-type, frozen
Crabmeat - fresh and frozen	Potatoes - frozen, baked, stuffed
Cream-type pies, frozen	
Deviled crabs - cooked, frozen	Potato patties and hash browns, frozen
Deviled crabs - uncooked, frozen	Scallops - breaded, frozen, uncooked
Eggs, whole, dried; egg yolks, dried	Scallops - frozen, fried
Fish, frozen, fried, breaded	Shrimp - cooked, peeled; shrimp meats - cooked
Fish, frozen, raw, breaded	
Fish cakes - frozen, fried	Shrimp - frozen, raw, breaded
Fish, smoked - hot process	Smoked fish - hot process

TABLE 8. ADMINISTRATIVE GUIDELINES FOR CRAB CAKES - COOKED, FROZEN; CRABS - DEVILED, COOKED, FROZEN

1. Sample correlates with establishment inspection showing substantial insanitary conditions, *and*
2. Examination of a minimum of 10 subs shows any of the following:
   a. Coliform >3.6/g (MPN) in 20% or more of subs, *or*
   b. *E. coli* >3.6/g (MPN) in 20% or more of subs, *or*
   c. Coag. pos. staph. >3.6/g in 20% or more of subs, *or*
   d. Plate count >10,000/g as geometric av. of subs.

sociated with illness. It is doubtful that the total absence of pathogenic organisms can ever be a reality. Coagulase positive staphylococci are carried on the skin and in the nasopharynx of approximately 50 to 60% of the normal population. *Clostridium perfringens* can be isolated from >90% of the stools of normal individuals and as long as man is intimately involved in food handling, we can expect to encounter foodborne pathogens of human origin. Presently, eggs, poultry, and red meats are commonly contaminated with *Salmonella,* and vegetables have been shown to harbor fecal streptococci within unopened pods, heads, and other structures. The natural habitat of *Clostridium botulinum* Types A and B is the soil and these organisms enter foods as soil-borne contaminants. *Clostridium botulinum* Type E is common contaminant of fish and is isolated with regularity from the intestinal contents of fish as well as from the Great Lakes and coastal waters. *Bacillus cereus,* as the name implies, constitutes a part of the normal flora of grains and cereals and may be isolated from flours and meals with ease.

It is the responsibility of individuals who prepare food to be cognizant of microbiological contamination and to institute those practices that minimize entry and growth of microorganisms in the product. Small numbers of certain potentially hazardous organisms in prepared foods are unavoidable but proliferation to excessive numbers through insanitary practices and temperature abuse is inexcusable.

The same principles of sanitation apply to catered foods as to processed foods—i.e., separation of raw and finished product; protection against environmental contamination; maintenance of proper time and temperature controls; minimization of intimate human contact during preparation; and use of high quality ingredients.

Our changing sociological patterns in this country have resulted in an increased mobility of our people and a de-emphasis of family or home-centered activities. This is reflected in our eating habits and today a majority of our population eats one or two meals a day away from the home. The available evidence indicates that catered and restaurant-prepared foods are frequently involved in disease outbreaks. One means of bringing about improvement in this situation is through stepped-up control and enforcement activities at the local, State, and Federal levels. Microbiological guidelines applied to factory processed foods have proven to be useful in reducing the incidence of foodborne disease associated with these products and we may expect that guidelines will be applied to catered prepared foods in the future.

METALS AND PLASTICS IN PACKAGING AND THE ENVIRONMENT

ELMER W. GRIESE

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Chicago, Illinois 60638

(Received for publication December 21, 1970)

ABSTRACT

Use of metal and plastic materials in contemporary packaging and the role and effect of the residue of this packaging in ecology is discussed. The materials involved are identified, as are the reasons for their use. Also, the disposable nature of each is discussed. The scope of the problem is given definition as it relates to litter, pollution, and solid waste management. Destruction, recycling, and secondary applications are explored as they are being advanced as approaches that offer potential solution to the problems of solid waste management. The government's activity to date as it relates to identifying the problem, establishing regulatory means, and sponsoring research as well as the position industry has assumed is noted. Emphasized is the opportunity created by the advance of our technological society for industry to suggest, demonstrate, and assume leadership in providing solutions through further applied technological advance.

This discussion is about metal and plastics in packaging and the effects of this usage on the environment. I don't believe I have to spend much time acquainting you with the subject of ecology and the current concern for the preservation of the quality of the environment. I would add, however, that in most instances we have reached the point of concern only because the quality of the environment frequently has been compromised by us to the point where the present quality is not what we want to preserve. In fact, we have to be concerned with placing things back into a relatively original order and relationship to one another. Returning to this level of quality has the aspect of being an awesome job and is frightening to many. In some instances, we have reached the point of concern and fear causing a certain amount of over-reaction.

LITTER AND POLLUTION

The things that are affecting the quality of the environment have been labeled litter and pollution. It is important to set apart used packaging materials, It is important to set apart the differences between litter and solid waste disposal. Litter, by its nature, is a tiny part of the solid waste disposal problem. Litter, however, often commands the most attention because it is in the forefront with a high level of irritancy. Commanding this respect, it overshadows the larger problem of waste disposal. Litter is commonly caused by irresponsible people, and the solution to this problem will come from education and enforcement.

Pollution is the result of mishandling of waste disposal or industrial by-products and may, to a small extent, also be a result of litter. Pollution, resulting from litter, is caused by the decomposition of that litter.

As was stated earlier, the major problem that faces us in an effective means of disposing solid waste. The Health, Education and Welfare 1969 Report, *The Role of Packaging in Solid Waste Management 1966-1976*, states that there will be 728 million tons of solid waste to be disposed in 1976. Of this total, 73.5 million tons, or 10%, will be used packaging materials. Of this amount of used packaging materials, 8.4 million tons, or 11%, will be metals and of this, approximately 6 million tons will be steel and aluminum beverage cans. Further broken down, only 2% of the total tonnage of packaging materials is plastics. In 1966, the average cost of collection and disposal of solid waste nationally was $9 per ton. An arbitrary doubling of this 1966 cost is forecast as the cost for 1976.

Although the above statistics point out that metal in packaging is a small part of the total solid waste problem, it is spotlighted because of the part it plays in litter. The magnitude of this problem may be further emphasized by realizing that the $18 per ton cost of solid waste disposal forecast for 1976 does not include the high cost of collecting litter.

Because litter is the result of so simple a process, throwing it away, simple solutions will be sought. It is not likely, however, that an all-encompassing one will be found. Basically, the answer is to educate the population, thus instilling a sense of responsibility for their environment.

METAL PACKAGES AND ECOLOGY

In discussing the role of metals in ecology, we should review those metals used in packaging. The list is short. Steel, tin, aluminum, and lead make up the bulk of metal found in packaging today. Many other trace metal elements find their way into packaging, but their proportion by weight to those above is negligible.

Steel is to be found in three forms, differing only in those metals appearing on its surface. These are commonly black plate, without a secondary metal coating; tin plate, with a secondary coating of tin;

and TFS (Tin Free Steel), with a protective coating of chromium.

These basic types of steel are being used mainly in can manufacturing. Aluminum also is used in packaging and in the manufacture of cans. Aluminum, because of its properties, also finds its way into many other varieties of packaging. Its application ranges from ends and bodies of cans to microscopic layers deposited on plastic films. Another high volume usage placing large amounts of aluminum in packaging is the formed container industry. These products are the ones commonly used to package bakery and frozen food products.

Tin, chrome, and aluminum are used as coatings in the packaging industry because of their properties of impermeability, conductivity, appearance, and resistance to corrosion. Steel and aluminum are used in packaging to form rigid containing bodies that utilize other properties of the materials; such as, rigidity, formability, heating stability, and at times those mentioned previously.

Lead is on this list mainly because of the role it plays in the fabrication of the common tinplate can. It is used here in solder to fabricate and join sheet ETP steel (tinplate) material into cylindrical form. Foils of aluminum and steel have been used in packaging in very thin gauges where its impermeable nature can form a protective barrier in the packaging and preservation of food stuffs.

The disposable characters of these metals vary depending upon their chemical properties and the environment in which they are placed after use. A standard tin can, for example, will decompose or rust in 6 months to 1 year if incinerated when initially disposed. Incineration burns off any protective corrosion-resistant surface material, such as organic coatings, and most of the protective layer of tin. When not burned, however, estimates show that this same can may last from 6 to 10 years before being completely reduced by oxidation.

Packaging products made of tin free steel or black plate degrade at a much more rapid rate when not burned, although the type of coatings that are applied to its surface most times are placed there to improve the product's resistance to oxidation. If burned, degradation takes place at about the same rate as that of the common tin can.

Aluminum, on the other hand, when used to fabricate cans, takes many times as long as the tin can to decompose. Aluminum, in other applications where lighter gauge material is utilized because of its resistance to oxidation, also takes a long time to degrade. Lead and chrome decompose when exposed to rain and sunlight and form harmless oxides.

In the foreseeable future, we do not envision the use of metals other than those mentioned above in significant quantities. In considering the materials that we are and will be working with, we can examine what practical steps might be taken, to take into account the problems of waste disposal caused by use of metal and plastics in packaging.

PLASTICS AND SOLID WASTE

The role of plastics in solid waste has been just covered in a position paper published by the Society of the Plastics Industry (SPI), Inc. *(3)*. I urge all of you to get a copy of this report which is available from SPI.

The report states that there are about 39 different families of plastics and many copolymers and combinations. Therefore, compared to metals, many more materials are in use presently with many more on the horizon. Since there are so many, I won't list them here—but I'm sure many of them are familiar to you.

IMPROVED DISPOSAL

Disposability of metals and plastics in packaging could be improved by exploring one or more of three approaches—destruction, recycling, or secondary applications. Of these, notable authorities are now spending much of their time speaking of the benefits of recycling as the only practical and ultimate solution. Such an approach obviously conserves resources, gives a high utility in terms of material consumption, and hopefully will prove to be economically sound.

Destruction

Destruction will probably receive some immediate attention because in some respects this is what goes on today with regard to those items that become litter and those items that are disposed of as solid waste. There will be attempts to speed up the time required for decomposition to help control the problem of metal and plastic packaging in litter and solid waste. These attempts will explore taking greater advantage of the two environmental exposure conditions that prevail in dumps and litter areas—rain and sunlight.

You have no doubt heard of efforts by the glass industry to produce a water soluble glass container that will decompose when littered or disposed on the landscape. Also, efforts are being made to produce plastic materials that will decompose through exposure to ultraviolet light. The metal packaging industry also will seek solutions of a similar nature. Self-destruct packages have already been talked about, and no doubt some researchers are hard at work in attempts to demonstrate viable solutions.

Unfortunately, this kind of solution will have the probability of leaving with us the polluting by-products of metallic and plastic decomposition.

Destruction through incineration is one of today's common means of disposing solid waste. Both metal and plastics present problems in many of today's incineration systems that are technologically outdated. Much has been said of plastics and the resultant problems created by incineration. These problems, production of black smoke and soot from polystyrene, toxic gas emission from polyethylene and HCl from PVC have been debunked in the SPI report (3). The SPI report states that incineration offers the most practical means for disposing of large amounts of plastics because of its inherent advantages and the inadequacies of other disposal systems. Further, there apparently is no truth to the recurring reports about significant levels of phosgene and HCl being emitted by the incineration of PVC.

New applications also will be sought. Some of these are already receiving some publicity. There is a Florida concern that is fabricating architectural screens from collapsed aluminum cans. An example from the glass industry is the projected use of crushed glass in a paving compound. In the same area, some consideration has been given to the use of crushed cans and plastic waste as filler in concrete paving materials, or in formed concrete building block. In considering the recycling of plastics, we primarily have to be concerned with not mixing resins. The complexity of the problems of direct separation may, however, prohibit direct recycling of plastic materials once they have gone through a distribution cycle and achieved a mix.

Short of solving this problem, one promising approach is now being explored. This approach is called pyrolysis and brings on chemical change by heat without air or oxygen. Pyrolysis promises the returning of some plastic waste to the raw material cycle.

Recycling

With regard to recycling metals, the most promising solution to the total problem, National Steel Corporation recently demonstrated successfully the reuse of 25 tons of tin free steel, scrap cans with aluminum tops, in making steel. Future tests will seek to demonstrate the capability of using tin cans with soldered side seams; and beyond that, tests utilizing other mixes of scrap metallic packaging will be attempted. It has been recommended by Mr. Stinson, president of National Steel Corporation and chairman of the board of The American Iron and Steel Institute, that a full scale demonstration project be conducted in one of the major metropolitan areas of the United States. The objective of this project would be the total collection of all used steel container waste, including household, commercial, or litter culminating in the recycling of that waste in the production of usable steel. A pilot project of this sort could develop, test, and demonstrate new techniques necessary for separation, collection, and preparation of steel packaging waste products and effectively eliminate these products from the existing waste disposal problem. Hopefully, it would demonstrate the sound economics of a scrap recycling system and provide guidelines to government and industry for implementation.

Other efforts to segregate and collect scrap are being effected by the aluminum industry. Reynolds Metals Company and, more recently, The Aluminum Company of America have initiated collection programs to recycle aluminum cans.

The research and development facilities of the numerous companies supplying metal and plastic packaging materials are presumably actively involved with researching ways to improve the disposable nature of their products. Research and development can attack the problem from two directions. One, they can examine how their products can be converted to packaging with the view of recycling in mind, or two, they might attack the problem by exploring ways that their product might dispose of itself once in the city dump or on the landscape as litter. Hopefully, more time will be spent on the first approach, as this would seem to be a more effective long range total solution.

Industry's approach

Industry has also taken on the challenge of education and has formed concerned groups such as Keep America Beautiful, Inc.; The National Industrial Pollution Control Council; and many of the companies involved with packaging have established corporate programs to educate the population in the communities in which they operate. Also, recently announced by Mr. Frank W. Considine, president of National Can Corporation, at the 32nd Annual National Packaging Forum, is the formation of an organization to be known as The National Center for Solid Waste Disposal. The Center concept is the brainchild of the leaders of the packaging industry. Its goals will be to test concepts and conduct the research and development of prototype systems to assist industry and government to find answers to the problems posed by litter and solid waste.

Government's approach

The government's effort to date has been mainly one of seeking to identify the problem. Various

governmental levels, central and state, have established panels, boards, and bodies that will seek to identify and regulate.

Flagrant offenders of regulations that are established will be prosecuted because of the obvious severity of the violation that causes pollution, litter, and/or other solid waste problems. Governmental bodies are also offering grants sponsoring research at both university and industrial levels. Hopefully, the future will find these governmental bodies following industry's suggestive leads so that methods of implementation will be devised. Perhaps the result of these actions will be a significant national effort mounted to provide effective and implemented solutions to the problem.

TECHNOLOGY AND ECOLOGY

We are all aware that there is a tremendous problem that we have created by becoming the advanced society that we now are. While there has been tremendous advance technologically in the packaging preservation of foodstuffs as a part of the natural growth of this complex society, we have not spent the time to consider the effects of a tremendous output in materials on the ecological system as a whole. The industry that created the packages that so well fit the demands of an advanced technical society has simply not considered the function of these packages in the solid waste stream. The massing of enormous tons of packaging materials presents a technological opportunity for problem solving not unlike the original problem of creating advanced packaging for a progressing society. The metal, the plastic, and the packaging supplier industries should accept the challenge and aggressively expand an already complex technology to develop answers and provide solutions to the problem of solid waste disposal. Those who accept the challenge and develop answers will certainly be rewarded as were those companies that have developed the advanced packaging that has filled previous needs.

The entire answer to the problem of solid waste management will not come from the packaging industry taking on this new opportunity. The problem, in many respects, is much larger than the largest companies involved with packaging. It is realistically a universal problem and vast sums of money will be required to provide a solution. The last thing we want to do, as some have already advocated, is to destroy our technological civilization, and decrease the standard of living in a move to improve the quality of life.

We should strongly reject any idea that promotes moving backwards. We believe that technologies are fully available to accomplish the development of a full circle system. This sort of waste disposal system would raise the lagging technology of solid waste disposal to the levels that have been achieved by the technologically progressive packaging industry. Clearly, if we can bring the same high efficiencies that exist in the production and distribution system common to food manufacturing and packaging to the final handling of that system's residue, we will have developed a continuous flow closed system that brings materials back to the starting point with no costly and detrimental effect as today.

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NOTICE
29TH ANNUAL DAIRY FIELDMEN'S CONFERENCE—JUNE 8 AND 9, 1971

The 1971 Dairy Fieldmen's Conference is to be held at The Pennsylvania State University. All meetings will be held in the auditorium of the J. Orvis Keller Building and the banquet will be held on Tuesday evening at the Nittany Lion Inn. Registrants should make reservations directly with the hotel or motel of their choice at their earliest opportunity, as several other large conferences will be meeting concurrently.

The fee is $12.50 per person and includes: Registration, conference proceedings, banquet, and Dairy Fieldmen's Scholarship. If more than one individual from a company or other association is attending, a preregistration form should be completed for each individual; but one check will suffice for the entire group. All preregistration forms and checks (payable to The Pennsylvania State University) should be sent to: Agricultural Conference Coordinator, Room 410, J. Orvis Keller Building. The Pennsylvania State University, University Park, Pennsylvania 16802. A large crowd is expected, so advance registration is very important.

ASSOCIATIVE GROWTH RELATIONSHIPS IN TWO STRAIN MIXTURES OF *STREPTOCOCCUS LACTIS* AND *STREPTOCOCCUS CREMORIS*[1]

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Abstract

A recently described differential agar medium was used to study strain interactions in two-strain mixtures of *Streptococcus lactis* and *Streptococcus cremoris*. Two *S. cremoris* strains (ML4 and DR7) exhibited marked dominance over four *S. lactis* cultures. One *S. cremoris* strain, designated 1, showed excellent compatibility in all combinations. *Streptococcus cremoris* HP was progressively suppressed by all *S. lactis* strains. The associative growth patterns at 32 C and 21 C were similar irrespective of the initial cell numbers of the component strains.

The technique described in this paper could be used in conjunction with phage tracer methods to investigate growth relationships among mixed strain lactic starters containing more than one strain each of *S. lactis* and *S. cremoris*.

Several investigators have examined associative growth relationships among lactic streptococci that are widely used as starters in the dairy industry. The earliest work in this area was done by Nichols and Ineson *(10)*, employing phage-tracer techniques to identify component strains in mixtures. Using similar techniques, Czulak and Hammond *(1)*, Collins *(2)*, and Lightbody and Meanwell *(7)* investigated strain-interactions among lactic streptococci. In a later investigation, Collins *(3)* studied the role of antibiotic production *(8, 11)* in dominance observed among mixed strain lactic starters. Recent studies on associative growth patterns in starter mixtures containing heterologous species *(6, 13)* also were conducted using strain-specific bacteriophages.

In all the foregoing investigations, the dominance and (or) compatibility among component strains in lactic starters were studied by indirect techniques using strain-specific phages and activity tests. Direct evidence through counting procedures could not be obtained because of the close relatedness of individual strains within lactic *Streptococcus* species and between species themselves, making it impossible to differentiate even colonies of heterologous species. Recently, Reddy et al. *(12)* described a differential medium for qualitative and quantitative determinations of individual components in two strain mixtures of *Streptococcus lactis* and *Streptococcus cremoris*. This paper describes the application of the differential medium to study inter-relationships among several two-strain mixtures of S *lactis* and S. *cremoris*.

[1]Journal Paper No. J-6744 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project No. 1838.
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Materials and Methods

Cultures

Four strains of *S. cremoris*, designated as HP, ML4, 1, and DR7, and 4 strains of *S. lactis*, designated as C2, E, 10, and 7963, were used. These strains were selected from the culture collection at the Department of Food Technology, Iowa State University on the basis of satisfacory acid-producing activity determined by the method of Horrall and Elliker *(4)*.

Propagation

The selected cultures were routinely grown in 11% Matrix milk medium (Galloway-West, Fond du Lac, Wisconsin) by inoculating a 1% milk culture and incubating it at 32 C for 14 to 16 hr.

Counting medium and technique

The differential medium described by Reddy et al. *(12)* was used, closely adhering to the specific technique recommended. The incubation period in the candle oats jar was, however, reduced to 36 hr from 48 hr. This modification allowed clearcut differentiation of *S. cremoris* colonies when their numbers relative to those of *S. lactis* colonies were very small.

Arginine hydrolysis test

To confirm the presence of *S. lactis* in two strain mixtures of lactis-cremoris, the arginine hydrolysis test described by Niven et al. *(9)* was employed. Tubes of medium were tested for NH_3 at 24 hr intervals for 5 days.

Experimental designs for associative growth studies

A graphical representation of the experimental design for associative growth studies is shown in Fig. 1. All platings for counts represented in Fig. 1 were made at dilutions of 10^{-7} and 10^{-8}. *At lower dilutions, differentiation and counting efficiencies were very poor.*

Whenever *S. cremoris* dominated the mixture, the extent of suppression of the corresponding *S. lactis* was determined by inoculating lower dilutions of the lactis-cremoris mixtures into Niven's broth *(9)*. After incubation, the cultures were

TABLE 1. POPULATION TRENDS[a] OF COMPONENT STRAINS IN MIXED CULTURES OF LACTIC STREPTOCOCCI WITH SUCCESSIVE TRANSFERS IN MILK.

S. lactis strains	Transfers	*S. cremoris* HP				*S. cremoris* ML4			*S. cremoris* 1			*S. cremoris* DR7		
		Pure culture	Pure culture	Mixed culture		Pure culture	Mixed culture		Pure culture	Mixed culture		Pure culture	Mixed culture	
		S. lactis counts	*S. cremoris* counts	*S. lactis* counts	*S. cremoris* counts	*S. cremoris* counts	*S. lactis* counts	*S. cremoris* counts	*S. cremoris* counts	*S. lactis* counts	*S. cremoris* counts	*S. cremoris* counts	*S. lactis* counts	*S. cremoris* counts
C2	PC[b]	200	150	—	—	130	—	—	95	—	—	95	—	—
	0[c]	200	130	130	46	100	NC[d]	90	91	90	27	85	10	11
	1	200	150	230	19	110	NC	130	80	62	41	81	NC	13
	2	190	130	170	13	95	NC	120	88	40	44	82	NC	17
	3	210	130	170	11	91	NC	100	82	25	50	86	NC	38
E	PC[b]	260	150	—	—	130	—	—	95	—	—	95	—	—
	0[c]	250	130	190	62	100	NC	150	91	116	42	85	NC	32
	1	230	150	270	39	110	NC	170	80	153	41	81	NC	94
	2	220	130	220	13	95	NC	110	88	95	41	82	NC	49
	3	230	130	220	4	91	NC	110	82	77	58	86	NC	23
10	PC[b]	170	150	—	—	130	—	—	95	—	—	95	—	—
	0[c]	200	130	180	61	100	NC	92	91	89	55	85	NC	57
	1	180	150	230	19	110	NC	140	80	130	46	81	NC	78
	2	180	130	290	7	95	NC	66	88	150	40	82	NC	66
	3	180	130	240	3	91	NC	130	82	150	36	86	NC	22
7963	PC[b]	260	150	—	—	130	—	—	95	—	—	95	—	—
	0[c]	230	130	150	29	100	8	90	91	130	39	85	46	8
	1	230	150	220	18	110	NC	130	80	120	14	81	1	35
	2	230	130	190	10	95	NC	120	88	73	20	82	NC	42
	3	240	130	220	NC	91	NC	130	82	53	53	86	NC	38

[a](count/ml) × 10^{-7}

[b]PC - Pure culture counts when blending.

[c]Initial propagation.

[d]No colonies at 10^{-7} dilution.

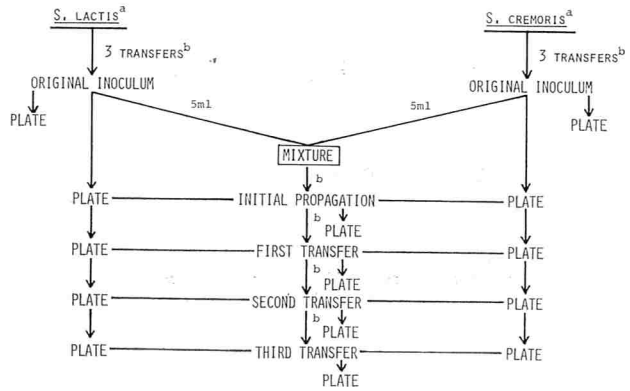
tested for NH_3. This procedure was applied only when no S. *lactis* colonies were detected at 10^{-7} dilution of the specific lactis-cremoris mixture cultured in milk. The maximum dilution of the two strain milk culture that gave a positive test for arginine hydrolysis provided the most probable numbers (MPN) of the S. *lactis* strain in the mixture. This procedure also is graphically shown in Fig. 2.

Results and Discussion

Results of associative growth patterns in 16 possible lactis-cremoris combinations of cultures chosen for this investigation are shown in Table 1. In this table, all values shown were calculated from colony counts at 10^{-7} dilution (see footnotes for Table 1). As explained under Experimental Methods, the most reliable differential enumeration of lactis-cremoris milk cultures was possible at this dilution. From data in this table, it is evident that pure culture colony counts at 10^{-7} dilution for all the strains at the time of blending were quite high, ranging from 95 to 260. Hence, the initial count of the component strains (soon after mixing) at 10^{-7} dilution in the various blends would have been one-half this value; i.e., ranging from 48 to 130, which could be accurately enumerated on the differential agar. In this experiment, no attempt was made to ensure equal or nearly equal numerical counts of the component strains in the two strain mixtures.

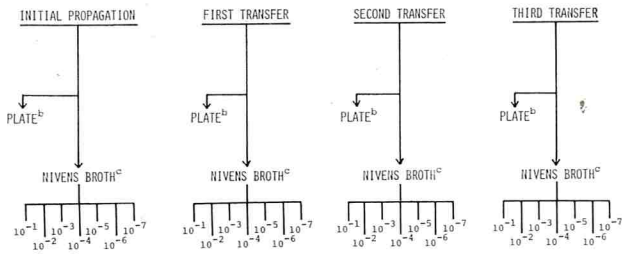
Pure culture counts for all strains remained stable through initial propagation and three successive transfers, indicating that differences in the populations of individual strains in the mixtures were caused by strain interactions and not by fluctuations in the cell numbers of pure cultures themselves from day to day.

In all combinations containing S. *cremoris* strains ML4 and DR7, there was a definite suppression of



[a] SELECTED ON THE BASIS OF ACTIVITY (> 0.4 % ACIDITY IN 3.5 HR. AT 37.7C)
[b] 100 ML RECONSTITUTED SKIM MILK INOCULATED AT 1 % AND INCUBATED FOR 17 HR. AT 32C, ALL COUNTS WERE DETERMINED ON DIFFERENTIAL AGAR AFTER INCUBATION FOR 36 HR. AT 32C IN A CANDLE OATS JAR.

Figure 1. Procedure used for determining population trends of component strains in mixed cultures of lactic streptococci with successive transfers in milk.



[a] FOR MIXTURES CONTAINING S. CREMORIS ML4 AND DR7, PROPAGATED IN MILK AS SHOWN IN FIG. 1.
[b] DIFFERENTIAL COUNTS TAKEN ON 10^{-7} DILUTION.
[c] EACH DILUTION WAS INOCULATED INTO NIVENS BROTH AND TESTED FOR NH_3 TO DETERMINE HIGHEST DILUTION WHICH CONTAINED THE S. LACTIS STRAIN FOR EACH SPECIFIC MIXTURE.

Figure 2. Procedure for determining the extent of domination by S. *cremoris* strains in two strains lactis - cremoris mixtures.

the corresponding S. *lactis* strains. This is evident from counts obtained after the initial propagation. Whereas the population of each S. *lactis* strain in the blends soon after mixing with either S. *cremoris* strain (namely ML4 or DR7) would have been at least 80×10^{-7}/ml (approximately, one-half the pure culture count at the time of blending, Table 1), after merely propagating once, the colony counts were considerably reduced or were not obtainable at a culture dilution of 10^{-7}. There were, however, differences in the extent of inhibition with different S. *lactis* cultures (Fig. 3 and 4). Each bar in these figures represents the maximum dilution of the various mixtures at each stage of propagation in milk (shown in Fig. 1 and 2), at which a positive Niven's test (indicative of the presence of S. *lactis*) is obtained. *Streptococcus lactis* E was almost completely suppressed, whereas the other S. *lactis* strains were reduced in count by 2 to 5 logarithms by the third successive transfer.

There was a progressive domination of S. *cremoris* HP by all strains of S. *lactis*. *Streptococcus cremoris* 1 exhibited excellent "compatibility" with all four strains of S. *lactis*. This strain, or cultures with similar associative growth patterns, would be the choice for use in cheese starters.

To verify if similar associative growth patterns could be obtained in the same mixtures when initial populations of the component strains at the time of blending were adjusted to equal or nearly equal numbers, another experimental design was adopted. Pure cultures were grown through several successive transfers under strictly controlled incubation conditions (time-temperature) and accuracy of inocula. After each transfer, single-strain milk cultures were plated on the differential agar, and counts were taken. Counts were quite stable for each strain after the second successive transfer. By using these data, dilution factors for each high count culture for each specific combination were calculated. At the time

TABLE 2. POPULATION TRENDS[a] OF COMPONENT STRAINS PREADJUUSTED TO APPROXIMATELY "EQUAL NUMBERS MIXED CULTURES OF LACTIC STREPTOCOCCI WITH SUCCESSIVE TRANSFERS IN RECONSTITUTED SKIM MILK.

S. lactis strains	Transfers	Differential counts							
		S. cremoris HP		*S. cremoris* ML4		*S. cremoris* 1		*S. cremoris* DR7	
		SL[b]	SC[b]	SL	SC	SL	SC	SL	SC
C2	PC[c]	49	48	120	110	120	100	50	70
	0[d]	63	18	NC[e]	99	79	57	6	90
	1	48	14	NC	110	88	69	NC	92
	2	55	8	NC	110	16	110	NC	32
	3	77	10	NC	120	6	90	NC	27
E	PC	45	48	84	99	84	86	45	70
	0	59	23	NC	160	91	86	NC	140
	1	40	8	NC	120	45	71	NC	130
	2	41	17	NC	120	8	89	NC	33
	3	72	16	NC	130	6	86	NC	38
10	PC	51	48	120	110	120	100	51	71
	0	110	18	NC	120	130	74	2	99
	1	100	9	NC	150	110	46	NC	160
	2	170	7	NC	140	83	54	NC	110
	3	220	3	NC	120	93	82	NC	120
7963	PC	55	48	100	110	100	99	55	70
	0	53	21	NC	110	62	70	4	78
	1	69	21	NC	120	29	75	1	78
	2	58	6	NC	130	14	81	NC	24
	3	110	9	NC	140	6	86	NC	29

[a](count/ml) × 10^{-7}
[b]SL - S. *lactis*
SC - S. *cremoris*
[c]Pure culture counts before mixing.
[d]Initial propagation.
[e]No colonies at 10^{-7} dilution.

of blending, dilutions were made in sterile Matrix medium, and diluted cultures were then used as inocula in the blends. Results of the experiment using such blends are summarized in Table 2. Associative growth patterns in mixtures initially containing near-equal cell numbers of the component strains were similar to those found in blends made up without prior numerical adjustments. Hoyle and Nichols *(5)* and Collins *(2)* also reported that wide differences in inocula did not determine ultimate strain dominance.

Both S. *cremoris* ML4 and DR7 exerted an inhibitory effect against all strains of S. *lactis* in mixtures with and without numerical adjustment at the time of blending. Lightbody and Meanwell *(7)* also found that S. *cremoris* dominated in every instance when grown in association with S. *lactis*. Similar trends were observed by Hoyle and Nichols *(5)* in lactis-cremoris mixtures made up with "starter strains." In mixtures containing either of these S. *cremoris* strains, dominance was exhibited *rather abruptly* after the initial propagation. It is probable that the abrupt manifestation of dominance could be caused by elaboration of an antibiotic that acts immediately and effectively against susceptible strain in the mixture. In this connection, the inhibitory effect of S. *cremoris* ML4 against S. *lactis* C2, found in these mixtures, is in agreement with results of Collins *(3)* who showed that this S. *cremoris* culture produced an antibiotic active against S. *lactis* C2.

The *gradual* domination observed in mixtures containing S. *cremoris* HP does not seem to be because of antibiotic production by the corresponding S. *lactis* cultures. Dominations of this nature could be caused either by differences in acid tolerance and (or) competitive growth abilities as suggested by Czulak and Hammond *(1)* and Collins *(2)*.

In later experiments, when the cultures were treated exactly alike with the exception of incubation temperature, which was lowered to 21 C (the routine propagation temperature of starter), trends similar to those observed at 32 C were obtained (data not presented here). Hence, we concluded that, contrary to the findings of Nichols and Ineson *(10)*, temperature of incubation had little or no effect on the associative growth patterns in mixed strain lactic starters. Collins *(2)* also found no correlation between temperatures of incubation and associative growth patterns. These experiments were repeated twice, and in every instance, trends in strain interaction were similar.

We have demonstrated the suitability of the dif-

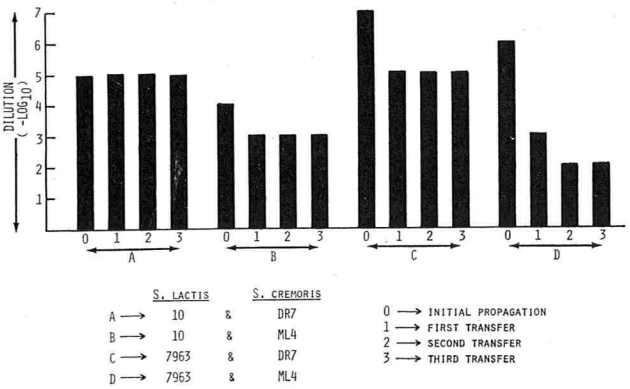


Figure 3. Results of arginine hydrolysis tests showing the extent of domination by S. *cremoris* strains in mixtures containing S. *lactis* strains.

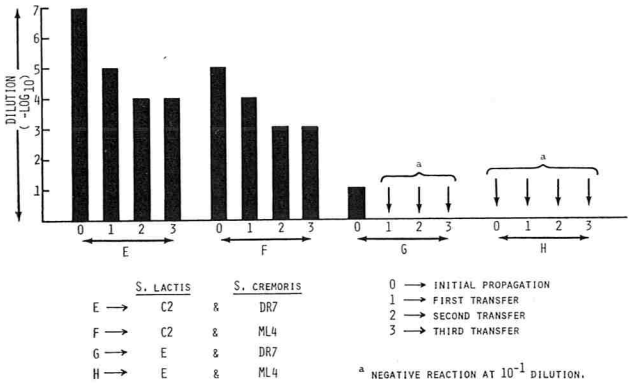


Figure 4. Results of arginine hydrolysis test showing the extent of domination by S. *cremoris* strains in mixtures containing S. *lactis* strains.

ferential agar of Reddy et al. *(12)* to study strain interactions in lactis-cremoris mixtures. The phage typing technique used by earlier workers could be used in conjunction with our procedure to study associative growth patterns in starter mixtures containing more than one strain each of these two species. Colonies from the differential agar could be picked and tested against specific phages to trace the identity of the component strains. In addition, extent of domination also could be demonstrated by checking milk or broth tubes inoculated and incubated with serial dilutions of the specific mixture against specific phage types. Such a procedure would simplify the methods previously used for similar studies.

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USE OF GEL FILTRATION AND ION EXCHANGE CHROMATOGRAPHY FOR PARTIAL FRACTIONATION OF A SOLUTION FROM WHEY CONTAINING SODIUM CHLORIDE, ASH AND LACTOSE

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Abstract

Lactose and chloride are partially separated from deproteinated salted whey (D.S.W.) by gel filtration. Approximately 24.1% of chloride was removed and 8.9% lactose was recovered from 3 ml of D.S.W. with a 10 g column of Sephadex G-10. On the other hand, 77.6% of chloride was removed and 74.5% lactose was recovered from 3 ml of D.S.W. with three continuous 10 g columns of Sephadax G-10. Ion exchange chromatography removed 92.1% and 99.1% of the chloride content of D.S.W. by using a single and double pass system, respectively.

Application of ion exchange resins for partial desalting of cheese whey has resulted in an increased use of whey for human consumption *(6)*. Bio-Rad Laboratories *(2)* reported that a resin incorporating acrylic cation exchange sites inside Dowex anion exchange can be used. Nakai et al. *(14)* found that 40% of ash was removed from 200 ml of cottage cheese whey with 100 ml of the ion retardation resin. Otherwise, 40% ash was removed from 450 ml whey on a mixed bed of Dowex 1 and 50. Gel filtration has been used to separate skimmilk and whey into two major fractions by means of Sephadex columns and a centrifugal Sephadex procedure *(3, 9, 10, 15)*. Recently Morr et al. *(11)* compared column and centrifugal Sephadex methods for fractionating whey and skimmilk. In the same year Emneus *(4)* found that gel filtration was suitable for desalting cheese whey. In 1969 the Sephadex equilibrium-diffusion technique for fractionating whey and skimmilk was described by Morr et al *(12)*. Whey in Egypt contains NaCl in high concentration which makes its processing and utilization practically impossible. Thus attempts were made to separate the salt from whey by gel filtration on a column of Sephadex G-10 and by ion exchange chromatography on a column of Dowex 1 and 50W.

Materials and Methods

(a) Deproteination of salted whey was carried out as described by Lucas et al. *(8)*.

(b) Gel filtration of deproteinated salted whey (D.S.W.): Exactly 3 ml of D.S.W. were applied to the top of a Sephadex G-10 column (10 by 250 mm). After entrance of the D.S.W. into the gel bed, elution with water was carried out at a flow rate of 12 ml/hr. The effluent was collected in fractions of 2 ml until the fractions were free of lactose and chloride. Fractions were examined quantitatively for lactose and chloride contents.

(c) Ion exchange chromatography of D.S.W.: The ion exchange resins Dowex 50W of the H+ form and Dowex 1 of the Cl− form, 100-200 mesh, were used. Regeneration and determination of the replaceable H+ and OH− of the cation and anion resins, respectively, were carried out according to methods of Murthy and Whitney *(13)*. The amount of cation and anion resins necessary for treatment of whey are expressed in term of milliquivalents of H+ or OH− per gram of wet resin. One hundred grams of D.S.W. were applied to the top of the Dowex 1 column (20 by 1000 mm). After entrance of D.S.W. into the gel bed, elution with water was carried out at a flow rate of 120 ml/hr. The effluent was collected in fractions of 25 ml until it was free of lactose. All fractions were combined and applied to the top of a Dowex 50W column (20 by 1000 mm), and treated as in the anion resin column. Fractions were combined and examined for lactose and chloride contents.

(d) Lactose was determined spectrophotometerically by the phenolsulphuric acid method as described by Barnett and Abd El-Tawab *(1)*. Chloride was determined volumetrically as described by Sanders *(16)*.

Results and Discussion

Gel filtration of D.S.W.

Results in Table 1, and Fig. 1 show that fractions 1 to 5 were free of lactose and chloride. Starting from fraction 6, the fractions could be divided into 3 major groups according to their lactose and chloride contents. The first group consisted of two fractions, 6 and 7, which contained 8.92% lactose. The second group consisted of eight fractions, 8 to 15, containing 81.50% lactose and 75.91% chloride. The third group, fractions 16-20, contained only 24.09% chloride. Therefore, about 24.09% of the chloride was removed from 3 ml of D.S.W. with the 10 g column of Sephadex G-10. In order to increase the quantitative separation between the lactose and chloride, the second group which contained 81.50% lactose and 75.91% chloride must be filtered through the

TABLE 1. LACTOSE AND CHLORIDE CONTENTS IN FRACTION ELUTIONS OF GEL FILTRATION OF D.S.W.

Fraction number (each 2 ml)		Chloride %	Chloride per gram in the fractions	Lactose %	Lactose per gram in the fractions	Lactose recovered %	Chloride recovered %	Chloride removed %
Sample (3 ml)		7.86	0.2358	4.00	0.1200	—	—	—
1, 2, 3, 4, and 5		—	—	—	—	—	—	—
Group I	6	—	—	0.008	0.0002	8.92	—	—
	7	—	—	0.525	0.0105			
Group II	8	0.10	0.0020	0.830	0.0166			
	9	0.58	0.0116	1.230	0.0246			
	10	1.00	0.0200	1.000	0.0200	81.50	75.91	
	11	1.46	0.0292	0.830	0.0166			
	12	1.51	0.0302	0.530	0.0106			
	13	1.55	0.0310	0.230	0.0046			
	14	1.46	0.0292	0.230	0.0046			
	15	1.29	0.0258	0.008	0.0002			
Total			0.1790		0.0978			
Group III	16	1.04	0.0208	—	—			
	17	0.86	0.0172	—	—	—		24.09
	18	0.45	0.0090	—	—			
	19	0.31	0.0062	—	—			
	20	0.18	0.0036	—	—			

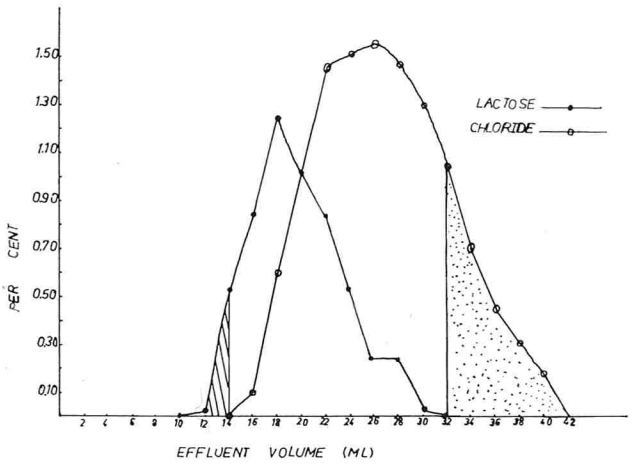

Figure 1. Gel filtrations of deproteinated salted whey (D.S.W.) (3 ml) on a column (10 by 250 mm) of Sephadex G-10. Eluate distilled water, flow rate 12 ml/hr.

Sephadex again. Meanwhile, use of several columns alternatviely would be necessary.

The experiment was repeated with a sample containing 8.48% chloride and 5.50% lactose, and using continuous gel filtration on three columns of Sephadex G-10. Results in Table 2 show that 77.60% of chloride was removed from 3 ml D.S.W. with three continuous 10 g columns of Sephadex G-10. At the same time 74.54% lactose was recovered. Continuous gel filtration proves the partial separation of lactose and chloride.

Single pass ion exchange system

Results in Table 3 show that seven samples of D.S.W. contained an average of 8.08% chloride and 4.63% lactose. After treating with anion and cation resins, they contained an average of 0.64% chloride and 4.35% lactose. Therefore, about 92.12% of the chloride was removed from 100 ml of D.S.W. with 100 g each of Dowex 1 and 50W. Lactose recovery after treating with anion and cation resins was 93.29%. In order to increase removal of salt from the D.S.W., it was passed twice over the anion and cation resins as described below.

Double pass ion exchange system

Results in Table 4 show that five samples of D.S.W. contained an average of 10.18% chloride and 5.29% lactose. After treating with anion and cation resins, they contained an average of 0.092% chloride and 5.05% lactose. Therefore, 99.08% of the chloride was removed from 100 ml D.S.W. with 100 g each of Dowex 1 and 50W. From the above results it can be concluded that the lactose content of D.S.W. was very slightly affected by the ion exchange resin treatment when either the single or double pass systems were used. These results agree with the data of Gehrke and Almy (5). They stated that the anion and cation exchange resins used for treating Cheddar cheese whey did not remove lactose from the whey solution at different pH values. They explained that the break-through point (B.T.P.) of the solution was designated as that point at which the concentration of the ion in the effluent was 5% of the initial concentration and 95% was still being adsorbed by the exchange. This might explain why all the chloride was not adsorbed on the anion exchange resin. Results obtained indicated

TABLE 2. GEL FILTRATION OF D.S.W. ON THREE COLUMNS OF SEPHADEX G-10

Fraction number (each 2 ml)		Chloride %	Chloride per gram in the groups	Chloride recovered %	removed %	Lactose %	Lactose per gram in the groups	Lactose recovered %
Column 1								
Sample	(3 ml)	8.48	0.250	—	—	5.50	0.165	—
Group I	6 to 8	—	—	—	—	0.25	0.015	9.09
Group II	9 to 14	1.53	0.184	73.60	—	1.15	0.138	83.64
Group III		—	—	—	26.40	—	—	—
Column 2		1.53	0.184	—	—	1.15	0.138	—
Group I	5 to 9	—	—	—	—	0.23	0.023	16.67
Group II	10 to 15	0.92	0.111	60.33	—	0.93	0.112	81.16
Group III		—	—	—	39.67	—	—	—
Column 3		0.92	0.111	—	—	0.93	0.112	—
Group I	5 to 10	—	—	—	—	0.71	0.085	75.89
Group II	11 to 15	0.56	0.056	50.45	—	0.24	0.024	21.43
Group III		—	—	—	49.55	—	—	—
Total amount			0.056	22.40	77.60		0.123	74.54

TABLE 3. LACTOSE AND CHLORIDE CONTENTS OF D.S.W. TREATED BY ANION AND CATION EXCHANGE RESINS (SINGLE PASS SYSTEM)

Trial	Lactose before treatment %	Lactose after treatment %	Lactose recovery %	Chloride before treatment %	Chloride after treatment %	Chloride removed %
1.	3.75	3.10	82.66	7.96	0.68	91.46
2.	4.00	3.88	97.00	7.86	0.58	92.62
3.	5.50	5.29	96.18	8.48	0.65	92.34
4.	3.50	3.30	94.28	8.80	0.66	92.50
5.	5.40	5.28	97.77	7.66	0.52	93.21
6.	5.00	4.69	93.80	7.80	0.49	93.72
7.	5.30	5.08	95.75	8.00	0.88	89.00
Mean	4.63	4.35	93.92	8.08	0.64	92.12

TABLE 4. LACTOSE AND CHLORIDE CONTENTS OF D.S.W. TREATED BY ANION AND CATION EXCHANGE RESINS (DOUBLE PASS SYSTEM)

Trial	Lactose before treatment %	Lactose after treatment %	Lactose recovery %	Chloride before treatment %	Chloride after treatment %	Chloride removed %
1.	5.40	5.00	92.59	9.93	0.096	99.03
2.	5.75	5.65	98.26	11.87	0.087	99.26
3.	5.00	4.75	95.00	9.50	0.091	99.04
4.	5.45	5.10	93.57	10.55	0.099	99.06
5.	4.85	4.75	97.94	9.04	0.088	99.03
Mean	5.29	5.05	95.47	10.18	0.092	99.08

that the chloride ions were preferentially removed from the D.S.W. solution by single or double pass on anion and cation exchange resin columns and the amount of chloride removed in the second system was more than in the first one. Thus desalting of D.S.W. by ion exchange resins could be acheived.

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AN ASSESSMENT OF THE FLAVOR QUALITY OF WHOLE MILK AVAILABLE AT COMMERCIAL OUTLETS

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ABSTRACT

A study was made of the flavor quality of whole milk available to the consumer in retail outlets. Results obtained on samples with both laboratory and organoleptic tests and their variation during the course of the year are presented.

A year-long study was made of the flavor quality of whole milk available to consumers in retail outlets in Connecticut. As part of this study, laboratory tests currently in use to determine overall quality were examined. Findings with the laboratory tests were related to taste and odor, the tests used directly by the consumer.

Since consumers are entitled to the best quality of food available, it is important that scientists and regulatory officials continually seek ways to improve quality. New methods to assess food quality have been under investigation in the laboratories of the Experiment Station *(2, 3, 4)*. With such methods available, recommendations can be made to processors and producers about how they can improve the keeping quality of their products *(4, 5)* through, for example, the Connecticut Milk Flavor Improvement Program. Over the years food processors and producers have welcomed such new testing methods. Most have attempted to provide the consumer with food of good quality and wholesome ingredients.

Efforts of producers and processors fail if subsequent treatment of food during transportation and storage and before and during sale are lax. The present study sheds some light in this area. We describe results obtained on retail whole milk samples with both laboratory and organoleptic tests and their variation during the course of the year.

METHODS

Milk samples in commercially packaged containers were collected by random selection, in duplicate, from retail outlets in Connecticut every 2 weeks. All samples were refrigerated in transit and delivered to the laboratory within 24 hr. At the time of collection the temperature of one of the samples was taken.

A Standard Plate Count *(1)*, coliform count *(1)*, and an oxidase count *(3)* were made on the unopened duplicate sample. In addition, each sample was tested organoleptically by a minimum of two experienced judges and a flavor score and flavor criticism assigned to it *(2)*. When an Acid Degree Value was determined *(1)*, the duplicate sample, the one on which the temperature was taken, was used. All data were coded on cards and processed. Numerical flavor scores were assigned as follows: 40 for a milk with no off flavor—called excellent, 39 or 38 for milk with a slight off-flavor—called good, 37 or 36 for milk with a moderate off-flavor—called fair, and 35 and below for milk with serious flavor defects—called unsatisfactory.

RESULTS AND DISCUSSION

The first test of quality applied was the flavor score of the milk sample. Those scoring 35 and under were considered to be unacceptable to the consumer. The range is shown in Table 1. Most milk available for sale appears to be of acceptable quality, at least as far as flavor is concerned. On the basis of acceptance or rejection, those scoring 35 or under being unacceptable; 88% of the milk sold at retail was of acceptable flavor quality. The unsatisfactory samples (12%) were examined to determine why they were not acceptable and if there was a pattern based on organoleptic analysis. Samples in all flavor score groups were segregated according to flavor criticism

TABLE 1. NUMBER AND PERCENTAGE OF MILK SAMPLES IN EACH FLAVOR SCORE GROUP.

Flavor score	Number of samples	Percent	Flavor designation and total % in group
			Excellent
40	18	1.6	1.6
39	532	47.2	
			Good
38	235	20.9	68.1
37	37	3.3	
			Fair
36	169	15.0	18.3
35	75	6.6	
34	14	1.2	
33	2	0.2	Unsatisfactory
			12.0
32	6	0.5	
31	0	0	
30	39	3.5	

[1]Deceased, October 18, 1970.

TABLE 2. NUMBER OF RETAIL WHOLE MILK SAMPLES IN EACH FLAVOR SCORE GROUP[1]

Flavor criticism	Flavor score											
	40	39	38	37	36	35	34	33	32	30	Total	%
OK	18										18	1.6
Cooked		528	94	6							628	55.7
Feed		4	141	15			1				161	14.3
Lacks freshness					133	44	7		1		185	16.4
Lacks freshness and unclean						1					1	0.09
Old							1		1	21	23	2.04
Old and bitter										3	3	0.27
Old and high acid										4	4	0.35
Old and putrid										1	1	0.09
Unclean				16	27	9					52	4.6
Rancid						4	2	1	1		8	0.71
Unclean and feed					1						1	0.09
High acid										1	1	0.09
Oxidized					8	13	1	1	2	1	26	2.3
Chemical										1	1	0.09
Malty										1	1	0.09
Putrid										3	3	0.27
Bitter						1	1				2	0.18
Acid and feed										1	1	0.09
Curdled										1	1	0.09
Musty						2	1		1		4	0.35
Unclean and oxidized						1				1	2	0.18
Totals	18	532	235	37	169	75	14	2	6	39	1127	
%	1.6	47.2	20.9	3.3	15.0	6.6	1.2	0.2	0.5	3.5		
Flavor Designation	Excellent	Good		Fair		Unsatisfactory						

[1]Some flavor groups have been combined for ease in tabulation and printing.

(Table 2). Examination of samples scoring 36 and above (acceptable milks) showed that 55.7% had only a slight cooked flavor. This of course was not unexpected and is only a reflection of the pasteurization process. Just over 14% possessed a slight feed off-flavor, but were not judged sufficiently offensive (except 1 sample) to be unacceptable to the consumer.

Of greater interest are the unsatisfactory samples (those scoring 35 and under) and their off-flavors. More samples in this group (63.2%) were criticized as old or lacking freshness. This suggests that milks offered for sale were not always fresh. Note that >11% of all samples were criticized as being old or lacking freshness and were given a score of 36, which is only in the "fair" category. Such data may indicate elevated temperatures at some point after processing or lack of shelf rotation of the product. Nevertheless, data in Table 2 show that milks sold at retail in Connecticut have few really bad off-flavors, and the few may be associated with faulty production (for example unclean or feed), faulty processing practices (malty or musty), or duration of storage (old or lacking freshness).

The samples which were placed in the unsatisfactory and fair categories were further classified according to the month of collection (Fig. 1). Surprisingly, most unsatisfactory samples were found in December, January, and February and in May and June. Those in the fair category essentially followed the same trend except that there was no peak in May and June and more fair samples were found in cold rather than in warm months. An attempt to explain this phenomenon has been made by comparison of these data with those shown in Fig. 2 A,B,C. This figure indicates unsatisfactory and fair samples plotted by month and off-flavor. Each month, criticisms of both old or lacking freshness led the list. The pattern for old and lacking freshness is essentially the same as seen in Fig. 1. Generally, among samples rated unsatisfactory that were criticized as old or lacking freshness, more were found in the warmer months than in the cooler months, although some increase was seen in December and January (Fig. 2A). The number of samples called unclean and found to be unsatisfactory increased very slightly in the cold months, but this could be attributed to faulty milk moving equipment on the farm. Samples which were judged unclean and placed in the fair category showed peaks

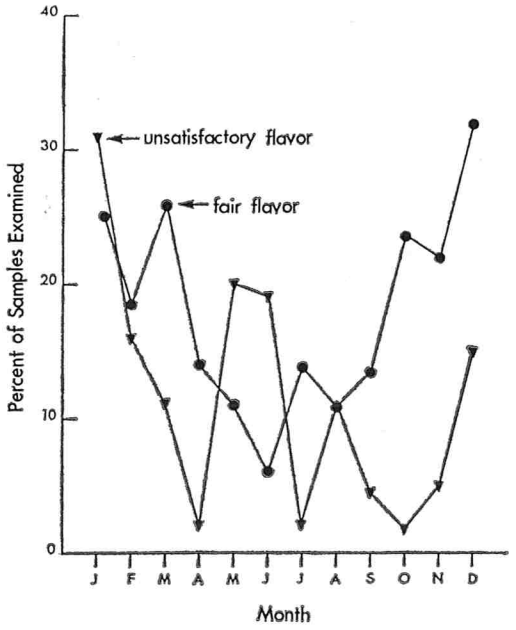

Figure 1. Per cent of samples examined each month judged organoleptically as unsatisfactory or fair.

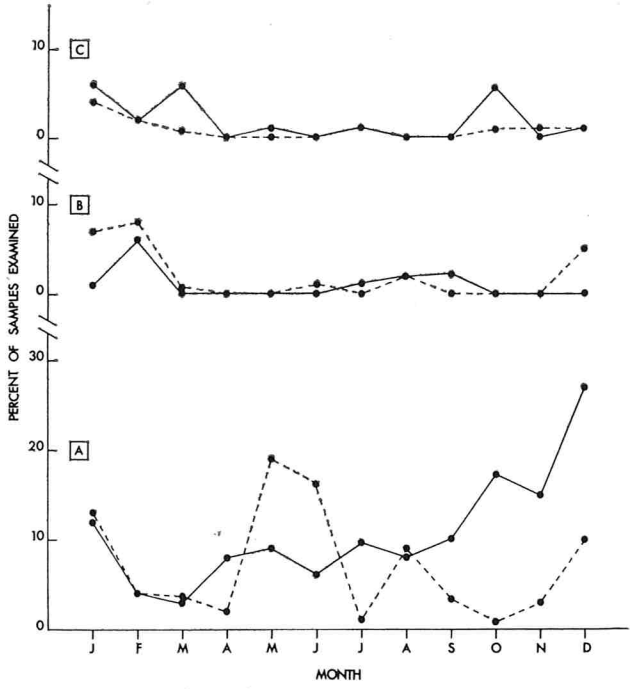

Figure 2A, 2B, 2C. Samples judged organoleptically as unsatisfactory (dotted line) or fair (solid line), classified by off-flavor and month of year; A = old and/or lacking freshness; B = oxidized; and C = unclean.

in January, March, and again in October (Fig. 2 C). Peak periods of oxidized flavor for unsatisfactory samples occurred in December, January, and February (Fig. 2 B). It is usually recognized that winter feeding conditions (dry feed, low vitamin E) is conducive to formation of oxidized flavor. Also, the assumption that bottled milk needs less care in the cold months may be the basis for more light-induced oxidation. Samples called oxidized but placed in the "fair" category showed a slight rise in June through September (also seen in unsatisfactory samples. The reason for a slight rise in oxidized flavor for these months is not easily explained. Light may cause an oxidized flavor in bottled milk. Of 63 milks in glass bottles examined in this study, 57 were from one dairy. This dairy led the list of all dairies (with at least 20 samples examined) in the percentage of samples having an oxidized off-flavor.

On samples where complete data were available, quality was further tested by applying the following bacterial standards. Samples were classified as unacceptable if they had a Standard Plate Count (SPC) of 25,000/ml or greater, or a coliform count of 5/ml or greater, or an oxidase count of 5,000/ml or greater (20% of the SPC). The oxidase count is a measure of psychrotrophic bacteria *(3)*, and has been shown to be correlated with the off-flavor called lacking freshness *(2)*.

Data on samples judged organoleptically unsatisfactory and also not meeting at least one of the bacterial standards used were segregated by month in Fig. 3. More unsatisfactory samples (relative to bacterial standards) were found during May and June than at any other time of the year. Secondary peaks for coliform organisms occurred in December, January, and March. Data for old or lacking freshness in Fig. 2 coincide with the oxidase, coliform, and SPC peaks seen in Fig. 3. No other off-flavor coincides with high bacterial counts. Although judgments may be made concerning this discrepancy, such as off-flavors in winter months coinciding with poor barn

TABLE 3. RANGE OF TEMPERATURE VALUES FOUND ON MILK SAMPLES COLLECTED AT RETAIL OUTLETS.

Temperature range	Number of samples	% of total
<40 F (acceptable)	322	28.6
40-45 F (borderline)	598	53.1
>45 F (unacceptable)	207	18.4

TABLE 4. RANGE OF ACID DEGREE VALUES OF 647 COMMERCIAL MILK SAMPLES NOT CRITICIZED AS BEING RANCID BY ORGANOLEPTIC ANALYSIS.

Acid degree value[1]	Number of samples	Per cent
0 to 0.69	162	25.0
0.7 to 1.2	444	68.6
>1.2	41	6.3

[1]Samples with a value <0.7 are not usually detected organoleptically as rancid. The range 0.7 to 1.2 is considered borderline and some people can taste rancidity at this level. Many people can taste rancidity when the milk has an ADV of >1.2 *(1)*.

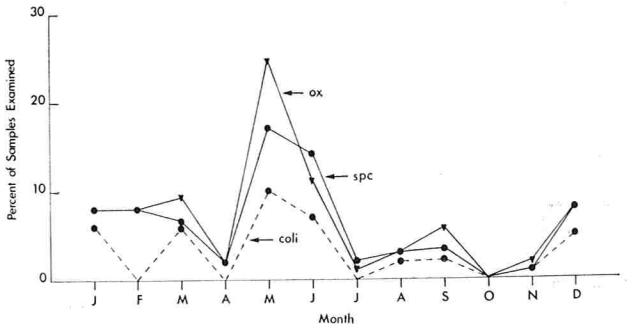

Figure 3. Samples judged organoleptically as unsatisfactory and not meeting bacterial standards segregated by month. SPC = Standard Plate Count; OX = oxidase count; Coli = coliform count.

conditions, it seems clear that presently conducted laboratory tests do not adequately measure the flavor quality of milk sold to consumers.

The higher bacteriological counts for milks found to be organoleptically unsatisfactory in May and June may be partly accounted for. Producers at this time of year are busy with field work and hence milk moving equipment and storage tanks may not receive as much attention as at other times of the year. Reports from fieldmen tend to substantiate this. Organisms being shed into the milk from these tanks could also be more resistant to pasteurization. Further, changes in handling techniques and distribution methods from winter to summer may, in part, account for this peak period. Although some samples placed in the fair flavor category gave high bacterial counts, the percentage was much less than for those placed in the unsatisfactory flavor group.

Obviously, not all off-flavors are caused by bacterial contamination and subsequent growth of the organisms. We must therefore conclude that an organoleptic test benefits the consumer more quickly and directly in her quest for a good quality product. This is not to infer that bacteriological tests are any less valuable. In fact, it has been shown that the oxidase test is a useful asset in predicting the quality of raw milk at the farm *(4)*.

Fifty-one dairies were represented in this study. However, 20 dairies accounted for 90.3% of the samples collected.

It is readily recognized that milk being a perishable food item must be kept under proper refrigeration at all times, from production to consumption. A temperature of 45 F or less is generally acceptable. However, temperatures <40 F are indeed the best with those 40-45 F being in the borderline range. A measure of how well the milks in this study were refrigerated can be seen from the temperatures of the samples tested (Table 3). Of 1,127 samples, 207 or 18.4% had temperatures higher than 45 F. Several explanations are possible. One is that the milk had just been delivered to the store and had not been properly refrigerated in transit. A second is that it was not immediately refrigerated on arrival at the store. A third, and one seen by many consumers, is that the milk was not packed properly in the case. That is, the case was filled beyond capacity and the top layer of containers was not properly cooled. There are even times, during rush sales periods, when milk is placed on the floor in front of the case; this is an illegal procedure. The last possibility is that the case was not operating properly.

The temperature of the milk offered for sale varied according to the time of year. The number of milks found to be over 45 F increased during the summer months and decreased during the winter (Table 5). In this study only 6 to 7% of the samples were above 45 F during December/January, rising to a high of 41% in August. These data substantially confirm the unpublished work of Barnard [cited by Watrous, et al. *(7)*]. Both our data and Barnard's show the need for better refrigerated transportation and storage during the summer months.

It is of interest to note how the retail milk samples collected were packaged. Most of the containers (86.5%) were quarts and were fabricated of paper. In all, paper containers accounted for 93.2%; plastic, 1.2%; and glass, 5.6% of samples collected.

An Acid Degree Value (ADV) was available on only 647 of the 1,127 samples collected. Of this number only 8 were criticized as having a rancid flavor. Based on standard recommendations *(1)*, milk with an ADV of >1.2 will taste rancid to many persons. The range of ADV's found is shown in Table 4. It is surprising that none of the 41 samples with an ADV of >1.2 were criticized as rancid, especially since of the 8 samples called rancid, 5 had an ADV of >1.2. Thomas et al. *(6)* indicate that an ADV much higher than 1.2 is necessary before the sample is judged unsatisfactory. The effect of more than one off-flavor

TABLE 5. PERCENTAGE OF SAMPLES COLLECTED EACH MONTH SEGREGATED BY TEMPERATURE TAKEN AT TIME OF COLLECTION (1127 SAMPLES).

Month	<40 F	40-45 F	>45 F
Jan	52	41	7
Feb	34	52	14
Mar	32.6	57.8	9.6
Apr	22	62	16
May	35	44	21
Jun	21.2	54.5	24.2
Jul	25.5	53.2	21.3
Aug	9	50	41
Sep	18	52.8	29.2
Oct	20	61	19
Nov	30	56	14
Dec	41	53	6

in the sample, and the effect of one enhancing the other may also play a role in whether the sample is judged to be rancid. In any event, since it appears that relatively high ADV's are needed before the consumer might complain, the value of this test in consumer acceptability tests is perhaps limited.

All data collected in this study were analyzed statistically in order to provide correlations between flavor analysis and laboratory tests. Although this will be the subject of another report, our data indicate that standard laboratory tests, presently in use, do not afford a close correlation with organoleptic analysis, and in this sense they do not adequately portray to the consumer the quality of the milk offered for sale. We do not infer, however, that laboratory tests be eliminated since the public health aspects of milk production are of vital concern.

All data in this study (on a coded basis) were made available to the individual dairies through the Connecticut Milk Flavor Improvement Program.

Milk offered for sale at retail in Connecticut, from an organoleptic standpoint, is good. It is felt that many samples judged to be organoleptically unsatisfactory could be eliminated if dairies could somehow persuade store personnel to see that stocks in the store are rotated or removed from sale more frequently. Also, it would help if the temperature of the finished product could be maintained at between 33-40 F to inhibit growth of psychrotrophic organisms, since it is these organisms which impart the off-flavor of old or lacking freshness. The basis for this recommendation is that more samples were criticized as lacking freshness or old than any other off-flavor. It is hoped that such off-flavors may be on the decrease since processors are becoming more aware of the effect of psychrotrophic organisms on their product. Further, often the oxidase (or psychrotrophic) count *(3)* is a more valid measure of keeping quality than the SPC. Processors should therefore include such newer tests in their overall quality control programs.

ACKNOWLEDGEMENTS

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MANUFACTURING MILK QUALITY: A RE-EVALUATION

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ABSTRACT

The bacteriological quality of manufacturing-grade milk is very similar to that marketed a decade earlier when bulk tanks first came into general use. Milk grading programs usually relied on reduction tests. These tests indicated that most milk supplies were good quality. Based on the Standard Plate Count, data is presented that show approximately one-third of the samples tested, in 1969-70 and in 1957-59, exhibit counts <200,000/ml. Considerable quantities of milk, received at processing plants have plate counts exceeding 1,000,000/ml.

Dairy farmers learned they could substitute cooling for cleaning because psychrotrophic bacteria predominated the microflora of most high count bulk milk. These bacteria do not readily reduce resazurin and methylene blue. Psychrotrophs also tend to grow in clumps preventing an accurate evaluation of milk quality using the Direct Microscopic Count (DMC). USDA uses the DMC to test check manufacturing plant's milk supplies.

Laboratories are recognizing the value of plating procedures, including the Plate Loop Count, to determine milk quality. Manufacturing-grade milk must be evaluated with a plating procedure before progress can be made in milk quality improvement. One grade of milk is far from being a reality if present levels of manufacturing-grade milk quality are considered.

Recently there has been a reawakening of interest in testing and grading of manufacturing-grade raw milk for bacterial quality. This interest in grading programs has been stimulated by at least three factors.

(*a*) The USDA, as part of its processing-plant evaluation program, obtains samples of a plant's mixed milk supply from holding tanks in the plant. Observations are made on milk quality from the results of the direct microscopic count method. As part of the USDA's plant evaluation program, inspectors study results of the plant's milk grading and improvement program. Comparisons are then made using results of direct microscopic counts (DMC) obtained on the mixed milk supply and the inspector's observations concerning the plant's milk quality improvement program. Recommendations are then made by the USDA concerning milk quality, urging appropriate action on the part of plant management.

(*b*) State regulatory officials have shown more interest recently in enforcing and/or modernizing existing State milk grading laws.

(*c*) Personnel involved with commercial, regulatory, and industrial laboratories, at least in Iowa, now realize that the methylene blue and resazurin tests as well as the DMC are of little value in grading manufacturing-grade bulk-tank milk. Some laboratories have begun using either the Standard Plate Count (SPC) or a modification, called the Plate Loop Count (PLC) to obtain a more realistic evaluation of the bacteriological quality of milk samples.

Interest in the value of various bacteriological tests used to evaluate bulk-tank manufacturing-grade milk as well as to determine the general quality of this milk began in the midwestern states during the early to mid-1950's at a time when many dairy farmers began converting from can to bulk-tank handling of milk. A study that evaluated these aspects of testing in Iowa was conducted in the Iowa Experiment Station during 1957 to 1959 and the results were published in scientific journals *(6-11)*. An excellent review article by Hartley et al. *(3)* summarizes the research accomplished through 1968 on bacterial tests used to measure milk quality.

Conclusions from this early Iowa study *(7, 10)*, based on the SPC, revealed that the bacteriological quality of manufacturing-grade milk varied widely. Of 701 samples, 37.2% had counts of <200,000/ml and 37.7% had counts >one million/ml. Compared to the SPC, the reduction tests and the DMC were not reliable for determining the bacteriological quality of manufacturing-grade bulk-tank milk *(6-11)*.

EARLY MILK GRADING PROGRAMS

Even after this study and similar studies from other research stations were published, dairy plant laboratories did not rush to use the SPC in their quality control work with manufacturing-grade bulk-tank milk farmers. An important factor for this trend may have been that there was little pressure from regulatory agencies to improve manufacturing-grade milk quality. Coupled with this lack of regulatory pressure was the keen competition for milk by creameries. The latter factor prevented a realistic milk grading program for fear of losing milk volume. Many dairy farmers learned of this situation and when the switch was made from can to bulk handling of milk, substituted cooling for cleaning in their day-to-day operations on the farm. Fieldmen and laboratory personnel also were reluctant to drop reduction tests because these tests were simple to perform.

As a result of these factors, little or no progress was made in improving the quality of manufacturing-grade milk after the switch began from cans to bulk tanks. Many people did not realize that milk quality was not improving because the tests used were not

providing accurate results. Others realized the situation but felt milk volume was the key to staying in the processing business. Regulatory officials did not insist on a uniform state-wide milk quality improvement program for all creameries. Whatever milk quality work was accomplished was done by a few individual plant managers who persuaded their farmer customers to adopt a quality control program because they believed that high quality products resulted from high quality raw milk and good processing practices.

REDUCTION TEST

Recently, the USDA proposed requirements for milk for manufacturing purposes based on bacterial estimate classifications using the SPC, DMC, and resazurin reduction tests *(13)*. Fortunately, the methylene blue reduction test was not included as a suggested test since the USDA has recognized this test is of little value in grading bulk-tank milk. However, the USDA did not eliminate the resazurin reduction test and the DMC although they also have been found unsuitable for bulk-tank milk *(10, 11)*.

Work at the Iowa Experiment Station in the 1950's illustrated the discrepancies of results between the SPC and the resazurin test *(6, 9, 10, 11)*. Comparison between the SPC and resazurin test results were made on 670 bulk milk samples. Of these samples, 462, or 69%, did not reduce the resazurin dye beyond 5P7/4 before 2.75 hr of incubation. Of the 462 milk samples thus placed in "Class 1" by the resazurin test, 224, or 48.5%, had SPC results exceeding 220,000/ml and 175, or 37.9%, had Standard Plate Counts exceeding 400,000/ml. Similar trends also were noted when the Plate Counts were compared with the results of the methylene blue test.

It also was noted that of the milk samples placed in "Class 1" (no color change beyond 5P7/4 in 2.75 hr) the range of counts on the milk samples was from <50,000 to 21,000,000/ml. Samples placed in "Class 2" (Color change beyond 5P7/4 in 2.75 hr but not before 1.5 hr) the range of SPC results was 110,000 to 50,000,000/ml. All samples placed in "Class 3" (color changed beyond 5P7/4 in 1.5 hr or less) had SPC results exceeding 500,000/ml. A similar pattern of wide distribution of SPC results for each methylene blue "class" also was obtained.

PSYCHROTROPHIC BACTERIA

These results illustrate, as have results from other studies *(2, 4, 12, 14)*, that reduction tests are not suitable for evaluating bulk-tank milk, particularly high count milk frequently observed within milk classified as manufacturing grade. Why are the reduction tests unsuitable for evaluating such high bacterial count bulk-tank milk? One important factor undoubtedly is that psychrotrophic bacteria predominate the microflora of bulk milk. We found that pure cultures of these psychrotrophic gram-negative bacteria isolated from high count bulk milk did not reduce the resazurin and methylene blue dyes *(11)*. Bulk-tank milk in which the microflora is predominately of the gram-negative psychrotrophic type, therefore, cannot be accurately evaluated with these dyes. Milk not cooled and stored below 5 C will have a microflora predominately of the gram-positive types and for such milk supplies, the dye-reduction tests would be adequate.

Extended incubation for the resazurin test has been suggested and, in fact, the latest USDA proposal for grading milk suggests using the resazurin test but specifies incubation and reading of tests on bulk milk for 2.5 and 3.25 hr rather than 1.5 and 2.75 hr. This longer incubation may provide the time necessary to elicit greater metabolic activity from gram-positive microorganisms and even from the predominating gram-negative psychrotrophs. However, as will be shown later in results using the proposed USDA incubation times, this modification is still not adequate to provide a reasonably accurate indication of the bacteriological quality of milk samples.

DMC AND PSYCHROTROPHS

Why is the DMC unsuitable for manufacturing-grade bulk-tank milk? Our work on this problem in the late 1950's *(10)* revealed that the psychrotrophic bacteria in the milk tended, in general, to grow in clumps. Each clump, no matter how many bacteria actually are present in each clump, would be counted as one unit in the DMC. When the SPC was performed on the same milk sample, the necessary shaking of the 2 or 3 dilutions needed to obtain countable plates would tend to disrupt the clumps of psychrotrophic bacteria. Each clump that appeared as one countable unit for the DMC would result in several individual countable colonies for the SPC. As a result, the SPC usually exhibited a much higher count than was obtained with the DMC. In fact, our study *(10)* on 586 manufacturing-grade bulk-milk samples showed that 245 or 41.8% of the samples had SPC results at least twice as high as the DMC on the same milk samples. In no instance was the DMC higher than the SPC.

From these results we conclude that the DMC and the reduction tests are very lenient in grading bulk milk when compared to the SPC. If we are to make any improvement in manufacturing-grade milk quality these inadequate tests should be dropped from regulatory standards. The SPC, the PLC, and,

TABLE 1. BACTERIAL EVALUATION OF MANUFACTURING-GRADE BULK MILK. PLANT A, JULY 1969

Bulk tank no.	DMC/ml	SPC/ml
1	1,000,000	910,000
2	2,400,000	7,400,000
3	390,000	1,400,000
4	6,200,000	17,000,000
5	1,000,000	4,300,000
6	790,000	1,700,000
7	1,600,000	2,300,000
8	680,000	300,000
9	69,000	280,000
	Silo tank samples	
1	2,900,000	10,000,000
2	5,500,000	9,700,000
3	4,900,000	12,000,000

possibly, the SPC preceded by C. K. John's suggested sample preliminary incubation at 13 C for 18 hr *(5)* must be carried out.

USDA Milk Quality Testing

The USDA has incorporated into its processing plant evaluation program, a DMC check on the plant's milk supply by testing mixed milk from plant holding-tanks. The results of DMC's performed by USDA have shown a very wide range in quality. In general, however, the overall quality of the milk samples considered to be representative of the manufacturing dairy plant's milk supply has been poor. The DMC's usually are in the range of the low millions. If these DMC's are considered an average of the bacterial quality of producer milk supplies, then, undoubtedly there are many producers marketing quite poor-quality milk. On the other hand, many farmers are producing and marketing good quality manufacturing-grade milk, which when pooled becomes an undistinguishable part of the whole.

From these USDA reports it is apparent that the overall quality of manufacturing-grade milk is similar to that produced in the mid-1950's when bulk tanks were first introduced in Iowa.

Bulk Milk Quality

Since the USDA is presently using the DMC to evaluate manufacturing-grade milk and allowing the use of the resazurin test, we recently conducted a survey of the general quality of bulk milk using several quality tests. The milk supplies of two large cooperative butter-powder processing plants were evaluated in July 1969 and again in July 1970.

Most of the milk samples were obtained from bulk-milk trucks as they arrived at the plant. A few samples were obtained from plant holding-tanks at various times after the truck milk was unloaded. Samples were collected in Whirl Pak bags (Nasco, Fort Atkinson, Wisc.) kept on ice, and returned to the laboratory for bacteriological testing. Plates for the SPC were incubated at 32 C ± 1 C for 48 hr ± 3 hr. Levowitz-Weber stain *(1)* was used for the DMC.

1969

Table 1 summarizes the results of the analyses of milk samples obtained at Plant A in July 1969. Samples were obtained throughout the day so that they represent samples collected from 5:15 a.m. to 7:30 p.m. Silo tank samples were obtained the following day at 9 a.m. and 1 and 3 p.m. from one tank as milk was being withdrawn for processing.

Two points are obvious from the results presented in Table 1. One is that the general bacteriological quality of the milk leaves something to be desired. It is not too difficult to imagine what some of the counts on samples from individual farms must have been to result in a truck sample SPC of 17,000,000/ml. The second point shown in Table 1 is that 8 of the 12 samples exhibited SPC's that were at least twice as high as results obtained by the DMC.

Table 2 summarizes results of testing conducted on milk samples obtained from Plant B in July 1969. Trucks were sampled as they arrived at the plant from 10 a.m. to 7:30 p.m. The silo tank sample was obtained immediately after the last truck milk sample was pumped over. A total of 378,000 lb. of milk was received that day. The methylene blue test was included in the analyses of the milk samples with readings made at 2.5 and 5.5 hr to place the samples in Class 1, 2, or 3.

Again, it is obvious that the general bacteriological quality of milk received at Plant B leaves ample room for improvement. The DMC also classified the

TABLE 2. BACTERIAL EVALUATION OF MANUFACTURING-GRADE BULK MILK. PLANT B

Bulk truck number	DMC/ml	SPC/ml	Methylene Blue Test: Hr to decolor	Methylene Blue Test: Class[1]
1	620,000	1,200,000		1
2	2,100,000	4,000,000	5.5	2
3	230,000	660,000		1
4	3,100,000	10,000,000	5.5	2
5	750,000	1,400,000		1
6	3,700,000	4,500,000	5.5	2
7	1,200,000	1,800,000		1
8	1,700,000	3,200,000	5.5	2
9	570,000	900,000		1
10	2,200,000	5,300,000	2.5	3
11	910,000	1,300,000		1
12	9,400,000	14,000,000	2.5	3
13	3,200,000	6,900,000	5.5	2
14	510,000	2,500,000		1
15	620,000	800,000		1
16	450,000	1,300,000		1
17	1,500,000	3,300,000		1
Silo Tank	2,000,000	5,300,000	5.5	2

[1]1959 Iowa and proposed 1955 USDA classification:
Class 1 = <200,000/ml SPC
Class 2 = 200,000 to 3,000,000/ml SPC
Class 3 = >3,000,000/ml SPC

TABLE 3. BACTERIOLOGICAL EVALUATION OF MANUFACTURING-GRADE BULK MILK. PLANT A, JULY 1970

Bulk truck number	DMC/ml	SPC/ml	Resazurin test classification		
			Iowa[1] USDA	USDA[2] Proposed	USDA prposed[3] after 3 yr
1	2,800,000	7,900,000	2	u[4]	u
2	1,300,000	2,000,000	2	u	u
3	4,500,000	14,000,000	3	u	u
4	1,800,000	8,900,000	3	u	u
5	450,000	620,000	1	1	1
6	510,000	860,000	1	1	1
7	710,000	1,200,000	1	2	2
8	3,000,000	4,700,000	2	u	u
9	990,000	980,000	1	2	2
10	85,000	410,000	1	2	2
Silo #1					
8:30 a.m.	1,200,000	2,700,000	1	1	1
4:30 p.m.	1,800,000	1,500,000	1	2	u
Silo #2					
8:30 a.m.	1,200,000	2,000,000	1	2	u

[1]1959 Iowa and proposed 1955 USDA classification
[2]Proposed 1969 USDA Classification
[3]Proposed 1969 USDA Classification 3 years after adoption
[4]u = Undergrade (probational 4 weeks)

TABLE 3A. BACTERIOLOGICAL EVALUATION OF MANUFACTURING-GRADE BULK MILK. PLANT B, JULY 1970

Bulk truck number	DMC/ml	SPC/ml	Resazurin test classification		
			Iowa[1] USDA	USDA[2] Proposed	USDA prposed[3] after 3 yr
1	1,600,000	7,000,000	3	u	u
2	170,000	240,000	1	1	1
3	510,000	1,100,000	1	1	1
4	280,000	690,000	1	1	1
5	1,400,000	5,900,000	1	2	2
6	850,000	1,900,000	2	2	u
7	1,400,000	3,000,000	2	2	u
8	790,000	1,300,000	1	2	2
9	45,000,000	32,000,000	3	u	u
10	2,500,000	2,400,000	2	2	u
11	230,000	120,000	1	1	1
12	2,200,000	5,800,000	2	u	u
13	460,000	1,300,000	1	1	1
14	570,000	1,600,000	2	2	u
Silo					
12 noon	3,500,000	5,400,000	2	u	u
4 p.m.	3,900,000	6,000,000	2	u	u

[1]1959 Iowa and proposed 1955 USDA classification
[2]Proposed 1969 USDA Classification
[3]Proposed 1969 USDA Classification 3 years after adoption
[4]u = Undergrade (probational 4 weeks)

milk samples more leniently than did the SPC. In many instances the SPC was twice as high as the DMC. One could argue that if the DMC was 1 million/ml, what difference does it make if the SPC was 2 to 2.5 million/ml on that sample? Perhaps that difference is not significant in that range, but if the DMC reveals only 450,000/ml compared to a SPC of 1,300,000/ml, the difference becomes very real.

Data in Table 2 show that according to the methylene blue test results, the milk samples would be classified too leniently. Only samples 10 and 12 were classified in the same category by both the methylene blue test and SPC. Fortunately reduction tests have been outlawed for evaluating milk in Iowa as of July 1, 1971.

Not too infrequently, the USDA notes on their Plant Evaluation Form, that a high DMC on milk at the plant may result from improper cleaning of the plant milk storage tank or to extended holding of the milk in the plant storage tank. These may be factors but from the results shown in Tables 1 and 2 it is obvious one of the most important factors causing high counts in the storage tank samples is the poor quality of much of the bulk milk going into the tanks.

1970

Results on samples obtained at Plant A and B during July 1970 are summarized in Table 3. Again, the SPC was used to compare the results of the DMC. The resazurin test also was used on these samples since the proposed USDA standards allow the use of any one of these three tests.

Table 4 establishes the relationships among the DMC, SPC, and resazurin reduction test.

Results of the SPC on the bulk truck samples shown in Table 3 indicate that the bacteriological quality still leaves a great deal to be desired. Again DMC values were much lower than results of the SPC on several samples. The resazurin test also was very lenient in classifying the milk and missed properly classifying several samples with very high SPC's. Extending incubation of the resazurin test, as proposed in the USDA standards, does classify the samples more nearly like the SPC than does the 2.75 hr test. However, several samples were graded in "Class 1" by the resazurin test using the three different reading periods failed to point out some samples with SPC exceeding one million/ml.

One important factor that must be kept in mind relative to these high count samples is that a majority of the bacteria in the milk samples are psychrotrophic in nature. This means that with milk coming into the plant with bacterial counts in the low millions there will be little time before the counts can skyrocket. This is especially true of milk arriving at 7 C or more where the generation time may be only 8 hr or less compared to 12 hr at 5 C or 16 hr at 2 C. So, holding temperature is very important as is frequency of milk pick-up on the farm. Every-other-day pickup is important to maintaining reasonable milk quality.

PLATE LOOP COUNT

The PLC has recently become a popular testing method for bulk milk in Iowa. This test is a variation of the SPC and thus has some of the advantages of the SPC. It is less complex, faster, and uses no dilution bottles since the 0.001-ml loop serves as a method

TABLE 4. BACTERIAL ESTIMATION CLASSIFICATION FOR BULK MILK

Bacterial estimate classification	DMC or SPC/ml	Resazurin reduction time to 5P7/4
1959 Iowa and proposed 1955 USDA classification		
1	<200,000	>2.75 hr
2	200,000 to 3,000,000	1.5 – 2.75 hr
3	>3,000,000	<1.5 hr
Proposed 1969 USDA standards		
1	<500,000	>3.25 hr
2	500,000 to 3,000,000	2.5 – 3.25 hr
Undergrade	>3,000,000	<2.5 hr
Proposed 1969 USDA standards effective 3 years after adoption		
1	<500,000	>3.25 hr
2	500,000 to 1,000,000	3 – 3.25 hr
Undergrade	<1,000,000	<3 hr

TABLE 5. PLATE LOOP COUNT OF MANUFACTURING-GRADE BULK-TANK MILK IN IOWA

Month	No. samples tested	Plate loop count/ml		
		<200,000	200,000-3 million	>3 million
1969		(%)		
July	2,901	34	52	13
August	2,726	31	55	14
Sept	3,305	36	51	13
Oct	4,234	56	38	6
Nov	2,899	55	39	6
Dec	3,743	57	39	4
1970				
Jan	3,523	54	39	7
Feb	2,914	54	40	6
March	2,380	51	41	8
April	1,791	50	44	6
May	3,098	35	50	15
June	3,561	34	53	13

TABLE 6. CLASSIFICATION OF MANUFACTURING-GRADE BULK MILK BY AN IOWA DAIRY

Methylene blue test		Plate loop count	
Classification	% of Samples	% of Samples	Count range/ml
		May 1969	
1	97.1	66.3	<200,000
2	2.3	26.4	200,000 – 3 million
3	0.6	7.3	>3 million
		June 1969	
1	98.9	48.7	<200,000
2	0.9	47.4	200,000 – 3 million
3	0.1	3.9	>3 million
		July 1969	
1	96.2	39.5	<200,000
2	2.8	51.2	200,000 – 3 million
3	1.0	9.3	>3 million

of sample dilution *(15)*. An important disadvantage of the PLC is that with only the 1/1000 dilution made on each milk sample, high count samples will give plates that have many more than 300 colonies. In these instances, areas of the plate are counted and appropriate calculations are made to determine the PLC. However, crowded plates are tiresome to count and the results would undoubtedly be lower than those expected from the SPC where dilutions would be made to cover a wide count range, thus avoiding crowded plates and lower counts because of competition.

Because of the advantages and overlooking the minor disadvantage, several plants and laboratories in Iowa are now grading milk on the basis of the PLC. Fieldmen report good reception by farmers because they now have an actual count/ml of milk which seems to mean more to them than a Class 1 or 2 result. Also, fieldmen report success in impressing dairy farmers on the importance of milk quality by showing farmers PLC plates of their milk.

Table 5 provides a year's summary of the PLC obtained by several laboratories in Iowa. Results show that there are still considerable quantities of milk with plate counts that exceed 200,000/ml and much with counts exceeding 3 million/ml. Note that the winter months give milk quality a slight boost.

For several years, quality control laboratories from Iowa have reported their results on manufacturing-grade bulk-tank milk using the reduction tests. In these reports, 95% or more of the milk samples tested were placed in the top quality Class 1. Now, however, the same Iowa laboratories, using the PLC, report the quality of milk as shown in Table 5.

Data in Table 6 illustrate well the results of one large cooperative dairy in Iowa obtained when it began including the PLC along with the methylene blue test on its bulk patrons' milk samples. The PLC gave quite a different view of quality.

IMPROVING MILK QUALITY

If improvement in quality of manufacturing-grade milk is to be realized within the next few years, several changes must take place. First, a plate count procedure must be used to evaluate bacterial quality of the milk. If this is done, then all concerned with milk quality will know where efforts need to be directed to make improvements in the milk quality. Secondly, plant fieldmen must use these test results coordinated with milking time inspections to help dairy farmers improve their milking and milk handling. Milk haulers also must be involved in the quality improvement program because of their frequent contact with their patrons. In too many instances haulers are a detriment to milk quality and to good relations between plant management and dairy farmers because of their desire to maintain or expand their hauling volume.

Regulatory officials must play a more active role in enforcing rules concerning milk grading. This can best be done by periodic testing of the plant's mixed milk supply and random check testing of producers' milk samples by laboratory personnel.

Regulatory officials should not do the fieldwork that the fieldmen should be doing. However, these officials must see that proper tests are used and correct results reported to farmers and to make sure fieldmen are working with dairymen, particularly those that need help as indicated by test results. These producers that do not respond through milk quality improvement then must be excluded from the market with an appropriate decree from the regulatory official.

ONE GRADE OF MILK?

Dairy economists talk glibly about one grade of milk being just around the corner. They obviously have not seen or understood the very high bacterial counts that a fairly large portion of manufacturing-grade milk contains. Of course, a share of this grade of milk is of excellent bacterial quality because some manufacturing-grade milk producers do take pride in their work.

Too many of the producers, however, seem to have little regard for milk quality. Many have more than enough equipment to market milk with SPC's of $<$3,000/ml. But equipment isn't the only answer to milk quality as it takes pride and elbow grease to do the job. The fight for milk volume by milk plants, the lackadaisical enforcement of milk quality regulations, and the use of "old fashioned" bacterial tests are undoubtedly other factors in helping to hold down milk quality.

There is however, hope for improving the general level of the bacterial quality of manufacturing-grade milk. Dairy industry leaders must back the use of plating procedures for determining quality levels of this milk as well as do their part in making sure dairy farmers that are riding along with a periodic rinse job on their milking and milk handling equipment are "educated".

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VIRGINIA TECH DAIRY MILKING SCHOOL
CONTINUING EDUCATION CENTER
BLACKSBURG, VIRGINIA 24061
JULY 12-16, 1971

A Dairy Milking School conducted by the Cooperative Extension Service will be held July 12 through 16 at Virginia Tech. This training for experienced dairy workers will be the third offering at Virginia Tech. It has proven most valuable in improving the abilities of men who are now employed. It is desirable for dairymen or managers to attend with their milkers. Better communication results. Men who would like to work on dairy farms but have no experience are welcome at this school but would need to acquire experience before or after attending. A special school could be arranged for the inexperienced if there is sufficient demand.

Admittance to the school is by application. Forms will be available in the office of your County Extension Agent-Agriculture or by writing to Dr. V. L. Baldwin, Virginia Tech, Dairy Science-Extension, Blacksburg, Virginia 24061. The class will be limited to the first 20 who apply. We must receive more than 10 applications before June 25. Applications should be sent to the Adult Registrar, Continuing Education Center, VPI, Blacksburg, Virginia 24061, before June 25.

A small conference fee of $12 will be required in advance to be received with the application. Checks should be made payable to Continuing Education Center, VPI. This is refundable if requested one week prior to the beginning of the school. Total costs for registration, conference room, certificates and frames, class materials, books, morning coffee, and an awards luncheon are included in the conference fee.

The school will begin at 8:30 A.M., July 12, and close following the luncheon on Friday noon, July 16. There will be lectures beginning at 8:30 each morning, laboratories, including farm visits, in the P.M., and discussions each evening at 7:30. This school requires more time than those held in counties. Commuters should plan to be available full time. Only county schools are held between milkings.

Food is available at the Continuing Education Center, the Student Center, some dining halls on the campus or at other restaurants in town. Room reservations may be obtained by writing to: The Continuing Education Center, Tech Motel, Lake Terrace Motel, Imperial Motel, University Motel, or Holiday Inn, Blacksburg, Virginia 24060. The Tech Motel is in downtown Blacksburg and within walking distance of the Continuing Education Center where rooms may also be available. Early reservations are advised.

EFFECT OF PASTEURIZATION CONDITIONS, TYPE OF BACTERIA, AND STORAGE TEMPERATURE ON THE KEEPING QUALITY OF UHT-PROCESSED SOFT-SERVE FROZEN DESSERT MIXES[1]

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Abstract

The first phase of this study was concerned with the shelf-life of commercial frozen dessert mixes prepared with nonfat dry milk of high-thermoduric count and pasteurized at 140.6 C for 3 sec. The shelf-life was 4, 3, and 2 weeks at 4.4, 10, and 15 C, respectively. Spore-forming bacteria comprised a major portion of the microbial flora of the spoiled products. However, a similar product prepared with nonfat dry milk of low-thermoduric count and inoculated before pasteurization with large numbers of unidentified *Bacillus* spores which had been isolated from the spoiled mixes had a shelf-life of more than 8 weeks at 4.4 C.

The second phase of the study concerned the shelf-life of soft-serve mixes containing spores of *Bacillus cereus*. Spores were inoculated in large numbers into raw frozen dessert mixes which were then pasteurized at ultra-high temperatures. When approximately one million spores/ml were present, only 12.5% were destroyed by heating for 3 sec at 104.5 C, and 99.5% at 137.7 C. However, during storage at 4.4 C, even with more than 1 million spores/ml surviving 104.5 C, the products had a shelf-life of more than 8 weeks, and the number of viable *B. cereus* organisms actually decreased by more than one-third during this time. At a storage temperature of 10 C, the product pasteurized at 104.5 C was spoiled after 4 weeks, and that pasteurized at 137.7 C was spoiled after 5 weeks with *B. cereus* numbering in the millions after this time. When stored at 15 C, the numbers of *B. cereus* were in the millions and the product was spoiled after 2 weeks regardless of the UHT treatment.

Soft-serve frozen dessert mixes are usually pasteurized at a distant processing plant, delivered to the retail establishment, and held at refrigeration temperatures in the retail store until frozen for consumption. Opportunities for growth of contaminating organisms are extremely great under such conditions, since the refrigerated space is usually limited and serves as the storage area for other food products sold at the soft-serve outlet. Doors to the refrigerated storage area are opened and closed frequently in most of these stores. As a result, the shelf-life of soft-serve mixes is quite variable.

Some processing plants have changed to Ultra-High Temperature (UHT) pasteurization in an attempt to improve the shelf-life of these products. This has not always been accomplished, and reports from the industry reveal that in some instances the shelf-life may actually be decreased in UHT-treated products. It has not been definitely established if the spoilage organisms survive the UHT treatment, or if they are post-UHT contaminants. If the microorganisms responsible for the short shelf-life are surviving the UHT conditions, then the most logical organisms involved are the heat-resistant sporeforming bacteria. Some evidence to support this supposition has been reported *(1, 2, 4)*. Ashton *(1)* reported the predominant organisms in UHT-processed milk to be members of the genus *Bacillus*. This finding could have particular significance in soft-serve frozen desserts, especially if the surviving organism is *Bacillus cereus*, an etiologic agent of human gastroenteritis *(7, 8)*, and which is present in small numbers in most raw milk *(6)*.

Therefore, this study was undertaken with a threefold purpose: *(a)* to determine the shelf-life of commercial frozen dessert mixes processed by UHT- treatments, *(b)* to determine under pilot-plant conditions the destructive effects of UHT treatments on spores of *B. cereus* in frozen dessert mixes, and *(c)* to determine the post-pasteurization shelf-life of these products under variable conditions of refrigerated storage.

Experimental Procedure

For the first part of the study, commercial samples of soft-serve mixes made with nonfat dry milk of high-thermoduric count (32,000/g) as the source of some of the serum solids were obtained from a commercial processing plant immediately after pasteurization. The pasteurization was accomplished in an APV plate heat-exchanger at 140.6 C for 3 sec. Samples were obtained in sterile screw-cap sample jars, and packed in crushed ice in a styrofoam ice chest until arrival in the laboratory. A sufficient number of samples were taken to allow for storage at 4.4, 10, and 15 C. The initial count on the pasteurized samples was determined, along with the number of heat-tolerant bacteria, and several jars of the sample were placed at each of the storage temperatures. At weekly intervals until the product was spoiled, a jar was removed from storage, the condition of the mix was observed visually, and plate counts for total bacteria and for heat-tolerant bacteria were determined. Heat-tolerant bacteria survived heating for 15 min at 80 C. Standard Methods Agar was used as the plating medium. Incubation conditions were 32 C for 48 hr.

[1]Journal Series Paper No. 916. University of Georgia College of Agriculture Experiment Station, College Station, Athens.

Sporeforming *Bacillus* organisms were found to be common in the microflora of spoiled mixes. Typical colonies representing the most frequently appearing *Bacillus* species were picked from pour plates of the spoiled samples into Trypticase Soy Broth. After incubation at 37 C for 18 hr, cultures were inoculated onto Nutrient Agar slants containing 1.0% soluble starch and 0.01% $MnSO_4$. After 7 days at 37 C, spores were harvested and spore suspensions were standardized in M/100 phosphate buffer as described previously *(5)*. Two distinctly different *Bacillus* colonies were chosen for further study. The size of the spores was greatly different, so the standardization procedure resulted in approximately twice as many spores in one suspension as in the other. The *Bacillus* spores were not identified with regard to species. Therefore, they were designated as Spores A and Spores B on the basis of the difference in size of spores and the appearance of colonies on plates of Standard Methods Agar.

These spores were then taken to a commercial processing plant and inoculated into carefully prepared soft-serve mix before it was subjected to UHT pasteurization in an APV plate heat-exchanger. In these mixes, the nonfat dry milk used as the source of serum solids was of extremely high quality (less than 3,000 total thermoduric bacteria/g). Samples of the inoculated mixes were taken for bacteria counts, and then the mixes were pasteurized at 140.6 C for 3 sec. Samples for determining the refrigerated shelf-life were taken in sterile screw-cap glass jars, the jars were partially covered with crushed ice in a styrofoam ice chest, and delivered to the laboratory for analysis and storage at 4.4 C. Visual observations of the samples were made daily, and bacteria counts were determined at the time the storage period began, and after 1, 4, and 8 weeks of storage at 4.4 C.

For the final part of the study *Bacillus cereus* was used as the test organism, and the work was conducted in the pilot plant of the University of Georgia Dairy Science Department. Spores were cultivated and harvested as previously described *(5)*, and spore suspensions containing approximately 50 million spores/ml were prepared in M/100 phosphate buffer (pH 7.2). This number of *B. cereus* spores was obtained by standardizing with a Bausch and Lomb Spectronic-20 colorimeter to 30% transmittance at a wave length of 625 mμ. Spore suspensions were refrigerated at 4.4 C until used in the experiments. A Model 40, No-Bac Unitherm IV, Ultra-High Temperature pasteurization unit was utilized. Temperatures were maintained with manually adjustable controls and product temperatures were monitored in the heat exchange sections of the unit by thermocouples attached to recorders. Steam was used as the heating medium and ice water as the cooling medium.

For each experimental trial, 90-lb. batches of soft-serve frozen dessert mix were freshly prepared. Spores were added to the mix after it had been passed through the heat-exchanger at 137.7 C to eliminate as nearly as possible any bacteria already present in the mix ingredients. Plate counts were made on the heated mix before addition of spores to determine the degree of sterility obtained. The concentration of spores added to the mix was approximately one million/ml. The actual number of spores per milliliter of mix was determined by the pour plate procedure.

After each experimental heat treatment, mix samples were aseptically collected in sterile containers just after passing through the cooling section of the heat exchanger, and were immediately placed in an ice water bath until the pasteurization of all samples was complete. Aseptic sampling was accomplished with a hypodermic needle welded beneath an outlet valve in the product line following the cooling section. The needle was kept immersed in 200 ppm chlorine solution, and was treated with flowing steam just prior to its injection into a sterile 60 ml rubber-stoppered glass sample bottle. This method proved satisfactory in providing aseptic sampling from the UHT unit.

Heat treatments were 104.4 and 137.7 C for 3 sec. Samples of the pasteurized mix, pasteurized mix plus spores, and of the UHT-treated mixes were plated as described previously *(5)*. The UHT-treated mixes were stored at 4.4, 10, and 15 C, and plate counts were determined at weekly intervals until bacterial populations reached extremely high numbers, or until visible physical deterioration of the product was evident. The pasteurized mix to which no spores had been added was stored at 4.4 C and plated at weekly intervals to determine any possible survival and growth of organisms from the mix ingredients *per se*.

RESULTS AND DISCUSSION

The effects of post-pasteurization storage temperature on the shelf-life of commercial soft-serve mixes are presented in Table 1. One item of importance here is that the skimmilk powder used in these mixes contained 32,000 thermoduric bacterial/ml, and some of these may have contributed to the short shelf life, even though the initial count immediately after pasteurization appeared to be sufficiently low to avoid trouble (less than 80/ml). However, Edwards et al. *(3)* have suggested that heat injury instead of heat destruction may be an important factor in UHT-treated spores, and if so, the heat-injured spores may have recovered and subsequently multiplied during storage of the products so treated. The shelf-life of mixes stored at 4.4 C was only 4 weeks; at 10 C, 3 weeks; and at 15 C only 2 weeks. Even in the product stored at 4.4 C, the bacterial numbers after 2 weeks would have exceeded any bacterial standard now existing for pasteurized products.

The fact that many of the bacteria involved were resistant to heating at 80 C for 15 min suggested that the organisms were sporeforming bacteria. Therefore, gram-positive rod-shaped bacteria able to form endospores were isolated from spoiled mixes. Spores were prepared from these and reinoculated into other mixes made with skimmilk powder of low-thermoduric count. Bacteriological quality of these products during 8 weeks of storage at 4.4 C is shown in Table 2.

Even though large numbers of spores were added to the mixes before UHT treatment, very small numbers were evident immediately after pasteurization. The numbers did not increase greatly, and the products were still good after storage for 8 weeks at 4.4 C as determined by organoleptic and visual examination. Apparently, the organisms selected as being typical sporeformers in the spoiled mixes did not survive the UHT-treatment when inoculated into the raw mix, nor were they simply heat-injured and subsequently recovered in the stored products. It seems possible that the alteration in mix composition involving the

TABLE 1. EFFECT OF POST-PASTEURIZATION STORAGE TEMPERATURE ON BACTERIAL GROWTH AND SHELF-LIFE OF COMMERCIAL UHT-PROCESSED SOFT-SERVE FROZEN DESSERT MIXES.

Initial count (after pasteurization)[2]:	Standard plate count (per ml) 20			Heat-tolerant bacteria (per ml)[1] 80		
Refrigerated storage at:	4.4 C	10 C	15 C	4.4 C	10 C	15 C
1 Week Storage	40	1,000	6.5×10^5	30	60	250
2 Weeks Storage	1.4×10^5	1.1×10^7	4.3×10^8 (curdled)	300	2.5×10^4	1.2×10^5 (curdled)
3 Weeks Storage	3.3×10^7	6.8×10^8 (curdled)		7,300	1.3×10^6 (curdled)	
4 Weeks Storage	6.2×10^8 (curdled)	———	———	23,500 (curdled)	———	———

[1]Heat-tolerant bacteria survived 80 C for 15 min.
[2]Pasteurization conditions were 140.6 C for 3 sec in an APV plate heat-exchanger.

TABLE 2. BACTERIOLOGICAL QUALITY OF UHT-PROCESSED SOFT-SERVE FROZEN DESSERT MIXES CONTAINING *Bacillus* SPORES DURING STORAGE AT 4.4 C.

	Plate count (per ml)	
	Spores A	Spores B
Initial count (Raw plus spores)[1]	1.6×10^6	4.8×10^5
Immediately after pasteurization[2]	20	10
After storage at 4.4 C for:		
1 Week	60	90
4 Weeks	120	150
8 Weeks	255	220

[1]The raw product was spoiled after 1 week at 4.4 C, and the plate count was $>1.1 \times 10^8$/ml.
[2]Pasteurization conditions were 140.6 C for 3 sec in an APV plate heat-exchanger.

use of nonfat dry milk of low-thermoduric count could have been responsible for this difference. Obviously the sporeformers selected because of their frequency in the spoiled mixes were not resistant to the UHT treatment, and some other less predominant species was responsible for the short shelf-life of the mixes evaluated in the first part of the study.

Spores of *Bacillus cereus* were used in the pilot plant studies with UHT-treated frozen dessert mixes. Again skimmilk powder of low-thermoduric count was used in the mix formulation, and the mix was subjected to 137.7 C for 3 sec before inoculation with *B. cereus* spores. The bacteriological quality of these mixes pasteurized at 104.5 C and 137.7 C after incorporation of more than one million spores/ml of *B. cereus* during refrigerated storage is presented in Table 3.

Heating at 104.5 C destroyed only 12.5% of the spores; whereas 99.5% were destroyed by heating at 137.7 C. However, in the mix stored at 4.4 C, numbers remained almost constant for 6 weeks and then began a gradual decline, and the product did not show visual spoilage even after 8 weeks of storage. At 10 C, the product processed at 104.5 C showed visual evidence of spoilage and large numbers of *B. cereus* after 4 weeks of storage, and at 15 C, after only 2 weeks of storage. After 5 weeks and 2 weeks at 10 C and 15 C respectively, visual evidence of spoilage and large numbers of bacteria were noted in the product processed at 137.7 C, indicating that storage of soft-serve mixes containing *B. cereus* spores at temperatures of 10 C or above could possibly create both spoilage and public health problems.

TABLE 3. BACTERIOLOGICAL QUALITY OF *Bacillus cereus*-CONTAINING SOFT-SERVE FROZEN DESSERT MIXES PASTEURIZED AT 104.5 AND 137.7 C FOR 3 SECONDS DURING STORAGE AT 4.4, 10, AND 15 C.[1]

	Plate counts after storage at:					
	4.4 C		10 C		15 C	
Storage time	Pasteurization temperature 104.5 C	137.7 C	Pasteurization temperature 104.5 C	137.7 C	Pasteurization temperature 104.5 C	137.7 C
0 Time	1.4×10^6	6.6×10^3	9.9×10^5	1.6×10^4	1.4×10^6	6.6×10^3
1 Week	1.4×10^6	3.1×10^3	4.9×10^7	2.7×10^7	2.2×10^7	1.2×10^8
2 Weeks	1.6×10^6	4.0×10^3	6.2×10^7	6.0×10^7	$1.6 \times 10^{8**}$	$1.5 \times 10^{8**}$
3 Weeks	1.6×10^6	2.7×10^3	3.0×10^7	3.1×10^7		
4 Weeks	1.3×10^6	2.6×10^3	$8.2 \times 10^{6**}$	2.0×10^7		
5 Weeks	1.2×10^6	3.0×10^3		$9.8 \times 10^{6**}$		
6 Weeks	1.2×10^6	4.8×10^3				
7 Weeks	8.8×10^5	3.1×10^3				
8 Weeks	7.6×10^5	3.2×10^3				

[1]The control mix to which no spores were added was pasteurized at 137.7 C; no organisms were evident immediately after pasteurization, and there were fewer than 20 organisms/ml throughout the storage period. In the UHT-treated samples stored at 4.4 and 15 C, the initial spore inoculum was 1.6×10^6/ml; in the samples stored at 10 C, the initial spore inoculum was 1.05×10^6/ml.
**Denotes curdled or proteolyzed samples.

The data obtained emphasize the importance of low-temperature storage even with UHT-treated products. Fortunately, many of the sporeforming bacteria in the normal flora of raw milk are in the vegetative state, and are easily destroyed by conventional pasteurization. Therefore, no such problems are likely to arise in a mix processing operation if the ingredients used in commercial formulations do not supply large numbers of spores, and if strict sanitation procedures are followed.

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REPORT OF THE COMMITTEE ON SANITARY PROCEDURES, 1969-1970

The following is a report of the activities of the Committee on Sanitary Procedures from July 1, 1969 to July 1, 1970. The 3-A Sanitary Standards Committees met in Hartford, Connecticut, September 23, 24, 25, 1969, at the Hartford Hilton Hotel. Committee members present: W. K. Jordan, Joseph S. Karsh, Louis A. King, Jr., E. T. McGarrahan, C. K. Luchterhand, R. M. Parry, H. L. Thomasson, and Dick B. Whitehead.

There was considerable objective discussion in regard to TENTATIVE SUPPLEMENT NO. 8 TO 3-A SANITARY STANDARDS FOR FITTINGS USED ON MILK AND MILK PRODUCTS EQUIPMENT AND USED ON SANITARY LINES CONDUCTING MILK AND MILK PRODUCTS, REVISED, SERIAL #0810, Second Draft, March 12, 1969, with respect to indication of installed position, the use of 3-A plastics, and the provision for "weep holes". There also was discussion of TENTATIVE AMENDMENT TO SANITARY STANDARDS COVERING HOMOGENIZERS AND HIGH PRESSURE PUMPS OF THE PLUNGER TYPE, SERIAL #0403, First Draft, February 5, 1969. CSP-USPHS requested the Task Committee to include the substance of the amendment in the current tentative revision (current at the time of this meeting).

Final action for signature was taken on the following:

(a) TENTATIVE AMENDMENT TO 3-A SANITARY STANDARDS FOR INTERNAL RETURN TUBULAR HEAT EXCHANGERS FOR USE WITH MILK AND MILK PRODUCTS, SERIAL #1203, Fourth Draft, July 22, 1969.

(b) TENTATIVE 3-A SANITARY STANDARDS FOR FLOW METERS FOR MILK AND LIQUID MILK PRODUCTS, Fourth Draft, July 30, 1969.

(c) TENTATIVE 3-A ACCEPTED PRACTICES FOR MILK AND MILK PRODUCTS SPRAY DRYING SYSTEMS, Sixth Draft, June 30, 1969.

The bronze plaque 3-A Honor Award was presented to William A. Dean, Jr. at a testimonial dinner on September 23. This DIC sponsored award was presented by Robert H. North, Executive Vice-President of Milk Industry Foundation on the basis of long and devoted service rendered to the 3-A program.

A token of appreciation was given to Clara Byerly of the DFISA on the occasion of her resignation from that association. She has served 7 years as general meeting liaison for the 3-A Committees in a most pleasant and efficient manner.

At the closing session, the chairman announced the retirement of W. R. McLean, USPHS, but Mac didn't make it, did finally retire as of July 31, 1970. We will all miss Mac and his robust comments in our deliberations.

Following the regular 3-A Sanitary Standard Committee's meeting, the egg equipment group (E-3-A Sanitary Standards Committees) met in joint deliberation and completed three new E-3-A guidelines for egg processing equipment: RUBBER AND RUBBER-LIKE MATERIALS; PERMANENT PIPELINES; AIR UNDER PRESSURE. In addition to these guidelines, the E-3-A Standard for:

(a) SANITARY FLOW METERS

(b) ACCEPTED PRACTICES FOR SPRAY DRYING EQUIPMENT

(c) 3-A SANITARY STANDARDS FOR TUBULAR HEAT EXCHANGERS.

This entire meeting at Hartford reflected again the very useful function of the 3-A Sanitary Standards Committees and the participation of CSP in this involvement. To me it represents the ultimate in cooperative effort.

3-A Sanitary Standards Committees, Biloxi, Mississippi, May 5, 6, 7, 1970, at the Buena Vista Hotel.

Committee on Sanitary Procedures members present: Dudley J. Conner, Harold Irvin, M. W. Jefferson, R. M. Parry, Wm. K. Jordan, Joe Karsh, C. K. Luchterhand, Sam O. Noles, H. L. Thomasson, and Dick B. Whitehead. Also, as special

(Continued on Page 263)

BACTERIOLOGICAL TESTING OF MILK FOR REGULATORY PURPOSES–USEFULNESS OF CURRENT PROCEDURES AND RECOMMENDATIONS FOR CHANGE

III. RAW MILK QUALITY—WHERE DO WE GO FROM HERE?

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(Received for publication October 22, 1970)

Abstract

The present systems for bacteriological testing of raw milk for quality and regulatory purposes are briefly discussed. Recommendations are made to partially bridge the lack of relationship between test results and farm conditions. These suggestions include: *(a)* further standardization of "standard methods"; *(b)* an increase in training and supervision of testing personnel; *(c)* use of more milking time inspections; *(d)* the revision of routine agar plate count testing to include automation, selective media, and enhanced colony productivity by the use of lower incubation temperatures and longer incubation times; *(e)* making results of bacteriological testing more readily available and understandable to the producer and the fieldman; and *(f)* increasing the stringency of our bacterial standards for raw milk.

Few sanitation and food-product quality programs can boast the record achieved by the fluid-milk industry of the United States. This is a familiar claim that we all have heard, most have taught, and some maintain. We may lay this verbal bouquet at the base of a monument of milk ordinances that the United States Public Health Service started building in 1924. There is no need to parrot the foreword and preface to the latest addition and edition, the *Grade "A" Pasteurized Milk Ordinance, 1965 Recommendations of the United States Public Health Service (18).* A good dairyman knows intuitively what is therein espoused. In essence, it is stated that milk is the finest food available for all people and most bacteria. Even though milk has tremendous potential as a distributor of disease, our dairy industry's nationally good public-health record has become better. Our industry problems, however, have become more complex because of "new products, new processes, new chemicals, new materials, and new marketing patterns, which must be evaluated in terms of their public-health significance." And, finally, good sanitation is good public health.

Surely, we cannot argue with these milky maxims. Only when faced by the specific problems of what we *are* measuring and what we *should* be trying to measure bacteriologically for regulatory purposes do we become uneasy. Introduce the phrase "in raw milk," and these problems become infinitely more complex. Apply pasteurization, and the problems become practical. It is not true that the secondary purpose of pasteurization, the destruction of the causative organisms of tuberculosis, brucellosis, and typhoid, is not as pressing now as in the past? Herd health has greatly improved and little raw milk is now consumed except by some farm families. Present pasteurization times and temperatures were established to destroy these and other pathogens, including *Coxiella burneti.* Since cream lines are no longer important, minimum pasteurization standards usually are exceeded.

Because of pasteurization, bacteriological testing of raw milk offers virtually no protection to health. The original purpose for pasteurization, the delaying of spoilage, is still important; bacteriological testing of raw milk centers upon this point.

To prevent bacterial spoilage, we insist that grade-A raw milk for pasteurization be cooled to 10 C or less within 2 hr after milking and maintained thereat until processed. We have developed efficient systems of milking, handling, storage, refrigeration, collection, and transportation. We have increased contact with equipment surfaces and length of storage while decreasing temperature of storage. At the same time, we have decreased the possible amount of infective material that could be present by improving herd health and destroying, by compulsory pasteurization, the microorganisms that escape our vigilant veterinarians. We have changed the bacterial flora and, in a sense, the significance of our testing.

Needs And Tools

What are we trying to accomplish, and what are our tools? We rely upon a preventive approach by reducing the initial microbial load and follow up

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[1]Journal Paper No. J-6779 of the Iowa Agriculture and Home Economics Experiment Station.
[2]Presented at the Annual Meeting of the American Dairy Science Association, Gainesville, Florida, June 29, 1970.

with measures to avoid further contamination and growth before processing. We use animal health requirements, inspection of equipment and premises, and an elaborate system of sanitary standards. We use swab tests, rinse tests, water analyses, antibiotic tests, chemical tests, flashlights, yardsticks, thermometers, noses, eyeballs, and (above all, bacteriologically, the Standard Plate Count (SPC). We now readily admit the lack of direct relationship between the SPC and public health. This was not always so. Consider this: in the sixth edition of *Standard Methods of Milk Analysis (1)*, 1934, it is stated, "Because many incubator thermometers have a red line placed at 37.5 C, attention is called to the fact that this is not the equivalent of the human body temperature, and that the proper incubation temperature is 37 C (98.6 F)". Subsequent editions *(2, 3)* have lowered the incubation temperature to the present 32 C, a temperature that bears little direct relationship to the temperature of the human or bovine body or public health. Present attitudes seem to indicate a tendency to consider even lower temperatures to obtain higher counts of microorganisms more directly associated with equipment contamination.

USEFULNESS OF TESTS

Are the current bacteriological tests (primarily the SPC) useful for regulatory purposes? During the past several years, critics of the SPC have become more outspoken *(4)*. But, why should we rush to discard an old friend? Even though we have long since abandoned the position that there is a direct relationship between the SPC and public health, we cannot deny that the bacterial limits of 100,000/ml before commingling with other producer milk or 300,000/ml as commingled milk have served well for regulatory purposes in the past. These limits could be easily met by observing simple sanitary precepts; counts in excess of these limits clearly indicated the need for corrective action. The time is overdue, however, for a long, searching look, first at the bacterial limits and then at the test (as many are already doing). Are these limits stringent enough with our present capability to produce better milk? Our time is too limited to consider the many facets of this question. In place of further discussion, attention is directed to the reviews of Hartley et al. *(10, 12)*. The gist of the 245 references cited therein is essentially that there is no assurance that any single test will accurately reflect farm production conditions. At the same time, there does not seem to be a simple combination of tests, as presently used, that can accomplish this feat, although some combinations may be better than others *(11)*.

We recently tried to correlate 8 tests with farm production conditions *(11)*. Farm conditions were evaluated at milking time, and a farm score was assigned mainly on sanitation and milking methods as well as on equipment conditions. Evaluation of the data indicated that the bacterial-test results were not highly correlated with farm production conditions; only the psychrophilic count showed significant correlation with the farm score. A most interesting observation was that the leucocyte count did show significant correlation with the farm score, but not with the bacterial-test results. There may be a lesson here. This point alone is worth further investigation. We, as so many others before us, can only conclude that frequent milking-time inspections are necessary to assure that recommended practices are used in grade-A milk production.

FUTURE DEVELOPMENTS

At this point in our discussion, we should rush into the widening breach between farm conditions and test results with a list of proposals of things to do. But first, let us briefly consider what may happen in the future. As the number of smaller herds decreases, farm inspection and sanitation control would be simplified, at least on a numerical basis. As the differences between grade-A and manufacturing-grade milks are eliminated and only one grade of milk exists, testing systems could be unified and simplified. As dairy cooperative and proprietary organizations continue to consolidate and otherwise grow in size and as they and other purchasers of raw milk become more highly integrated and standardized in their use and requirements of and for milk, then quality-control personnel and systems as well as fieldman usage should become more efficient. Theoretically, at least, the total services available through the fieldman should be increased. With unified operations, technical know-how and administrative efficiency should increase. Hauling and routing, even marketing efficiency, all in one way or another have a direct or indirect effect upon bacteriological testing for regulatory purposes.

NEEDED CHANGES

But, back to the breach. What changes should be made to and with bacteriological testing of raw milk? If a radically new procedure had come to my mind, we would now be working on it at Iowa State. I assure you, we are not so engaged. Therefore, these suggestions are rather prosaic. So saying, I submit the following:

(a) We need further standardization of our "standard methods."

(b) If fewer people are to test the same or larger amounts of milk, these people should be more highly trained and more closely supervised.

(c) Fieldmen's effectiveness could be increased if their work was performed primarily during milking.

(d) If the agar-plate technique could be automated, as is being tried in The Netherlands, and thereby made cheaper per analysis, more tests per patron should be run. Substitution of several selective media in a device of this nature would permit a more analytical approach to testing.

More attempts should be made to enchance SPC recovery. Addition of growth factors might permit greater and more rapid growth of udder bacteria, perhaps even at lower temperatures. The use of lower temperatures and longer incubation times would give greater recovery of microorganisms commonly associated with poor sanitation methods. Combinations of incubation temperatures might enhance recovery of different significant groups of microorganisms.

(e) Results of bacteriological testing should be made more readily available and understandable to the producer and the fieldman. The fieldman should be trained to use this information to greater advantage. Computerization would make possible condensation, evaluation, and faster recall of test results. The utility of scientific and technical knowledge lies only in what *can* be done and what is done with it.

Close control over sampling and sample handling should be established.

Recognizing that this is an unpopular approach with many groups, present standards should be made more stringent. In proposing a "Standard Milk Ordinance for Alabama Municipalities," L. C. Frank *(8)* suggested the equivalent of a SPC of 50,000/ml. The plating medium and incubation temperature then in use did not afford near-optimal recovery of microorganisms, but even with this advantage, known or unknown, Frank evidently did not consider this figure overly difficult to attain, even in 1924.

These suggestions are not novel and may be less than useful or interesting, but I submit, someone should do something.

In regard to tests other than SPC, interest has been quickening. Dr. C. K. Johns has been a leading exponent of preliminary incubation (PI). The value of PI when applied to pasteurized milk is well established *(7)*; more definitive studies of the value of this method when applied to grade-A raw milk in conjuction with observation of farm production conditions would be desirable. Many workers have long proposed enumeration of specific groups of organisms. Among those groups considered have been coliforms *(14)*, gram-negative bacteria *(6)*, thermoduric bacteria *(17)*, oxidase-positive bacteria *(9)*, psychrotolerant bacteria *(5, 15, 16)*, and even enterococci *(13)*. Although each of these tests seems to have some drawbacks, perhaps replicate plating, in special instances, may have merit. For example, the revelation of total numbers and the ratio between gram-negative and gram-positive bacteria in the same sample of raw milk would have information of far greater value than a single SPC of that sample.

If sales of imitation or filled milks increase, the need for tests for specific groups of microorganisms peculiar to or significant in the product may increase. This thought may introduce an off-key note in a discussion of grade-A raw milk, but it should be considered. For instance, thermoduric bacteria are more likely to be present in nonfat dry milk than in raw milk. The reverse should be true with psychrotolerant bacteria. The presence of either group in the individual ingredients and in the final combined and processed product would carry different connotations of meaning.

In conclusion, it is true that our technology has outstripped our testing system. It seems logical that bacterial standards in terms of SPC per milliliter should be made more stringent. And, until more suitable testing procedures can be developed (or tested and proved, if they already exist), greater emphasis should be placed upon other aspects of sanitary, hygienic milk production, particularly on milking-time inspections.

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REPORT OF THE COMMITTEE ON SANITARY PROCEDURES

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guest from the Mississippi State Board of Health was Clinton Van Devender.

Items completed in joint deliberation were as follows:

(a) PROPOSED TENTATIVE AMENDMENT TO 3-A SANITARY STANDARDS FOR STORAGE TANKS FOR MILK AND MILK PRODUCTS, SERIAL #0104, FIRST DRAFT, FEBRUARY 2, 1970.
PROPOSED TENTATIVE AMENDMENT TO 3-A SANITARY STANDARDS FOR STAINLESS STEEL AUTOMOTIVE MILK TRANPORTATION TANKS FOR BULK DELIVERY AND/OR FARM PICK-UP SERVICE, SERIAL #0509, FIRST DRAFT, FEBRUARY 2, 1970.
TENTATIVE AMENDMENT TO THE 3-A SANITARY STANDARDS FOR FARM MILK COOLING AND HOLDING TANKS, REVISED, SERIAL #1304, FIRST DRAFT, DECEMBER 15, 1969.

(b) TENTATIVE AMENDMENT TO 3-A SANITARY STANDARDS FOR MULTIPLE-USE PLASTIC MATERIALS USED AS PRODUCT CONTACT SURFACES FOR DAIRY EQUIPMENT, SERIAL #2004, REVISED DRAFT, FEBRUARY 12, 1970.

(c) AMENDMENT TO RESCIND AMENDMENT TO 3-A SANITARY STANDARDS FOR STAINLESS STEEL AUTOMOTIVE MILK TRANSPORTATION TANKS FOR BULK DELIVERY AND/OR FARM PICK-UP SERVICE, SERIAL #0510. A motion to rescend #0507 immediately was passed by the separate voting of the combined group.

(d) AMENDMENT TO 3-A SANITARY STANDARDS FOR STAINLESS AUTOMOTIVE MILK TRANSPORTATION TANKS FOR BULK DELIVERY AND/OR FARM PICK-UP SERVICE, SERIAL #0511.

(e) TENTATIVE SUPPLEMENT #2 TO THE 3-A SANITARY STANDARDS FOR FITTINGS USED ON MILK AND MILK PRODUCTS EQUIPMENT AND USED ON SANITARY LINES CONDUCTING MILK AND MILK PRODUCTS, REVISED, SERIAL #0810, THIRD DRAFT, SEPTEMBER 24, 1969.

(f) TENTATIVE 3-A SANITARY STANDARDS FOR HOMOGENIZERS AND PUMPS OF THE PLUNGER TYPE, REVISED, SERIAL #0404, SECOND DRAFT, SEPTEMBER 4, 1969. This revision re-casts the original standard of 1949 in the new format, and provides for the inclusion of criteria for plunger-type pumps that are not homogenizers.

(g) TENTATIVE 3-A SANITARY STANDARDS FOR STAINLESS STEEL AUTOMOTIVE MILK TRANSPORTATION TANKS FOR BULK DELIVERY AND/OR FARM PICK-UP SERVICE, REVISED, SERIAL #0508, FOURTH DRAFT, NOVEMBER 20, 1969.
TENTATIVE 3-A SANITARY STANDARDS FOR STORAGE TANKS FOR MILK AND MILK PRODUCTS, REVISED, SERIAL #0103, FIFTH DRAFT, NOVEMBER 20, 1969.

(h) TENTATIVE AMENDMENT TO 3-A SANITARY STANDARDS FOR FITTINGS USED ON MILK AND MILK PRODUCTS EQUIPMENT AND USED ON SANITARY LINES CONDUCTING MILK AND MILK PRODUCTS, SERIAL #0812, FIRST DRAFT, APRIL 28, 1970. This is a brief amendment clarifying that the list of fittings found on subsection F.1 of the standard is a list of fittings for which there are drawings rather than a list of all the fittings covered by the standard.

This was a meeting of much debate, but the objectivity of the discussion proved to be productive and I feel that much was accomplished. It was also the feeling of the group that the discourse at this meeting further paved the way for constructive development of standards for a greater segment of the food processing industry.

Following this meeting, there was a joint meeting of E-3-A SANITARY STANDARDS COMMITTEES, MAY 7, 1970. There was some preliminary coordination between the various committees and then the agenda was established for deliberation in the joint session of all committees. At this meeting, the following were approved for signatures:

(a) TENTATIVE E-3-A SANITARY STANDARDS FOR NON-COIL TYPE BATCH PASTEURIZERS SERIAL #E-2400. This standard was adopted, subject to revision in the thermometer specifications and the Secretary was instructed to prepare new drafts for signing and publication.

(b) TENTATIVE E-3-A SANITARY STANDARDS FOR INLET AND OUTLET LEAK PROTECTOR PLUG VALVES FOR BATCH PASTEURIZERS SERIAL #E-1400.

There was considerable discussion of the following: TENTATIVE E-3-A ACCEPTED PRACTICES FOR EGG PRODUCTS SPRAY DRYING SYSTEMS SERIAL #E-60700. There was considerable discussion concerning this particular practice and the draft was referred back to the DFISA Technical

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BACTERIOLOGICAL TESTING OF MILK FOR REGULATORY PURPOSES–USEFULNESS OF CURRENT PROCEDURES AND RECOMMENDATIONS FOR CHANGE

IV. QUALITY AT THE POINT OF CONSUMPTION[1, 2]

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(Received for publication October 22, 1970)

Abstract

A plate count has a glorious past, though not deserving of worship. We are operating in a technological and socio-economic environment far removed from conditions which justified many standards, which arose from reliance on a plate count. There is little, if any, relation between microbial tests and the level of sanitation in modern fluid milk processing plants. Some redirection of sampling programs would be helpful and especially if standards were established to include a consideration of time after pasteurization. It is suggested that the results on plate counts should be expressed as CFU/μl or CFU/mg (colony forming units per microliter or milligram as appropriate). This terminology would include all microorganisms and present a more practical expression of the results.

In the future, improved methods for quality evaluation should be available through application of sophisticated instrumentation. These systems may involve recognition and quantification of specific microbial activities or residues. The system also should be useful for identification of unsanitary equipment and contaminated products.

Conceptual Background of Microbiological Testing

The standard of comparison for all microbiological testing is a plate count. It's the oldest. It's the most accurate. It's the most hallowed.

The hallowed position of a plate count should be challenged. Changes in technology and socio-economic conditions warrant some redirection and repositioning of the attitude toward a plate count. The challenge is not a technical sense of reliability of a plate count, though its reliability is commonly overrated, but in the technological sense of its applicability.

Use of terminology "a plate count" is intentional as the intent is to discuss the general concept of a plate count rather than the presently accepted Standard Plate Count, Coliform Count, etc. There have been many modifications in procedures and media. Lowering the incubation temperature and use of a medium to eliminate the necessity for adding milk are two examples. Most modifications are considered "improvements," as a larger number of colonies are obtained. The increase in numbers results from recovery of fastidious or inert organisms; neither group has been proven of significance in sanitation and milk spoilage. Common reason indicates these organisms are less significant than other organisms in sanitation, because of their competitive inability in soil harborages.

Socio-economic conditions have changed with improved transportation, refrigeration, etc. In this light a plate count is less useful as a criterion of quality than during the earlier days of development of the industry. Most of our criteria for quality and sanitation were established in the earlier days of the industry. New regulations are commonly based on tightening older standards. Older regulations were often established in light of the anticipated effect on the ultimate criterion of quality–a plate count. The basic concept of two mutually dependent criteria for evaluating a single system should always be open to question.

A specific example of changes in technology and socio-economic conditions is the shift from everyday delivery to the present expectancy of a shelf life of more than 14 days. The everyday delivery was in harmony with the quality available at that time. Some of the pioneers in the industry relate the story of quality in their day by saying, "We delivered every day in the cool of the morning, put the milk at the housewife's door, knocked, and then ran to get away before the milk spoiled."

The microflora in spoiled milk in those days was different than the mircoflora of milk today. We have essentially eliminated many of the spoilage organisms of importance in the early days of our industry. For example, older texts list *Streptococcus lactis* as one

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[1]Published with the approval of the director as Paper No. 2928, Journal Series, Nebraska Agricultural Experiment Station, Lincoln.

[2]Presented at the Annual Meeting of the American Dairy Science Association, Gainesville, Florida, June 29, 1970.

of the important spoilage organisms of milk. Our work in recent years indicates <1% of the total microflora of raw milk to be *S. lactis (6)*. But, with the improvement in milk quality, our general socio-economic environment has improved. There has been a general increase in concern for the public welfare. We have recognized or acknowledged additional hazards from microorganisms; e.g., salmonellae, *Clostridium perfringens*, and aflatoxins from molds. Thus, we are justified in seeking new criteria of microbiological quality. But, we need a bold new outlook.

CONCEPTS OF QUALITY

We should deal with concepts of quality in three parts according to the factions with vested interests. The public health concept is well recognized as avoidance of unsanitary practices and pathogenic microorganisms. Industry is motivated to provide products that have good public acceptance and shelf life. The general consumer concept is based on confidence in guardians of public health and in the traditional good faith in industry.

There is a more specific public interpretation that should be considered. The typical consumer extends the shelf life of products to the threshold of detectable organoleptic spoilage. Refrigeration of samples is the practice, but failures through omission are common. The consumer makes a cursory check of a product and finds that it's acceptable or that it's not excessively spoiled and uses it. Nature of the microflora at the point of marginal rejection only can be surmised through reported work with other major goals *(1, 4, 6, 11)*.

Historically speaking, the natural microflora of milk included vigorous acid producing bacteria, which inhibited many objectionable bacteria. Modern technology provides an overall safer product, but it is without the inherent safety factor of acid forming bacteria. Thus, our bacteriological evaluation of quality should include consideration at the threshold of detectable organoleptic spoilage.

We recognize that most milk, when consumed, is neither on the threshold of spoilage nor represents a health hazard. These so-called normal, ideal conditions presuppose proper handling of the product.

Abnormal conditions, however, constitute a greater challenge for quality control and public health protection. Socio-economic conditions do not contribute to ideal practices, but allow handling of milk only to prevent spoilage. The dairy plant and its distribution system are primarily motivated by shelf life, which is an extension of the life of the product before detectable spoilage. Distributors, including stores, handle the product to prevent spoilage and customer complaints. The housewife adjusts her handling of dairy food products to prevent detectable spoilage. Use of tests on fresh pasteurized, packaged products to predict quality at the time of spoilage is essentially worthless.

Why evaluate quality when the hazard is essentially nil? Tests on fresh products at best may aid in the prediction of shelf life. Microbiological evaluations, therefore, should be made as near as possible to the point where the product presents the greatest hazard.

PREDICTING MICROBIOLOGICAL QUALITY

The problem is overwhelming when attempting to predict microbiological quality at the point of consumption by use of data on freshly processed products. The biological system is so complex that a significant test is highly unlikely. Storage time allows growth of cells, recovery of injured cells, and adaptation of cells to new media. Temperature has a similar complex influence on cells. History of exposure of cells; e.g., heat injury, sanitizer injury, osmotic injury, cold shock, etc., has a major effect on the microflora *(2, 8, 10, 12)*. Perhaps most important, however, is the nature of the microflora including kinds of microorganisms as well as the relative population density, which influences competitive outgrowth.

A specific example of the problem of quality evaluation by a plate count can be traced to research, which originated and fostered the method. Inherent wide variation is recognized and replicate plating is the practice. In control work where results are unofficial, however, it is common to use a single plate at each dilution. Such a system sets a plateau of enforcement. Industry, whose products are being evaluated, establishes a program to avoid trouble. Thus, most enforcement effort becomes a practice based on results of a single plating.

As an example of the problem of variation in a plate count even with replication of plating, some specific figures might be useful. Freshly pasteurized, packaged milk commonly contains <1,000 organisms per milliliter. The organisms of most significance, coliforms and psychrotrophs, account for <10 per milliliter *(7)*. In the initial count, 1% of the total microorganisms are of most concern. After incubation of packaged milk to simulate spoilage, psychrotrophs and coliforms account for 90% of the total population *(6)*. Thus, the primary problem centers around microorganisms contributing 1% of a total plate count on freshly pasteurized, packaged milk. A figure of 1% is insignificant in light of the large variation inherent in a plate count even with replications. If psychrotrophs alone are considered, and these constitute the single most important spoilage problem, results from a total plate count become even less meaningful. Furthermore, the problem of numbers is

confounded by injury and recovery phenomena to which psychrotrophic bacteria are particularly susceptible.

A PLATE COUNT AS AN INDICATION OF PAST SANITARY PRACTICES FOR THE PRODUCT

Microbiological testing is also generally assumed to have a correlation with sanitation. Work with farm sanitation ratings and results on microbiological tests on products therefrom question the degree of reliance that should be given this assumption *(3, 5)*. It's hard to imagine even as much correlation between sanitation ratings of a dairy plant and the usual quality tests. If it is true there is not a significant correlation between plant counts and levels of sanitation in modern dairy food plants, we would be just as well off to randomly select plants and times for scolding by regulatory sanitarians. This technique is less expensive and would maintain the pressure of regulatory sanitarians. The element of pressure beyond question is helpful.

In practice, we must continue the use of a plate count or plate counts until there is an acceptable alternative. Also, in the past we have often found new microbial problems and could likewise encounter new ones in the future. A plate count is a legitimate defense.

THE CHALLENGE TO MICROBIOLOGICAL EVALUATION

Since we haven't a better quality test than a plate count, the challenge is for better direction of its use. We should include an evaluation of products for quality at the threshold of rejection by organoleptic evaluation. The kinds of microorganisms and the potential health hazards at this point should be of value in establishing criteria for regulatory standards and actions.

If there are to be meaningful microbiological standards, limits should be established with stipulations of time after pasteurization included in the methods. The present 20,000/ml limit is essentially meaningless immediately post-pasteurization. The limit is equally meaningless, being excessively restrictive, near the point of consumption. There should be a limit on the freshly pasteurized, packaged product and a limit near the point of consumption. Numerical figures for these limits should be based on results of previously suggested research. Two limits would be much more meaningful in quality control and regulatory activities.

Some other suggested interpretations would make a plate count more meaningful and perhaps present dairy foods in a better light to our public. The results should be expressed at CFU/μl or CFU/mg (colony forming units per microliter or milligram as appropriate). For example, the present limit on count for pasteurized milk would be 20 CFU per microliter rather than 20,000 per milliliter. This terminology would, of course, include all micoorganisms rather than the commonly used term bacterial count. In addition, the numbers would not appear so astronomical to the public who is not aware of their true meanings.

FUNDAMENTAL RESEARCH CHALLENGES

A highly desirable goal for research in the field of quality evaluation at the point of consumption would be analyses for products of microbial activity. The goal would be to determine metabolic end products from past microbial activity, thus indicating the degree of mishandling of the product. The present emphasis on residues in foods indicates this approach would present a more promising challenge for the future than to study some very low probability of contamination with a single pathogen.

Work along the lines of identification of end products of microbial activity using modern, sophisticated instruments appears rewarding according to preliminary work in our laboratory. Tests could be applied immediately after pasteurization or at the point of consumption.

Another research approach might be the use of residual enzymes contributed by bacterial contaminants as a potential tool for evaluating quality and past microbial activity.

Still another avenue for fundamental research is in the application of sophisticated instrumentation directly to evaluation of sanitation. Gas chromatography for the recognition of even trace materials seems highly promising *(9)*.

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REPORT OF THE COMMITTEE ON SANITARY PROCEDURES

(Continued from Page 263)

Committee for further study and revision. An ad hoc meeting for finalizing this practice is expected sometime in October. Then it will be presented to the entire Committees for consideration at the next full meeting of the Committees.

The accomplishment of these two meetings represents many hours of homework and dedication on the part of all participants. It is with sincere regret that we are obliged to accept the resignation of Sam O. Noles for reasons, as we would say in Mississippi, "Having De High Blood 'n De Low Heart". I am sure Sam will do fine, and we will be hearing from him after a little extended rest and relaxation.

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Dr. Richard M. Parry, Dairy Division, State Department of Agriculture, State Office Building, Hartford, Connecticut 06100.

Mr. Dudley J. Conner, State Milk Inspector, Division of Environmental Health, 275 East Main Street, Frankfort, Kentucky 40601.

Dr. W. K. Jordan, Department Food Science, Stocking Hall, Cornell University, Ithaca, New York 14850.

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Mr. Harold Irvin, Omaha-Douglas Health Department, 1202 South 42nd Street, Omaha, Nebraska 68100.

Dr. Louis A. King, Jr., 2444 DeCook South Court, Park Ridge, Illinois 60068.

Mr. Joseph S. Karsh, Alleghenny County Health Department, 39th Street & Penn. Avenue, Pittsburgh, Pennsylvania 15224.

Mr. P. J. Dolan, Bureau of Dairy Science, California Department of Agriculture, 1220 North Street, Sacramento, California 95814.

Mr. John C. Schilling, Milk Control, Division of Health, Milk Control Section, St. Louis, Missouri 63103.

Mr. F. E. Fenton, Standardization Branch, Dairy Division, C & MS, U.S. Department of Agriculture, Washington, D.C. 20250.

Dr. J. C. Olson, Division of Microbiology, Food & Drug Administration, Department HEW, 200 C Street, Washington, D. C. 20204.

Mr. Sam O. Noles, State Board of Health, P. O. Box 210, Jacksonville, Florida 32201.

Mr. O. M. Osten, Food Inspection Division, Minnesota Dept. of Agriculture, State Office Building, St. Paul, Minnesota 55101.

Mr. H. L. Thomasson, P. O. Box 437, Shelbyville, Indiana 46176.

Dick B. Whitehead, *Chairman*, 818 17th Street, Wilmette, Illinois 60091.

EGG PROCESSORS COMPLETE E-3-A PROJECTS AT MILWAUKEE MEETING

E-3-A Sanitary Standards Committees adopted a new standard for storage tanks, a revision for homogenizers and an amendment and supplement for thermometer fittings at their Milwaukee spring meeting. These sanitary guidelines—the result of cooperative action by the Sanitary Standards Committees of five groups to establish voluntary criteria for cleanability of processing equipment and product protection—will be published in the *Journal of Milk and Food Technology* later in the year. Reprints of the new standards and amendments will then be available from the *Journal*, International Assn. of Milk, Food & Environmental Sanitarians, P.O. Box 437, Shelbyville, Ind. 46176.

Action taken at the April 22 meeting combines for a total of 14 separate E-3-A Sanitary Standards and Accepted Practices circulated by the egg processing industry since the inception of the program in December, 1968. Tentative drafts and proposals of projected practices for egg breaking, egg washing and HTST pasteurization of liquid eggs were considered by the Institute of American Poultry Industries user group. A special pasteurization conference signaled a significant new effort to model egg pasteurization criteria on accepted 3-A fundamentals. These three projects were referred to the Technical Committee of Dairy & Food Industries Supply Assn. for implementation. They will largely constitute the E-3-A future agendas.

Dairy & Food Industries Supply Assn., Institute of American Poultry Industries, International Assn. of Milk, Food & Environmental Sanitarians, U. S. Dept. of Agriculture and U. S. Public Health Service work together in the E-3-A effort.

PROGRAM

FIFTY-EIGHTH ANNUAL MEETING

INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC.

In cooperation with

CALIFORNIA ASSOCIATION OF DAIRY AND MILK SANITARIANS
CALIFORNIA FIELDMEN'S CONFERENCE

AUGUST 15-19, 1971

Sheraton Inn, Harbor Island — **San Diego, California**

REGISTRATION

Monday, August 16—1:00 P.M.-8:00 P.M.
Tuesday, August 17—8:00 A.M.-6:00 P.M.
Wednesday, August 18—8:00 A.M.-1:00 P.M.
Registration Fee $10.00

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Ladies Activities: Leland Lockhart, Al Dutra
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SUNDAY, AUGUST 15, 1971

1:30-5:30 P.M.—Executive Board—Santa Ana Room
8:00-11:00 P.M.—Executive Board—Santa Ana Room

MONDAY, AUGUST 16, 1971

1:00-8:00 P.M.—Registration—Foyer

COMMITTEE MEETINGS

Check Bulletin Board

SPECIAL MEETINGS:

8:00 A.M.-12:00 noon—Executive Board—Santa Ana Room
1. Report on Local Arrangements
2. Report of Executive Secretary
3. Report of Sanitarians Joint Council

1:30 P.M.-5:00 P.M.—Executive Board—Santa Ana Room
1. Report of Journal Management Committee
2. Regular Agenda

1:30 P.M.-5:00 P.M.—Individual Committee Meetings
(See Bulletin Board)

5:30 P.M.-6:30 P.M.—Reception—Madrid Room

7:30 P.M.-9:00 P.M.—Affiliate Council—Board Room A

7:30 P.M.-10:00 P.M.—Executive Board—Santa Ana Room
1. Committee Chairman
2. Meet with Past Presidents
3. Report of Affiliate Council Chairman

TUESDAY, AUGUST 17, 1971

8:00 A.M.-6:00 P.M.—REGISTRATION—Foyer

MORNING—GENERAL SESSION—MADRID ROOM

ORLOWE M. OSTEN, *President-Elect, Presiding*

9:30—INVOCATION
REVEREND ELLIS R. SHAW

9:35—ADDRESS OF WELCOME
JERRY W. FIELDER

9:50—PRESIDENTIAL ADDRESS
DICK B. WHITEHEAD

10:15—THE NATIONAL CENTER FOR TOXICOLOGICAL RESEARCH
DALE R. LINDSAY

11:00—ENVIRONMENTAL PROTECTION ADMINISTRATION
Deputy Administrator
(To be announced later)

11:45—NOMINATIONS, 1971

AFTERNOON—MILK SANITATION SECTION—MADRID ROOM

ROBERT L. VAN BUREN, *Presiding*

1:30—DOOR PRIZE DRAWING

1:45—MILKING REQUIREMENTS FOR DAIRYMEN, COWS, AND MARKETS
JAMES W. CROWLEY

2:30—DESIGN FOR PROPER MANAGEMENT OF LARGE DAIRY HERDS
WILLIAM FAIRBANK

3:15—MILK BREAK

3:30—RECYCLING DAIRY WASTE FOR POLLUTION CONTROL
CHARLES L. SENN

4:15—REPORT ON 13TH EDITION OF STANDARD METHODS FOR EXAMINATION OF DAIRY PRODUCTS
ELMER H. MARTH

AFTERNOON—FOOD AND ENVIRONMENTAL SANITATION SECTION—TOLEDO ROOM

ELMER E. KIHLSTRUM, *Presiding*

1:30—DOOR PRIZE DRAWING

1:45—(To be Announced)

2:30—(To be Announced)

3:15—MILK BREAK

3:30—CONSUMER PROTECTION IN LOS ANGELES COUNTY
DALE D. REEVES

4:15–MICROWAVE OVENS AND THEIR PUBLIC HEALTH SIGNIFICANCE
ROBERT L. ELDER

TUESDAY EVENING, AUGUST 17

7:30-9:30–EVENING DISCUSSION GROUPS
These discussion groups are for the benefit of our members who have special questions or problems which they wish to discuss informally with others. Selected individuals have agreed to answer questions and otherwise assist in discussions.

7:30–FOOD SANITATION
Santa Ana Room
NINO INSALATA, *Moderator*
JERRY DOOLIN
JOHN BARNHART
(TO BE ANNOUNCED)

7:30–MILK
Board Room A
CLIFFORD COSGROVE, *Moderator*
ROBERT VAN BUREN
WILLIAM FAIRBANKS
GEORGE DE MEDEIROS
JAMES CROWLEY

7:30–ENVIRONMENTAL SANITATION
Board Room B
THOMAS H. SORG, *Moderator*
CHARLES SENN
(TO BE ANNOUNCED)
ROBERT BARRET

WEDNESDAY, AUGUST 18

MORNING—GENERAL SESSION—MADRID ROOM

PAT J. DOLAN, *Presiding*

8:30–DOOR PRIZE DRAWING

8:45–FREEZE DRYING OF FOOD
JOHN L. BARNHART

9:30–MILK BREAK

9:45–DOOR PRIZE DRAWING

10:00–ANNUAL BUSINESS MEETING
1. Report of Executive Secretary
2. Report of Secretary-Treasurer
3. Committee Reports
4. 3A Symbol Council Reports
5. Report of Resolutions Committee
6. Report of Affiliate Council
7. Old Business
8. New Business
9. Election of Officers

12:00- 1:15 P.M.–LUNCH
Board Room A
California Association of Dairy and Milk Sanitarians–California Fieldmen's Conference

WEDNESDAY, AUGUST 18

AFTERNOON—MILK SANITATION SECTION—MADRID ROOM

MILTON E. HELD, *Presiding*

1:30–DOOR PRIZE DRAWING

1:45–1971 INTERSTATE MILK SHIPPERS CONFERENCE AND ITS FUTURE ROLE
EARL O. WRIGHT

2:15–QUALITY PAYS
GEORGE M. DEMEDEIROS

3:00–MILK BREAK

3:15–MILK INDUSTRY IN MEXICO
MARIO RAMOS CORDOVA

4:00–AUTOMATION IN THE DAIRY LABORATORY
GARY H. RICHARDSON

AFTERNOON—FOOD AND ENVIRONMENTAL SANITATION SECTION—TOLEDO ROOM

WALTER F. WILSON, *Presiding*

1:15–DOOR PRIZE DRAWING

1:30–THE TRUTH ABOUT PHOSPHATES
ROBERT B. BARRETT

2:15–PROBLEMS IN ESTABLISHING THE ECOLOGICAL SIGNIFICANCE OF TREATED WASTEWATER DISCHARGES IN COASTAL WATERS
GEORGE E. HLAVKA

3:00–MILK BREAK

3:15–AGRICULTURAL SANITATION OF LIVESTOCK MANURES FOR CONTROL OF FLIES, DUSTS, AND ODORS
EDMOND C. LOOMIS

4:00–A TOTAL RECYCLE BIOCHEMICAL PROCESS FOR CATTLE WASTES
LEE G. CARLSON

AFTERNOON—FOOD INDUSTRY SANITATION SECTION—BARCELONA ROOM

RICHARD P. MARCH, *Presiding*

1:30–DOOR PRIZE

1:45–BETTER UTILIZATION OF FISHERY RESOURCES THROUGH IMPROVED AND

NEW HANDLING AND PROCESSING CONCEPTS
HERMAN S. GRONINGER, JR.

2:15–EGG AND EGG PRODUCTS–CONTINUOUS PASTEURIZATION
HANS LINEWEAVER

3:00–MILK BREAK

3:15–QUALITY CONTROL IN THE CONFECTIONARY INDUSTRY
GERALD S. DOOLIN

4:00–WINE QUALITY AND SANITATION CONTROL
MAYNARD A. AMERINE

WEDNESDAY EVENING AUGUST 18

6:30- 7:30–RECEPTION
Toledo Room

7:00–ANNUAL AWARDS BANQUET
Barcelona and Madrid Rooms
DICK B. WHITEHEAD, *Presiding*

INVOCATION
IVAN PARKIN

MASTER OF CEREMONIES
TED SHIELDS

INTRODUCTIONS

PRESENTATION OF AWARDS
SAM O. NOLES, *Chairman*

1. Past President's Award
2. Citation Award
3. Honorary Life Membership
4. Sanitarian's Award

The Sanitarian's Award is sponsored jointly by the Diversey Corporation, Klenzade Products, Inc., and Pennwalt Chemicals, Inc.; and is administered by the International Association of Milk, Food and Environmental Sanitarians, Inc.

INSTALLATION OF OFFICERS
ENTERTAINMENT–GEORGE JESSEL

THURSDAY, AUGUST 19

MORNING—GENERAL SESSION—MADRID ROOM

DICK B. WHITEHEAD, *Presiding*

9:00–DOOR PRIZE DRAWING

9:15–HEART DISEASE–WHAT DO WE KNOW ABOUT DIET AS A RISK FACTOR
ELWOOD W. SPECKMANN

10:00–"MISSION 5000" SOLID WASTE DISPOSAL
THOMAS J. SORG

10:15–NATIONAL FOOD PROTECTION CONFERENCE REPORT
KEITH H. LEWIS

ENTERTAINMENT MEN AND WOMEN

MONDAY, AUGUST 16
5:30 P.M.-6:30 P.M.–RECEPTION
MADRID ROOM

WEDNESDAY, AUGUST 18
6:00 P.M.–COCKTAIL HOUR
TOLEDO ROOM

7:00 P.M.–BANQUET AND ENTERTAINMENT
BARCELONA AND MADRID ROOMS

THURSDAY, AUGUST 19
1:00 P.M.–DAIRY PLANT TOUR AND BARBECUE
(SPONSORED BY CALIFORNIA FIELDMEN'S CONFERENCE)

ENTERTAINMENT FOR THE LADIES

TUESDAY, AUGUST 17
Harbor Cruise

WEDNESDAY, AUGUST 18
Tour–Sea World
Tour–Balboa Park
Ladies' Hospitality Room

PROGRAM PARTICIPANTS

AMERINE, MAYNARD A.–Professor, Dept. of Viticulture and Enology, University of California, Davis, California

BARNHART, JOHN L.–Acting Chairman, Dept. of Food Science, University of Idaho, Moscow, Idaho

BARRET, ROBERT B.–Vice President and Tech. Director, Klenzade Division, Economics Laboratory, Osborn Building, St. Paul, Minnesota

CARLSON, LEE G.–Research Director, Babson Brothers Company, Environmental Division, 461 W. Fullerton Avenue, Elmhurst, Illinois

CORDOVA, MARIO RAMOS–General Director, National Association of Pure Milk Producters, Paseo De La Reforma, No. 330, Mexico 6, D.F.

COSGROVE, CLIFFORD J.–Extension Professor of Dairy Manufacturing, University of Rhode Island, Kingston, Rhode Island.

CROWLEY, JAMES W.—Extension Dairyman, University of Wisconsin, Madison, Wisconsin

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GRONINGER, HERMAN S.—Research Chemist, U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Tech. Laboratory, 2725 Montlake Boulevard, Seattle, Washington

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INSALATA, NINO F.—General Foods Corporation, 275 Cliff Street, Battle Creek, Michigan

KIHLSTRUM, ELMER E.—616–54th Place, Western Springs, Illinois

LEWIS, KEITH H.—Director, Office of Food Sanitation, Bureau of Foods, Food and Drug Administration, DHEW, 200 C Street Southwest, Washington, D. C.

LINDSAY, DALE R.—Associate Commissioner for Science, FDA, 5600 Fishers Lane, Rockville, Maryland

LINEWEAVER, HANS—Chief, Poultry Laboratory, USDA, Berkeley, California

LOOMIS, EDMOND C.—Extension Parasitologist Coordinator, Agricultural Sanitation Program, University of California, Department of Entomology, Davis, California

MARCH, RICHARD P.—Professor, Department of Food Science, 118 Stocking Hall, Cornell University, Ithaca, New York

MARTH, ELMER H.—Associate Professor of Food Science and Bacteriology, Department of Food Science, University of Wisconsin, Madison, Wisconsin

NOLES, SAMUEL O.—State Milk Consultant, Florida Board of Health, Jacksonville, Florida

OSTEN, ORLOWE M.—Acting Director, Dairy Industries Division, Minnesota Department of Agriculture, State Office Building, St. Paul, Minnesota

PARKIN, IVAN E.—Old Mail Trail Grove Beach Point, Westbrook, Connecticut

REEVES, DALE D.—Senior Sanitarian, Los Angeles County Health Dept., 220 North Broadway, Los Angeles, California

RICHARDSON, GARY H.—Professor, Food Science and Industries, Utah State University, Logan, Utah

SENN, CHARLES L.—Lecturer. School of Public Health, University of California at Los Angeles

SHAW, ELLIS R.—Pastor of Brooklyn Heights Presbyterian Church, San Diego, California

SHIELDS, TED—Assistant Manager and Public Relations Director, California Milk Producers Advisory Board, 1700 McHenry Avenue, Modesto, California

SORG, THOMAS J.—Chief, Basic Data Branch, Division of Technical Operations SWMO, 5555 Ridge Avenue, Cincinnati, Ohio

SPECKMAN, ELWOOD W.—Associate Director, Nutrition Research, National Dairy Council, 111 North Canal Street, Chicago, Illinois

VAN BUREN, RORERT L.—Bureau Chief, California Department of Agriculture, Bureau of Dairy Service, 1220 N Street, Sacramento, California

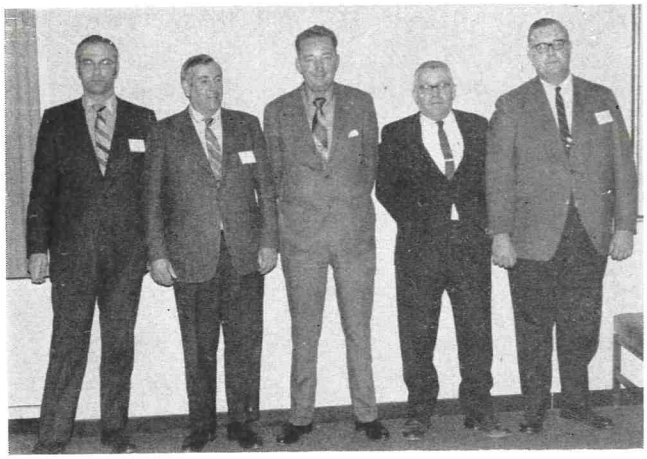
WHITEHEAD, DICK B.—818 17th Street, Wilmette, Illinois

WILSON, WALTER F.—Director, Bureau of Environmental Sanitation, County of Los Angeles Health Department, 220 North Broadway Street, Los Angeles, California

WRIGHT, EARL O.—Associate Professor and Food Technologist, Dept. of Food Technology, Iowa State University, Ames, Iowa

ASSOCIATION AFFAIRS

VIRGINIA ASSOCIATION OF SANITARIANS & FIELDMEN'S ANNUAL CONFERENCE



Left to right: A. V. Huff, international chairman; R. J. Schutrumpf, president; V. M. Yeary, 1st vice-president; J. O. Gunter, 2nd vice-president and W. H. Gill, secretary-treasurer.

On March 3, 4, and 5, 1971 the Virginia Association of Sanitarians and Dairy Fieldmen held their annual conference at the Donaldson Brown Center for Continuing Education in Blacksburg, Virginia with some eighty-five (85) members present.

The program this year was unique in that the first afternoon was used for field trips arranged by Dr. P. J. Muldoon. The membership visited the Corning Glass Works to watch the extrusion of glass pipelines, some of which will be used in dairy farm equipment. Tours of the VPI & SU Campus included visits to the new Anaerobic Laboratory and the Food Science Building proved extremely interesting and informative to the group.

On the first full day of the conference, Dr. E. N. Boyd gave a brief picture of the research now in progress at VPI & SU's Department of Food Science. Other speakers during the morning lectured on various phases of waste treatment and stream pollution. Anaerobic bacteria and Perfringens Food Poisoning were subjects discussed during the afternoon session by professors from VPI & SU.

The featured highlight of the day was Joe Johnson from the Associated Milk Producers, Arlington, Texas; speaking on the art of Communications. His earthy humor and engaging manner was indeed a welcome adjunct to the program.

The program on the last day began with the current status of research projects involving the Department of Dairy Science with Dr. R. G. Cragle as narrator. The rest of the morning there were several other lectures on milk problems including a panel discussion of the Milko-tester. The program ended with a short business session at noon to allow the membership to drive safely home before dusk.

ANNUAL MEETING ONTARIO MILK AND FOOD SANITARIANS ASSOCIATION

CITATION FOR THE SANITARIAN OF THE YEAR AWARD MADE TO ROBERT H. JARDINE ON WEDNESDAY, JANUARY 27, 1971

The association's Sanitarian of the Year Award was presented by honorary life member Mr. Jim Baker, Toronto (left) to Mr. Bob Jardine.

It has been the custom at the annual meeting, to honour a member whose work in one of the fields of sanitation has been outstanding. The selection for the award was by ballot, and is a gentleman who has spent some 25 years in the service of dairy producers, processors and manufacturers.

The recipient grew up and received his early education in Creemore, Ontario. He later attended the Ontario Agricultural College at Guelph where his interests focused on Dairy Science and were directed particularly to cream and milk production and the manufacture of butter.

This year's recipient then took time out to serve in the RCAF during World War II. After his college years, and his subsequent discharge from the RCAF, he acquired a creamery near Stratford to

The Past President's Gavel was presented by Mr. Herm Cauthers (right) to Dr. A. N. Myhr, Professor of Food Science, University of Guelph.

Honorary life membership in the association was presented by Mr. Bob Jardine, (left) to Mr. Jack Bain, London.

which he later added a cheesemaking section. He operated this plant until part way through 1949. Some months earlier he had accepted a position as fieldman for the Ontario Cream Producers Marketing Board. During this period and until he disposed of his plant, he commuted between it and whereever he was required as the Board fieldman.

In 1950, he became secretary-manager of the Cream Producers Marketing Board. His office was at 409 Huron St., Toronto.

He held this position until 1960 and, during that period, he was untiring in his efforts to improve the quality of farm separated cream and of butter. His work in this field met with no small degree of success. He also found time during his tenure of office to serve as secretary of the government authorized Ontario Milk Producers' Coordinating Board. After a couple of years, pressure of work for the Cream Producers made it impossible for him to continue his post with the Coordinating Board.

Two major achievements in the field of dairy advertising and promotion while he was serving in these positions must be fully credited as his brain children. The first being the devolopment of the slogan "It's always better with butter" a few months after margarine was legalized in Ontario. The other was the promotion of the dairy industry and its products through the butter models at the Canadian National Exhibition and the Royal Agricultural Winter Fair. Butter modelling is still a feature at these two major exhibitions sponsored by Ontario's dairy producers.

The Dairy Branch of the Ontario Department of Agriculture in 1960, persuaded him to join the Dairy Branch staff. After orientation, he was sent to Perth County to supervise and extend the quality programme. He entered this work with energy and thoroughness, administering the regulations without fear or favour but with understanding.

Nevertheless, our recipient's efficiency and integrity was appreciated by the producers who gave him a measure of cooperation that, too often was not accorded government men in the field. It was through his efforts while in this position that the Perth Dairy Club (now a part of O.M.F.S.A.) was organized. A member of the Club has previously received the "Sanitarian of the Year Award".

His success in his assignment was such that it was almost inevitable that he would be brought back to Toronto and the Milk Commission of Ontario where his knowledge, talents and administrative ability would have the wider scope they deserved.

It is a pleasure and a privilege for us to welcome him here tonight as the Milk Commission's Director of the Milk Products Division and to honour him with our "Sanitarian of the Year Award". His name is Robert H. Jardine, familiarly known as Bob.

FLORIDA SANITARIANS TOLD THAT RECIPROCITY IS KEY TO FREE MILK MOVEMENT

"In our changing world, there is less and less need for the diversity of laws and regulations which in the past reflected differing local conditions and mores," Shelby Johnson, Chairman of the Interstate Milk Shipments Program, told the 150 conferees attending the 1971 Florida Association of Milk, Food and Environmental Sanitarians annual meeting. The Kentuckian also stated that we must continue our efforts to minimize local regulatory differences so that our respective milk and milk product laws, regulations and interpretations do not

Speakers at the 1971 Florida Association of Milk, Food and Environmental Sanitarians annual meeting included: (L to R) Mr. Bob Rutgerson, Foss America, Inc., Fishkill, New York: Dr. Dick Brazis, F.D.A., Cincinnati, Ohio; Mr. Frank La Perch, Technicon, Tarrytown, New York; Dr. C. Bronson Lane, University of Florida, Gainesville, Florida; Vic Yeager, Farmbest, Jacksonville, Florida.

become arbitrary and costly. "Reciprocity is the key to free milk movement," said Johnson to the delegates meeting at the Langford Hotel in Winter Park, "and the IMS Program has made tremendous strides in securing movement of good quality milk and milk products in inter and intrastate commerce based on such reciprocity agreements."

Dick B. Whitehead, President of the International Association of Milk, Food, and Environmental Sanitarians defined sanitation as the procedure and control of the total environment to milk and food processing that will result in maintaining the wholesomeness of the product, and provide protection against pathogenic organisms in the package or product. "It is imperative that men in industry and the regulatory sanitarians combine their talents to effect the maximum in sanitary procedures as well as design and construction of processing and cleaning equipment." Whitehead concluded by stating that the dairy industry has been the leader in minimizing the hazards of food borne diseases, and must continue in this important role.

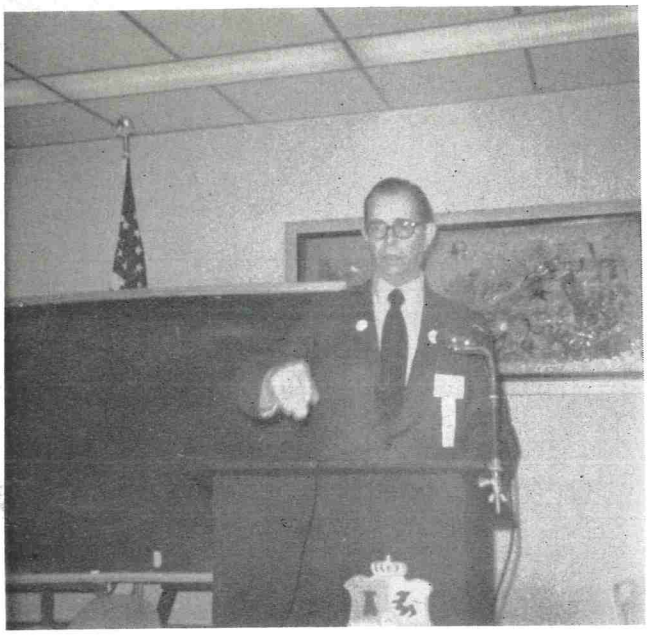
"Two-thirds of the food products which will be found on the grocery shelves in the 1980's haven't even been conceived as yet," commented Dr. George Muck, Vice President of Research and Development for Dean Foods, Rockford, Illinois. "The dairy industry can get its share of the 1980's market by creating a consumer need and meeting this need with new dairy products which are nutritious, convenient, properly priced, palatable, and of high quality," he continued. Muck summarized by stating that the regulatory trade barriers must be removed to enable our industry to compete effectively with its food competitors.

According to Dr. Richard Brazis, F.D.A., Cincinnati, Ohio, proper training, supervision and confidence in obtained results are requisites for an effective testing program for somatic cells. He mentioned that errors in counting leucocytes in milk films can be minimized by using clean slides, proper staining procedures, optimal light, and the correct microscope calibration.

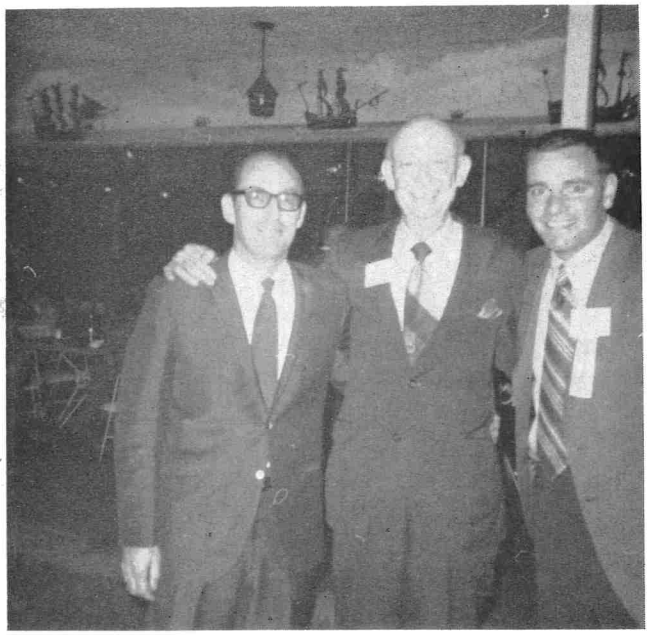
Mr. Shelby Johnson (extreme left), IMS Chairman, Frankfort, Ky. smiles at the antics of the following during the Florida Association hospitality hour: (L to R) Mr. Dave Fry, T. G. Lee Dairy, Orlando, Florida; Mr. Jay Boosinger, Florida Dept. of Agriculture and Consumer Services, Tallahassee, Florida; Mr. Jim Beatty, Farmbest Jacksonville, Florida; Mr. Dick Whitehead, IAMFES President, Chicago, Illinois.

Dr. Ken Smith, Associate Professor of Dairy Science, University of Florida, said that the potential shelf life of milk and milk products can be extended with the use of aseptic and sterile processing procedures, and use of glycol cooling systems. "The dairy industry is rapidly adopting higher heat treatments and colder storage conditions for its products to protect them from premature bacterial degradation," he said.

Dr. C. Bronson Lane, Associate Professor of Dairy Science, University of Florida, urged the dairy industry to correct some of the conditions which are stifling its growth, namely: the manpower crisis; milk price wars; poor quality milk for the school lunch programs; low priority for new product re-



Dick B. Whitehead, President of the International Association of Milk, Food and Environmental Sanitarians, addresses the delegates at the Florida Association annual meeting.



Mr. H. L. Thomasson, Executive Secretary of the IAMFES, Shelbyville, Indiana poses with Florida Association officers Mr. Dave Fry (1970 President), T. G. Lee Dairy, Orlando, and Dr. C. Bronson Lane (1971 President-elect), University of Florida, Gainesville.

search and development; statutory relics impeding free milk movement; and divisiveness between producer and processor groups.

Agriculture's effects on the environment were discussed by Mr. John Ketteringham, Air and Water Pollution Control Board, Orlando, Florida. The conferees also heard Dr. H. H. Van Horn, Chairman of the Dairy Science Department, University of Florida, talk about the role of his department's research, teaching, and Extension programs in meeting dairy industry needs in Florida.

Mr. Frank LaPerch, Tarrytown New York, discussed Technicon's Autoanalyzer for somatic cell counting and demonstrated the use of this instrument. Mr. Bob Rutgerson, President of Foss America, Inc., Fishkill, New York, talked about the present status of the Milko-tester (an electronic fat-testing device), and showed the conferees how this apparatus can be used in laboratory testing programs.

A panel discussion on open-dating of dairy products highlighted the first day activities. Miss Ann Fisher, Florida Power and Light Company, Daytona Beach, Florida, said that most consumers she has talked with favor open dating to assure them of the product's freshness. Mr. Joe Antink, Executive Director of the Florida Dairy Products Association, Orlando, Florida, said that open-dating of milk would be costly, and the added cost would have to be passed on to the consumer. He also stated that milk is often mishandled by the retailer and consumer, causing a subsequent shortening of the product's shelf life. "Open-dating would give the consumer a false sense of security as to the product's quality and flavor." Mr. Jay Boosinger, Florida Department of Agriculture and Consumer Services, Tallahassee, Florida, said that there is no public health significance associated with this issue. According to Boosinger, it would be extremely difficult to date dairy products that have been subjected to extended shelf life processes such as aseptic and sterile packaging. Mr. Bill Boardman, Executive Vice President of Dairy Farmers, Inc., Orlando, Florida, served as the panel's moderator.

At the annual awards banquet, Mr. Howard Brown, Florida Department of Agriculture and Consumer Services, Jacksonville, was selected as the outstanding dairy lab technician in Florida. Mr. Norman Tobey, Taylor Instruments, St. Petersburg, was recognized as Florida's outstanding dairy industry man, and Mr. Mel Neff, Upper Florida Milk Producers Association, Jacksonville, won the outstanding fieldman award. Mr. Lyle Chaffee, Pinellas County Health Department, St. Petersburg, was honored with the outstanding sanitarian award.

Program chairmen for this event were: Vic Yeager, Farmbest, Jacksonville; Dave Fry, T. G. Lee Dairy, Orlando; Dick Jolley, Florida Department of Agriculture and Consumer Services, Tallahassee; Dan Horne, Palm Beach County Health Dept., West Palm Beach; John Miller, Upper Florida Milk Producers Association, Orlando.

Outgoing President Dave Fry gave an address at the Association's annual business meeting. Officers

elected for 1971 were: Mr. Dan Horne, President; Dr. C. Bronson Lane, President-elect; Mr. Jay Boosinger, Secretary-Treasurer.

MISSOURI ASSOCIATION OF MILK AND FOOD SANITARIANS 39TH ANNUAL CONFERENCE

The Missouri Association of Milk and Food Sanitarians, at its 39th Annual Conference in Columbia, Missouri, presented its "Sanitarian Citation Award" for "outstanding work in the field of sanitation" to Mr. Clarence W. Dromgold, Acting Administrative Chief, St. Louis Health Division.

Mr. Dromgold has made a career of Milk Sanitation, serving with the Philadelphia Dairy Council on raw milk quality control from his granduation from the Pennsylvania State University in 1928 until 1935, when he joined the staff of 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.

In 1960 Mr. Dromgold received the Sanitation Service Award for 25 years membership in the Missouri Association of Milk and Food Sanitarians. He is an active member of several state organizations and International Association of Milk, Food and Environmental Sanitarians, Inc.

A native of New Bloomfield, Pennsylvania, Mr. Dromgold now makes his home in Centralia, Illinois. He is married, and the Dromgolds have one son.

J. S. CUNNINGHAM AWARDED 3-A PLAQUE

Joseph S. Cunningham, in recognition of his ten years of "indefinable and undramatic behind-the-scene contributions," received the 3-A Sanitary Standards Committees' Bronze Plaque at the group's spring meeting. In making the presentation, Dean R. Stambaugh, Reitter Foods Co., chairman of the Dairy Industry Committee's Sanitary Standards Subcommittee, praised Mr. Cunningham for unique "financial and administrative efforts" and his presence as a "quiet, effective and constructive force" for the advancement of the 3-A program.

The citation to the executive vice-president of Dairy & Food Industries Supply Assn. noted, "If Joe's position had been occupied by a less cooperative and less sympathetic personality, 3-A as an operating agency would not be where it is today." Awarded April 20, the coveted plaque is not a casual token; only six other men, each outstanding in his contribution to the industry, have been so recognized. Past recipients, their organizations and the year they were honored: E. H. Parfitt, DIC, 1963; Thomas Burress, DFISA, 1964; C. A. Abele, IAMFES. 1966; Roberts Everett, DFISA, 1967; Fred Uetz, DIC, 1968; and W. A. Dean, Jr., DIC, 1969.

Dean Stambaugh, chairman of DIC's Sanitary Standards Subcommittee, presents DFISA Executive Vice-President J. S. Cunningham with 3-A Honor Plaque under the watchful eye of Harold E. Thompson, U. S. Public Health Service.

Mr. Stambaugh added that the occasion was also a sobering one in that the Milwaukee meeting was Mr. Cunningham's last. He has resigned his DFISA position effective June 30 and will work in exposition managing and consulting.

3-A is a voluntarily supported effort by all the national dairy processing trade association to suggest and outline sanitation criteria. Standards have been issued for 28 items of dairy industrial equipment as a result of the program.

NEWS & EVENTS

ANNOUNCING THE MODEL "SEVENTIES" ZERO CONCORD TWIN-VACUUM PIPELINE MILKING SYSTEM

Dairymen who are troubled with high leucocyte counts in their herds—decreased milk production—and milk that's not up to proper quality and flavor standards—should be interested in the new Zero Concord Twin-Vacuum Pipeline Milking System designed for the "Seventies", which was put on the market recently by Zero Manufacturing Company of Washington, Missouri.

The value of stable milking vacuum has been emphasized in a number of reports and authoritative articles which clearly state that no matter what type of mechanical milking system is used stable vacuum at the teat end is of prime importance. And that unstable situations in which vacuum varies more

than two inches at the teat end have been associated with increases in mastitis. Only with stable milking vacuum and the elimination of air injection at the milker units can a dairyman hope to reduce leucocyte counts up to 65%—increase milk production as much as 20%—and prevent mechanically-induced rancidity.

The new Model "Seventies" Zero Concord Twin-Vacuum Pipeline Milking System has a new, still-further-improved, more-compact milker unit which has brought new features of efficiency and economy to this revolutionary milking system. It's made of a combination of a new kind of light, strong, transparent material for visual milking—and a sturdy, stainless steel base. Another important, new feature is that this milker unit provides for total, as well as visible, washing and sanitizing of the entire system —without disassembling. This not only includes washing and sanitizing the milk conveying vacuum pipeline and other milk contact surfaces—but also the milking vacuum pipeline, the pulsators and even the outside of the inflations and the inside of the shells. It also, has a built-in Vacuum Teat Release Valve that automatically releases the vacuum from the cow's teats immediately after completion of milking. In addition, it has a big-capacity inflation tube and claw which prevents vacuum drop at the teat ends.

Twin-Vacuum principle removes a major cause of rancidity because—one vacuum milks the cows and an entirely-different vacuum moves the milk through a separate pipeline into the bulk tank. This does away with the need of injecting air into the milker units to move the milk. Because no air injection at the milker units is necessary—Twin-Vacuum prevents agitation and foaming of the milk throughout the entire pipeline—preventing this major cause of rancid and off-flavor milk. And it keeps contaminated air out of the milk.

For more detailed information about the new Model "Seventies" Zero Concord Twin-Vacuum Pipeline Milking System—write to Zero Manufacturing Company; Dept. IR-71; Washington, Missouri 63090 U.S.A.

NOTICE

The Dairy Fieldman's Safe Insecticide Guide for 1971 is now available at 5 cents per copy from The Dairy Fieldman 2885 Vogay Ln., Northbrook, Ill. 60062.

SHORT COURSE ON FOOD INDUSTRY WASTES

September 13-16, 1971—Short Course on "Food Industry Wastes and Ecological Management (waste prevention, waste treatment, regulatory aspects, environmental problems,) University of Florida, Gainesville, Florida 32601. Sponsored by the Florida Section Institute of Food Technologists and the Florida Cooperative Extension Service. Fee . . . $40.00. For further information write to Dr. R. F. Matthews, Department of Food Science, University of Florida, Gainesville, Florida 32601.

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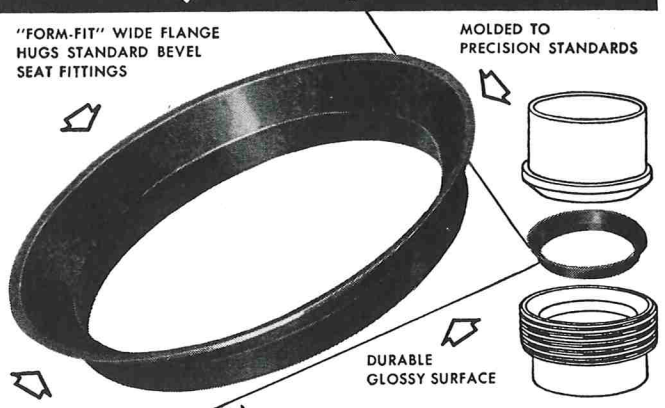

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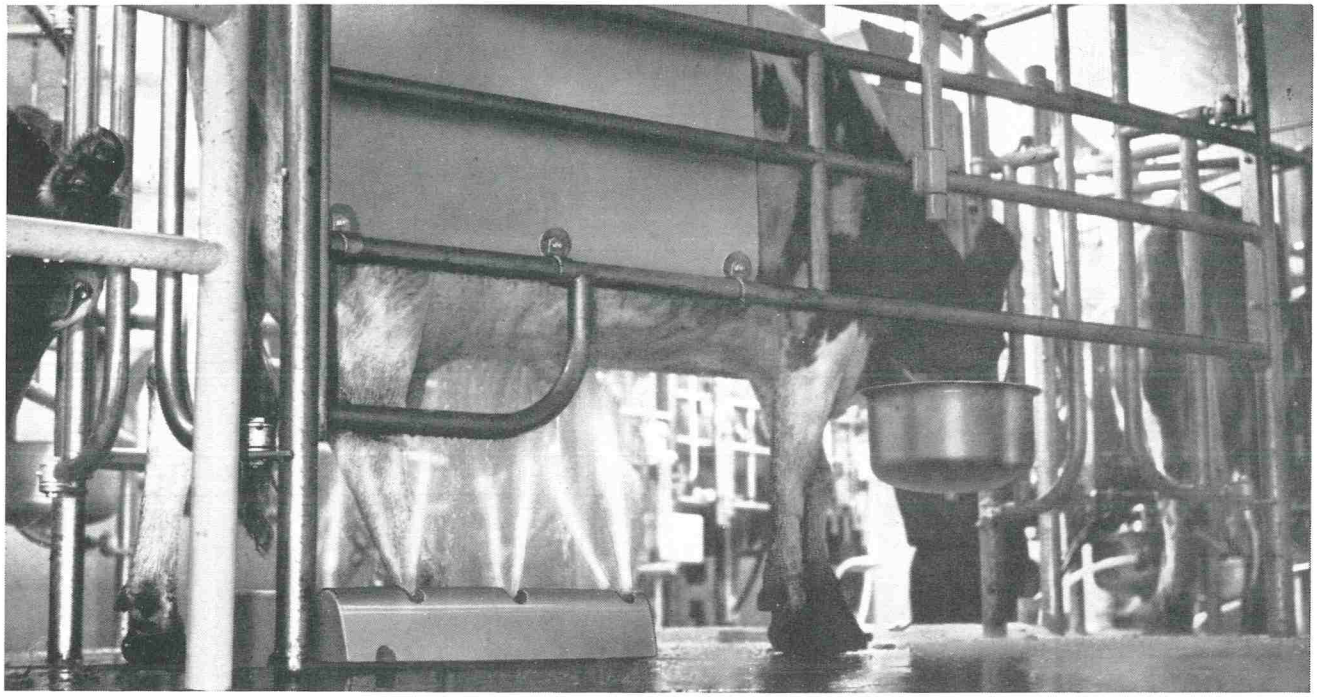

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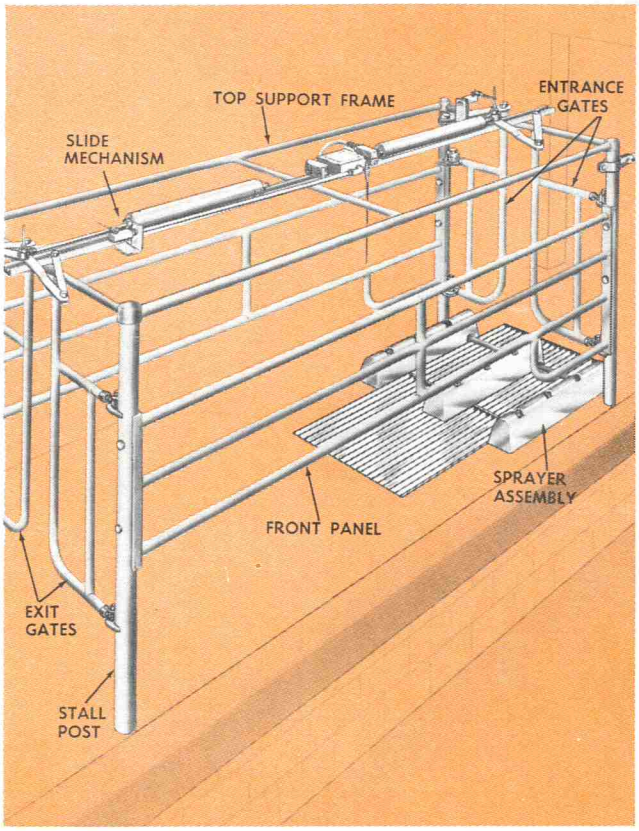

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